

Modern Architecture and Climate

Design before
Air Conditioning

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It is likely—bordering on certain—that the existential interests of future men and women will focus on technical images.
— Vilém Flusser

What is proper to every event is that it brings the future that will inherit from it into communication with a past narrated differently.
— Isabelle Stengers

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The Barcelona Lotissements

In 1931, Le Corbusier and his atelier designed a block of apartments as part of a larger urban plan for Barcelona.¹ The apartments had much in common with familiar projects by the Swiss-French architect, such as his Pessac development of 1920–24 or his houses for the Weissenhof Siedlung in 1927 (see figure 1.11). The Barcelona apartments, referred to simply as Lotissements (French for “subdivision,” though with a sense of the British “allotments” or garden plots) were grouped in blocks of two or four, each unit a thin three-story structure. These blocks were, in most cases, mirrored along the axis of a centralized staircase that was partially open at the roof, serving as ventilation shaft and light well. The ground floor had an open court living space, set behind a single hinged door that tucks into the side and out of the way. In most drawings of the project, the ground floor façade is shown open, creating the kind of indoor/outdoor space also characteristic of Le Corbusier’s *jardins suspendus*—though here remarkably more social and community oriented. This ground floor was double height in the back; a remarkable move that opened the downstairs *jardin* to the day-lit staircase, inducing ventilation through the court and taking advantage of natural illumination (figure 0.2; figure 0.3).

In these configurations of the living space—visible in section—the importance of light, air, and a relationship to the sun emerge as a crucial theme in Le Corbusier’s oeuvre, and, as this book will describe, in modern architecture before the advent of air conditioning.² This specific temporal and technical framing suggests a different analytic framework for architectural history, one that treats as its object the spatial, climatic, and material inter-relationships of a building. Le Corbusier’s Lotissements were, if not the first, a significant early instance of a kind of social and technical approach to the design of a building façade that sought to acclimatize the interior, architecturally, and thereby to improve the quality of life that would happen within.

The façade is rendered as a mechanism of climatic mediation. It both integrates this project into the history of architectural modernism (laying out a recognizable architectural past and future) and opens it up to a more general history of design methods, material innovations, and attention to systems. A history of architecture and climate. Although the Barcelona project was never built, the drawings the studio produced presented new graphic means by which a climatically active façade system could be understood and reproduced; it initiated decades of discussion about climate design methods. These discussions, and their resonance to the present, are the subject of this book.

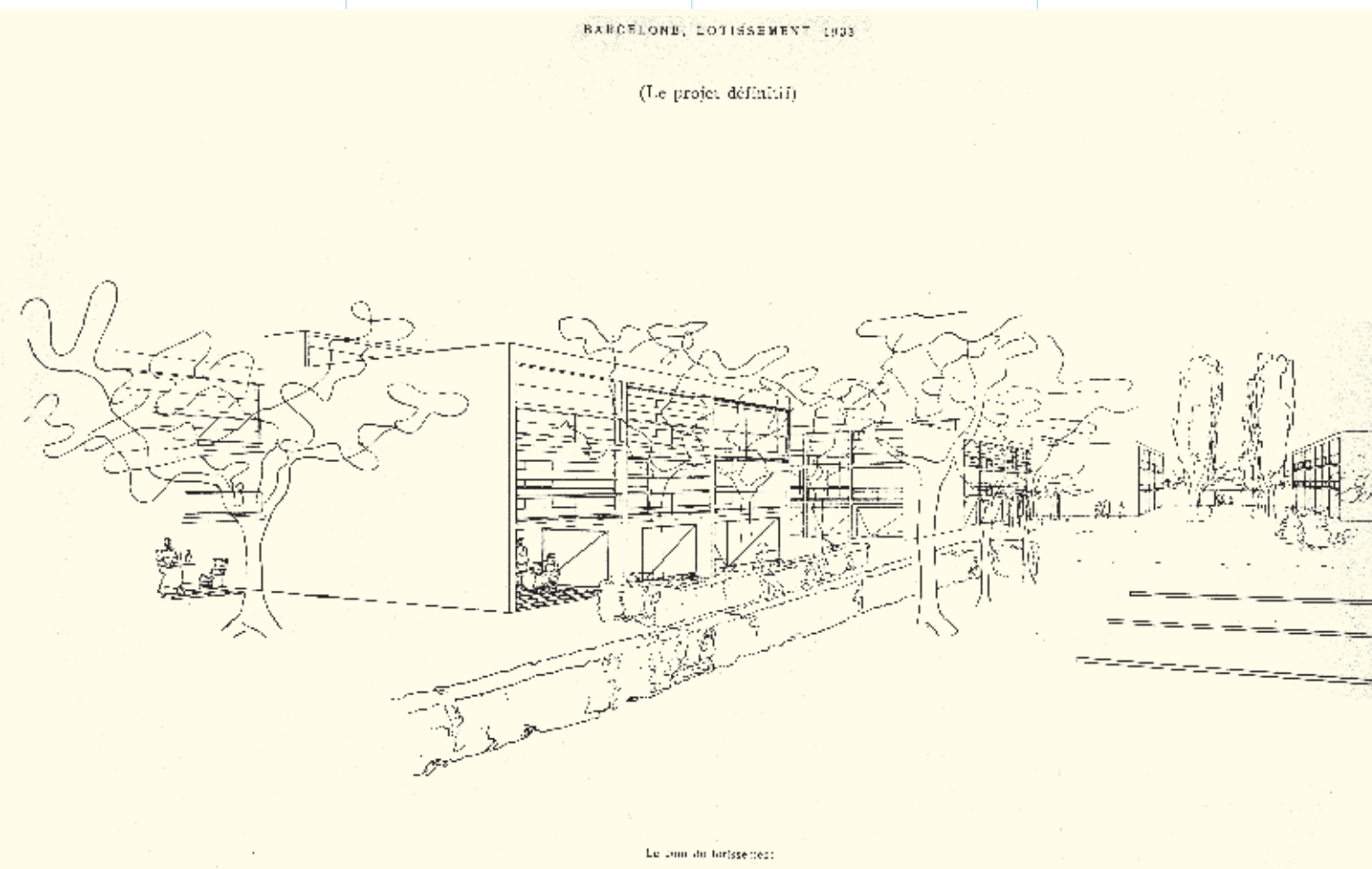
The Barcelona apartments sat on the fringe of the Plan Macia, a larger urban redevelopment project typical of Le Corbusier’s urban work of the period, and was developed with the Catalan collaborative GATCPAC (figure 0.4).³ The larger project was framed by the theme of “une maison, une arbre”: that an essential aspect of a house was to have a tree as part of the yard; again, the “allotment” aspect. Each house was to have had a tree planted for it, often more than one. As shown in the initial drawing from the archives, the roof was also planted, an elevated garden space (figure 0.5).

Above the ground floor interior patio, the second floor, as the initial plan shows, had a kitchen and a dining area as well as a deep balcony—one similar to those in the better known Immeuble Villas of 1922. The third floor had three bedrooms: a large one at the back for the parents; a smaller one, without a window, for the “garçons”; and another small room for “jeunes filles” open to the end of the hallway and the terrace. On both of the upper two floors there were small terraces at the front, with a wire mesh balustrade. The rear stair continued to a raised area on the roof, a lantern, perhaps best seen in the model. The lantern operated as a large exhaust flue for the staircase/ventilation shaft. It was also a sun room and provided access to the planted roof terrace. In an early drawing (figure 0.5), a figure walks atop

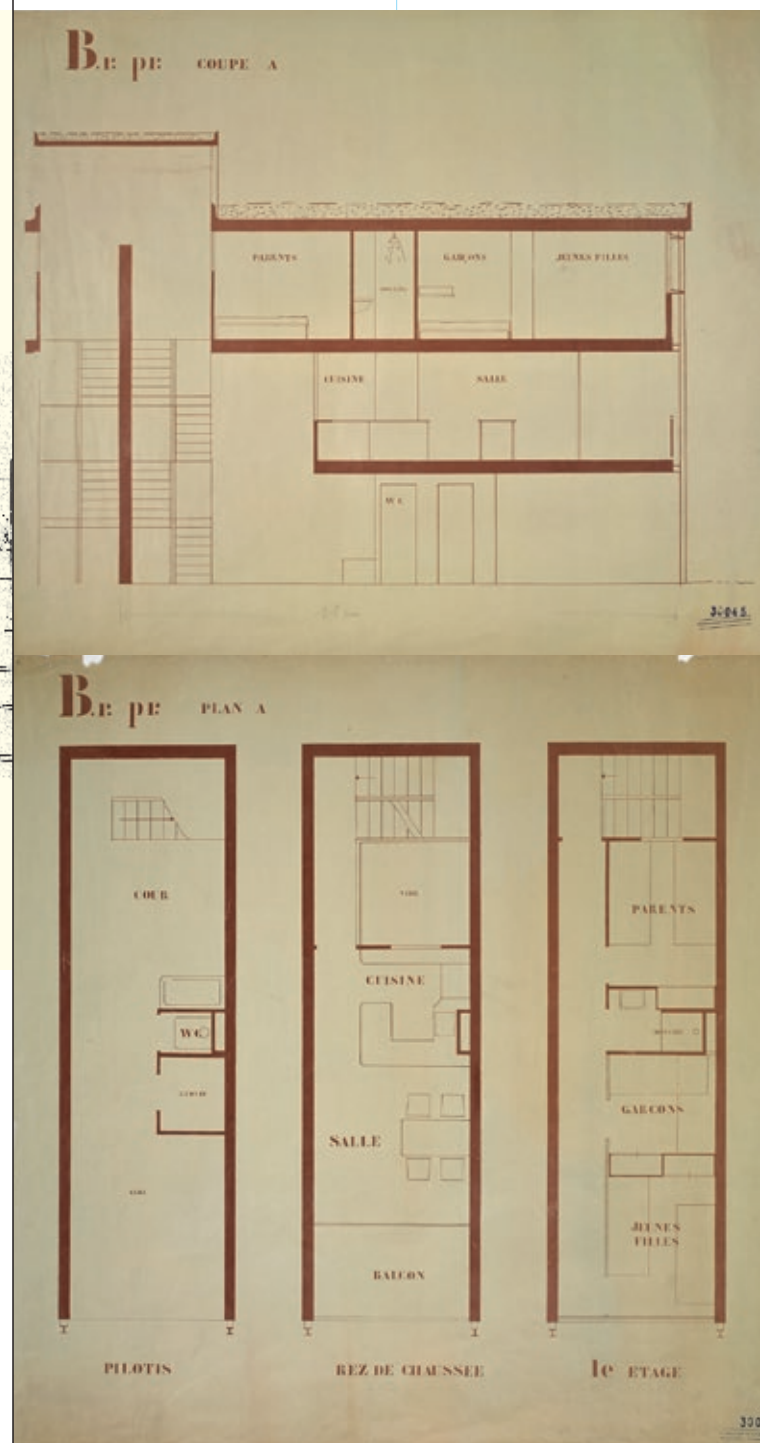


0.1 Le Corbusier, Lotissement, Barcelona, 1931 (project). Model from 2002, made by the Cité de l’architecture et du patrimoine, Paris.

