FRAMING CLIMATES

The architecture of artificial environments

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Theoretical Dissertation

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Abstract

This master thesis places itself at the end of the dichotomy between the rural and the urban by questioning the authenticity of the nature-culture divide. As our civilization enters the era of the Anthropocene — literally the "human era" — the once-stable boundary between human and natural has become blurred, uncertain, vague. Hybrid phenomena such as global warming, pollution, plastic surgery or biotechnical agriculture are today's symptoms of an artefactual Earth. Meanwhile, urban sprawl is spreading all over the planet, destroying the classic vision of the city-as-object and the rural-as-background. The world seems to tend towards the total artificialization of nature, whereby a dystopian (and terrifying) version of the Arcadian ideal might become reality. The human dream of the controlled environment is encapsulated in the figure of the greenhouse, architectural container of extreme natures and environments without context. Its abstraction generates ambiguity and unfamiliarity and provides a stimulating lens through which to reconsider architecture's relation to nature in today's context of climate change and crisis. This work is a study of the greenhouse figure as an ideological object, archetype of the construction of artificial environments.

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Introduction

The gesture of framing climates illustrates the profound desire of human control over unpredictable nature. The proliferation of natural disturbances such as earthquakes, tsunamis, droughts, the melting of the ice caps or the imbalances in seasonal and annual cycles, have brought the issue of climate into our lives in a dramatic and unprecedented way. This shift in paradigm revealed the many problematic layers that have populated our common and scientific knowledge of nature, rendering the word very problematic. It is, therefore, necessary to unpack the layers of meaning in the word nature and its synonyms, and in the specific case of this work, to understand the meaning of *climate*, recognizing its uncertain contours.

Nowadays, the word *climate* is synonymous with "weather", "atmosphere" or "environment" and often refers to meteorological data. However, looking closer at its Greek etymology, *klima* designates "the inclination of Earth with regards to the Sun"[1], whereas the Latin roots of *clima* speaks about "a region of Earth"[2]. In both definitions, the word *climate* is assimilated with a condition of place, a specific situation. Hence, quoting the German philosopher Peter Sloterdijk, "it is this terrestrial question of location that becomes ever more binding in the course of modernization"[3].

The quest for **framing climates** seems to lie at the very foundation of architecture. On the one hand, architecture has organized individuals and societies through space and time, by settling them in specific sites and situations. On the other hand, it has set up these conditions of place artificially. Seeking miniature paradises, the traditional discourse on Arcadia has gradually slipped into the utopia of controlled

1.
WordReference Random House Learner's Dictionary of American English © 2018.

2.
Ibid.

3.
Sloterdijk Peter, *Le palais de Cristal. A l'intérieur du capitalisme planétaire*, Pluriel, (2011).

4.
Murphy Douglas, *Last Futures. Nature, Technology and the End of Architecture*, Verso, (2016).

environments. The materialization of the inhabitable space has been made through the dominance of the human over his surroundings. Beyond gathering a community of plants and animals that have common characteristics with the environment they exist in, climate has become a bank of information that man must regulate in order to live in stabilized comfort.

From its very beginning to its contemporary applications, the figure of the greenhouse is characterized by a specific attention toward nature managed through technological assistance. It stands as the apparatus for the artificialization of the environment. Therefore, the figure is employed here as a tool to understand how its architectural evolution has framed the relationship between people and climate and humanized the concept of nature. A certain simplification has been made in order to reduce the research to a series of archetypes. Far from denying any complexity, this approach tries to give a certain consistency to ideas by presenting them through their strongest traits. The intention is to demonstrate that, by being both conceptual and material, architectural objects cannot be understood without referring to their context. For this reason, the different typologies and their structural evolution are studied in relation with the disciplines of history, philosophy and botany. The confrontation of these domains makes it possible to contextualize the development of the greenhouse, while acknowledging the specificities of each time period. As shown by English writer and architect Douglas Murphy, "the greenhouse, like the geodesic domes of a century later, simultaneously embodied the most futuristic technology of the time, and an aesthetic reaction against this very same modernity".[4] This historical approach also enables an assessment of the present situation by giving it a solid background and by highlighting its peculiarities, which could be a starting point for the *projet de master*.

The chapters are structured in a linear way, identifying five characteristic artificial environments and placing them in context. The study is followed by a speculative conclusion looking for a reconsideration of architectural processes regarding their surroundings through the act of framing. It aspires to learn from environmental aesthetics by identifying their poetry, whether physical or philosophical.

1.
Lapis specularis, transparent stone (Antiquity).
2.
Glass Bell jars, (Middle Age).
3.
Closet.
4.
Unknown, *Citrus winter shelter,* near lake Garda, Italy (1660).
5.
Le Vau L., *Orangerie of Versailles,* France (1662).
6.
Mazois F., *Choiseul Passage,* Paris (1827).
7.
Rohault de Fleury C., *Jardin des plantes,* Paris (1837).
8.
Burton D., Turner R., *Palm House of Royal Kew Gardens,* London (1844).
9.
Meynadier H., Rigolet M., *Jardin d'hiver on the Champs-Elysées,* Paris (1846).
10.
Paxton J., *Crystal Palace,* London (1851).
11.
Balat A., *Royal greenhouses of Laeken,* Belgium (1905).
12.
Otto F., *Pneumatic greenhouses,* (1964).
13.
Banham R., *Environment bubble,* (1965).
14.
Drop City, Colorado, USA, (1965).
15.
Fuller B., *US Pavilion,* Expo 67, Montreal, Canada, (1967).
16.
Archigram, *Cushicle,* (1967).
17.
Haus-Rucker-Co., *Oase n7,* Documenta 5, Kassel, Germany, (1972).
18.
Space Biosphere Venture, *Biosphere 2,* Arizona, USA, (1991).
19.
Grimshaw N., *Eden Project,* (2000).
20.
Lacaton A., Vassal J.-P., *Coutras House,* Coutras, France, (2000).
21.
Dessimoz Büchi, *Globe of Science and Innovation,* Cern, Geneva (2002).
22.
Ishigami J., *Japan Pavilion,* Venice Biennale, (2008).
23.
architecten de vylder vinck taillieu., *PC Caritas,* (2016).
24.
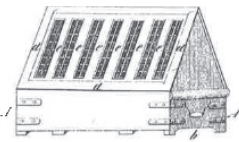Big, Heatherwick, *Google campus,* (-).

Antiquity

Middle Age

Renaissance
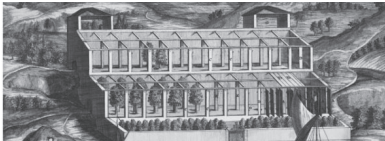
Industrial Revolution

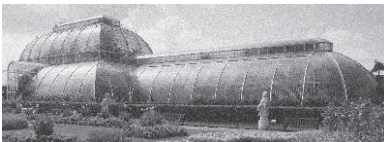**Post WWs**

Today

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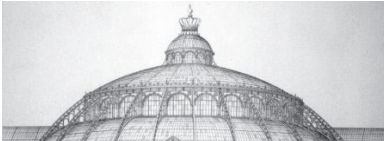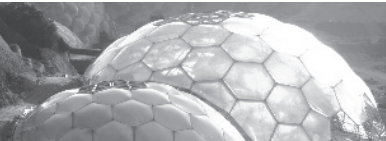2.

