Contents

The Climatic Basis of Modern Architecture

The writings, drawings, and buildings of Le Corbusier operate like a screen, selectively framing our view of the history and relevance of climatic modernism. As the Barcelona Lotissements project already begins to suggest, climate was essential to Le Corbusier's articulation of the principles of modern architecture in the interwar period and to their development after World War II. Buildings, texts, and diagrams indicate that Le Corbusier considered a flexible relationship to the climatic surround to be an essential aspect of the promise of modern methods and design ideas. Alongside a large number of architects of the period, most of the climatic modernists discussed in later chapters were, in one way or another, heavily influenced by Le Corbusier; for many, climate was an essential aspect of their master's work, and they saw themselves as developing his legacy on these terms. However, the voluminous historical literature on the work and influence of Le Corbusier has, with few recent exceptions, ignored this robust evidentiary thread.[1]

There are profound discursive obstacles to embracing the repositioning of architecture according to its relevance to environmentalist debates. Formalism, broadly considered, appears to resist the integration of architectural ideas into the constellation of cultural practices aiming to reconfigure social conditions according to environmentalist pressures. A history of architectural modernism with a focus on the production of novel form has, at risk of overgeneralizing, been the dominant narrative of relevance to debates in the field since the 1960s.[2] This was rendered explicit in Peter Eisenman's 1963 doctoral thesis at Cambridge, "The Formal Basis of Modern Architecture," which saw in the iterative manipulation of platonic solids the capacity to resolve the purported paradox of form and function.[3] Although only recently published, the ideas embedded in Eisenman's thesis, his insistence on the importance of modern architecture being almost exclusively in the formal tools that it engendered, have consumed significant aspects of architectural academia and, while less direct relative to professional activities, have conditioned the discussion of architecture since. Eisenman's project is a symptom of a wider turn away from social and political effects of architectural ideas and practices toward a widely embraced emphasis on the "autonomy" of architecture as a discipline—a premise that has, with a number of substantive exceptions, guided theory, pedagogy, and a number of practices for the last few decades.[4]

And yet, the history of architectural engagement with climate is robust. It offers tantalizing context for many familiar projects and ideas, and opens out to new ways of thinking about architectural engagement with technology, environment, and social conditions. At stake are the terms and

1.1 From the Le Corbusier archive.

1. Obstacles

means by which architecture is valued. The computational production of novel form is still seen by many historians, critics, and practitioners as the metric of value in the field—"innovation" in architecture tends to involve the production of heretofore unimaginable spatial experiences, generated through computational means and, at times, through collaboration with structural engineers or others. Concern over how those spaces and structures relate to the environmental conditions of the building is rarely discussed.

This may seem odd to those unfamiliar with architecture culture; indeed, it is something of an overstatement. There is extensive, elaborate, and excellent work occurring in architecture on technical questions in search of energy efficiency, though such questions rarely appear as central to the public value of a building. Think, for example, of the Pritzker Prize or high-profile building competitions, which until very recently tended to pay little attention to environmental questions. While there may be reasonable assumptions that some form of environmental metric should be in place to produce an architecture worthy of accolades, the terms of that metric are not always clear, and in any event, a building's success or failure, in the eyes of the architectural public, rarely relies on questions of climatic performance. While a comprehensive analysis of how architecture is valued—arguments about what, in fact, constitutes a substantive distinction in the context of differential evolution—exceeds the scope of the present volume, one of the essential claims of this book is that an alternative narrative of architectural innovation is available to inform such a criteria, one of direct relevance to questions about how to integrate form and performance, and as a means to shift the conception of architectural value in the present. New narratives can begin to suggest alternative legacies and emphasize new criteria for assessing architectural ideas and practices. The work of Le Corbusier, in its importance to claims of formalist lineage and in the richness of alternative historical threads that it offers, is here both obstacle and opportunity.

One of the effects of inserting climate into architectural histories is that it opens up a new set of events, and a new set of criteria, for understanding how that history has developed with relevance to the present. Emphasizing other *events*, as Isabelle Stengers suggests, can shift historical narratives, the legacies they imply, and the futures they offer an opening toward. This causal inversion, of a past rearticulated according to its relevance to possible futures, will continue to frame my approach to the effect of climate on the history of architecture. The ambition here is less to contribute to the scholarly literature on Le Corbusier and more to establish a historical ground from which to articulate the robust history of climatic modernism that followed from him.

The Barcelona Lotissement, already mentioned (see figures 0.1 to 0.6), represents an impasse and a transition. The façade as shading device was conceived as a means to temper the effects of the all-glass wall on the thermal interior. The Barcelona project was one of a number of such experiments in the 1920s intended to ameliorate the challenges faced by drawing the principles of European modernism into different climatic conditions. While Barcelona is, of course, in Europe, it was, for Le Corbusier and others, one of the southern ports among a select group of cities forming a consolidated ring of a specifically Mediterranean culture, with specific architectural needs. Other essential cities, most also of direct relevance to Le Corbusier's experiments in the period, included Marseille, Algiers, and Rome.[5] The Mediterranean basin thus embodied, in miniature, the climatic and lifestyle distinctions later encountered elsewhere. The climatic differences between the northern coast of Africa and the shores of Lake Geneva, for example, serve to emphasize how crucial climatic distinctions were to refining the design methods of interwar modernism—and how imbricated they were in the racialized and colonial frameworks of the period.[6] Barcelona was in this sense suggestive, if not representative, of a set of climatic and cultural challenges presented to the new architectural principles of modernism—challenges that would amplify the importance of the shading device and resonate across subsequent experiments in regions with more intensive climatic distinctions.

The Lotissements were a laboratory, a test site, for the paired strategies of the dom-ino diagram and the brise-soleil shading device, and for the paired principles of adaptability and normativity. A significant effect of *climate* as a historical and historiographic framework is the recognition that the purported potential of architectural modernism, in the years of its development and early expansion, was a capacity to produce a consistent interior across different regional, cultural, climatic, political, and economic conditions—as Le Corbusier indicated in a lecture in Buenos Aires in late 1929:

> Every country builds its houses in response to its climate. At this moment of general diffusion, of international scientific techniques, I propose: only one house for all countries. . . . The Russian house, the Parisian, at Suez or in Buenos Aires, the luxury liner crossing the Equator. . . . In winter it is warm inside, in summer cool, which means that at all times there is clean air inside at exactly 18°.[7]

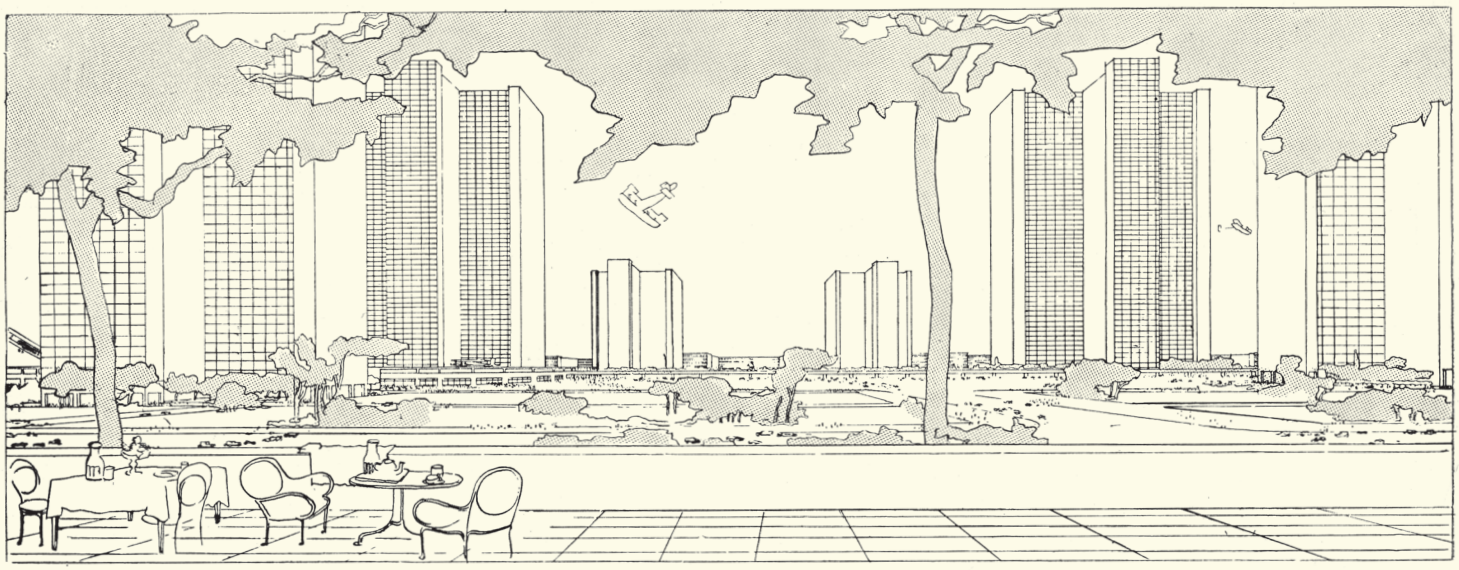
The Athens Charter, similarly, insisted that every building should be oriented so as to receive at least two hours of direct winter sunlight.[8] The universalist, internationalist premise of modern architecture was, in this sense, the capacity to adapt the building to a given site and sociocultural condition, to use architectural means to adjust the building design toward a normative thermal interior. Conceptually, this interior was a space requisite for the elaboration of modernity—in the sense of social modernization and industrialization, and on both material and symbolic terms, as the deployment of modern strategies and techniques for the production of a universal space of life, work, and leisure—what Peter Sloterdijk later termed "the world interior of capital," emergent, as Sloterdijk notes, in the Crystal Palace of 1851. It was, by the 1920s, refined through a set of spatial, material, and technological strategies of adaptability and normalization.[9]

The geopolitical ramifications are significant. The climatic perspective also reveals that, despite its apparent affiliation with familiar tropes of metropolitan sophistication, the historical development of architectural modernism is really about an encounter with the dynamism of the so-called periphery—architecture became modern in the Global South. Or, better, the terms and tenets of architectural modernism were articulated in response to the challenges presented by other climates, other cultures, and as a result of strained colonial and metropolitan hegemony. Barcelona in 1931 was in this sense representative and transitional, a stand-in for a more elaborate interest in climates distinct from those of northern Europe—climates that would come to be seen, by Le Corbusier, as the site for architectural experimentation. These experiments in the capabilities of modernism, as a system of adaptation and normalization, then returned to the north once the concept of acclimatization was refined and applied through mechanical conditioning.