Architecture, Media, and Climate



0.2 Le Corbusier, Lotissement, perspective, from the *Oeuvre complète*, 1929–1934.



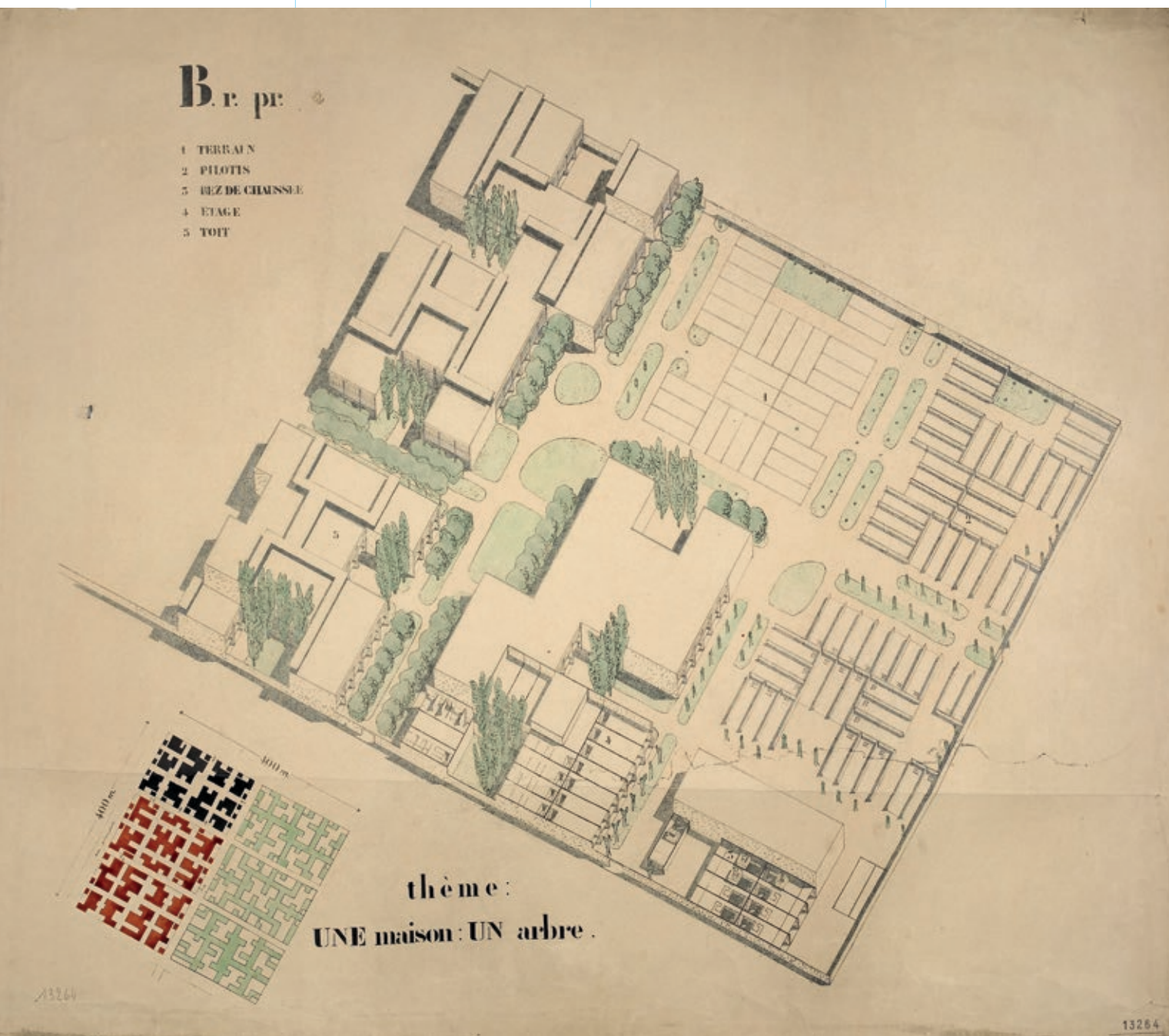
0.3 Le Corbusier, Lotissement plan and section.

the lantern space, seeming to be catching butterflies. In most later representations, the top of the lantern is more functional (for ventilation and climatic management) than habitable.

Louvers on the façade of the second and third floor—lining the balcony off the dining area and the young girl’s bedroom—were proposed to provide seasonal shade. Drawings and models of the project indicate that the deep terrace at the second floor and the thinner terrace on the third (not really occupiable given the louver system) both had shading devices set back just behind the vertical plane of the façade—the shading system was embedded in the architecture, in the thickness of the façade itself rather than on top of or outside it. The “la façade” elevation in the *Oeuvre complète* (figure 0.6) indicates that at the bedroom floor the louvers could seal the window off from light; the living floor has some gaps between the louvers, allowing daylight in most conditions.

Both floors had sets of three large louvers. They were operable, and could be moved together according to four settings: tilted up, tilted down, vertical (closed), or horizontal. Adjustments would be made according to seasonal and diurnal patterns of the sun. Schematically, at least, the Lotissement project sketches out the *first principle* of emergent climatic design methods: an adjustable shading system at the façade, keyed to the specific microclimate on the exterior and the volumetric and material details of the interior, has the capacity to modify the daylight and thermal conditions of that interior, and to make it more comfortable year-round. The façade is in this sense embedded both in the interior (the architecture) and the exterior (the climate); it mediates, mitigates, and negotiates. The bioclimatic architecture of the 1950s would later elaborate on this principle, insisting not only on a carefully articulated façade system, but also that the façade for each elevation be treated differently, according to the precise dynamics of solar exposure.

After the site-specific façade, a *second principle* of climate design methods: the section drawing is essential to understanding these façade-based manipulations. The façade section drawing in the *Oeuvre complète* (figure 0.6) shows the louver system on the second floor as a series of X marks, representing the in-between, diagonal states; on the third floor a central vertical line bisects a series of horizontals—they are open and/or closed. This was an early exercise significant to the historical developments being traced