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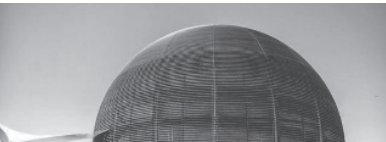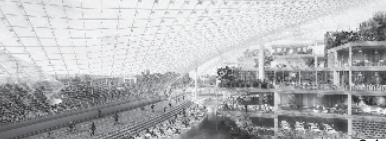7.

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History	Philosophy	Botany	Structure	Scale	Typology
Antiquity Roman empire Middle Age	Cosmos The world from the inside	Oral tradition Domestication of plants and animals Medicinal herbs	movable, wheeled stone, wood	Cloth Furniture	*Cold Frames* *&* *Bell Jars*
Renaissance Colonial empires Great expeditions International trades	Exoticism Cabinet of curiosities The finitude of the world Discovery	Independent science Microscope Classification of species	stone, wood, glass	Room Building	*Orangeries* *&* *Winter Gardens*
Industrial Revolution World`s fairs	The Great Interior Capitalism Progress, prosperity Leisure	Geography, ecology Modern botany Photosynthesis	curvilinear metal structures new glass panels	Environment	*Crystal Palaces* *&* *Arcades*
WWI, WWII, Cold War Space conquest Cybernetic Environmentalism Thermodynamic	Globalization The world from outside Objectification of the globe Closed system	Molecules Computers Gene technology	geodesic structures pneumatic structures metal, glass, plastic	Biosphere	*Domes* *&* *Bubbles*
Post-media age Climate change Economical crisis Tourism	Anti-capitalism Minority rights Political ecology Ecofeminism Reflexivity	Global environmental issues Climate change Sustainability Biological diversity	wood, metal, glass, polycarbonate, plastic	?	*Environmental* *Thresholds*

1. Cold Frames & Bell Jars

The Cosmic Closet

The greenhouse's technical origins as winter storage for plants dates back to Antiquity. Attempts to protect certain plants during the cold season were carried out in both ancient China and the Roman Empire. The first artificial method for growing plants, built in Roman times, was very similar to the cold frames of today. In order to please Emperor Tiberius, who enjoyed eating a cucumber-like vegetable daily, this plant was cultivated in wheeled carts and moved out into the sun to boost its growth. Then, at night and on wintery days, the vegetable was withdrawn and placed under the cover of an oiled cloth called *specularia* or under frames glazed with a transparent stone known as a "sheet of selenite" (*lapis specularis*).

During medieval times, plantations were, at first, made directly in the ground with a shelter built around them for protection against the cold. Glass bell jars were used to grow plants in winter and spring, whereas bell jars made of straw were applied in summer to protect plants from the bright sun. In this way, weather impacts were regulated. Later on, miniature portable greenhouses were built to take the plants out in the summer and bring them back inside in winter. Similar to precious jewelry boxes, they underlined the fragility and the delicacy of plants. Subsequently, the first gardeners were called the "goldsmiths of the earth".

This relatively small scale, from cloth to closet, goes hand in hand with an oral tradition of knowledge and a meticulous attention toward nature. Its movements were perceived as mysteries, well illustrated by Heraclitus' aphorism *phusis kruptesthai philei*, "nature likes to hide". This marks the beginning of an extremely ambiguous point of view on nature that places it as something that man must dominate and subdue to serve himself. Hence, Antiquity corresponds to the starting point of domestication of plants and animals, while Medieval times signs the first gardening arrangements as enclosed gardens within the confines of monastic cloisters.

fig. 1, *Bell jars*, engraving

fig. 2, *Closet*, engraving

fig. 3, *Cosmographia*, Petrus Apianus, Antwerp, 1539.

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fig. 184
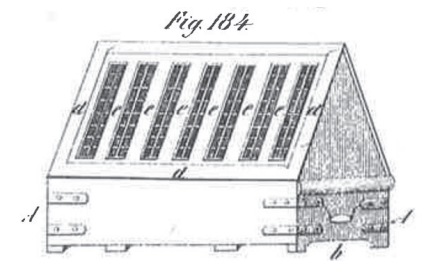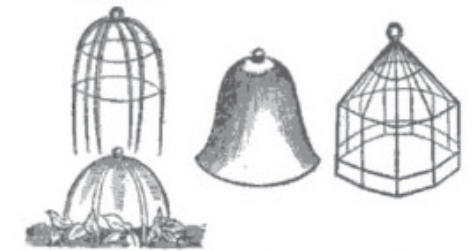
Schema huius præmissæ diuisionis Sphærarum.

1.
Hadot Pierre, *Le voile d'Isis.
Essai sur l'histoire de l'idée de
Nature,* Gallimard (2004).

This large period of time is also responsible for the transition from the principle of *phusis* to the idea of nature. According to Plato, phusis designates a process of growth and is considered as a spontaneous rise of things, like birth. As this process has no other end than nature itself, Aristotle came to identify it to a divine art. The personification of mother-Nature appeared and "the word *phusis*, which originally meant an event or the realization of a thing, has come to mean the invisible power that realizes this event".[1]

Moreover, those primitive forms of greenhouses also seem to suit the ancient conception of the cosmos, which places the world as an entity only observable from within. Indeed, cold frames and bell jars become pieces of furniture that participate to the order of the universal system by having a specific regard towards its moves. Attention is given to the rigor of the cold and the benefits of the sun and astral cycles are made to contribute to cultivation, as seasonal variations dictate the cadence to the plant life. Listening to the rhythms of the universe, humans experience the art of immersion where no distinction is made between man and its environment.

The cosmic closet offers a first accurate and careful approach to the controlled environment with a peculiar regard on the interaction between the "whole" and the plant itself. However, the current design of the greenhouse owes maybe even more of its roots to the constructions of the Renaissance orangeries and winter gardens, built to shelter the new plant species imported from the British and Hispano-Portuguese colonial empires.

2. Orangeries & Winter Gardens

The Exotic Room

The discovery of the Mediterranean world and other, faraway cultures through the great maritime expeditions and the expansion of colonial empires, engendered a certain taste for the exotic. At first, winter shelters appeared during the late sixteenth century to protect citrus and palms introduced in Central and Northern Europe. According to an idea that will remain strongly anchored until the mid-nineteenth century, plants from America, the Near East, Africa or the Far East would need heat all year round. The theory of acclimatization, according to which all plants can adjust to all climates within a succession of generations, shows a lack of knowledge of the optimal climatic conditions of plants at this time. It is only with Alexander von Humboldt's work on the relation between latitude and altitude that the theory's faults will be demonstrated.

Meanwhile, an increase in botanical studies encouraged by a research into the flora of the tropics and the invention of the microscope in Europe, around 1620, drove botany to become an independent science, distinct from medicine and agriculture. At the beginning of the sixteenth century, botanical gardens were created for scientific purposes in Italy, with the early manifestation of the need for citrus shelter during the cold season. The aim of this construction was the protection of plants from climatic harshness. Citrus fruits were used at that time in diverse applications — cooking, perfume, soap — and became the object of desire throughout the European aristocracy who was fascinated by the "away".

Traces of orange houses, that could be dismantled in summer and reassembled in winter, were found in Germany, dating from the middle of the sixteenth century. After that, structures with only a sole southern wall and a movable roof were built for less costs. At around 1700, the figure of the glasshouse, a purposely-built structure made of wooden planks, emerged in Holland for the first time.