This periphery operated not only spatially but also temporally—as much as assumptions and presumptions were made about the geographic and climatic aspects of a given region and its culture, largely according to the presumed superiority of the metropolitan center, the emergence of modern architecture also depended on a host of complicated interrelationships with the vernacular and the traditional as cultural patterns purportedly inferior to those that followed. Climatic modernism consisted largely of attempts to formalize and render optimizable a range of building strategies that reach back millennia. Indeed, protection from the elements has long been a substantive aspect of the origin narratives of architecture; most cultures were, until the structured imperatives of industrialization, cultures of climatic adaptability. The thickness of walls, the use of earth-based thermally active materials, the deployment of screens, extended eaves, and other shading systems, and many other strategies intended to temper the interior at least in periods of climatic extremes. In part, the project of architectural modernity was to produce design techniques—universal or generally applicable—that could deploy new materials and strategies in order to provide the same, or better, thermal mitigation as these other, ongoing practices. In this sense, architectural modernism followed on the developments of various colonial architectures that regulated or rendered scientific the traditional practices that they sought to replace. That such vernacular or traditional strategies were less energy dependent, in both embodied and operating terms, is not insignificant to the present dilemma. More generally, here again, attention to climate reveals some of the broad complications and contradictions in the presumed progressive trajectory of modern architecture.

Reorienting Modernist Icons

Climate was essential to Le Corbusier before the Barcelona project, even before the specific strategy of the shading device came to the fore. A number of his better-known projects attended to their solar orientation and climatic positioning—more generally, in Le Corbusier's work and that of many of his followers, an essential aspect of "the new architecture" was its capacity to manipulate design and materials so as to open for the inhabitant the experiential conditions of their atmospheric surroundings. The Villa Savoye (1928) and the Immeuble Clarté (1929), both discussed further on, were designed, in part, according to their relationship to the sun and according to the



Une ville contemporaine: Le centre de la Cité vu de la terrasse de l'un des cafés à gradins qui entourent la place de la gare. On voit la gare entre les deux gratte-ciel de gauche, peu élevée au-dessus du sol. Sortant de la gare, on voit l'autodrome filant à droite vers le Jardin Anglais. Nous sommes au centre même de la ville, là où la densité et la circulation sont les plus fortes. Les terrasses des cafés à gradins constituent les boulevards fréquentés. Les théâtres, salles publiques, etc., sont parmi les espaces entre les gratte-ciel, au milieu des arbres.

1.2 Le Corbusier, view of the Ville Contemporaine from an Immeuble Villa *jardin suspendu*, drawn in 1922, from the *Oeuvre complète, 1910–1929*.

means by which the built condition mediated and amplified the potential benefits of that relationship for seasonal heating and cooling.

Even further back, from the early 1920s, drawings of the Ville Contemporaine indicate the value placed on the façade's interface between social behaviors and planetary systems. Immeuble Villas—the multistory apartment blocks on the edges of the Ville Contemporaine—were drawn with a thick façade punctured by deep penetrating terraces (known as *jardins suspendus*) that served to provide each unit with outdoor space—thus, the means by which the apartment was to be seen as a "villa"—and also to shade the interior from direct summer sun (figure 1.2; figure 1.3). Later versions included apertures and interior shafts to induce ventilation, drawing the outside air through the living space.[10] The climatic concerns were general rather than scientific—orientation of the housing blocks relative to the sun was not a primary concern of the overall urban plan, nor were other issues such as the specifics of wind patterns or other climatic effects and inducements considered.

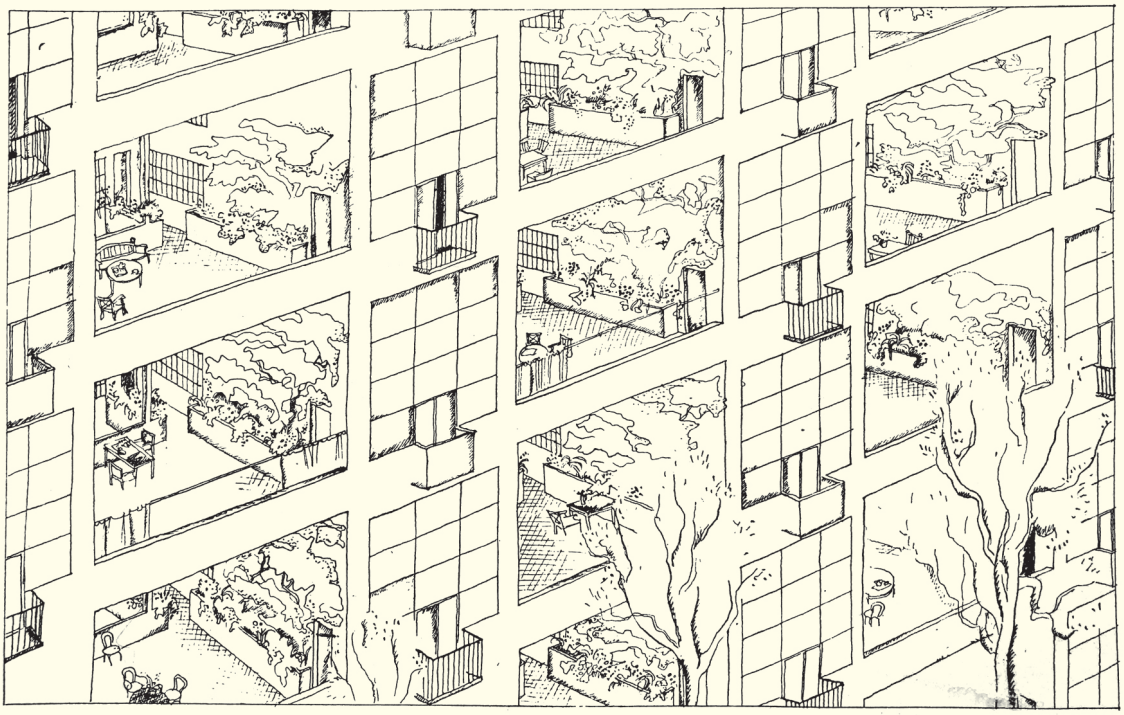
The basic strategy of deepening the façade to provide shading became a subject of much architectural elaboration. It was refined in the numerous Unités d'Habitation that Le Corbusier and his office built in the 1950s, which were celebrated for the ingenious combination of shading and programmatic amenity of the *jardins suspendus*, and also, later, criticized for inadequate attention to site orientation, thereby gesturing toward nuanced temperature control but falling short of fully achieving it. Many of the texts by climatic modernists of the 1950s began with discussions of the promise, and ultimate disappointment, of the Unité in Marseille—completed in 1952—in terms of these basic misconceptions of climatic performance (figure 1.4).[11]

Le Corbusier's ideas and built projects were, without doubt, essential to the articulation of architectural modernism—not in a vacuum, to be sure, but rather as representative of wider trends. On the one hand, climate was not an essential aspect of all architectural modernisms—many, if not most, celebrated principles of the early modernists did not take climatic issues into account. Imperatives concerned with reducing ornamentation, emphasizing volumetric design strategies, and the focus on new materials can be, and certainly have been, read without relevance to

«IMMEUBLES-VILLAS» 1922

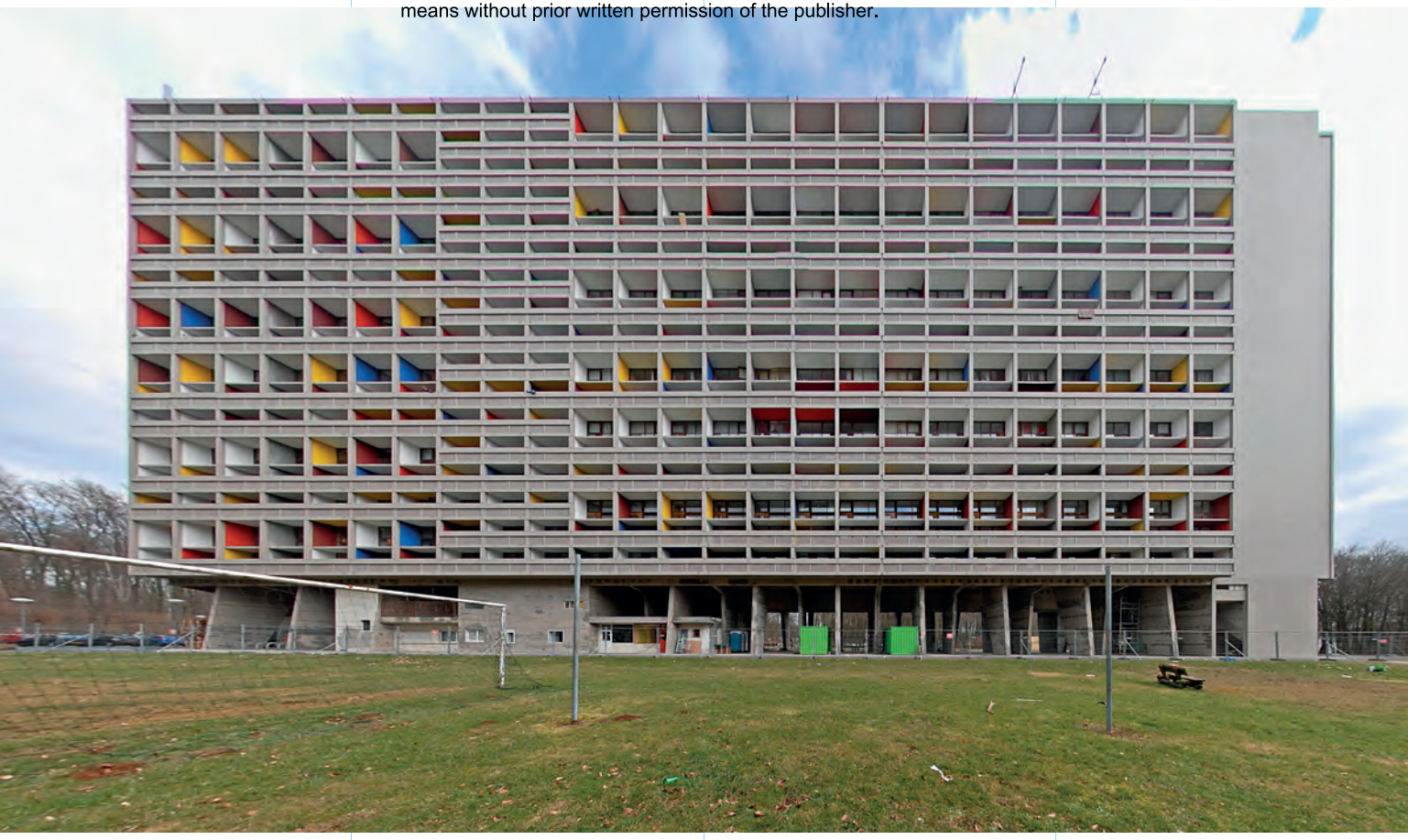
Un immeuble de 120 villas superposées

«IMMEUBLES-VILLAS» 1922



« Lotissements fermés à alvéoles ». Le module étriqué des façades actuelles (3,50 m.) est porté à 6 m., conférant à la rue un caractère d'ampleur tout nouveau.