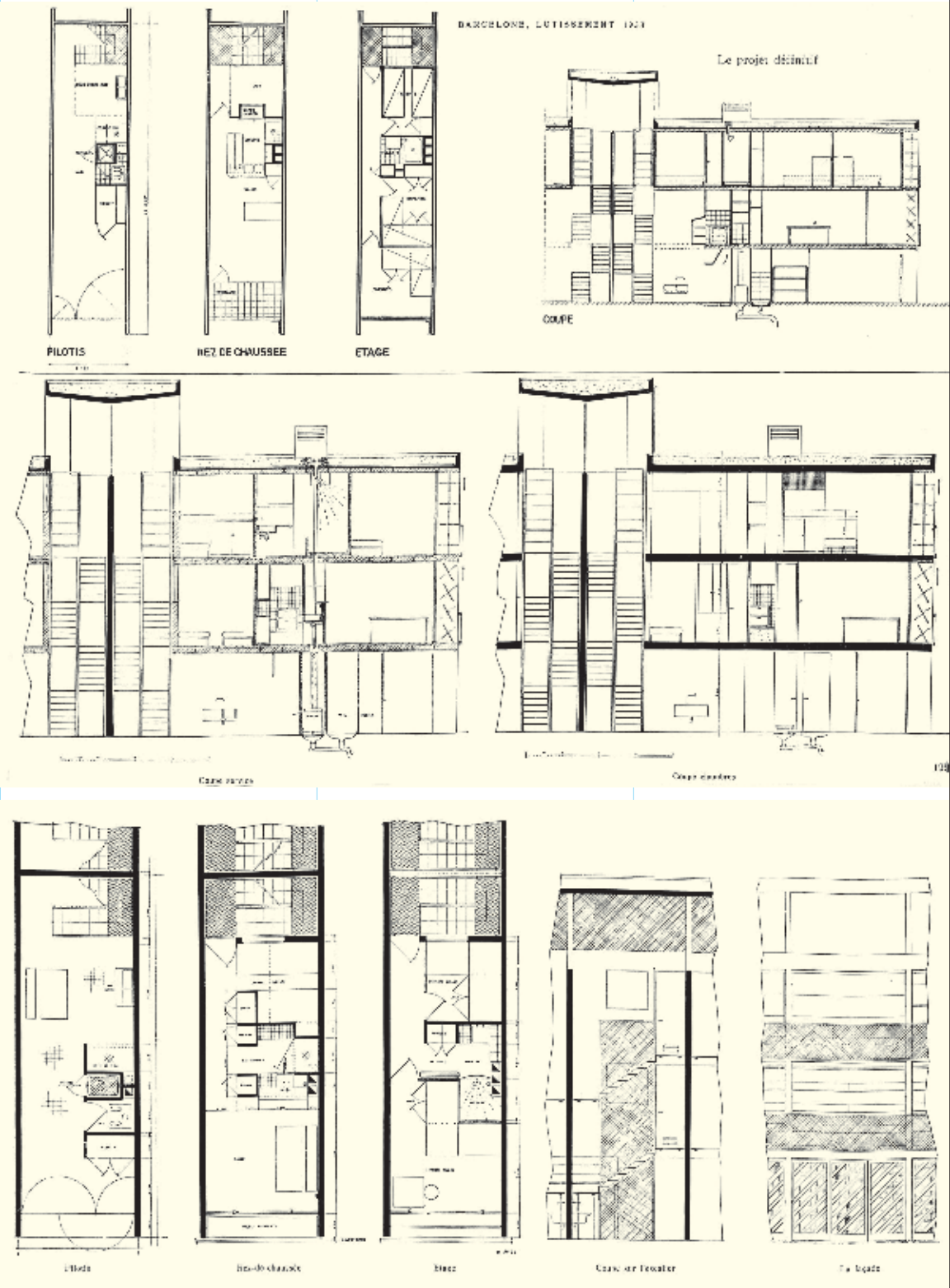


0.4 Le Corbusier, Lotissement
block plan.



0.5 Le Corbusier, Lotissement
concept drawing, c. 1931.

0.6 Le Corbusier, Lotissement plan and section from the *Oeuvre complète 1929–1934*, indicating the daylight staircase and the façade.



in this book: the expression, in graphic form, as technical image, of a carefully designed façade shading system, distinct for each program and orientation it faced. The variability of the façade, read as a media event, suggests a new relationship between cultural patterns and social practices, on the one hand, and the design of interactions with the façade, on the other.

Although the louvers themselves vary in detail, the mechanism to move them is uniform across the floors. The second and third floor façades are represented differently in an attempt to suggest the dynamism of the overall system—that it had multiple states of rest, that it could be adjusted in order to alter the experiential conditions of the interior—against the option of illustrating one setting and thereby giving the impression of their being one, or one preferred, state. The climatic façade section aims to map alternatives, to represent conditions across multiple settings, in relationship to season and daylight, and as a means to suggest both the building’s flexibility and the general presumption of a building system that *changes*. Modern architecture, in this important sense, was challenged, before air conditioning, by the dynamic systems implications of the building as climate mediator. The X and bisected horizontal line work together, graphically, virtually representing this dynamism in the façade system, and reflecting the social life envisioned within: A life of comfort, the house as a platform for sociability, health, and progress.

In the Barcelona project, the façade is a media device, in a way both material and symbolic. The premise of a dynamic, site-specific façade invited new terms for representation—of the building, of the humans inside it, of the environment and the patterns of the geophysical world that surrounded it. Articulating a distinction from this world of geophysics, of *nature*, is of course part of the broad ambition of architecture: to delimit the social from the natural. The porous boundary of the shaded façade offers new material terms—“an environmental filter,” as it will be called it in 1957—and new symbolic terms for understanding how humans live inside the built environment. The exchange between material experimentation and design representation will intensify in subsequent years and through subsequent projects; the façade, as media, is the primary element for experimentation in climatic modernism and, in section, the primary aspect of design representation.

Climate can only be understood through representation. The façade is a technical system for cultural engagement with the natural world that explicates a social relationship to climate, represents it. It is a liminal space between the interior and the exterior, between the building’s program and the region’s climate; it contains both. The façade is drawn (literally) as a means to indicate a specific cultural relationship to climate, a refined approach to the porous line of distinction between the civilized interior and the less predictable world outside. The line of the façade was theorized across the development of architectural modernism. The complexity of this interior/exterior relationship, the significance of the line that divided it, was experimented with and materialized as a new kind of image—technical images that conceptualized the thermal interior and aimed to optimize the conditions of this interior according to perceptions of health and productivity, of culture and progress, and of a universal norm. The sectional drawing of the façade is an emblem, then, for how a range of media reflected ideas about architecture and climate, and for how to render those ideas in built space, to bring specific thermal conditions into being. The building façade is both a screen on which to watch environmental change and an industrial-material system from which to produce it.

The Lotissements were relatively undeveloped as an architectural project. However, they set out a premise for the proliferation of design ideas and methods that became a significant thread in architectural modernism over the next few decades. It is in this sense an epochal, recursive project, an object from the past that describes a relationship to climate with unanticipated relevance to the present and the future.

At the Right Place

Modern Architecture and Climate tells the history of shading devices, brise-soleil, louvers, screens, fins, жалюзи, and other attempts to control the way that the sun enters the building by architectural (rather than mechanical) means. It surveys the midcentury tumult around energy, politics, technology, and design and documents—through diagrams, sections, photographs, collages, and other media—to describe a complex cultural apparatus intending to make sure that, as Victor Olgay put it, “interception of the energy happens at the right place”—solar radiation is

deflected at the façade, before it enters the building.⁴ A simple yet, as will be shown, epochal imperative to focus design innovation in the context of radiation, thermodynamics, and geophysics. This book is a history of the façade being seen as the right place to engage in climate. The façade was a mechanism of climatic mediation and environmental management, from the early 1930s in the sectional drawings of Le Corbusier to the elaborate methodological diagrams of the Olgyays in the 1950s and early 1960s. This is a history of the façade as media and of the brise-soleil as a cultural technique—as a mediating device, selectively blocking the sun, and as a media device, rendering visible specific cultural relationships to climate patterns, as those relationships and patterns change over time.

It is also a history of how modern architecture was formulated, initially, as a strategy of climatic adaptability. Developments of modernism were a means to induce a way of living (*l’esprit nouveau*, in Le Corbusier’s phrase) in which the building was the essential medium through which to construct adaptable conditions of comfort according to regional and seasonal vagaries—even though, at many junctures, this premise of adaptability was overwhelmed by an insistence on normative conditions, especially in the context of architecture’s relationship to economic development and the global spread of capital. These multiply implicated architectural strategies, as climate-sensitive methods, are themselves premediations, again on material and symbolic terms, and at times an inversion of the structured dependence on fossil fuel that accelerated in the post-war period.⁵ The dynamic façade in this sense reflects a different architectural past, one in which the profligate use of fossil-fueled HVAC (Heating, Ventilation, and Air Conditioning) systems, behind delicate glass façades, is seen as one of many threads in the historical development of architecture, across a timeline rich in variety and sensitivity of design methods.

The sectional exploration of the façade precipitated and developed alongside methods for conceptualizing the designed interior as a space of thermal optimization. The planetary interior emerged as a conditioned space of social inhabitation—a space of control for commerce and the processing of the global economy, a space of consistency and rationalization, of the working stiff and the man in the gray flannel suit, of the conditioned domestic interior, static as a space of

tradition. Ideas and methods relative to thermal consistency and variability were initially seen to be activated through architecture—that is, by design methods rather than through mechanical systems. Elaborate techniques and systems were developed to account for climate as part of the design of the building, including especially the relationship between the volume of the interior, the precise microclimatic location of the site, and shading devices on the façade, as mediator. This same accounting for climate—the volumetric considerations, the concept of the “comfort zone,” the general notion of regulating the interior—was later pursued through mechanical HVAC systems, working off the regulatory parameters established through nonmechanical means.

Put slightly differently, the conceptualization of the thermal interior initially developed through careful coordination between design elements, knowledge of climatic patterns, and assumptions about inhabitants’ resilient capacity to adjust to different thermal conditions; this same aspiration for achieving thermal balance was then integrated into mechanical systems, modeling processes, and regulatory structures that, by contrast, were seen to be universal and everywhere applicable, able to produce an identical climate anywhere and across time. In this sense the International Style (despite the suspicion with which this term is generally accorded today) was in fact quite bold and effective—modern architecture, to a significant and underanalyzed extent, was about the delivery of a certain kind of managed thermal space, initially through design and then as part of the proliferation of air conditioning around the world. This book tells the story of climate as a project for design, just before air conditioning.

It is also about how the global imperative for the rendering normative of the built interior, when read through architectural-climatic media of the period surrounding World War II, provides evidence for the unintentional acceleration of the destabilization of climate systems.⁶ Climate-methodological images, the aspirations for new ways of living that they sought to represent, and the buildings that they produced instigated and reflected new desires. They sought to articulate the possibility of a new kind of social and economic life, consistent across the unevenness of climate and of capitalist development.

This is a complicated set of connections that is also remarkably simple. Technical images and shading devices led to new ways of conceptualizing the thermal interior; these conceptual models became the object of regulatory mechanisms and mechanical systems intended to normalize the interior conditions around the globe. The focus is on the *architectural* methods (that is, rather than *mechanical* methods) that were developed to conceptualize and condition this planetary interior. The focus is also on how, by placing climate in the center of the historical trajectory of architectural modernism, a new perspective emerges relative to the role of seemingly “peripheral” regions and practices. Modernity is here less a promise of progressive liberation and more a framework for analyzing architecture’s role in the project of economic development, with some interest in the prospects for new kinds of architectures, and new kinds of development, now that fossil-fueled modernity’s promise has sharply faded.⁷

The façade is essential, though of course it is only one of many elements of a building that determines the thermal conditions of the interior—the roof, relationship to the ground, siting, volume of enclosed spaces, among numerous other factors, are taken into consideration when assessing a building’s thermal condition. The façade is, for the purposes of this book, representative of these other factors. This is in part because it is often designed to represent the public or urban face of the building, and in part because sectional drawings of the façade emerge, in the archives revealed through the episodes that follow, as crucial to disciplinary articulations of specific aspirations relative to architecture and climate. While numerous other kinds of image production, especially the integrative diagram, also proliferate and also become important sites for tracing these threads, the façade section is the essential tool for reconceiving architectural value according to climatic performance.