In the beginning, *orangeries* were basically hothouses reserved for rich people. Very expensive, they were an object of luxury, a sign of a privileged position in society. At the end of the seventieth century, it
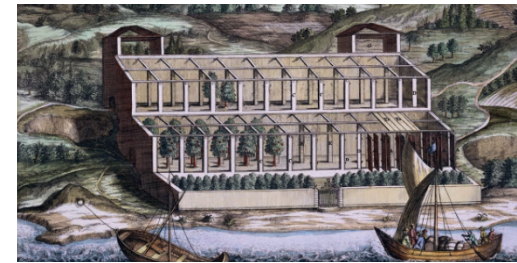
fig. 1, Painting of a citrus garden near Lake Garda in Italy. *Nürnbergisches Hesperides,* Volkamer J.C., 1708.

fig. 2, Painting of the orangery of Versailles in France. *L'Orangerie du Château de Versailles,* Allegrain E., Martin J.-B., ca. 1695.

became an indispensable element of the great French gardens such as Fontainebleau, Sceaux, Chantilly and Cheverny. Versailles might have shown the most powerful example of such architecture. Designed by Louis Le Vau, in 1662, the orangery is built in masonry as an extension of the palace, facing the garden. The southern facade is pierced with glazed wooden frames. In England, Germany and Austria, where the climate is colder, it was necessary to build solid buildings, properly heated during the winter by big wood stoves in earthenware. Hence, during the eighteenth century, the word *orangerie* refered to a building made of thick walls with windows facing south.

Progressively, the edifice acquired more refined aesthetic qualities, by introducing increasingly glazed surfaces on its exposed façades and became the privileged place for parties and receptions for the nobility. Used for banquets, theatrical productions and festivals, the building was a symbol of the Baroque-era lifestyle. At the end of the eighteenth century, the winter garden tooks over the austere orangery. Built as an architectural object at the service of beauty and social life, it was thought of as a place of culture as well as a protection for exotic plants. Combined with living accommodations, the display of plants became a common passion in society and numerous *wunderkammer* ("cabinets of curiosities") and collections took place in winter gardens like in the picture gallery. Botanical enthusiasts, who could now read specialized reviews, were witnesses of a will to diffuse horticultural know-how.

As a result of exoticism, eighteenth century saw a movement of philosophical and economical reflections which pushed to a better knowledge and control of climatic and agronomic elements. Hence, parallel to the attempts of plant classification, greenhouses were differentiated in various types: the hothouse, the temperate house and the cold house. This distribution according to temperature, made it possible to better answer the needs of each species, but their combination also induced a decrease in thermal loss.

The introduction of an orientalist dream landscape in the daily life of European aristocracy was made with convenience and comfort. The combination of plant rooms with living spaces expressed the union of nature, landscape and man. According to the botanist and garden designer Loudon, architectural unity between the house and the winter garden could be guaranteed through the effect of contrast. First, attached to the open rooms of the house such as the salon, the billiard room or the library, the winter garden became an independent building, seen from the mansion. The highest expression of the private winter garden and its last step of development was reached at Laeken, where King Leopold II of Belgium built an ideal town of thirty-six glasshouses which be-

fig. 3, *Jardin d'hiver Champs-Elysées,* Provost, Paris.

fig. 4, *Drawing of the great rotonda,* Balat A., Laeken.
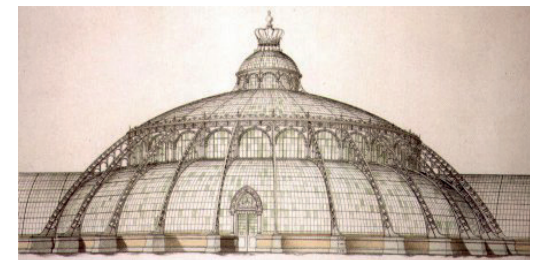
1.
Kohlmaier Georg, von Sartory Barna, *Das Glashaus, ein Bautypus des 19. Jahrhunderts*, Prestel Verlag, (1981).

2.
Ibid.

came the center of the royal life. On a surface of four hectares, architect Alphonse Balat recreated a fairy-tale world where even the church was a glasshouse. Erected between 1874 and 1905, this architecture made of rounded metal and glass structures celebrates the greatness of the Belgian monarchy of the nineteenth century and displays its colonial authority over Congo. This intimate form of greenhouse, in which the owner and his friends could entertain, immerged in an artificial world, presented nature as a piece of work to be enjoyed.

In its public form, the winter garden was perceived as an establishment made for leisure and amusement. Thanks to technical evolution, it became possible to settle the plants into well-tempered indoors, where light and heat were available in large quantities. Ever more spectacular, these bright and comfortable spaces were the object of new attractive uses: "The early urban assembly places and centers of entertainment, especially dance halls, cafés, and restaurants, were the first reason for the creation of public winter gardens"[1]. Built in 1846, on the land of Parisian horticulturists and market gardeners, the *Jardin d'hiver* on the Champs-Elysées is described by Victor Hugo as a heavenly place. Despite the entrance fee, visitors gathered there to drink tea, to chat or read the newspaper, or simply to buy flowers. Hence, public winter gardens appeared as palaces of the people, privileged places where the link between human and nature is strengthened within the city.

From a low and narrow room to a spacious conservatory, "the metamorphosis of the glasshouse into an indoor garden with a tropical climate was accompanied by a further increase in the size of the structure"[2]. The public form of the winter garden announces therein the impressive structures of the nineteenth century. While the exotic room celebrates a distant nature, crystal palaces and arcades herald the greenhouse as a symbol of the new domestic comfort in the city.

3. Crystal palaces & Arcades

The Commodified Interior

During the nineteenth century, the glasshouse is distinguished in three types. The winter garden, mentioned before, keeps developing its two private and public forms, whereas greenhouses for horticultural production are growing to meet the needs of an increasing population. Their structures are mostly made of wood for cost-related reasons but also to guarantee heat and humidity during the exploitation. Meanwhile, crystal palaces emerge all over Europe, especially in France and England, as the incarnation of an industrial dream for a public keen on technical prowess. In continuity with the public winter garden, which can be considered as "an early herald of the entertainment industry"[1], those edifices are intended to house commercial activities such as exhibitions, concerts or theatrical performances.

Restaurants, cafés, theaters, and anything usually arranged along boulevards, are now overlaid by glass-ceilings. The covered passages of Paris are all pedestrian streets, privately owned and lined with small shops on the ground floor. The famous arcades are described by Walter Benjamin as a symbol of the Parisian city-life in the nineteenth century. With the character of the *flâneur*, defined as a bourgeois dilettante, exploring through long walks the city, Benjamin gives a melancholic flavor to this metal-and-glass architecture and announces the figure of the tourist. Greedy for strangeness and novelty, the tourist-voyeur wants close at hand what he would normally only find elsewhere. His comfort is the guarantee of his non-commitment to the distant, the security of his consumerist environment. It is, in this context, not surprising that the advent of tourism will hence sound the death knell of urban winter gardens, as it will make the "far away" accessible from anywhere at any time.