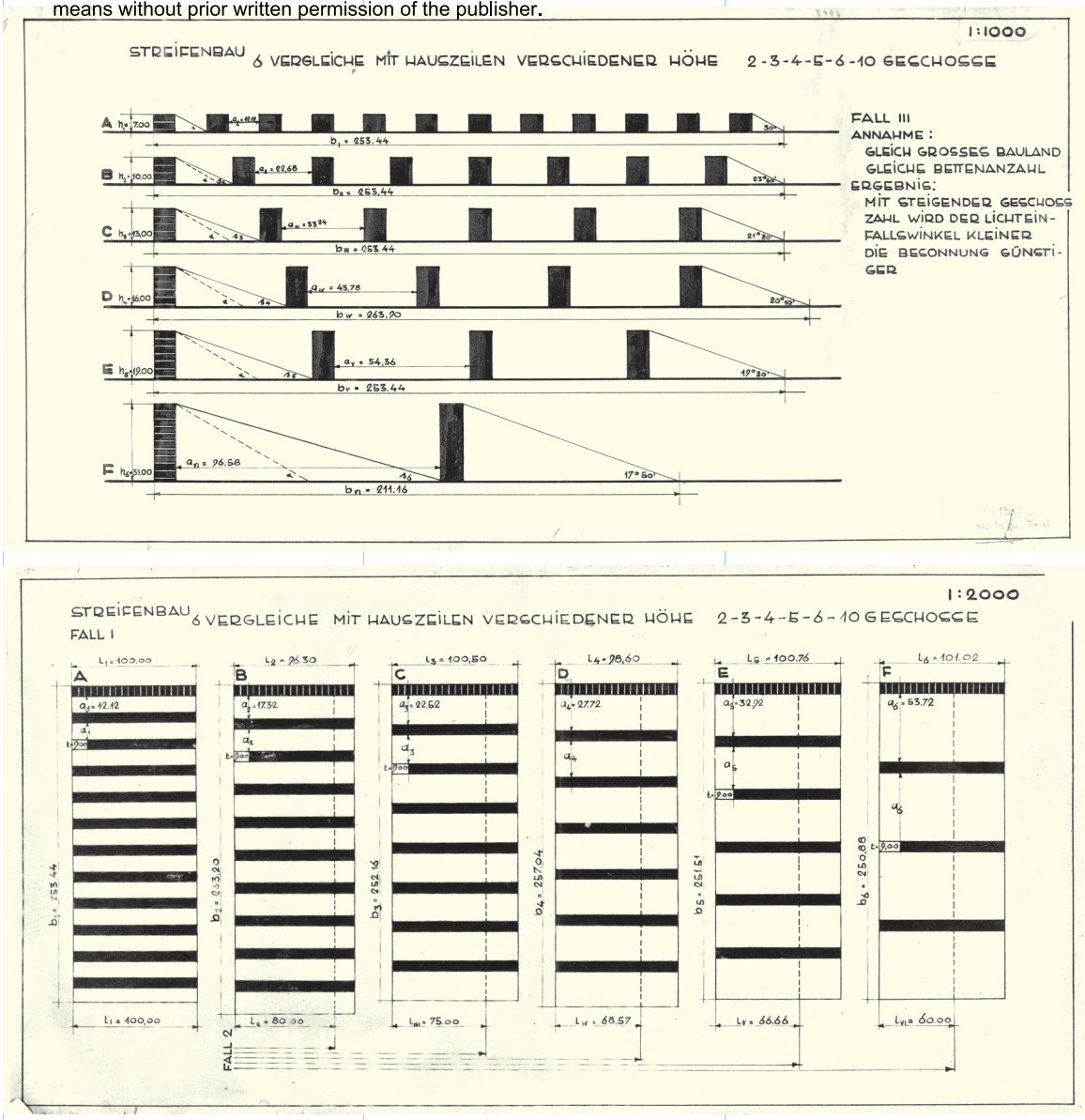
1.3 Le Corbusier, Immeuble Villas, 1922, from the *Oeuvre complète, 1910–1929*.



1.4 Le Corbusier, Unité d'Habitation, Briey, France, 1953.

concerns of climate adaptability; perhaps excluding ornamentation, most of these principles can be (and also, more recently, have been) read as available for productive engagement on these precise terms. On the other hand, Le Corbusier is atypical in taking on, as he did in the 1930s and '40s in particular, the importance of climate as a conceptual driver for design.

Although not as atypical as it might seem. Walter Gropius's "light and air diagram," for example, relied on a general understanding of climate in relationship to building height, orientation, and disposition on the site; Gropius's analysis settled on a relatively long spacing between mid-rise structures (figure 1.5).[12] The drawing, and the ideas behind it, were the subject of discussion at the 1930 meeting of the International Congress of Modern Architecture (CIAM) in Brussels; the meeting's topic was "Rational Land Development."[13] Somewhat more passively, Mies van der Rohe's Tugendhat House (1928) developed what the architect Colin Porteous calls an "opportunistic approach to taking advantage of fine climate" through the capacity for the glass wall on the southern façade to be pulled down into the basement by a mechanical system, opening up the living space to the exterior.[14] It would be specious—or, at least, the evidence is not being presented here—to claim either Gropius or Mies as substantive progenitors of architectural-environmental thinking; rather, these projects suggest a widespread, though largely vague and unscientific, interest in how modern strategies and materials can, through engagement with the exterior climate, change the experience of the interior.[15] Another iconic modernist, Frank Lloyd Wright, offers a somewhat more direct genealogical trace, albeit framed in the context of his general approach of a so-called organic relationship to site and interior plan arrangements. This is perhaps most evident in his Solar Hemicycle House, one of his Usonian Houses built in Wisconsin in 1946 (figure 1.6).[16] It plays out an arc, in plan, in order to take most advantage of changing solar



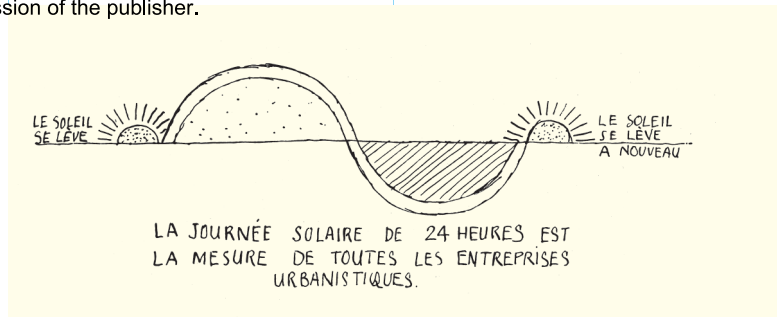
1.5 Walter Gropius, diagrams from "Houses, Walk-Ups, or High-Rise Apartment Blocks?" (1955 [1931]), Harvard Art Museums/Busch-Reisinger Museum, gift of Walter Gropius.

patterns and is built into a small berm to increase insulation.

Most of these proposals and buildings were intended to maximize solar insolation—the absorption of radiation so as to heat the interior—rather than to keep it out or carefully modulate it according seasonal variation.[17] The main concern in western and northern Europe, and in the United States, was heating, not cooling. Architectural knowledge of climate patterns, not to mention climate science, was piecemeal and circumstantial. All the same, these brief examples form a crack in the seemingly solid edifice of formal concerns as the context for architectural innovation, identifying the importance of climate, or at least geophysical systems, as a promising aspect of a more nuanced understanding of the field.

With Le Corbusier the concern is significantly more direct, albeit according to some variation across different periods of his career. "All modern architecture," he wrote, "has a mission to occupy itself with the sun."[18] He saw climate—the daily patterns of the sun, the regional patterns of weather—as essential to the development of a given design, and he saw the capacity of a building to manage climate as an important benefit of the new kinds of architecture that he tirelessly sought to promote. He made numerous drawings

1.6 Frank Lloyd Wright, Solar Hemicycle House, Middleton, Wisconsin, 1948.



1.7 Le Corbusier, drawing of the solar cycle, which is the frontispiece to the *Oeuvre complète, 1934–1938*.

of a stylized rendition of the basic pattern of a solar path across the sky, often above the caption: "the sun rises, the sun sets, the sun rises again" (figure 1.7)[19] Many drawings of the buildings discussed further on, at least after 1936, were accompanied by sketches, off to the side or in the corner of the paper, indicative of this iconic horizontal *S* curve, a sort of emblem of attention to solar and climatic factors, however schematic or at times misconstrued. In the context of his broader influence on the development of modern architecture, Le Corbusier's interest in climate was significant, providing a substantive avenue for historical exploration. The relative lack of attention in the historical literature to this climatic legacy indicates some obstacles to historiographic clarification and necessitates a return to some familiar drawings and buildings in order to reconsider their possible impacts.