From the Brise-Soleil to the Planetary Interior

Modern Architecture and Climate is divided into two parts. The first, “The Globalization of the International Style,” narrates the growth of climatic modernism in relationship to architectural innovations from the 1920s to the 1940s. The first chapter looks at Le Corbusier’s engagement with climate to understand the historical development

of shading and also to assess how the significance of climate as an aspect of modern architectural history has been clouded in the historiography. The second chapter looks to the proliferation of the brise-soleil in Brazil, emphasizing how climatic modernism developed in relationship to the political, social, and economic modernization programs of that country—and thereby figures a broader relationship between architecture, risk, and development. The third chapter examines a series of tests for these modern architectural strategies: first, Richard Neutra’s so-called Planetary Test for postwar reconstruction in Puerto Rico, and then a different kind of geopolitical hedge in the American embassy building program in the Middle East, Africa, Southeast Asia, and elsewhere in the 1940s and ’50s. The story all along is tightly focused on the images that are produced, the context for their dissemination, and the analytic relevance of these media practices to understanding climate and environment, as they are emerging as socially relevant categories.

The second part, “The American Acceleration,” focuses on American design-methodological discussions of climatic modernism after World War II. Here, the technical image—its figures, its tropes, its dissemination, its technicity—was organized more precisely around a capacity for instrumentally applying a set of methods to a given building project—or, better, toward the development of a universal system for architectural-climate analysis. The project was no longer simply to construct new spaces, seemingly appropriate to an expanding industrial modernity, but to develop disciplinary methods that restructured the relationship between architecture and climate so as to better inhabit the planetary interior. These methods were explored diagrammatically. The images produced premeditate and prefigure conceptions of conditioning and environmental management that would emerge in subsequent decades. They also render in sharp relief the developmentalism embedded in architecture’s transformations over this period, embedded with patterns of racial and economic injustice in processes of industrialization, modernization, and growth.

Chapter 4 (the first in part two) tells the story of the Climate Control Project, a collaboration between *House Beautiful* and the Technical Education Office of the American Institute for Architects. The purpose of the project was to “communicate to the architect the complexities of climate completely in images” and involves

a number of significant developments in the design of the thermal interior and its representation.⁸ An unexpected mix of interdisciplinary climate thinkers—anthropologists, meteorologists, physicians, decorators, astronomers, historians, photographers, a large number of architects—got involved in the effort. Chapter 5 looks at the intensification of climate-design methods in labs and conferences, especially at the Princeton Architectural Laboratory in the mid-1950s, where Victor and Aladar Olgyay performed their research, wrote their books, and built the Thermoheliodon—perhaps the last, certainly the most ambitious, nondigital architectural-climatic modeling device. They drew a large number of diagrams attempting to articulate a careful, technically astute method for correlating a building to its climatic surround. The last chapter, “Conditioning” examines the hybrid building types that emerged in the 1950s as a transition toward mechanical acclimatization of the interior, in the context of the increasing regulation of interior space by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE), founded in 1959, and as a passage toward reliance on fossil fuels. In the conclusion, the planetary interior is discussed as a site for contested modes of building and living, and as a space of politics.

In some ways, this book has already been written—written and rewritten a number of times over the past few decades, as architects and historians have struggled to insert issues of energy, environment, and climate into the mainstream of architectural discourse. Many of the climatic façades in Brazil (the concern of chapter 2) were collected at the end of Victor and Aladar Olgyays’ *Solar Control and Shading Devices*, published in 1957 (itself an important reference in chapter 5). James Marston Fitch’s book *American Architecture and the Environmental Forces That Shape It* (discussed in chapter 4), the 1974 revision of his 1947 text (“Environmental” was added in the later version) begins with a lament that architects had not effectively (if at all) taken up the environmental challenges and opportunities that sat right in front of them. Not to mention the complicated ways in which Reyner Banham’s *Architecture of the Well-Tempered Environment* (1976) was received in the field and the vicissitudes of its historiographic treatment since.⁹ Further, numerous texts have been written and illustrated with examples of best practices in terms of the energy-efficient technologies available in the present. At a number of

junctures since World War II, the question of how architects can integrate their practices with scientific knowledge of the biosphere has come to the fore, been debated, and, haltingly, emerged as a framework for design intervention.

And yet, this discussion could not be more timely. Conditions have, of course, changed since the 1930s, and the 1960s—the climate has changed, scientific knowledge of climate has changed, and the tools of the architect have changed, all beyond recognition. The way that historians consider the relationship of scholarship to practice and culture has also undergone provocative transformation—a number of writers have recently discussed how uncertainty about the future has disrupted familiar patterns and methods of historical scholarship.¹⁰ This book operates at the intersection of careful, theoretical elaboration of architectural-historical complexities and the urgency of the climate crisis. While I am attentive to the substantive distinctions between previous eras and our own—architects of the period under analysis knew nothing of the consequences of carbon emissions—I am also sensitive to the unexpected relevance of these marginalized forms of architectural knowledge.

Indeed, the hoped for effect of this book, of the discussion of architecture and climate more generally, is this: by rescripting the historical narrative of architectural modernism, other futures will be seen to be possible. As part of a wider arrangement of social and environmental forces, this text aims to enjoin architects, scholars, and others toward engagement with climate as a central aspect of architecture culture and the building industry. As Isabelle Stengers has recently written, “What is proper to every event is that it brings the future that will inherit from it into communication with a past narrated differently.”¹¹ The histories here presented, and the broader project of the environmental history of architecture to which they relate, reframe the terms by which we consider a given architectural phenomenon to be seen as a *historical* event—a building, a drawing, an idea—in order to narrate the past differently, drawing out threads that have been concealed, so as to communicate with, pose trajectories for, an as yet undetermined future. In this sense I humbly aspire to, at best, open this discussion of histories and possible futures, of the techniques of climate management, to further contributions of scholars, architects, and others interested in the techno-cultural challenges of mitigating and

adapting to climate instability. Which is to say: in light of the unintended consequences of the global proliferation of HVAC systems since the mid-1950s—carbon emissions, lifestyles rooted in burning fossil fuels, global warming, threats of species extinction—this history of nonmechanical practices is also about possible futures.

This is a history focused on the future, because it is likely that aspects of the built environment of tomorrow will resemble and reassemble elements of this relatively recent past—in the sectional treatment of the façade, in the reconceptualization of thermal comfort, in the cultural capacity for adaptation, in the recognition of new entanglements between architecture, politics, and social patterns that play out in the planetary interior. The cultural absorption of shading devices and climatic strategies sit just below the surface—just behind the façade—of more familiar narratives of architectural modernism; what began in Barcelona suggests an elaborate thread of architectural activity, rich in its interconnections, its object of study, and its relationship to contemporary questions.

Environmental Media

Weather can be experienced; we need media to understand climate. Buildings can be experienced; we need media to understand architecture. Media is both general and specific—though the term as used here is not the media that plays out through journalism, radio, television, and the public sphere, or not exclusively. Media, for the purposes of this book, initially, is a means of cultural communication and reflection—images, their production, dissemination, and analysis, that provide insight into the methods and perspectives of historical agents.¹²

Media is evidence, more broadly, for cultural approaches to concepts such as climate. The narrative of *Modern Architecture and Climate* follows the emergence of the technical image—an image seen as an instrumental device, a technique, for changing the sociobiotic relationship. Technical images will be mapped, in this book, across a thirty-year transition from the vaguely experiential to the precisely scientific; from a humanist, romantic version of nature as a site for balance and harmony, to a data-driven understanding of climate as a realm of the chaotic and barely predictable, rethinking the position of

humans and habitats within it. The façade’s liminality will similarly be seen to register an architectural approach that is increasingly informed by new kinds of expertise.

Climate methods in architecture emerge through media, reimagining the future as a space of speculative investigation.¹³ Analyzing these images, and framing the façade as a form of media itself, allows for analysis and interpretation of cultural norms and aspirations. The category of “environmental media” relevant in this period encompasses those images, devices, and other processing systems that seek to operate on the distinction between environmental knowledge and social practice. Architecture, in this sense, is both a material and a symbolic substrate for a range of new ideas about social engagement with climatic patterns.

Reconceptualizing “Environment”
Many of the concerns and questions that drove the development of modern architecture focused on the environment, even though this term was generally not in use.¹⁴ As part of their thinking about new ways of building in the world—new materials, novel organization for social activities—modern architects imaged and imagined the environment, as both obstacle and opportunity. They did so as a matter of course, and earlier than most other professionals who have since become concerned with it. While much of this concern was related to seemingly quotidian issues of placement on site, or the orientation of windows, there were also sophisticated discussions of, for example, access to light and air, isolating pedestrians from automobiles and their pollution, materials and their efficiency, prefabricated construction methods, and other careful means of considering the effects of the environment on design, and of design projects, as they aggregated, on environmental health. Many of the innovations around materials and design methods that were essential to the articulation of the principles of modern architecture were also arguments for a different relationship between social patterns and the uncertainty and unpredictability of environmental conditions—if not yet on a planetary scale.

In order to draw out the specificity of this conjuncture of architecture, media, and climate, the focus of this book is on those practitioners and writers who self-consciously sought to produce a new way of thinking about architecture’s relationship to the geophysical systems that

affect a given site. This drew on knowledge of both the geophysical conditions of the exterior, broadly conceived as climate, and the interior space that was produced in relationship to it, understood as a thermal interior. New kinds of images were needed to explore, understand, and communicate the novel terms, forms, and technologies that could best operate on these two conditions—the climate and the thermal interior—and their interconnections.