The erection of the *Crystal Palace* of Joseph Paxton, on the field of Hyde Park in London, in 1851, signals the first event of the international Great Exhibition and, according to Peter Sloterdijk, the beginning of the enclosed interiority of consumerist capitalism and industrialized

1.
Kohlmaier Georg, von Sartory Barna, *Das Glashaus, ein Bautypus des 19. Jahrhunderts,* Prestel Verlag, (1981).

fig. 1, *Passage Choiseul,* photograph of Roger-Viollet, Paris, ca. 1910.

fig. 2, *Admission ticket for the Great Exhibition,* Unknown, London, 1851.
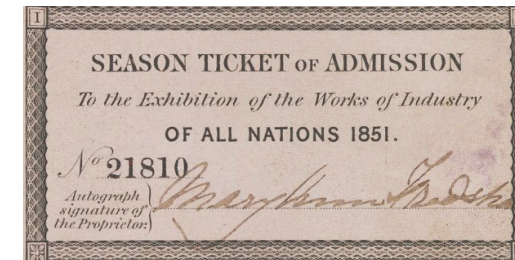
modern culture. All the continents are gathered within one building, with a stand for each country to demonstrate its technical advancement. Through the fashion of exhibiting industrial goods at the great scale of world's fairs, it is no longer the display of nature that matters but the market value of progress and prosperity instead.

  It also celebrates the hope for a new and better world, with "the dialectical starting point of this utopia consisted of reconciling man with nature not outside town and industry but in and through them"[2]. As industrial growth is ruining nature, those weightless structures are seen as an opportunity to both conserve the environment and enjoy the pleasures of free time. Compassion for the disappearing nature denotes a step forward in a romanticism that formulates the dream of an accordance between man and his surroundings. As the observation of nature goes hand in hand with a certain feeling of self-pity guilt, the greenhouse became "a place of retreat from the real world"[3].

  With the desire of supremacy over nature, the Industrial Revolution sings the glorious song of technology and science. Now that scientists have come to understand the finitude of the world and that no place is left to be discovered, energies are repurposed towards mechanical development. From around 1820, new forms of glasshouses appear, thanks to a better know-how in that domain and to a new mastery of iron, cast-iron and glass. The race towards the larger, the higher and the lighter begins. In 1836, with 15 meters in hight, the *Jardin des Plantes* greenhouses, designed by Charles Rohault de Fleury, are the biggest greenhouses ever built. Described by the Swiss historian Siegfried Giedion as "the first construction simply consisting of an iron carcass with glass surfaces"[4], their structure impresses as much as their steam-heating system which enables them to function independently from sun orientation. Classified as historical monuments since 1993, they are the oldest greenhouses still standing today. In 1844, the *Royal Kew gardens' Palm House* of Burton & Turner takes the place of the largest greenhouse in the world. This icon of Victorian architecture consists of a space frame of wrought iron arches, held together by horizontal tubular structures, which support glass panels. The 19m high central nave is surrounded by a walkway at 9m high. It has been considered world heritage since 2003. In 1851, the *Crystal Palace* of Joseph Paxton oversteps all glass-iron edifices built until then. Erected in less than a year for the first international Great Exhibition hosted in London, its dimensions and mode of construction are exceptional: 33m high, 560m long, covered by 300 000 glass pans, with all its parts standardized and no specialized labor required for construction. The industrial production of prefabricated elements allows, then, a quick and easy assembly and disassembly.

2.
Ibid.

3.
Ibid.

4.
Giedion Siegfried, *Espace, Temps, Architecture*, La Connaissance, (1968).

fig. 3, *Crystal Palace's interior*, Unknown engraving, London.

5.
Kohlmaier Georg, von Sartory Barna, *op. cit.*

6.
Ibid.

7.
Ibid.

With curvilinear structures and new dimensions of glass panels, technological progress brought unprecedented possibilities of heating. In fact, "the glazing created an enormous cooling surface and drastically reduced the heat-storage capacity"[5] and "the development of hot-water and steam heating at the start of the nineteenth century was the decisive step"[6]. Through controlled means, like the thermosiphon invented in 1840, the re-creation of artificial environments was finally accessible.

As the idea of climate entered the architectural realm, Prussian naturalist Alexander von Humboldt reintroduced it in botany in order to classify plants through terrestrial locations. The link between geography, ecology and plant distribution is made to redefine a new cosmology. Botany reaches also its modern form with its division in three fields of study: morphology, anatomy and physiology — basically, the external form of plant, its internal structure and its functional operation. Leaving the garden for the laboratory, scientists sharpen their physical and biological knowledge, primarily with the discovery of photosynthesis.

Because of technical and structural problems, and because of their ambition to host both plants and masses of people, these glass-and-iron structures did not primarily classify as architecture in the strict sense. With lightness and elegance, they mark a turning point in architectural aesthetics. In 1847, Henry Cole expresses his vision for a convergence between fine arts and engineering sciences. Furthermore, it is the contention between gardener and architect, which is illustrated here. As all the structural members of the glasshouse were visible, "in addition to the plants, the elements of the structure were on display themselves and hence were to be perceived as part of the aesthetic effect"[7].

For the sake of comfort, the establishment of the commodified interior signals the beginning of a new architectural theory that places the individual at the center of its preoccupations. Looking for a reduction of distances, man starts to experience the world as a network on which he can make profit. This vision will be emphasized by the close dialogue between architecture and technology, developed in the 1960s' spherical architecture.

4. Domes & Bubbles

The Immersive Globe

In the 1960s, architecture found itself having to deal with the ecological movements born with the 1950's radical sense of finitude of the world. Through the works of thinkers such as Rachel Carson, Paul Ehrlich and Aurelio Peccei with Alexander King (founders of the Club of Rome), the awareness of human lifestyle and consumption as agents on climate change alerted for a reconciliation of technological society with the environment. This resolution, already suggested by the giant iron and glass halls of the nineteenth century, embodied itself in the spherical forms of the dome and the bubble.

At this time, American historian Reyner Banham challenged architects to rely less on the traditional separation between structures and mechanical services, proclaiming that "the history of architecture should cover the whole of the technological art of creating habitable environments"[1]. As comfort and leisure became the new products of global trade, new forms of architecture were needed.

In 1964, the *pneumatic greenhouses* of Frei Otto gave a bucolic touch to high-technology, used in a time of growing concern for resource depletion and ecological disruption. But it is in a context of biological discoveries, leisure development, civil rights movements, Vietnam and Cold War propaganda that Buckminster Fuller introduced the futuristic form of the dome at the Expo 67, in Montreal. The *US Pavilion*, originally covered with a thin plastic membrane that was destroyed by fire in 1976, is a crystalline structure which aims to demonstrate the potentialities of high-tech sustainability. Through material efficiency, structural integrity, and modularity, Fuller developed a visual language of cosmic imagination. It marked a shift from the idea of architectural space to the notion of air-conditioned atmosphere. Within domes, it is the control of the air that became the very object of structural research. In fact, "the dome has made the only climate a project"[2].

As the figure came to express the interiorized exterior, it embraced the scale issues of the giant envelops, developed also at that time.