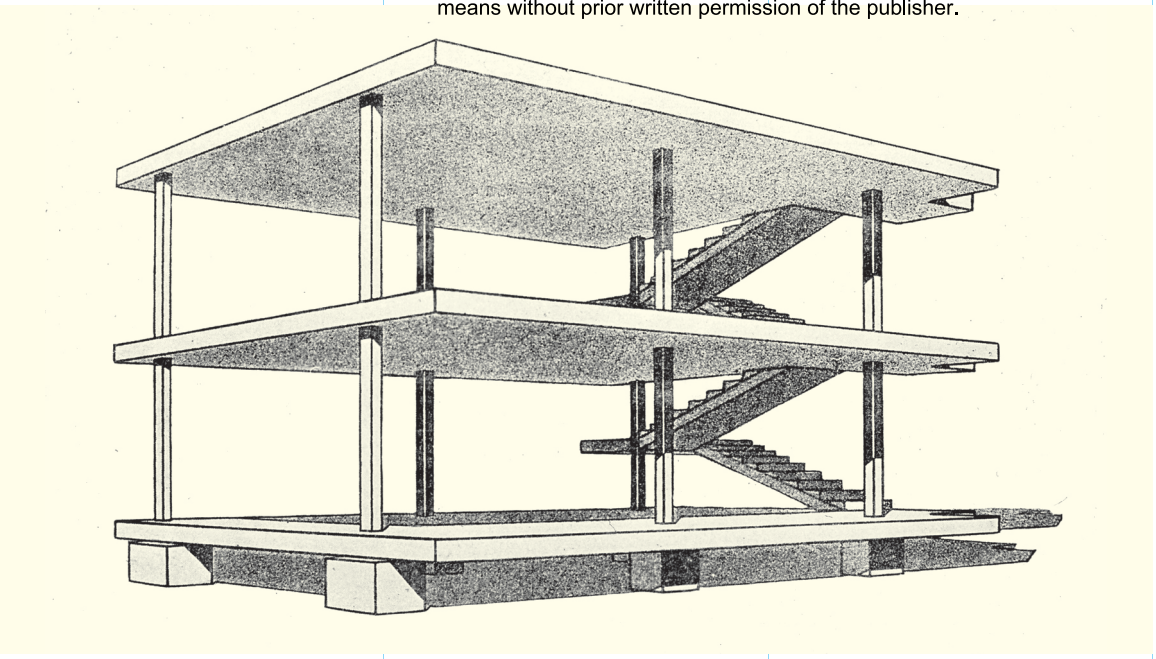
The Dom-ino

Architectural investigations of climate played out through technical images as much as through buildings and were rooted in an early set of diagrams that generated a range of opportunities for architectural elaboration. Perhaps the most significant diagram in the early history of modern architecture was the dom-ino drawing, made by Le Corbusier in a number of iterations beginning in 1914 (figure 1.8). Although not explicitly climatic in origin or intent, it compresses into a single image the material and structural innovations of "the new architecture," and it also suggests the prospects for the modern building as a climatic technology.[20]

The basic premise was this: a structural steel frame held up a reinforced concrete floor plate. Because the steel frame bore the structural load of the building, masonry or stone walls, which heretofore were essential to hold the building up, were no longer necessary. The façade could instead be filled with glass, concrete, or other materials for expressive, affective, and climate management purposes. The dom-ino was, in many ways, the shift that ushered in the wave of experimental thinking that has come to be called modern architecture. The discussion in the field changed, slowly but inexorably, from concerns over the structural and expressive capacities of load-bearing walls to the freedom of design structural steel afforded.

Le Corbusier's "five points towards modern architecture" were articulated on these terms. These design principles, often said to have been realized in the 1928 Villa Savoye, included the open plan, the free façade, the horizontal window, the pilotis, and the roof garden or *jardin suspendu*. All are the result of the structural freedom allowed by the dom-ino idea. Numerous authors have recently sought to interpret all of the five points on environmental terms; at least four are relevant specifically to the building as a device of climate management. The liberation of the façade allows for its deployment as a filter for radiation; the open plan allows for volumetric determinations to also respond to solar incidence and other climatic patterns; and the horizontal window is, in this sense, representative of the debate around glazing that would later be overcome by Le Corbusier through the more general concept of the *pan de verre*—or wall of glass. The *jardin suspendu*, or elevated outdoor space, helps to bring together principles around leisure and the experience of the outdoors that many modernists saw as essential to the new ways of life their architecture could facilitate. This indoor-outdoor space was also a thermal buffer, in many cases, to reduce the impact of direct sun on the interior.

Some specialist historians, and their students and readers, are perhaps already feeling discomfited. Le Corbusier's life and work developed in a period when labeling him an environmentalist would be meaningless.[21] However, his concern for the relationship of the building to its climatic

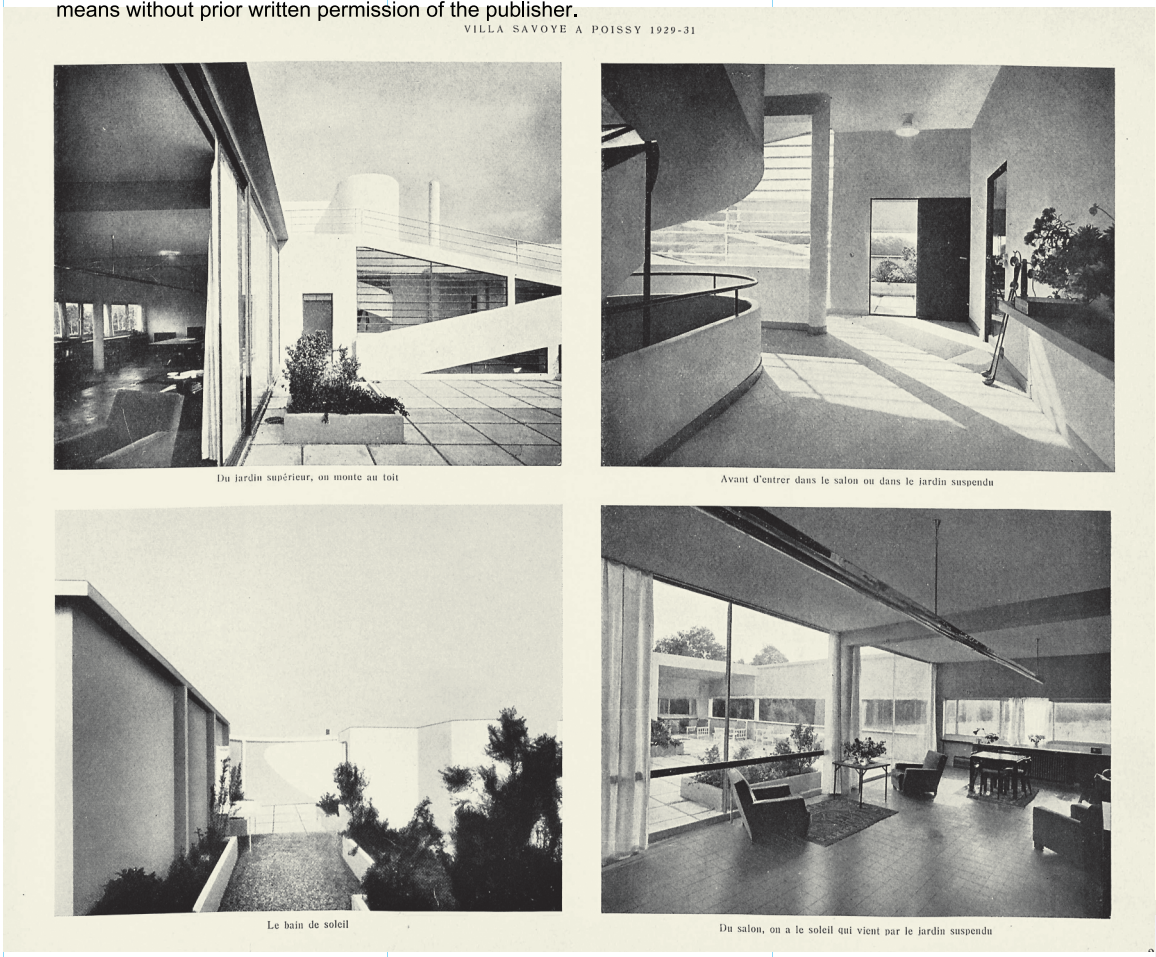


1.8 Le Corbusier, dom-ino diagram, 1914, from the *Oeuvre complète, 1910–1929*.

1.9 Le Corbusier, Villa Savoye, Poissy, France, 1928. Drawing with "soleil" arrow, from the *Oeuvre complète, 1929–1934*.

surround indicates the significance of a general approach to architectural modernism—one that sought to understand the conditions of the site, on a number of terms, and take them into account in deploying modernist strategies. Indeed, this is the point—Le Corbusier was not an environmentalist; rather, the project of modern architecture broadly construed was to engage with and rearticulate the complexity of issues we now address as "the environment."[22] All architecture is "environmental" in that it offers an opportunity to reconfigure the relationship between economies and ecologies, between people and their surroundings. It is more an issue of disposition—of how that relationship is imagined, and how it is seen to be malleable according to the specific flows of capital, materials, and ideas that inform a given project.

The *soleil* (sun) arrow pointing in to the *jardin suspendu* at the Villa Savoye, in a perspective drawing from 1928, is a meek symptom of this historical and historiographic complication (figure 1.9). Later photographs of the interior spaces as illuminated by the open access to the interior garden are a more robust indication that the ways of life imagined as essential to modernity—the cultural conditions of the *temps nouveaux*—were replete with a different relationship to the sun, the climate, and the body. Modern architecture was not just about new forms, materials, and structural principles, but about how these could together encourage new ways of living—better ways of



1.10 Le Corbusier, Villa Savoye, photographs of "sunlight on floors" and the roof garden, from the *Oeuvre complète, 1929–1934*.