The intersection of architecture, media, and climate brings to the foreground a conception of the environment as instrumental—it is of interest as a system, as a means to develop operational approaches to human life—and sees planetary systems as subject to engagement, manipulation, and optimization. Many histories and contemporary discussions approach the concept of environmentalism with a focus on increased scientific knowledge of ecosystems—at a local, regional, and planetary scale—as this knowledge intensified from around the 1920s; other histories examine a range of bureaucratic and countercultural social movements that sought to renew “nature” as a site of cultural value, through legislation or protest.¹⁵ The emergence of climatic modernism developed along this same historical continuum and in relationship to a number of these threads and other related historical patterns; however, it does so with a different emphasis, and with different ends.

The environmentalism of the climate-design methodologist was not one of land ethics, of “nature” as a site for reflection, or of an experimental ground for modeling peak ecological conditions. Architects instead sought to analyze how physiological norms, social behaviors, and atmospheric patterns were intertwined, and how the built environment could optimize these interconnections in producing spaces for habitation and work. It was a question of gathering data and minimizing risk. This was, importantly, not called “environmentalism” in any substantive fashion—the project was not one of social transformation; it is only from the present perspective that one can recognize these ideas, methods, and actions as aspects of a project for socioenvironmental change. Rather, the focus was on the capacity of applied scientific knowledge and material strategies to alter, and, hopefully, improve the relationship of societies to their surroundings. This aim operated experientially, at the scale of the individual—the inhabitant of the house, the

worker in an office building—and at the scale of the population, where data and technical knowledge abstracted the techniques and the ends of improving quality of life. (The so-called comfort zone, which will be the subject of much discussion in the latter half of this book, was the figure conceptualized to model the experience of the interior according to optimized data sets.)

This is not to say, at this stage, that such efforts were successful on the terms as they were proposed. The means and ends of climatic analysis are significant as process: they opened up a new realm for architectural ideas and methodological application. “Climate” was and is a site for knowledge production in architecture that, in different ways across the decades under discussion here, provided access to a constellation of interconnections between scientific, technological, and bureaucratic innovations and the wide-ranging social transformations that these were seen to be in relationship to. At the limit, climate in architecture was, and is, a cipher: a way to talk about social collectives in their relationship to geography, economy, and politics, through the technical image.

This conception of environmentalism as applied knowledge is less about a concern for the seemingly inherent harmonies of the natural world and more about an interest in understanding the interaction of economies (social relationships to resources) and ecologies (uneven geographical and climatic conditions). This inflection of the sociocultural project of environmentalism reflects a broader disposition of the book, a sort of realpolitik that looks for historical knowledge according to contemporary use value, both technologically (how to build something) and historico-conceptually (how to think in relationship to history).

In this context the concept *architecture* has itself evolved, has been socially constructed in response to changing conditions in the world and changing knowledge about planetary systems. In much contemporary discourse, architecture is considered to be a process almost exclusively focused on cultural expression through creative form-making. Yet, the search for a novel form in and for itself is a relatively new phenomenon, indeed beginning in the debates of postmodernism just as this story of climatic creativity was ending. The architectural discourse of the past half century or so has naturalized the field as one that is focused on the formal to the exclusion of

environmental, behavioral, or social, even though many architects, historians, and critics have operated otherwise.

There are other examples, other histories that underlay relational approaches to architecture. Lewis Mumford’s urban histories and criticism, for example, drew strongly on the work of Patrick Geddes, whose formulation of paleotechnic and neotechnic—of a new realm of technological relationships and correlate social formations—was essential to Mumford’s understanding of the political and economic relevance of the built environment.¹⁶ Geddes, for his part, was influenced by the forest manager, governor of Vermont, and ambassador to Italy George Perkins Marsh, seen by many as an American protoenvironmentalist.¹⁷ The environmental historians Ramachandra Guha and Joan Martinez-Alier have commented on this Marsh-Geddes-Mumford thread. Marsh, Guha, and Martinez-Alier write, posited “man as an ‘active geological agent’ who could ‘uphold or degrade’ but who was, one way or another, a ‘disturbing agent,’ who . . . overthrew the stabilities of existing arrangements and accommodations.”¹⁸ Balance or harmony where not substantive concerns; instead, regulatory methods to reduce human impact or to manage a resource came into play.¹⁹

Mumford, under Marsh’s influence, as Guha describes it, recognized the ambivalence of technology relative to environmental stewardship, and emphasized the complexity and unpredictability of the consequences for the natural world and for societies and their political and economic frameworks. Mumford was concerned that concepts of the environment were conceptually inadequate as they did not consider individual and collective desire, the impact of social actions and activities on the ecosystem, and the complex feedback loops—between desire, economic production, and ecosystem management—that pertained. As Guha and Martinez-Alier summarized: “Like [John] Muir and [Aldo] Leopold, Mumford valued primeval nature and biological diversity, but unlike them, he focused simultaneously on cultural diversity and relations of power *within* human society, refusing to divorce individual attitudes to nature from their social, cultural, and historical contexts.”²⁰ How nature is considered, or constructed, makes a profound difference in how the consequences of social actions are understood, configured, and rendered relevant.

Architecture, posed across this nexus of economies and ecologies, produces a distinct realm for discourse, a field of technical knowledge that seeks to adjust, reflect, and reconsider—in a word: *mediate*—the relationship between scientific knowledge of planetary systems and social means of expressing collective will relative to that knowledge. Architecture works toward new understandings of effective (in the sense of species continuation) means of engaging ecosystem conditions and behaviors, and is part of the cultural milieu that elaborates on, visualizes, and otherwise demonstrates these relationships. Again, the façade system is essential—as much for its architectural technicity as for its delimitation of the interior as cultural space, and further for its framing of the climatic exterior as a subject for scientific inquiry. Architecture operates as a material and symbolic intervention in the life-world, simultaneously interpreting this world through sophisticated visual technologies and intervening in it to alter and shape the conditions for future life.

This variety of environmentalism is less about “saving the planet,” simply because the need was not yet present and identified—we are decades before Greenpeace, and all the geophysical knowledge and social awareness that modern environmentalism implies. Climatic modernism was about understanding how social and geophysical systems interact, and operating on those systems so as to alter them—most frequently, these alterations were framed as optimizations, and sought to simultaneously improve what were considered, in different historical contexts, to be ideal for both social opportunities (improving ways of life) and biotic opportunities (as a matter of course, not overcompromising the conditions of the planet that allow human life, and life in general, to persist). Such were the concerns of the climate methodologists, their precursors and successors.

None of these ambitions should be taken at face value—that is, these architectural-environmentalists had their own professional aims, biases, and sociocultural dispositions, and pressures from clients or institutions. This is not a story of triumph over the elements; rather, it is a story of identifying in climate a new object of history and a new subject of design practice, an interest in how design methods were refined for climate, and of the consequences of this expanded architectural discourse

on the changing climate patterns of the past and the present.

It is also the story of a new kind of subjectivity—a narrative that reflects how individual desires have transformed in relationship to physiological and climatological changes. The concept of “comfort” is the important aspect here, and its occupation of the architectural-climatic discussion. Comfort is the ideal of all capitalist and induced forms of built developmentalism—relative to quality of life, to efficiency in the workplace, and such—and also the object of panic, the thing we can’t let go of, the driver of so much of our climatic disruption. It is an epochal concept—it must be seen, that is, for the epochal transformations associated with it. The façade as media also shudders across this line of the Great Acceleration: the more comfortable we are, as a species, the more at risk we are, as a species. Architecture of the twenty-first century needs to be consumed with this fact.

Climate design methods of the 1950s encouraged inhabitants to interact differently with their façades and the spaces those façades helped produce, thereby activating a new relationship between inside and outside, and hence between societies and environments. It was dynamic, flexible, and, across a shorter time period, adaptable. Reconfigurable: able to be seen as operated on differently, to different effects. Not a static object. Climatic modernism, as with architectural modernism more generally, produced new subjects—new individuals with novel desires, newly sensitive to the thermal conditions of the interior. We have produced our air-conditioned selves through architecture. In this sense, architecture does not simply reflect a given social formation, but is generative, productive of new relationships.²¹

Architecture focused on climate is part, of course, of a biopolitical process. Biopolitics poses as its analytic object means of intervention in “the general system of living beings,” offering, for better or worse, new ways of interacting with people, things, and spaces in a fashion that is resonant with the means and ends of climate design methodologists.²² Michel Foucault also proposed to reconfigure the object (not just the subject) of historical analysis along the expanded terms just outlined, and under the figure of the “technical schema of this notion of milieu” that he described as “a kind of pragmatic structure . . . present in the way in which the town planners try to reflect and modify urban space.” He described the milieu as a sort of given space of social formation: “The

apparatuses of security work, fabricate, organize and plan a milieu . . . as [a] set of natural givens—rivers, marshes, hills—and a set of artificial givens—an agglomeration of individuals, of houses, etc. The milieu is a certain number of combined, overall effects bearing on a population.”²³

The concept of the milieu in Foucault—which cannot simply be translated as “climate,” but is not unrelated—developed in relationship Georges Canguilhem’s treatise from 1948, translated as “The Living and Its Milieu.” It is summary and canonical, organizing the concept as a means to understand both the history of its scientific articulation and the relationship between governance and environment the concept proposed. The sociotechnical concept of milieu relies on reflexivity, a definition of surroundings that necessitates a human agent as a point of reference, or, at least, this is how it was imagined by the evolving biological sciences: “The milieu on which the organism depends,” Canguilhem writes, “is structured and organized by the organism itself,” and further, “the environment he is supposed to be reacting to finds itself originally centered in and by him . . . therefore man’s proper milieu is not situated in the universal milieu like a thing contained within its container. A center does not dissolve into its environment. A living thing does not reduce itself to an intersection of influences.”²⁴

The qualifying of architecture by “climatic,” as in *climatic modernism*, is intended to be descriptive, a means to indicate the focus of a practice, an image, a building, and is projective—the project of the practice, the image, the building, was to operate on design and scientific knowledge so as to better coordinate (in a temporally, geographically, and conceptually bounded fashion) the relationship between people and things. Climate became a space of social analysis and optimization before it became the harbinger of a planetary society out of control.