1.
Banham Reyner, *The architecture of the well-tempered environment*, The Architectural Press, (1969).

2.
Rouillard Dominique, *Superarchitecture. Le futur de l'architecture 1950-1970*, La Villette, (2004).

fig. 1, *US Pavilion*, Fuller Buckminster, Expo 67, Montreal, 1967.
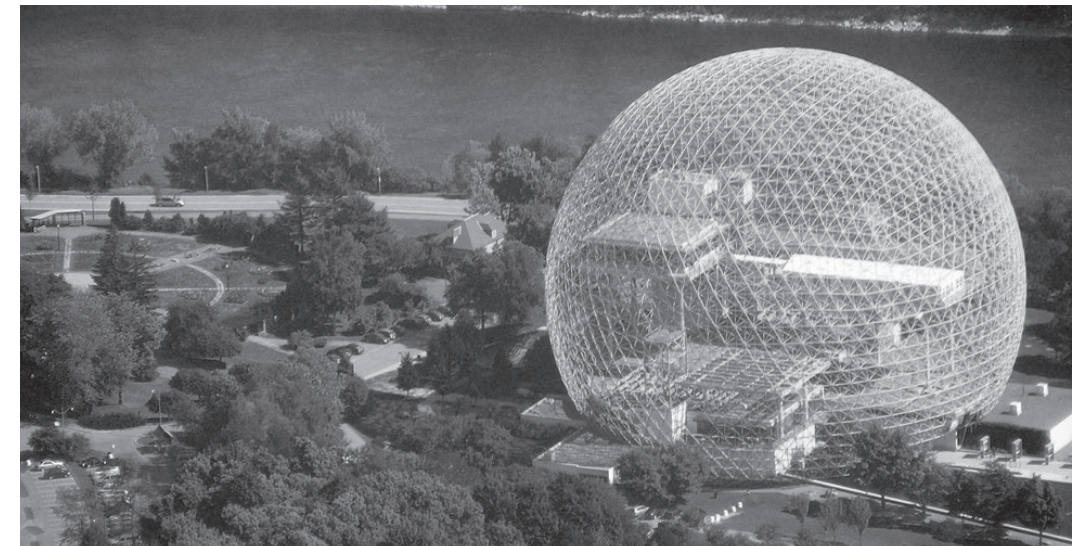
3.
Ibid.

From the *Aircraft Hangar* of Wachsmann, in 1955, to the *NoStop city* of Archizoom, in 1970, the megastructure aesthetic pointed out "an internal space that would no longer be the negative of architecture, an interior opposed to an outside, but a space object generating experiences"[3]. Focused on the individual consumer, mobile and unpredictable, this radical architecture generated a new taste for immersive experiences. The exploitation of purely architectural performance gave place to indeterminacy and social freedom.

Developed in parallel to first and second wave environmentalism, the World Wars and the Space Age, much of these projects evoked a strategy against an exterior seen as potentially threatening, toxic, and uncertain. The objectification of the globe was epitomized with NASA's images of an Earth observed from space. Hanging weightless in the universe, our home planet was now perceived as a finished and distant object. *The Whole Earth Catalog* was the first magazine to publish satellite photos of the world from the outside. Not surprisingly, its founder, Stewart Brand, later became very influent in the development of the Silicon Valley. In fact, cybernetics drove the thinking of the environment as a network, where one could live connected to the distant but isolated from the near. Capsule-like projects appeared during the age of media and communication systems, proposing spaces of individual comfort as future forms of living. This architecture of bubbles — from the *Environment Bubble* of Banham, in 1965, to the 1972 *Oase n7* by Haus-Rucker-Co, through Archigram's 1967 *Cushicle* — explored the possibilities of architecture as a refuge from urban environment. Trying to understand the very nature of man, and with the help of biophysical conceptions, new parameters emerged regarding the relationships between architecture, subjects and the surroundings. The idea of a technologized camp —like in the rural counterculture community *Drop City* settled in Colorado in 1965— suggested a return of the found Eden only reachable through the combination of nature with cybernetics.

This neo-nomadism expressed a new condition of human intimacy. Inflatable technology appeared as an architecture of absence, a completely free and pliable interior. The potential expansion of one's own sphere demonstrated a completely new point of view on the notion of scale. As shown in the movie of Charles and Ray Eames, *The Power of Ten* (1977), man was now experiencing a world that went from atoms to cosmos and vice-versa. As a result, indeterminacy became an ever more significant concern in architecture, while sciences were leading to always more accurate knowledge on nature. In botany, computers drove to gene technology and a better master on plant life.

Biosphere 2, an Earth system science research facility located in

fig. 2, *The Whole Earth Catalog,* fall 1968.

fig. 3, *Drop City,* Colorado, 1965-1973.

fig. 4, *Cushicle,* Archigram, 1967.
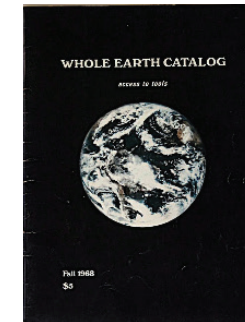
4.
Murphy Douglas, *Last Futures. Nature, Technology and the End of Architecture*, Verso, (2016).

5.
Banham Reyner, *op. cit.*

Arizona, is the world's largest closed system experiment, built in 1991. According to English writer Douglas Murphy, it is "a mix of space-age nostalgia, environmental utopianism and mass entertainment"[4]. This 12'000-sqm space frame was intended to show the viability of artificial ecological systems to maintain human life in outer space. It bears the number 2 as a reference to the original planet Earth that it attempts to preserve. A crew of eight people was supposed to live in it, growing all of their food, re-using all of their wastes. Heavily publicized, *Biosphere 2* missions are widely considered as failure, as they had to deal with problems such as low amounts of food and oxygen, die-offs of many animals and plants included in the experiment, squabbling among the resident scientists, and management issues.

The experience of the immersive globe, owes its roots to a positivist vision of a high-tech future more than to a project of ecology. "But such structures may be open to objection on a number of grounds; culturally they may be over-emphatic, economically they may be too expensive, functionally they may be intractable to alteration, environmentally they may be incapable of delivering the performance for which society had hoped"[5]. Thereby, the figure of the greenhouse seems, today, to seek new alternatives.

5. Environmental Thresholds

1.
Interview by Amy Frearson for Dezeen magazine, (2015). Source: https://www.dezeen.com/2015/02/27/big-and-heatherwick-unveil-vibrant-new-neighbourhood-for-googles-california-hq/

2.
Description found on the official website of the Cern. Source: https://visit.cern/globe/history-globe

The Reflexive Space

Today, old discourses on nature are outdated and must be re-thought. Facing all global environmental issues and the urge of climate change, botany has entered a period of great concern for protection and safeguarding of plants. At the same time, ecological preoccupations are driving us to a reflect on the current relevance of the very notion of species and researches have been lead on the new concept of biological diversity. The study of great cycles of matter and energy plays now an important role in the resistance against processes of globalization. The de-objectification of the world tends to re-integrate the notion of climate as a site-specific condition, as it aims to give voice to minorities and sub-systems.

Re-interrogating the greenhouse as a contemporary architectural figure is not easy, especially regarding its roots in engineering and its diversity of historical languages. The most recent forms of domes and bubbles have been used in many contradictory ways. Architect Nicholas Grimshaw employs it in his *Eden Project* in Cornwall, in order to encapsulate tropical plants and to display the consequences of climate change. While exoticism is no longer en vogue, this tourist attraction recalls the mass entertainment character of the early urban winter gardens. Recently, the collaboration of BIG with Heatherwick Studio gave birth to a climatic enclave projected for *Google*'s corporate campus. Under the cover of a gigantic envelop, the architects say they "try to make pieces of environment you can work in, in multiple ways"[1]. On a completely different note, the *Globe of Science and Innovation*, built for the Cern in Geneva, is a symbol of sustainable development. This 40m-diameter sphere, made entirely of wood, was originally designed by the Swiss architects Dessimoz & Büchi for the national exhibition Expo 02. Composed by two shells, with circulation in between, the outer one is designed "to protect the building from the Sun and the elements, like Earth's atmospheric layer"[2]. Like an exoskeleton, this ecological re-interpretation of the bubble reminds us of the cautious medieval bell jars made of straw.