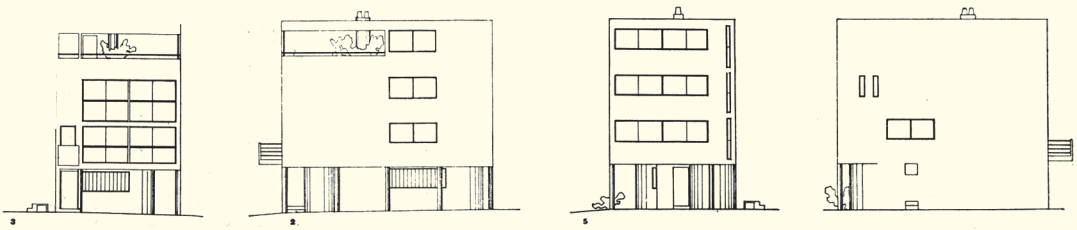
living, it was hoped, in terms of sociability and health (figure 1.10).[23]

While the effects of these new times have long been interpreted relative to an interest, however compromised, in improving the lived conditions of the masses through spatiopolitical interventions, these new subjects were also conceived for their capacity to adjust to the mediated conditions of the thermal interior—to adapt, in their clothing, comportment, and in their relationship to the building, to seasonal changes in climate. In sum, the dom-ino diagram liberated the architect to explore new capacities for formal and material expression and opened up the built environment to a more intensive positioning as a biopolitical operation for the production of novel subjectivity, newly sensitive to climatic conditions.

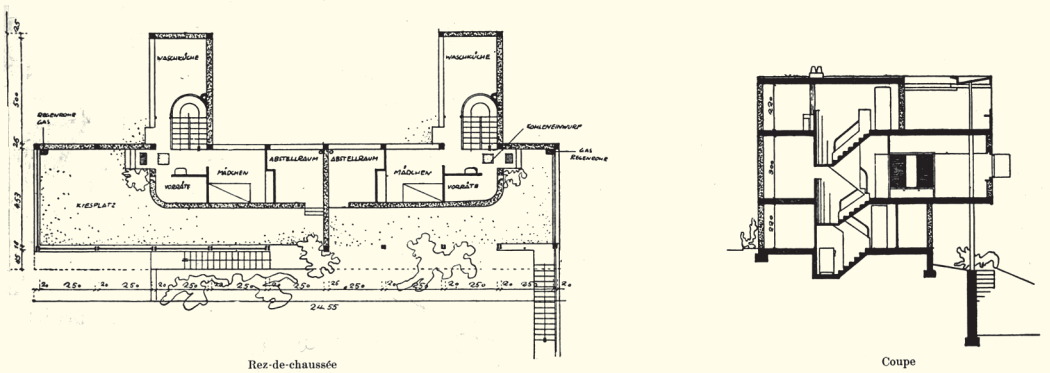
The dom-ino was an idea, expressed in diagram, and not a built object or specific proposal. It was a generative project—one that could, and did, result in numerous, almost endless interpretations.[24] The combination of steel frame and concrete slab did not imply a specific building type, program, or site condition, but rather offered a set of parameters—as formula, device, assemblage, rule book—that could be interpreted and articulated in any number of ways. Le Corbusier distilled the ideas of a range of innovators in the field into an open yet formulaic approach to building with a new set of materials, anywhere. The dom-ino, as a historical agent, in this important sense, was not only generative of numerous possible built conditions but also makes clear the significance, the instrumentality, of the technical image as a generative device, as a means for producing different possible futures (figure 1.11).

A fundamental aspect of the dom-ino diagram was this embedded premise of adaptability. Modern architecture offered itself—argued according to these principles to clients, other architects, government agents, and experts—as an approach to building that could be adapted to a range of possible site conditions, building programs, and numerous other variables. While much was made, and

Façades



« *Standardisation de l'élément fenêtre, à échelle humaine. Unité et ses combinaisons.* »



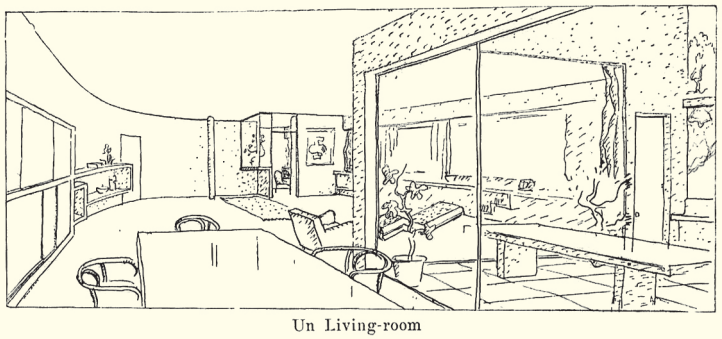
1.11 Le Corbusier, House at the Weissenhof Siedlung, near Stuttgart, 1927. Elevations, plan, section, and photograph from the *Oeuvre complète, 1910–1929*.

has since been made, of the internationalist premise of these innovations, there is a hint already of an inversion in understanding this principle of universalism—in order to be universally applicable, the dom-ino did not propose one building type applicable everywhere but, rather, a set of generative principles that could be adjusted for any number of variable site conditions. Universalism was articulated, at least in part, as a premise of and process for regional adaptation.[25]

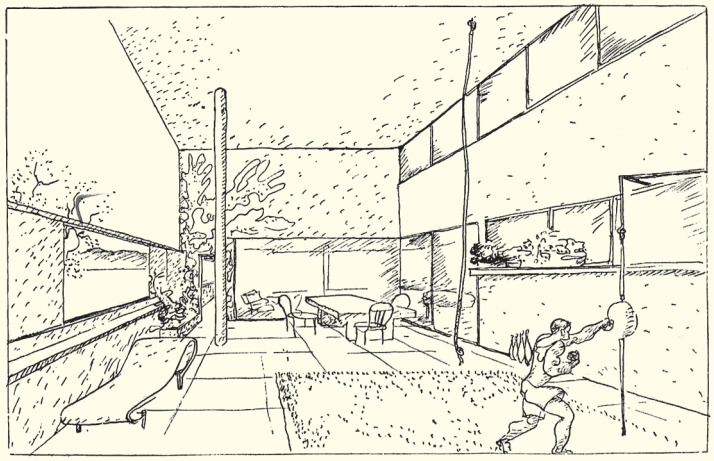
Architectural ideas conceived to have universal applicability were one aspect of a much wider set of cultural, economic, and governmental efforts to establish a certain kind of functional consistency across geographic and cultural space—if not precisely a universal space, and a universal way of life, then an imposed articulation of normativity. Which is to say, architectural modernism-as-universalism was such due to its capacity for regional inflection—more precisely, for adjusting the exterior, and the mediating condition of the façade, so that the interior could be consistent across time and space. Because of this regional adaptability, modern architecture first realized its promise outside the metropolitan center.

The formulation of universalism emerged from a very specific sociogeographic space. The buildings and interiors that were imagined and built across the Global South in the 1930s, '40s, and '50s, in other words, were based on a cultural, experiential, and thermal model of the Euro-American male, engaged in particular modes of commerce and industrial development, with very specific lifestyle habits, gender norms, and economic and labor relations, and embodying a very specific sense of culture (figure 1.12).[26]

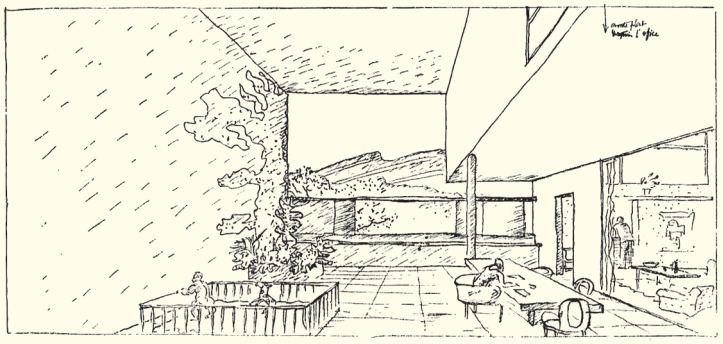
Indeed, this bias of the universal is explicit in a parallel historical trajectory that, at this same time, was testing the physiological effects of conditioned space. The Carrier company, one of the innovators in the air-conditioning industry, began experiments to derive universal parameters for thermal comfort in the 1910s. Their experiments, in a controlled laboratory at Yale University, have been rehearsed in many contexts. They relied exclusively on shirtless, white males in their twenties as subjects. This illustrates, almost too conveniently, the limited conception of comfort that would develop in subsequent decades. As architects and engineers sought to bring such conditioned interiors into other climates around the globe, these limited parameters became articulated as the norm.[27]



Un Living-room

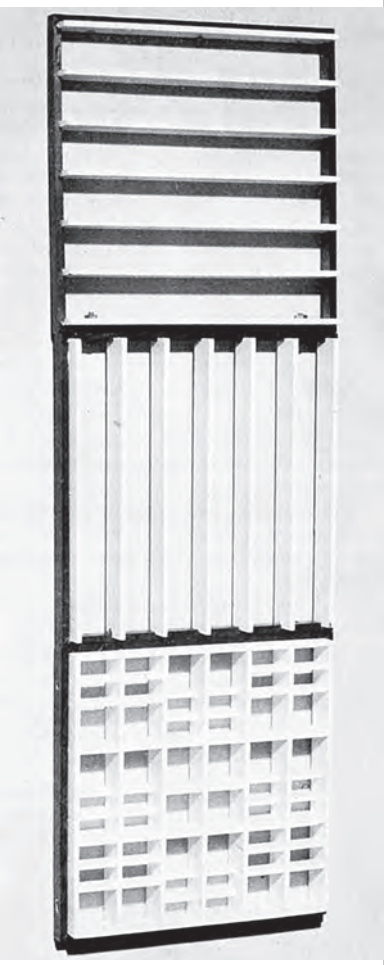


Un jardin-suspendu



Un jardin-suspendu

1.12 Le Corbusier, drawings of the lifestyle imagined in the interior/exterior space of the *jardin suspendu*, for the first Immeuble Wanner project, 1928, from the *Oeuvre complète, 1910–1929*.



1.13 Model of different louver orientations for brise-soleil façade attachments, from Olgyay and Olgyay, *Solar Control and Shading Devices*.

At risk of overgeneralizing: modern architectural strategies were proposed and received as a method for inserting a certain type of thermal interior—one that was seen to derive from and to be amenable to inhabitants from Euro-American metropolitan centers—into almost any climatic, social, or political condition. Articulated as universalist space, it was also a regime of materials, styles, and a more general built environmental condition that was recognizable to a political-economic position centered in western Europe or the United States, even though many, if not most, of the early examples were built elsewhere. The promise of modernism was, in no small measure, articulated as the capacity for design methods to bring a specific, and seemingly healthy, way of living from the center to the periphery, to the colony, and to the hinterlands. This promise was realized, in part, through experiments in those peripheral regions that were then reinterpreted for the Euro-American metropolitan centers, as will be seen in subsequent chapters.