The Technical Image

The primary tactic of climatic modernism was the technical image—an image produced through technical means, that resonates across multiple realms of technologically informed sociobiotic engagements, and that speaks most clearly to those familiar with a given representational system. Technical images, especially in the cases at hand—the design-methodological diagrams of the climatic modernist—attempt to survey and understand economic and ecological intercon-

nections and operate on them; they strive for sociobiotic improvements. They articulate an imaginary of the possible, albeit often overinvested in the promise of technology to resolve political debates.²⁵

The category of the technical image is capacious. Vilém Flusser approached this category as not only images produced by technology—such as photographs or charts reliant on computational processing—but also as images, often on screens, that only existed through technological means. Technical images are made up of points: “on close inspection, all [technical images] prove to be envisioned surfaces computed from particles.”²⁶ Most of the images explored in this book just barely predate, on Flusser’s terms, the technical image proper; the concern of *Modern Architecture and Climate* is to investigate the transition toward technical images and their effects, and indeed of technicity and instrumentality more generally as they came to be embedded in diagrams and forms of climatic-architectural expertise. Data, concepts, and interconnections later processed through computation were here premediated, subject to diagrammatic correlation, and to an excess of misplaced assumptions and implicit intentionality that used images as tools to try to make sense of a world and its near-future possibilities. They seem naive, in contrast to the computational systems that they were essential to conceptualizing and creating. They are interesting not for their contemporary technical effectiveness but as evidence of attitudes and aspirations and the changing conditions of knowledge production.

The diagram is the primary technical image of climatic modernism—the sectional diagram even more so. Architectural interest in the relationship of design interventions to surrounding climatic conditions has long been expressed through diagrams—from Le Corbusier’s sketch of the shading characteristics of the Immeuble Clarté in 1928 to any number of false color circulation drawings that aim to indicate the climatic performance of a newly designed building today. The diagram, as a “map of social forces,” is an ideal visual medium for bringing together heterogeneous inputs and understanding their possible relations.²⁷ Diagrams seek to simultaneously provide coherent information and to process that information according to a possible future scenario. The diagram is, again, projective, seeking to articulate new possibilities and to do so in a generative fashion, allowing for multiple specific

consequences from the general model simultaneously being analyzed and proposed.²⁸

Concerns over site, orientation to the sun, and the relationship of materials to heat and humidity are all embedded in these methodological diagrams. Of course, a general understanding of climate was implicit in many vernacular or traditional conceptions of shelter. Much of what is being discussed here could be seen as an attempt to modernize (often without adequate technological means) this range of traditional practices, according to regional inflections. The diagram is in this sense the instrument of modernization, where ideas about absorbing previous tactics into contemporary strategies were drawn together. Architectural techniques intended to understand and communicate the relationship of a building to its climate not only on the specific terms of a regional practice but also according to a set of generalizable, universal principles.

Diagrams have long had a disciplinary role in architecture. Scholars have argued that the schematic, quasi-representational, and projective capacity of the diagram was essential to the turn toward architectural modernity. Anthony Vidler sees Jean-Nicolas-Louis Durand’s drawings of universal building types at the end of the eighteenth century as generative of the modernist focus on function and abstraction.²⁹ Sven-Olov Wallenstein also cites Durand’s drawings as transitional, moving the discipline from a focus on “expressing sense”—the aesthetic elaboration of contemporary thematics—to one whose task was to “find the optimal equation” amid a range of aesthetic, technological, and social (usually governmental) factors.³⁰ Others have emphasized how the diagram as an abstract figure was essential to the scientific management regimes that proliferated in the period of mass industrialization—organizing workflows, and also organizing human bodies, as factories, office towers, and suburbs were optimized through innovations in design and construction.³¹

The diagram has a specific history in the period of climatic modernism, one that highlights attempts to frame the image, and visualization more generally, as instigation toward certain kinds of human behavior. The use of visual tools to schematically bring together different kinds of social and natural forces intensified, from the late 1940s, in many fields of inquiry, from biology to engineering to behavioral science.³² Architectural diagrams, though diverse in form and subject, tended to focus on the presentation of schematic ideas

that can generate a variety of design solutions. Climate modernists were interested in assessing the relationship between a building and its climate and developed image-making methods that would help communicate new design principles to other architects. They used diagrams in an attempt to operate on the discipline, that is, in order to steer the field toward specific kinds of knowledge as they sought to develop new kinds of practice.

Many architectural-climatic diagrams took the novel figuration of social and biotic systems as their explicit subject. A new kind of image was being created, one that imagined new ways for humans to flourish according to increased knowledge of global ecological systems. Such diagrams were frequently proposed in a context that identified them as a means to instigate change, according to the aspirations that the image, however abstractly, sought to represent. In this form of disciplinary expansion—taking the climate into account—architectural diagrams did not precisely articulate a new ethico-political principle, nor did they rely on the purported truth-value of science to clarify proposals for behavioral change.³³ Neither strictly political, nor aesthetic, nor scientific, the diagram as technical image offered something new—an affective indication of collective desires for transforming sociobiotic relationships, at a moment when those relationships were not yet very well understood.

Technical images, Flusser proposed, tended to figure “relationships among things that no one would otherwise suspect.” Although Flusser’s focus, again, was on images that were produced through technical means—photographs and images on screens—he also saw in the visual production of information a new class of images intended to serve as models for action.³⁴ Thus a significant transition: from an aspirational diagram expressing desire to a computational or data-driven image that makes a claim to objective knowledge, and a precise intervention in the sociobiotic matrix. Caught in this transition, many diagrams of the climatic modernists attempted fact and aspiration; they tried to draw out of subjective experience some universal validity, and to produce a new image of the world in order to influence new kinds of expertise that could bring that worldview into being.

The Façade as Cultural Technique

The images of the climatic modernists are technical in specific ways, in both content and form.

Most are focused, either implicitly or explicitly, on the façade as the liminal condition of the built environment that clarifies and operates on the relationship between the thermal interior and the atmospheric system. These diagrams tend to focus on the specific technical condition that can best mediate between those two climates. This has already come up through the figure of the section—a diagram that reveals the unseen in the thickness of the façade and renders the façade according to its epochal profundity. The section attempts, with increasing sophistication, to posit the façade as a defining aspect of a specific character of built environment: for how it produced interior space, for how it expressed that production to a more general cultural field, and for how it generated—or accelerated the generation of—a specific relationship between social and biotic patterns, between the thermal regulation of the conditioned interior and the effects of emissions on the global climate.

The sectional diagram of the dynamically shaded façade is open to analysis and speculation. It is a media system. The façade section not only represents a given design proposal for a given site, it also operates in a generative fashion, reflecting and producing ideas about interior and exterior on cultural, conceptual, and material terms. It helps to reveal perspectives on the concept “nature” as they were constructed in a given time and place, and, reflexively, it reveals conceptions of the human in the priorities and aspirations for social transformation that can be read through the façade and the conditions it invokes.

“Every culture,” as Bernhard Siegert writes, “starts with the introduction of distinctions, and techniques that process this distinction.”³⁵ This inside/outside dynamic, mediated by the façade, has epochal consequences, in the sense that it allows for an understanding of developments that shift our perception of the historical and contemporary relationship between humans and their environment, between economies and ecologies. Siegert has traced the general significance of this liminality: the distinction between inside/outside; culture/nature (also: thermal interior/atmospheric system)—and its historic significance. “Culture” distinguishes itself from “nature” through media, understood as material and symbolic *cultural techniques* that process, activate, and emphasize this distinction.

The façade is one example; the building is an essential cultural location for processing these

distinctions.³⁶ As Siegert clarifies, speaking directly to the terms of this book: “there is no such thing as *the* house, or the house as such, there are only historically and culturally contingent cultural techniques of shielding oneself and processing the distinction between inside and outside.”³⁷ The concept and condition of the façade of climatic modernism is of a threshold that can be opened or closed and often contains a range of intermediate states.

As a dynamic register of the techno-social, architectural practices differentiate according to their approach to the façade, with historical vicissitudes of cultural approaches to climate evident in façade sections and other drawings. At stake is not simply the processing of distinctions itself, but how they gain significance, how the symbolic is rendered material through these approaches. Culture is revealed and produced through the articulation, visualization, and eventual habitation of a specific façade condition—or, really, the thermal interior that the façade produces. The façade—especially as rendered in section—distinguishes between the inside and outside, managing that divide, and also distinguishes one historical moment and set of cultural norms from another. Innovations in the façade are screens for understanding cultural relationships to climate; as a result, façades are useful for exploring cultural norms as they relate to carbon emissions and the ways of life they have offered.

The façade section speaks to both inside and outside. It communicates between the two, tracing a thin thread of culture that has been concerned with architecture and climate for many decades. This façade section depicts a palimpsest, a multilayered (literally) site for analysis of the past and the possible futures it contains. The perspective of cultural techniques allows for a view of the façade that recognizes its cultural expressivity—its elaboration, on architectural terms (either as project or built object) of a specific desired relationship between the inside and the outside. This set of desires transforms over the thirty years analyzed here: from one of a dynamic, operable, carefully designed shading system for selectively conditioning the thermal interior, to the façade as a tightly sealed membrane between interior and exterior, housing a fossil-fueled mechanical system. The façade is the medium of symbolic expression and the material condition by which humans have engaged with atmospheric systems, for better or worse.