Meanwhile, in a very poetic way, Japanese architect Junya Ishigami proposed, at the 2008 Venice Biennale, to re-read the ambiguous interaction between architecture and landscape. Arranging boxes of ultrathin glass in the Arsenal's garden, the structure emphasizes and augments the existing atmosphere. Nearly non-present, the greenhouses become the landscape as much as plants. In the words of the critic and historian Taro Igarashi, "Ishigami seems to possess an awareness of space in which all given elements, the plants, furniture and architecture, the terrain and the environment, can exist simultaneously without relative merit and maintain their interconnectedness"[3]. This disintegration of limits is a manifesto for an architecture beyond building, an architecture that treats the structural performance and the surroundings as equally important. Here, the refinement of the intervention evokes both the fragility of a bell jar and the shimmering elegance of the crystal palace.

In 1972, the Architectural Design magazine published an article by Colin Moorcraft, calling for a "beyond industrial technology" movement. Foreseeing the upcoming economic crises of the post-media age, the writer declared that "the gap between what man is not getting and what natural flows have to offer is narrow and could be bridged by fairly simple systems"[4]. He pleads, then, for the implementation of a design-based on cooperation, integrity and flexibility. This humble yet relevant wish seems to appear in the guise of Lacaton & Vassal's practice. In 2000, in Coutras, the architects applied the bioclimatic concept of prefabricated open structures to the domestic space. Literally juxtaposing two horticultural greenhouses to create a house, the economical gesture enables the users' interaction with natural ventilation and sun heating. It demonstrates the possibility of spatial production through natural climatic management. This architecture considers the winter garden as an inhabitable technical element, a space in-between outside and inside. The performative aesthetic of materials, such as transparent polycarbonate, is used to create continuity and fluidity between the house and its environment. The responsibility given to the inhabitant to manage his own living space provides an architectural quality of incompleteness.

The idea of "composing with" is also strongly present in dvvt's (de vylder vinck taillieu) definition of sustainability: "Sustainability is how we live differently in the summer. And in the winter. Sustainable is a place where we want to live. Simplicity"[5]. With their *PC Caritas* project, the Belgian office goes even further in the reversal of the indoor-outdoor duality by staging "a house which gives a garden a home"[6]. This old healthcare building is re-employed as a park where open activities can take place. Introducing greenhouses as "rooms of wonders", inside the untouched structure, highlights the poetic consequence of a dialogue

3.
Igarashi Taro, "*A few things I know about Junya Ishigami*", in Ishigami Junya, *Another scale of architecture*, Toyota Municipal Museum of Art, (2010).

4.
Moorcraft Colin, "*Designing for survival*", AD 7,(1972), p.413-421.

5.
architecten de vylder vinck taillieu in A+U, 561, June 2017.

6.
Ibid.

fig. 1, *Globe of Science and Innovation*, Dessimoz Büchi, Cern, Geneva 2002.

fig. 2, Lacaton Vassal, *Maison Coutras*, Coutras, France, 2000.

fig. 3, *Japan Pavilion*, Ishigami Junya, Venice Biennale, 2008.

fig. 4, *PC Caritas*, dvvt architecten, Melle, Belgium, 2016.

7.
Ishigami Junya, *Another scale of architecture*, Toyota Municipal Museum of Art, (2010).

between architecture and the situation this one is placed in.

All three of these examples of contemporary application of the figure of the greenhouse are reminiscent of the domestic character of the older winter garden. Luxury is, this time, synonymous with the extra space in which content prevails over form. Political ecology and anti-capitalist movements have dared architecture to give political dimensions to the living space. These architectures are part of a sustainability project that tries to reactivate the circular relationship between cause and effect. The reflexive space engendered goes beyond the utopia of the controlled environment by establishing thresholds between man and nature. Beyond form and the individuals, the relationship between subject and object is reversed . Its aesthetic is made of integrity and reversibility and cherishes the belief that "in something lying between natural phenomena and built structure there may be new potential for architecture"[7].

Logic of place, Lee Kun-Yong, 1975.
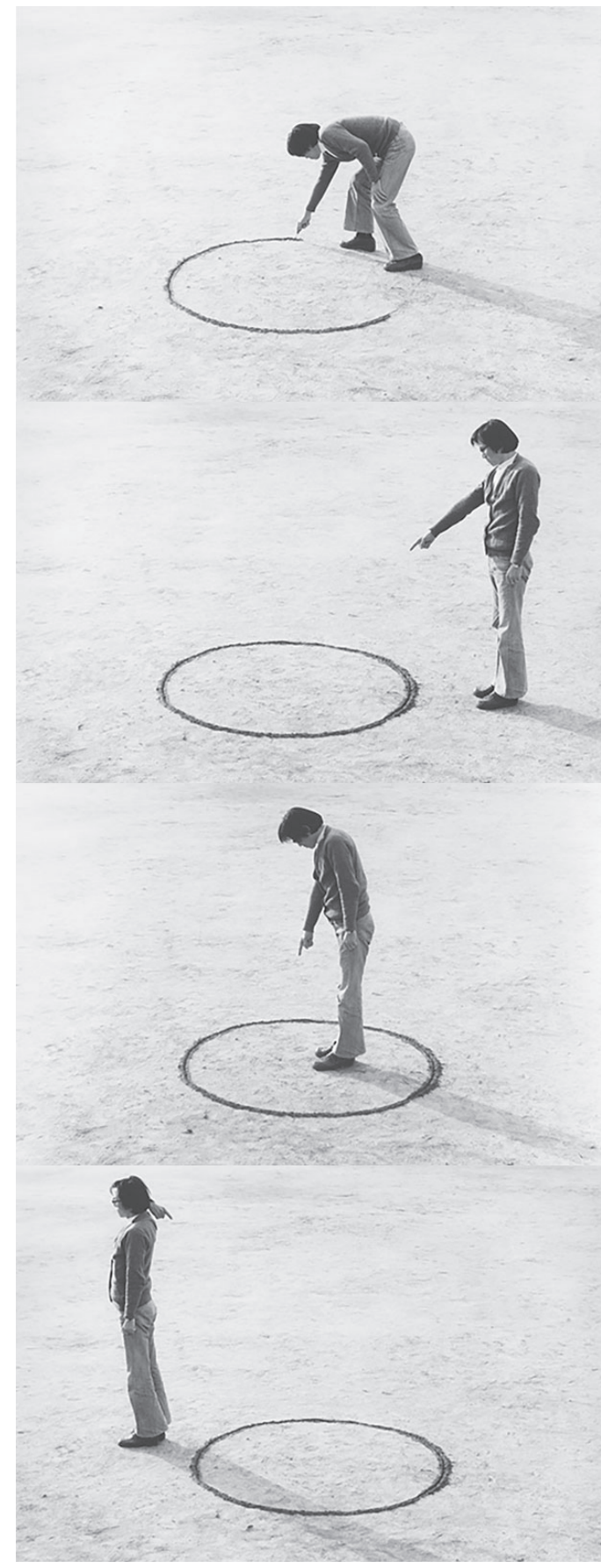
On the Act of Framing

Because of their ambition to embrace both material and conceptual representations, architectural stances often tend to be defined by oxymora. The one presented in this work's title, *Framing Climates*, concerns the architecture of artificial environments seen as the paradoxical aspiration of giving shape to intangible notions and boundless spaces. This ambiguity encapsulates a wide panoply of aesthetic categories that illustrate our misled confidence in the technological control of nature.