It was not a question of adjusting the basic tenets of modernism to accommodate these new conditions; rather, it was a basic tenet of modernism, summarized through the dom-ino diagram, that it had a robust capacity for adaptation, a flexibility in approach that allowed it to be applicable as a tool of modernization, colonization, and globalization across the mid-twentieth century. Architecture became modern by mediating non-European climates and cultures, and by attempting through architectural means to make these climates and their inhabitants amenable to various forms of political and economic intensification.

The Brise-Soleil

An excerpt from Le Corbusier's 1930 lecture in Buenos Aires addresses these general parameters, albeit cryptically. "Teach your children," he said to his audience, "that architecture is about sunlight on floors."[28] There are a number of interesting aspects to this elocution—first, as suggested in the ample wash of sunlight on the floors of the Villa Savoye (see figures 1.9, 1.10), one of the projects of Corbusian modernism was to encourage a new and purportedly more healthy relationship with the patterns of climate, especially relative to the path of the sun. That the intrusion of solar rays into the interior had a different experiential, thermal, and cultural valence in the Global South did not yet register for the Swiss-French architect, though it soon would.

Also of significance—"teach your children." Architectural modernism was projective, speculative, about the near future. Le Corbusier and others were focused on how integrating new principles and parameters into the built environment would construct, literally, a new world. The dom-ino was a generative device; Corbusian modernism, more generally, was focused on how the new ways of building could produce new subjects, newly conditioned to the experience of the city, of industrialization, and of the variables of climate as mitigated through the façade.

With such a universalist internationalism in mind, the shading device, or brise-soleil, emerged as the necessary correlate of the dom-ino idea (figure 1.13). One of the apparent conundrums, for historians of Le Corbusier, and of the so-called heroic period of modernism more generally, is his turn, in the late 1920s, away from purist, Platonic solids as the basis of design and toward a more

1.14 Le Corbusier, a *pan de verre* on a mid-rise residential block, from the *Oeuvre complète, 1934–1938*.

expressive, even regionalist approach. Here again, climatic effects are essential to understanding this set of events and to understanding the difficulty of their integration into narratives of modernism.

These narrative patterns revolve around the complications introduced by the dom-ino idea—in particular around the fact that once the façade was liberated from structural demands, it came to be filled with glass. Familiar architectural means to manage solar radiation, and to more generally use architecture to condition interior space, were confounded. Generally speaking, masonry and stone, often from the region of the building site, had offered thermal behaviors that glass and concrete do not. In hot climates, the thickness of the wall absorbed solar radiation during the day and released it to a cool interior in the evening; in cool climates that same thickness could offer some insulation for heat produced by a fireplace or other means. The use of stone and brick façades was not always carefully correlated to regional solar patterns, or sensitive to the changing demands placed on the interior; however, over the *longue durée* of architectural experimentation and expression, façade materials—from adobe to brick to quarried stone—mediated the climatic exterior to provide a set of interior thermal conditions relatively adapted, often without explicit theorization, to their use. This picture of vernacular-as-climatic-architecture would need to be addended with a discussion of domestic and labor habits, variabilities of clothing, and such, as will be suggested in later chapters. These forms, habits, and means for using materials were disrupted by industrialization and the innovations of architectural modernism. Indeed, this was one of the major effects of architectural modernism—a fundamental interruption of familiar patterns of climatic management, opening those patterns up for new kinds of technological engagement.[29]

Many other buildings and experiments could fill in this gloss on the continuities and disruptions

between traditional practices embedded in specific cultures and the internationalist premise of modernism. Other writers have emphasized the transition from colonial adjustments to the liminal space between interior and exterior, looking at verandas, balconies, and extended eaves in this context.[30] Le Corbusier's Villa Baizeau, designed many times for a site in Carthage and finally built in 1928, builds on this tradition with its parasol roof, interior ventilation, and a series of alternating extended floor slabs to shade the façades and spaces below—the building became essential to the architect's self-referential typology of shading as developed right after World War II. Scholars have also noted the use of local stone in the partition walls of the Maisons Loucher (1929) and the extended eave in the roof of the Maison Erazzuris, planned for a coastal site in Argentina in 1930.[31] In many ways the discourse on climate here being traced can be seen as a fraught attempt to modernize traditional means for climate management—to technologize the louvers, screens, blinds, extended eaves, and many other techniques that have been used to shade interiors for centuries.

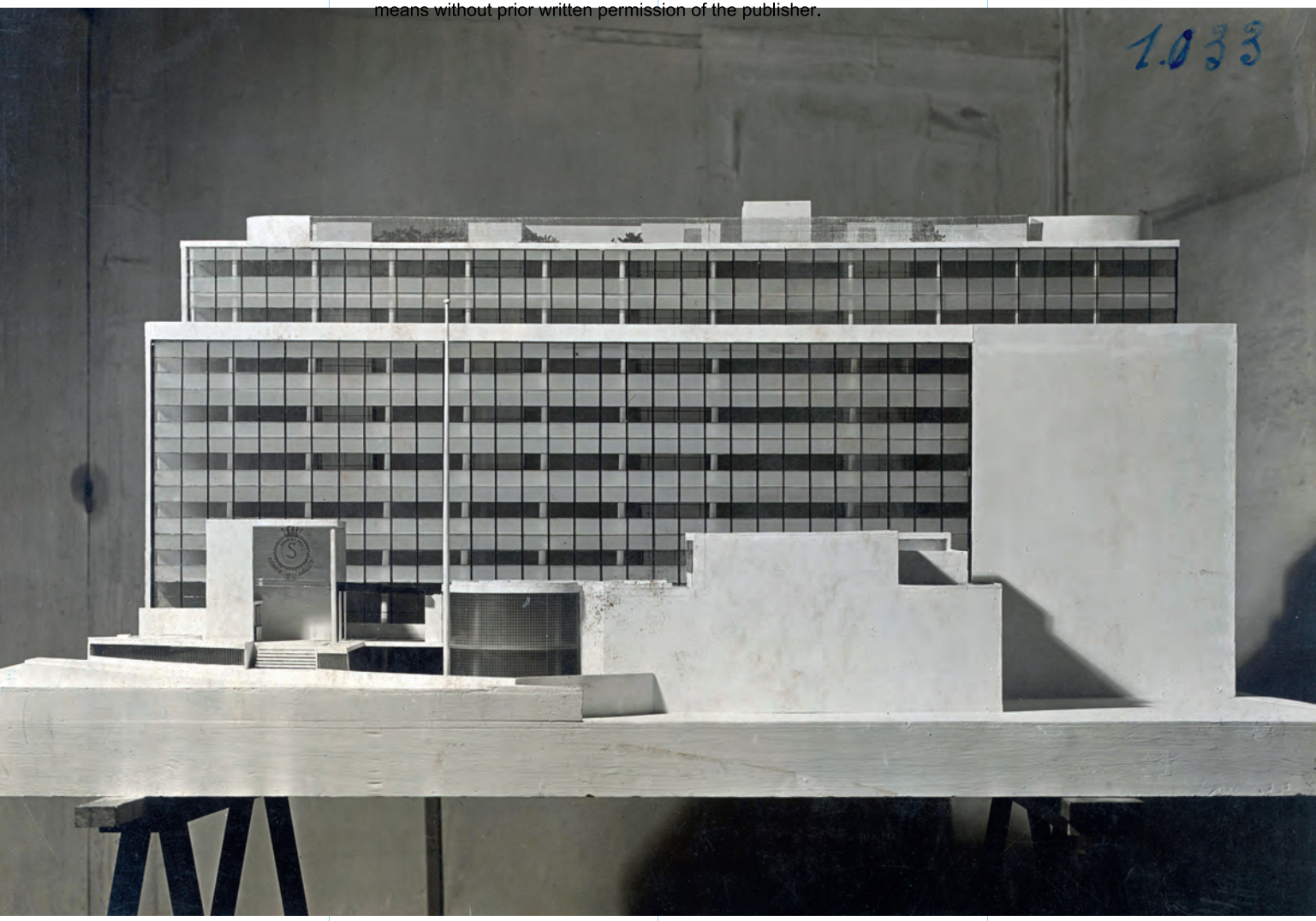
Perhaps even more significant than the basic gesture of the dom-ino—liberating the façade from structural demands—was the subsequent move of filling that façade with glass. It introduced numerous complications to the development of modern design methods. Indeed, there was much international debate among early modern architects regarding the amount, disposition, and technical characteristics of the glass that would be inserted into the now-open façade.[32] Previous limitations to the use of glass were also obviated by an abundance of supply, and a glass industry eager to expand its customer base; in general, until the early 1940s, this glass exhibited poor insulation qualities. The *pan de verre*—or wall of glass—in the early experiments arising from the dom-ino diagram, are antecedents of the curtain walls and all glass houses and towers—much more technologically sophisticated as insulating membranes—that developed later in the twentieth century (figure 1.14).

The *pan de verre* profoundly changed the thermal conditions of the interior, not necessarily for the better. In the third volume of the *Oeuvre complète*, published in 1946, Le Corbusier lamented the "problem" of the transparent envelope, indicating that by this time, because of the basic condition of overheating, the "hour of doom" was fast approaching for it.[33] The brise-soleil was needed to temper these effects, further clarifying modernism as a flexible means of building that could be adapted to different regional and social conditions. In combination, these two principles of modernism—the dom-ino and the brise-soleil—were essential to a new way of building and to a new way of living.