This invocation of “the façade as media,” or of “the shading device as cultural technique,” is not simply to say that the façade mediates, or expresses, or articulates the desires of the liminal condition of the relationship between nature and culture, but also that the façade is epochal—an object of historical analysis and an agent of change on the conditions of history, change to the environmental conditions that allow for human life to persist, or not, on this planet. Although it was largely done without awareness of these eventual consequences, symbolic and material investment in the sealed façade—as distinct from the porous, dynamic façade of climatic modernism—has contributed significantly to the erosion of climatic stability and will continue to lead to atmospheric chaos, geographical displacement, and other forms of economic and political unrest, with increasing intensity. Architecture materially concentrates and symbolically represents, as media, collective desire on these terms, and the façade section suddenly becomes a political device, an essential battlefield for sociopolitical contestation. Architecture can render our desires meaningless or infuse them with hope.

The Politics of Planetary Knowledge

This positing of the façade as media reads architecture for its environmental positioning—in relationship to its technicity and for the means by which it conditioned subjects for a different kind of cultural world. Another term of epochal significance: *conditioning*—how to prepare, practice, become adept at a set of usually muscular or physiological activities; or, how to mechanically transform an interior space into a pleasant thermal environment. Air conditioning is also people conditioning, culture conditioning, and bioproductive of a way of life that elicits specific attitudes and lifestyles, regulations, clothing, habits, and any other number of technological, material, and social path dependencies.

It is self-evident that air conditioning, and people conditioning, are realms for contestation and for the production of the future—they are sites for politics, however mediated and complex. In particular, the convergence of scientific knowledge about climate and its manipulation—albeit often abstractly, partially, or ineffectively—in buildings emerges as a realm of planetary contestation. Both the articulation of architectural modernism and the knowledge of climate systems were

invested, if in different ways and through different means, in making claims at the scale of the planet. Modern architecture and climate science produced and reflected flows of knowledge and materials around the globe and also the emergence of global imaginaries.³⁸ The simultaneous development of shading devices and of atmospheric sciences was part of a new way of understanding the planet, the species, and a cultural means of mediating the two.

If the precise terminology of the International Style, as invoked by Philip Johnson and Henry-Russell Hitchcock in the 1932 exhibition of that name at the New York Museum of Modern Art, is itself historically delimited, it nonetheless suggests the importance of a universal framework to the innovations of architectural modernity.³⁹ The capacity to image and conceptualize planetary systems was an essential aspect of the postwar development of climatic knowledge as well—such data and models were significant to the more general postwar conception of the global.⁴⁰ Modern architecture and climate science both emerged from a handful of sites—Princeton, Oslo, Cambridge, Los Angeles. The climatological sciences also relied on the form and content of technical images.

At the intersection of these parallel histories of culture and climate lies this potent site of politics—of arguments focused on struggles for the improvement of life conditions. To frame a sense of politics as a means of articulating, through the built environment, a relationship between social and planetary systems is also to recognize the forms of exploitation embedded therein, in terms of human energy and of environmental resources.⁴¹ Knowledge of climate patterns, as with that of the environment more generally, was a significant part of the colonial project.⁴² Scientific encounter with unfamiliar geographies and unknown flora and fauna spurred colonial agents to understand their biodynamic conditions more rigorously, generally with the aim of more effective exploitation of resources and populations.

Modern architecture flourished first in authoritarian, colonial, and neocolonial contexts, and many of its innovations are caught up in ambivalent (at best) governmental strategies that offered new ways of life for some while intensifying the exploitation of others. In architecture and urban planning, this led to a wide range of hybrid formal systems and also to a more

systematic understanding of the relationship of climate, among other environmental effects, on the material and spatial conditions of buildings. Other, more precise forms of climate knowledge also intensified.

How, then, does an analysis of climate intensify specific historical legacies relative to the universalist premise that sits at the heart of the modern architectural project? (And how has this ambition at the level of the masses, the people, the species returned, problematically, in contentious discussions around climate and carbon emissions?) In tracing design methods and technological devices as they migrated between the so-called centers and peripheries of twentieth-century culture, such questions will come to the fore. At the least, the framework of architectural modernism, its universal terms, however ambivalently detailed in the historical record, lays bare the concomitant formulation of a specific kind of subject. Modern buildings required “modern” inhabitants, conditioned for life in specific spatioclimatic configurations.

The sectional drawing of the Barcelona Lotissements provides an initial window into the emergence of climatic modernism. It was a specific type of architectural approach that is distinct from the larger swath of architectural and other modernisms and also reveals patterns endemic to these broader narratives, especially as they take purchase on the present. What began, or at least intensified, in Le Corbusier’s project for Barcelona was a material system of climate management and also an architectural approach to absorbing geographic and cultural difference through technology. The technical image emerged as a site for political contestation by virtue of its articulation of the relationship between cultural desires and the experiential challenges of the environmental surround. Here the façade was media, operating as a means of processing and understanding distinctions between interior and exterior, between nature and culture, between cultures of expansion and contraction. Case studies on the façade as media—reflecting and enacting cultural priorities, and embedded in the politics of development and economic growth, form the evidentiary foundation of this book. The stories of architects, their designs and attempts to refine the relationship between the thermal interior and the vagaries of atmospheric systems, forms a history of how

design was seen as a tool to improve quality of life—according to some, usually for others. It is also a history of how architects and others came to accept and attend to climate as an obstacle to be overcome, rather than a process available for dynamic cultural engagement. Today, again, many architects are designing dynamic façades—much more dynamic than heretofore, at times excessively so—in hopes of encouraging a cultural shift toward attentive forms of climatic engagement. *Modern Architecture and Climate* is thus both a history of these architectures and a preview of architectures yet to come.

Introduction: Architecture, Media, and Climate

1. The 1929–34 *Oeuvre complète* dates the project to 1933. Josep Quetglas’s document in the archives traces the derivation of the project to 1931, as the Plan Macia was also being developed, and indicates that it was being worked on until 1939, with a small drawing in the 1938–46 *Oeuvre complète* as well. Josep Quetglas, “Lotissement,” Archive of the Fondation Le Corbusier, Paris.

2. See, for example, Colin Porteous, *The New Eco-Architecture: Alternatives from the Modern Movement* (London: Taylor and Francis, 2002); Paul Overy, *Light, Air, and Openness: Modern Architecture between the Wars* (London: Thames and Hudson, 2008); Susannah Hagan, *Taking Shape: A New Contract between Architecture and Nature* (London: Architectural Press, 2001), among many other texts that will be discussed further on. See also Daniel Barber, *A House in the Sun: Modern Architecture and Solar Energy in the Cold War* (New York: Oxford University Press, 2016).

3. GATCPAC was the Grup d’Arquitectes i Tècnics Catalans per al Progrés de l’Arquitectura Contemporània, the Catalan version of a number of Spanish collectives operating under the more general GATEPAC. For specific relevance of the group to the Barcelona project, see Jean-François Lejeune, “Madrid versus Barcelona: Two Visions for the Modern City and Block (1929–1936),” *Athens Journal of Architecture* 1, no. 4 (October 2015): 271–95.

4. Victor Olgyay, *Design with Climate: Bioclimatic Approach to Architectural Regionalism* (Princeton, NJ: Princeton University Press, 1963), 14.

5. See Richard A. Grusin, “Premediation,” *Criticism* 46, no. 1 (Winter 2004): 17–39; and Richard A. Grusin, “Radical Mediation,” *Critical Inquiry* 42, no. 1 (Autumn 2015): 124–48.

6. Dipesh Chakrabarty, “Climate and Capital: On Conjoined Histories,” *Critical Inquiry* 41, no. 1 (Autumn 2014): 1–23; J. R. McNeill and Peter Engelke, *The Great Acceleration: An Environmental History of the Anthropocene since 1945* (Cambridge, MA: Belknap Press of Harvard University Press, 2016).

7. Walter Mignolo, *The Darker Side of Western Modernity* (Durham, NC: Duke University Press, 2011).

8. Paul Siple, “Climatic Criteria for Building Construction,” *Proceedings of the Research Correlation Conference on Weather and the Building Industry* (Washington, DC: National Academy of Sciences, 1950): 5–22, 7.

9. Reyner Banham, *Architecture of the Well-Tempered Environment* (Chicago: University of Chicago Press, 1976); see also Michael Osman, “Banham’s Historical Ecology,” in *Neo-Avant-Garde and Postmodern: Postwar Architecture in Britain and Beyond*, ed. Mark Crinson and Claire Zimmerman (New Haven, CT: Yale University Press, 2010), 231–50; and Todd Gannon, *Reyner Banham and the Paradoxes of High-Tech* (Los Angeles: Getty Publications, 2017).

10. See, for example, Dipesh Chakrabarty, “The Climate of History: Four Theses,” *Critical Inquiry* 35, no. 2 (Winter 2009): 197–222; Amitav Ghosh, *The Great Derangement: Climate Change and the Unthinkable* (Chicago: University of Chicago Press, 2016); David Armitage and Jo Guldi, *The History Manifesto* (New York: Cambridge University Press, 2014); Christophe Bonneuil and Jean-Baptiste Fressoz, *The Shock of the Anthropocene: The Earth, History, and Us* (New York: Verso, 2017); and Naomi Oreskes and Erik M. Conway, *The Collapse of Western Civilization: A View from the Future* (New York: Columbia University Press, 2014).

11. Isabelle Stengers, *In Catastrophic Times: Resisting the Coming Barbarism* (Ann Arbor, MI: Open Humanities Press, 2015), 39.

12. Eva Horn, “Air as Medium,” *Grey Room*, no. 73 (Fall 2018): 6–25.

13. Thomas Nocke and Birgit Schneider, eds., *Image Politics of Climate Change* (Bielefeld, Germany: Transcript Verlag, 2014); Horst Bredekamp, Vera Dunkel, and Birgit Schneider, eds., *The Technical Image: A History of Styles in Technical Imagery* (Chicago: University of Chicago Press, 2015).