As shown before, climatic shells can vary in their architectural materialization, as a result of preoccupations of many orders, be it structural, historical or philosophical. Their various forms embody a physical spatiality as much as an idea of space. This crucial moment of embodiment, when architecture happens, can be epitomized as the act of framing. Tellingly, the etymology of the word *frame* is itself paradoxical, providing two opposite interpretations of the term. The first defines it as "an enclosing case or border into which something is fitted".[1] The second one describes it as "an open structure that gives shape and support to something"[2], or even "the system around which something is built up".[3] Hence the act of framing means two opposite gestures that seem to be two sides of the same coin — a frame can be closed or it can be open, it can be a border and a limit, or a center and a support. In light of this duality, it is useful to return to the previously studied figures in order to speculate on archi-

tectural processes regarding the general act of framing environment and architecture's threshold position.

The Enclosing Case

Since the medieval *hortus conclusus* ("enclosed garden"), humans have been setting limits between so-called "savage nature" and the "cultivated landscape". Seeking the re-creation of a garden of Eden on Earth, the establishment of a closed system allowed the total control and construction of a good, God-worthy, nature. For the sake of protection and preservation, the safe inside was carved out from the chaotic outside through the erection

of walls. This interiorization of nature lead to a contraction of the world and an artificialization of the environment.

The act of enclosing seems to be at the very foundation of the architecture of greenhouses. From the cold frames to the domes, the greenhouse has historically provided the technical apparatus necessary to master an interior environment. Whether for botanical or social purposes, it gave birth to different functions, at different scales, and generated three major contradictions that deserve to be examined. The first one consists in the very idea of "artificial nature". The attribution of mystical and idealized qualities to an object is the definition of fetishism, and fetishized nature is easily objectified and instrumentalized. In its aspiration to optimize the environment, the greenhouse seems to claim that nature has become so vulnerable that it needs technological support to exist. In a way, it is the absence of nature that is celebrated instead of its reality. It presupposes the existence of two natures: one dying outside, endangered and neglected by human action, and another luxurious one indoors, protected and artificially recreated through technological assistance.

This kind of dystopic dualism is well expressed in the movie *Silent Running* (Douglas Trumbull, 1972), which stages a planet Earth cleared out of plants. A few specimens have been preserved inside enormous geodesic domes in outer space, attached to giant space frames. Freeman Lowell, the resident

botanist and ecologist, is assisted by robots to protect those last remaining plants while fighting against nuclear charges coming from Earth. The final scene is relevant, as it shows the very last forest greenhouse drifting into deep space, with a robot tenderly caring for it. This romanticized greenery has always been the first preoccupation of the greenhouse. From the simple bell jars to the giant bubbles, through fancy orangeries, the idea of nature has been put under the protection of a shell, preserved from terrestrial threats even beyond human annihilation.

This leads us to the second incongruity manifested throughout this study. By creating an artificial paradise, the architecture of the greenhouse shuts itself off and generates a space of exclusivity. In search of purity, the controlled environment uses enclosure as an act of resistance against the unsafe outside. Like the phenomenon of immunization in biology, the comfort zone corresponds to a balanced state that is established through parsimonious tolerance. The exclusive interior expresses a desire of total autonomy and self-sufficiency which seems easily reachable in the privatization of space. Furthermore, the expansion in scale that happened through history makes it seems like this privatization integrates ever more people into an ever-larger area. But in fact, the fortification against "the other" produces only climatic enclaves and segregation. This kind of immunized interiority becomes what Peter Sloterdijk calls an ignorance machine or an integral defense mechanism, which "provides architectural support to the basic right not to pay attention to one's environment"[4].

This mindset is well illustrated in the *Truman Show* of Peter Weil (1998). In the movie, Truman Burbank is the unsuspecting star of a reality show which is broadcast live around the clock and across the globe. The character lives happily ignorant in a small community set

in fake reality under a giant dome. As the plot unfolds, Truman discovers the trickery and gradually tests the limits of his world. Once again, the final scene is very eloquent as it stages the lonely man sailing away, hoping for an escape, when his boat suddenly punctures the wall of the dome. The conquest of the bigger scale collapses here with the manifestation of the wall as a dead-end. For us, winter gardens and crystal palaces have historically implied discrimination because they interiorized both an idea of luxury and a conception of progress. The development of domes into corporate buildings, such as the *Google Campus*, sharpens even more the contradiction of such aggressively enclosed global capitalist communities.

The illusion of false openness is particularly present in the quest for the ultimate form of transparency. As such, the persistent enquiry toward an immaterial image of architecture can be seen as the third ambiguity contained in the figure of the greenhouse. For the sake of efficiency, this architecture seeks to achieve a certain autonomy that allows for the total control of interior nature. Through the dissolution of the structure's outer borders, space becomes the ethereal container. The previous typological study showed that every form of greenhouse tends to engage in a dialogue with its surroundings, even if most often that dialogue is one of withdrawal. The irony lies in the way that this apparatus of disengagement is materialized, always made up of glass and transparencies.

It is this very specifically sarcasm that is explored in the movie *Playtime* (1967). Jacques Tati places Monsieur Hulot and a group of American tourists in a futuristic Paris built of modernist glass and steel high-rises. Arriving for an important meeting, the iconic character gets lost in this shimmering environment made of generic business office furniture. The French director makes fun of this immaterial architecture that, by fading too much, becomes an obstacle to the serene strolling of Hulot. Another point that this film reveals is the impact of transparency on visibility, hence on control. By reducing the structural mass, this architecture seems to want to blur the borderline between interior and exterior, despite the fact that this

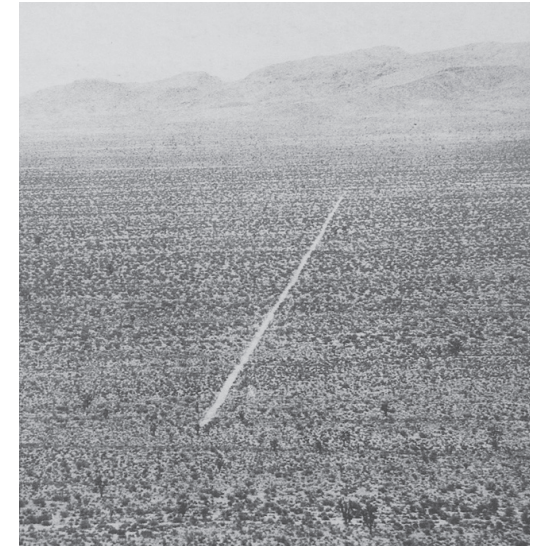fundamental act of separation and segregation is not only its founding act but also its manifest result.

Foregrounding these contradictions reveals that, beyond form and materiality, it is through the act of framing that the ethics of architecture manifests itself. It is thus within this interval, and with the help of the second definition of the word *frame*, that we should strive to think up another ethics of space, on that does not seek strict enclosure but rather commits itself to being open to context.