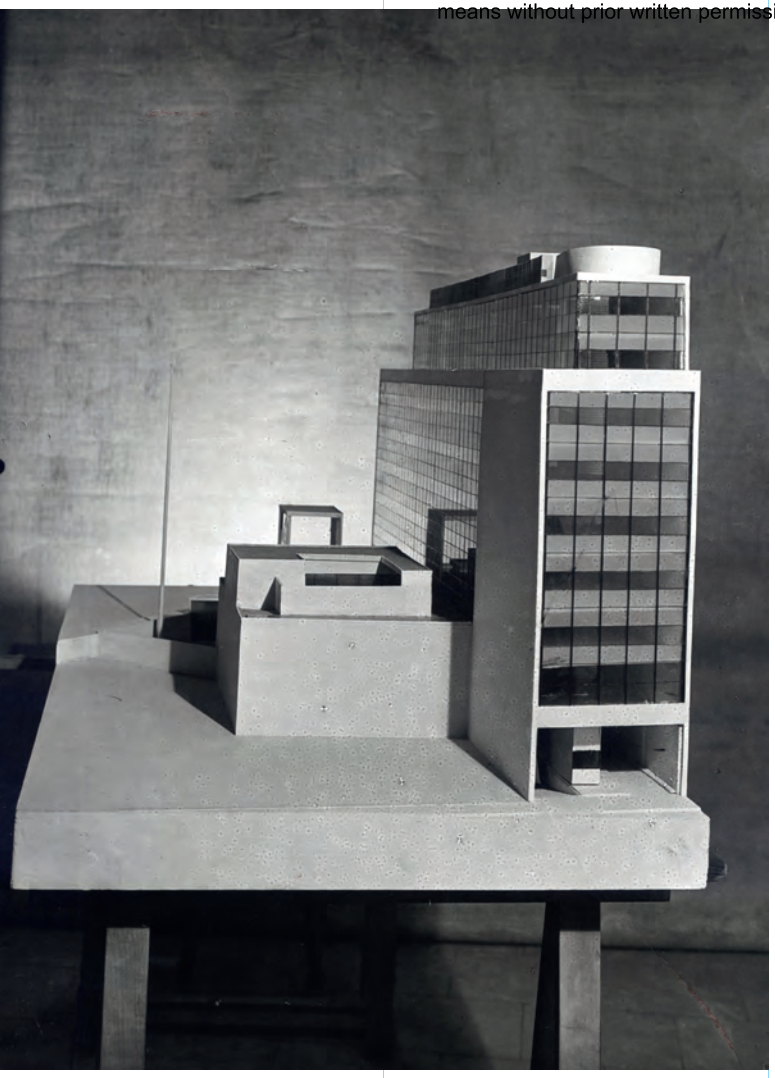
Much of the struggle with the *pan de verre* emerged through the design and construction of the Cité de Refuge de l'Armée du Salut—one of Le Corbusier's first large-scale buildings in France, with design work dating from 1929 (just after the construction of the Villa Savoye mentioned previously) (figure 1.15). The project was for temporary living spaces for homeless or otherwise economically disadvantaged individuals, initiated by the French office of the international Salvation Army. As has been detailed at length in the specialized literature, the Cité de Refuge was initially proposed to include specifications for what Le Corbusier termed a *mur neutralisant*—a wall that would neutralize the external conditions of the climate relative to their impacts on the interior. It was, indeed, with this neutralizing membrane in mind that Le Corbusier predicted the international consistency of buildings at a permanent 18°.[34]

The technological aspects of the *mur neutralisant* were ambitious—the *mur neutralisant* involved a double-skinned curtain wall on both of the long façades of the building, with an air space between the two layers of glass (figure 1.16). In the winter, the air space was to be filled with warm air in order to "neutralize" the cold air of the exterior; in the summer, the same space would be filled with cooled air, to prevent the warm air from entering. There were a number of what Reyner Banham later described as "Le Corbusier's obstinate environmental misapprehensions," relative to the physical capacities of cooling and warming interior space, evident in this plan.[35] Most problematic, the glass on each side of the air space offered little insulative capacity, so that when it was filled, for example, with warm air in the winter, that air simply radiated through the glass wall into the atmosphere, having little effect on the interior. When it was completed in 1928, the building was freezing in the winter and overheated in the summer (figure 1.17).

Both Banham and Kenneth Frampton discuss these misapprehensions at length. Frampton in particular sees them as essential to a second phase of Le Corbusier's career that involved a turn to a more expressive formal approach as well as



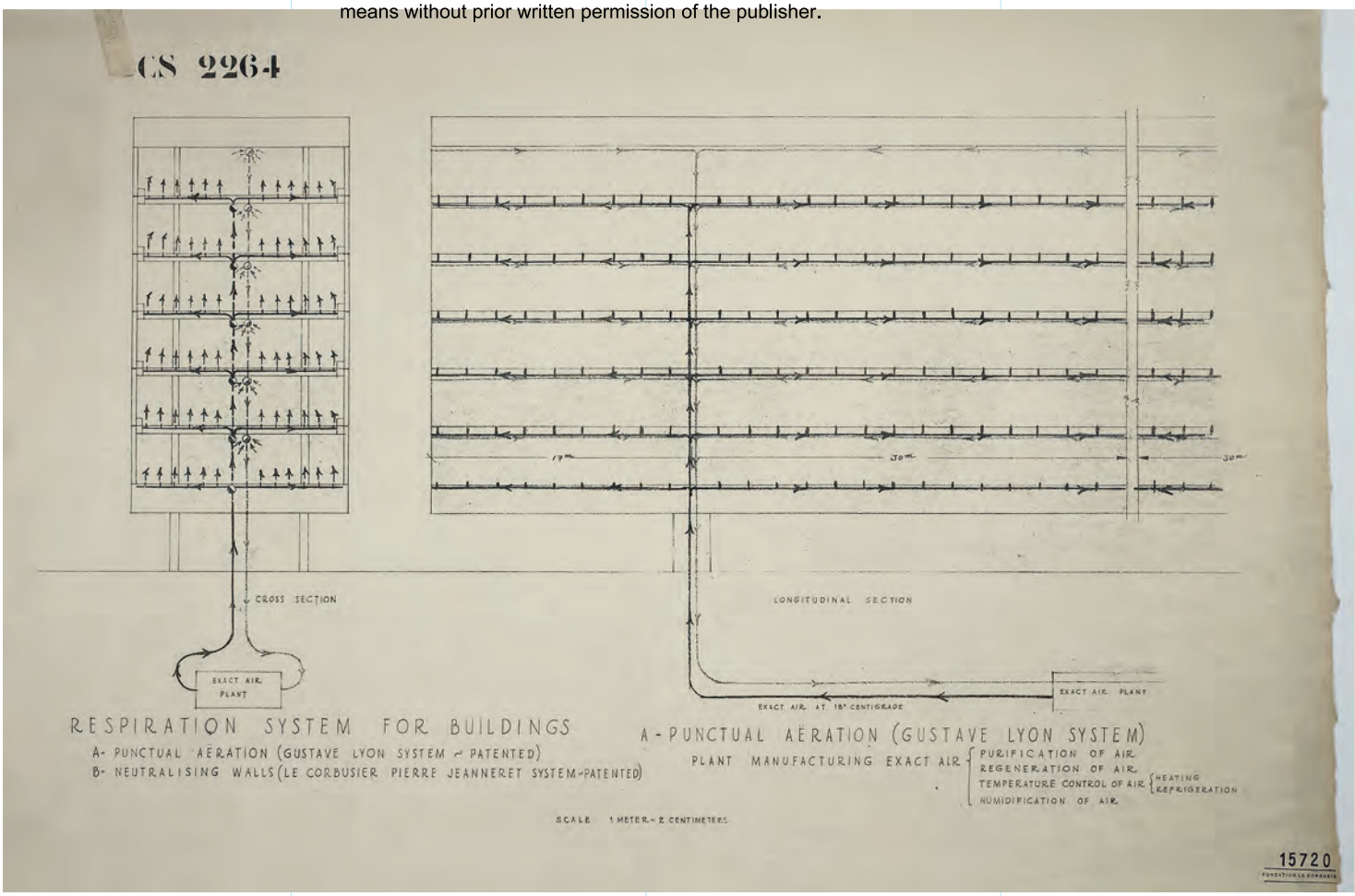
1.15 Le Corbusier, model of Cité-Refuge de l'Armée du Salut, Paris, 1928.



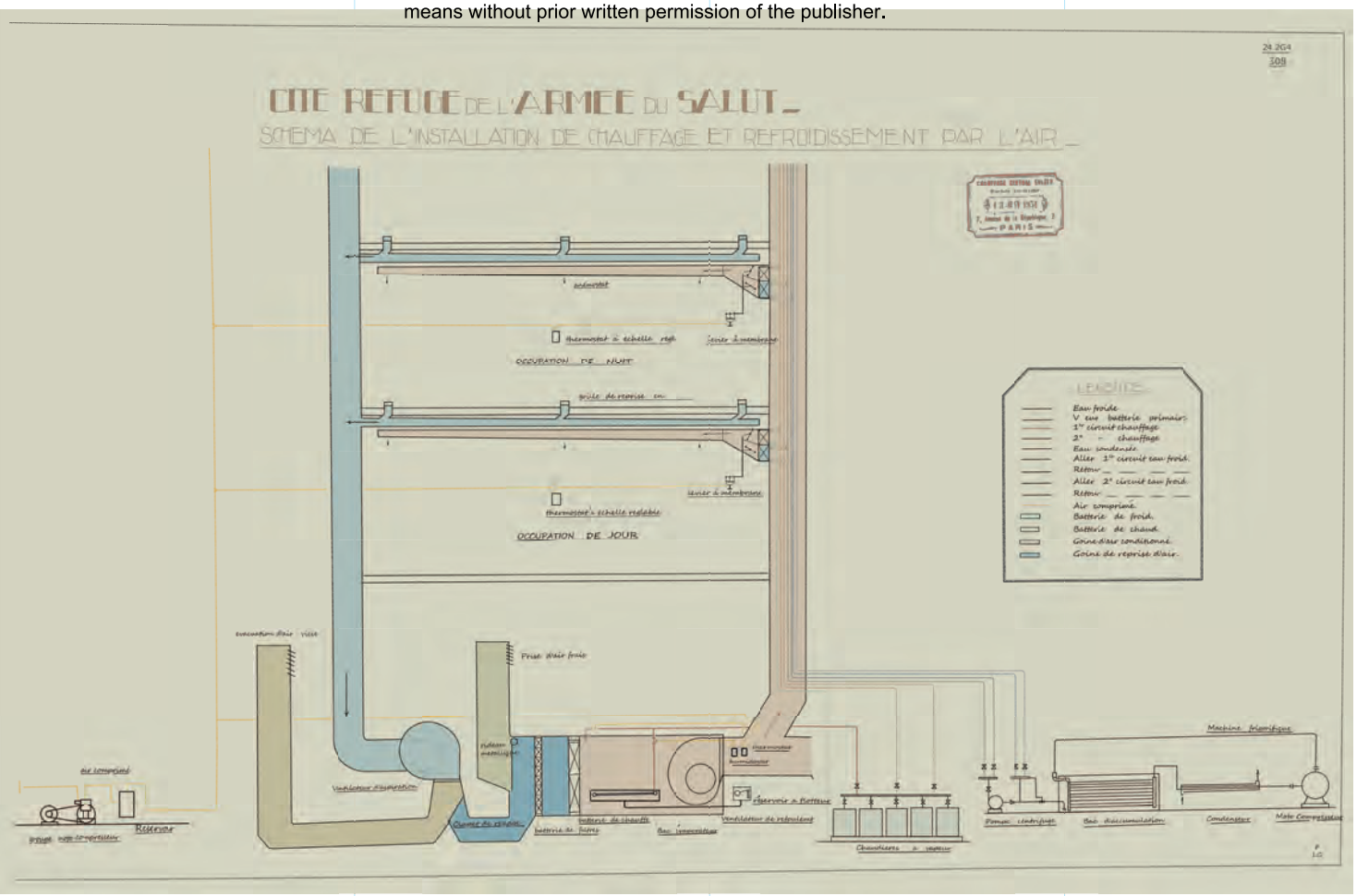
a reliance on passive shading technologies rather than technologically intensive conditioning systems.[36] Which is to say—the obstacle of climate, if nothing else, served to detour the work of Le Corbusier away from the purist principles of his early buildings (such as the housing complex at Pessac) and toward a more formally expressive approach to the inherent possibilities of new materials, programs, and technologies (such as the church at Ronchamp). Both historians also emphasize the challenges the architect faced in connection with the technological capacities of the French building industry and relevant regulatory agencies.