14. For a general discussion of the continuity of environmental and climatic concerns, albeit under different names

and frameworks, see Fabien Locher and Jean-Baptiste Fressoz, “Modernity’s Frail Climate: A Climate History of Environmental Reflexivity,” *Critical Inquiry* 38, no. 3 (Spring 2012): 579–98. On a different note, Kevin Bone’s seminar and exhibition at the Cooper Union, collected as *Lessons from Modernism*, proposes that early architectural modernists offer robust technical and spatial examples for contemporary designers to follow.

15. For a relatively recent discussion of these trends, see J. R. McNeill, “The State of the Field of Environmental History,” *Annual Review of Environment and Resources* 35, no. 1 (2010): 345–74.

16. Patrick Geddes, *Cities in Evolution: An Introduction to the Town Planning Movement and the Study of Civics* (London: Williams and Norgate, 1915), esp. 60–83; Lewis Mumford, *Technics and Civilization* (New York: Harcourt Brace, 1934), esp. 364–83.

17. George Perkins Marsh, *Man and Nature; or, Physical Geography as Modified by Human Action* (New York: Scribner, 1864).

18. Ramachandra Guha and Joan Martinez-Alier, “The Forgotten American Environmentalist,” in their *Varieties of Environmentalism: Essays North and South* (New York: Longman, 2002), 185–202, 187; see also the discussion of Marsh in Paul Hawken, *Blessed Unrest: How the Largest Movement Came into Being, and Why No One Saw It Coming* (New York: Viking, 2007). The Marsh quotes are from *Man and Nature*.

19. See Michael G. Barbour, “Ecological Fragmentation in the Fifties,” in *Uncommon Ground: Rethinking the Human Place in Nature*, ed. William Cronon (New York: W. W. Norton, 1995), 233–55; and Daniel B. Botkin, *Discordant Harmonies: A New Ecology for the Twenty-First Century* (New York: Oxford University Press, 1990).

20. Guha and Martinez-Alier, “Forgotten American Environmentalist,” 200.

21. Sven-Olov Wallenstein, *Biopolitics and the Emergence of Modern Architecture* (New York: Temple Hoyne Buell Center for American Architecture and Princeton Architectural Press, 2009), 20–21.

22. Michel Foucault, *Security, Territory,*

Population: Lectures at the Collège de France, 1977–1978 (New York: Picador, 2003), 366.

23. Foucault, *Security, Territory, Population*, 21.

24. Georges Canguilhem, “The Living and Its Milieu,” *Grey Room*, no. 3 (Spring 2001): 6–31, 26–28. It was originally published as *La connaissance de la vie* in 1952, after being presented as a lecture at the Collège de France in 1946–47.

25. Andrew Barry, *Political Machines: Governing a Technological Society* (New York: Athlone Press, 2001).

26. Vilém Flusser, *Into the Universe of Technical Images* (Minneapolis: University of Minnesota Press, 2011), 33 and throughout; and Mark Poster, “An Introduction to Vilém Flusser’s *Into the Universe of Technical Images and Does Writing Have a Future?*,” in Flusser, *Into the Universe of Technical Images*, ix–xvii.

27. Gilles Deleuze, *Foucault* (Minneapolis: University of Minnesota Press, 1986), 57.

28. See Robert Somol and Sarah Whiting, “Notes around the Doppler Effect, and Other Moods of Modernism,” *Perspecta* 33 (2002): 73–77.

29. Anthony Vidler, “Diagrams of Diagrams: Architectural Abstraction and Modern Representation,” *Representations*, no. 72 (2000): 1–20, 10–11.

30. Wallenstein, *Biopolitics and the Emergence of Modern Architecture*, 23. I will elaborate on Wallenstein’s premise in chapter 2.

31. Hyungmin Pai, *The Portfolio and the Diagram: Architecture, Discourse, and Modernity in America* (Cambridge, MA: MIT Press, 2002); Mauro F. Guillén, *The Taylorized Beauty of the Mechanical: Scientific Management and the Rise of Modernist Architecture* (Princeton, NJ: Princeton University Press, 2008).

32. Bruno Latour, “Visualization and Cognition: Drawing Things Together,” in *Knowledge and Society: Studies in the Sociology of Culture Past and Present*, ed. Henrika Kuklick and Elizabeth Long (Greenwich, CT: JAI Press, 1986), 1–40; Joy Knoblaugh, “The Work of Diagrams: From Factory to Hospital in Postwar America,” *Manifest*, no. 1 (2013): 154–65.

33. Gisela Parak, *Eco-Images: Historical Views and Political Strategies* (Munich: Rachel Carson Center, 2013); Sheila Jasanoff, “Image and Imagination: The Formation of Global Environmental Consciousness,” in *Changing the Atmosphere: Expert Knowledge and Environmental Governance*, ed. Clark A. Miller and

Paul N. Edwards (Cambridge, MA: MIT Press, 2001), 309–38; see also Sheila Jasanoff, “A New Climate for Society,” *Theory Culture Society*, no. 27 (2010): 233–53.

34. Flusser, *Into the Universe of Technical Images*, 11.

35. Bernhard Siegert, “Doors: On the Materiality of the Symbolic,” *Grey Room* 47 (Spring 2012): 6–23.

36. There is a long history of architectural considerations of the façade as membrane, in particular the work of Siegfried Ebeling in the late 1920s and then by some of 1960s experiments in inflatable space. See Siegfried Ebeling, *Space as Membrane* (London: Architectural Association, 2010); see Spyros Papapetros’s essay in the volume, “Future Skins.” On the 1960s inflatables, see Reyner Banham, “Monumental Wind-Bags,” *New Society* 11, no. 290 (April 18, 1968): 569–70; and Whitney Moon, “Environmental Wind-Baggery,” on the E-Flux Architecture platform. <https://www.e-flux.com/architecture/structural-instability/208703/environmental-wind-baggery/>. Accessed September 18, 2018.

37. Bernhard Siegert, *Cultural Techniques: Grids, Filters, Doors, and Other Articulations of the Real* (New York: Fordham University Press, 2015), 2, 9; see also Reinhold Martin, “Unfolded, Not Opened: On Bernhard Siegert’s *Cultural Techniques*,” *Grey Room* 62 (Winter 2016): 102–15.

38. Ursula Heise, *Sense of Place and Sense of Planet: The Environmental Imagination of the Global* (Oxford: Oxford University Press, 2008).

39. Philip Johnson and Henry-Russell Hitchcock, *The International Style: Architecture since 1922* (New York: W. W. Norton, 1932).

40. Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, MA: MIT Press, 2010).

41. See Hilde Heynen’s interpretation, for an architectural audience, of Marshall Berman’s formulation of the distinctions between modernism, modernity, and modernization, in Hilde Heynen, *Architecture and Modernity: A Critique* (Cambridge, MA: MIT Press, 1999).

42. Richard Grove and Vinita Damodaran, “Imperialism, Intellectual Networks, and Environmental Change,” *Economic and Political Weekly* (October 14 and 21, 2006): 4345–54; 4497–505; Peder Anker, *Imperial Ecology: Environmental Order in the British Empire, 1895–1945* (Cambridge, MA: Harvard University Press, 2002).

Chapter 1

1. Recent literature has begun to explore these aspects of Le Corbusier’s work. As noted further on, the present chapter seeks less to contribute to the historiography of Le Corbusier and more to see him as a hinge toward a new perspective on the history of architecture and climate more generally. Some examples of this recent literature include Rosa Urbano Gutiérrez, “‘Pierre, revoir tout le système fenêtres’: Le Corbusier and the Development of Glazing and Air-Conditioning Technology with the Mur Neutralisant (1928–1933),” *Construction History* 27 (2012): 107–28; Colin Porteous, *The New Eco-Architecture: Alternatives from the Modern Movement* (London: Taylor and Francis, 2002); Ignacio Requena-Ruiz, “Building Artificial Climates: Thermal Control and Comfort in Modern Architecture, 1930–1960,” *Ambiances* (November 2016): 1–22; Daniel Siret, “Généalogie du brise-soleil dans L’œuvre de Le Corbusier,” *Cahiers Thématiques*, no. 4 (2004): 169–81; Daniel Siret, “Rayonnement solaire et environnement urbain: De l’héliotropisme au désenchantement, histoire et enjeux d’une relation complexe,” *Développement durable et territoires* 4, no. 2 (July 2013). A previous generation of scholars also explored these themes, largely in response to Reyner Banham’s celebration of Le Corbusier’s climatic aptitude; see Harris Sobin, “The Role of Regional Vernacular Traditions in the Genesis of Le Corbusier’s Brise-Soleil Sun-Shading Techniques,” *Traditional Dwellings and Settlements Review* 6, no. 1 (Fall 1994): 80; Fritz Griffin and Marietta Millet, “Shady Aesthetics,” *Journal of Architectural Education* 37, no. 3/4 (Spring 1984): 43–60; see also Christopher Mackenzie, “1993 February: Le Corbusier in the Sun,” *Architectural Review* (June 20, 2011).

2. Symptomatic of this emphasis is a persistent anxiety about the intrusion of environment-focused practices into this realm of formal virtuosity, perhaps best expressed in the subtitle (if less clearly in the articles) of a recent collection from the Harvard Graduate School of Design: Erika Naginski and Preston Scott Cohen, eds., *The Return of Nature: Sustaining Architecture in the Face of Sustainability* (New York: Routledge, 2014).

3. Peter Eisenman, *The Formal Basis of Modern Architecture* (Zurich: Lars Müller, 2006); see also a series of editorials in the journal *Oppositions* in the 1970s, including Mario Gandelsonas, “Neo-Functionalism,” *Oppositions*,

Notes