The Open Structure

In his description of the open work, Umberto Eco insists on the quality of the "uncertain" and the "unfinished" in the realm of art. For the sake of richness and freedom, he pleads for a subject/object turnaround that would engage the public as much as the author. This participatory approach attempts to redefine authorship as a suggestive definition of structure whereby the interactive crossing of borders is encouraged. Using such a strategy to reanimate the dialogue between architecture and its surroundings could be a tool to project environmental objects onto an enlarged world.

As previously stated, openness is at the basis of some relevant contemporary interpretations of the greenhouse. Used in exhibitions or in domestic spaces, those forms humbly suggest alternative answers to the ambiguous character of the technological shell. They also magnify a notion of climate defined in the introduction as a condition of place.

One strategy that counteracts the idea of nature fetishism identified above, could be articulated as a certain poetics of normalcy. According to Japanese architect Junya Ishigami, "a quality of nature is that it is governed by certain rules which at the same time we're never really aware of… I am interested in creating something that would merge into the normalcy that surrounds us"[5]. In this perspective, rather than protecting a privileged nature, the role of the architectural frame is considered as a possibility to emphasize an existing situation. It embraces the environmentalist criticism of the idealized aesthetic categories of the Picturesque, the Beautiful and the Sublime. In that sense, this architecture seems to borrow a lot from land art and its attentive attitude towards the "here". Arranging elements found on-site, earthworks amplify the existing conditions and render vis-

ible the minute accidents of the surroundings. This sensitivity to place and topography is, in a way, reminiscent of Antiquity's respect for the mysteries of nature and a profound trust in the cosmos. With humbleness, it admits that, sometimes, doing almost nothing is the most productive way of revealing the specificity of a place.
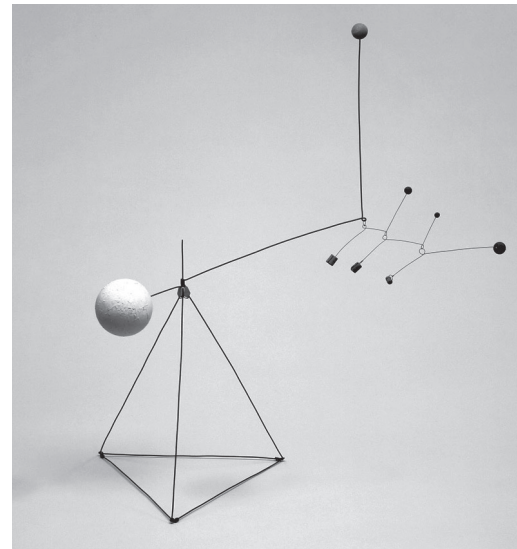
This brings us to a second strategy for openness, that works to overturn immunization in favor of inclusivity, and could be articulated as the principle of hospitality. With the idea of "doing with", the French architects Lacaton & Vassal promote an architecture designed from the inside out. The influence of natural elements is directly integrated in the conception of space and the relation between humans and their environment is accentuated. While referring to economy and simplicity, the architects focus on providing a generosity and abundance of space. The residents shape their own environment in relation to the exterior by opening their windows to ventilate and pulling the curtains to shelter from the sun. Staged as a place of daily performance, the living space be-

comes a way of being present in the world. One could associate this position to the tradition of the *happenings* — originally called *environments* — developed by American artist Allan Kaprow during the 1960s. Between installation and performance art, much of those works aimed to integrate domestic life in their practice. Steeped in the *avant-garde* dream of merging art and life, Kaprow declared, in 1991, that "art was like the weather"[6]. This aphorism refers to the generosity of the unstatic and the liberty left to improvisation when the subject and object interact. Similarly, by looking at otherness as a possibility to enlarge the intimate sphere, Lacaton Vassal's architecture calls for an organisation lying in daily life measures rather than in formal systems.

Finally, a third strategy towards designing architecture as an open work would be to avoid any tendency for over-characterization, and to research an "informal" architecture rather than an immaterial one — withdrawn shapes and blurred limits, whence the separation between architectural figure and environmental ground, or between intervention and found place, becomes reflexive and hard to define. The dispersal of borders can be achieved by privileging content over form. The work of De Vylder Vinck Taillieu attaches great importance to the reversibility of space. Doing so, the architects encourage a connection that tends towards open space: "Between the intimate house and the open world"[7], a process is en-

gaged, which tries to intensify indoor/outdoor exchanges. Quoting Umberto Eco on Mallarmé's poetic work, one can argue that "the important thing is to prevent a single sense from imposing itself at the very outset of the receptive process"[8]. In this quest for "work in movement", Eco also brings Calder's mobiles as "elementary structures which can move in the air

and assume different spatial dispositions. They continuously create their own space and the shapes to fill it"[9]. Once again, the simplicity of the gesture underlines the situation's peculiarity.

The aesthetic of suggestiveness introduces a poetics of space that places climatic inclusion as a focus point. Considered as a specific terrestrial condition, climate becomes the privileged object of architectural care. In this context, and in the words of Peter Sloterdijk, "the need to have an opinion on climate (…) prepares the fundamental change of attitude by which men leave their status of so-called "masters and possessors" of nature to become designers of the atmosphere and guardians of

the climate (…)"[10]. This change already seems to happen within the architectures that experiment with the idea of the open *frame* by articulating some of the principles here enunciated — normalcy, hospitality and informality. Foregrounding the fundamentally spatial link between people and their environment, the open frame turns architecture into a threshold support for openness and reflexivity, while returning to the original meaning of *climate* as a condition of place.

1.
Collins Concise English Dictionary © Harper Collins Publishers.

2.
Ibid.

3.
Ibid.

4.
Sloterdijk Peter, *Sphären III*, Frankfurt/M.: Suhrkamp (2004) p. 540.

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Interview by Katrien Vandermarliere, curator of deSingel exhibition, Antwerp, Ja+u (2013). Source: https://www.japlusu.com/news/junya-ishigami-how-small-how-vast-how-architecture-grows

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8.
Eco Umberto, *The Open Work*, Harvard University Press, (1989) p. 8.

9.
Ibid., p. 12.

10.
Sloterdijk Peter, *op. cit.*, p. 153.

fig. 1, *Topographia Paradisi Terrestris*, Athanasius Kircher, 1675.

fig. 2, *Silent Running*, Douglas Trumbull, 1972.

fig. 3, *Truman Show*, Peter Weil, 1998.

fig. 4, *Playtime*, Jacques Tati, 1967.

fig. 5, *Mile Long Drawing*, Walter de Maria, 1968.

fig. 6, *Fluids*, Allan Kaprow, 1967.

fig. 7, *Small Feathers*, Alexander Calder, 1931.

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Source: Neuman, *Art de construire et de gouverner les serres*, Editions du Bon jardinier, 1844.

fig. 2, Unknown engraving, *Closet*,
Source: Neumann M., *Glashäuser aller Art, Grundsätze und Erfahrungen über die Anlegung, Erhaltung und Pflege*, 1852.

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Source: Allain Yves-Marie, *Une histoire des serres, de l'orangerie au palais de cristal*, Quae, 2010.

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Source: http://gallica.bnf.fr/ark:/12148/btv1b53026298z.r=-champs%20elysées%20jardin%20d%27hiver?rk=42918;4

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Source: http://collections.vam.ac.uk/item/O121261/ticket-unknown/

fig. 3, Unknown, *Crystal Palace's interior*, London.
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