A generous interpretation of the failure of the *mur neutralisant* was that it resulted from an inadequate application of the principle of Le Corbusier's design: the mechanical system was too small to produce heated or cooled air adequate to the system, and the difficulties of constructing a fully sealed (that is, leak-free) curtain wall were also just being understood.[37] However, as Rosa Urbano Gutiérrez has documented, the basic principle of the system was misconstrued. She quotes a document from the archive in reference to a version of the system proposed for the Centrosoyuz in Moscow, in 1929, in which an American air-conditioning engineer, consulted by Le Corbusier, indicates that "the method would require, in order to heat and ventilate the building, four times as much steam and twice the mechanical power as would be necessary with methods currently employed in our country under comparable atmospheric conditions."[38]

Frampton points to these technological and bureaucratic barriers of the *mur neutralisant* as instrumental to what he sees as Le Corbusier's life-changing "loss of faith in the manifest destiny of the machine age" and a search for other means of activating the building as a system of climatic mediation—architectural means, rather than mechanical ones.[39] This new imperative is developed through the design of another structure, an apartment building in Geneva. The Immeuble Clarté, on the boards as the complications with the Cité building were becoming clear, used design means for tempering the thermal conditions of the interior. Although, arguably, the summer cooling demands of Geneva are not as significant as in other elevations and latitudes, the resultant design provides the opportunity for the diagrammatic elaboration of the brise-soleil as a principle of modern architecture, with impacts that will

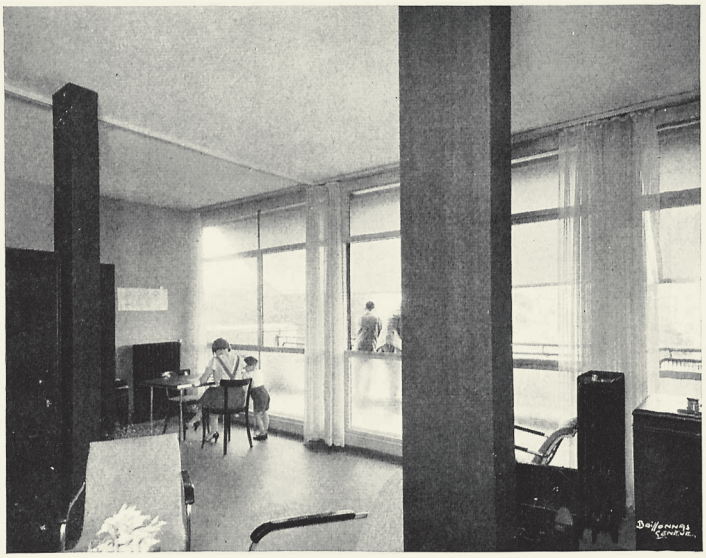


1.16 Le Corbusier, drawing of the "Respiration System for Buildings" proposed for the Cité-Refuge de l'Armée du Salut, Paris, 1927 and the Centrosoyuz, Moscow, 1928.



1.17 Le Corbusier, Cité-Refuge de l'Armée du Salut, heating and cooling scheme. Redrawn from the archive for clarity, 2019.

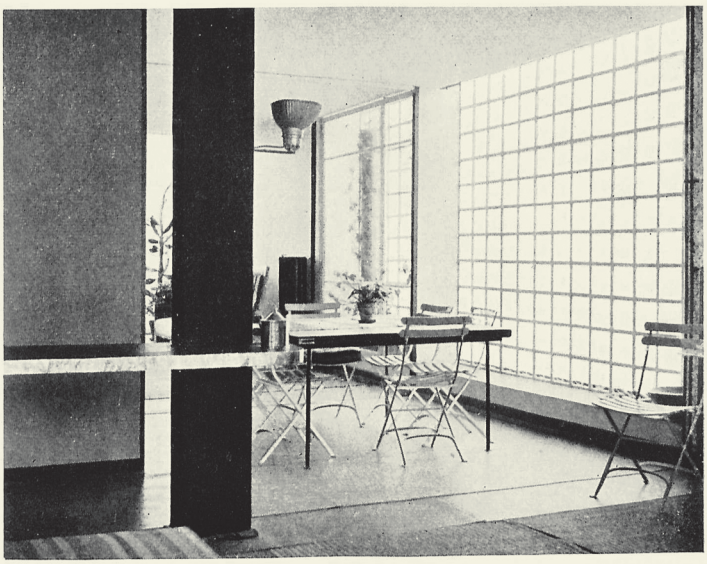
IMMEUBLE «CLARTÉ», GENÈVE 1930-32



Intérieur d'un immeuble locatif

Intérieur du même immeuble

La terrasse devant les appartements



Un living-room

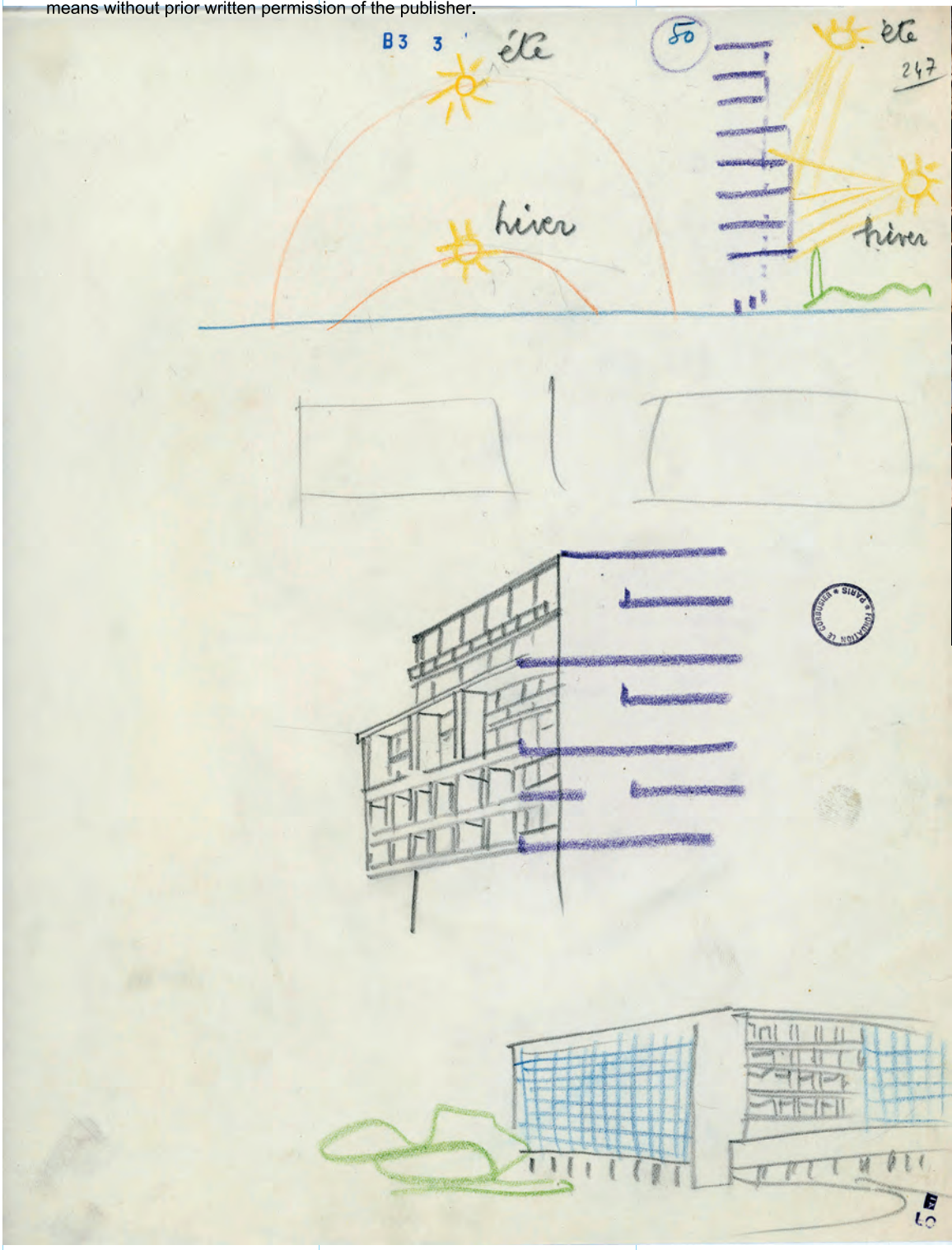
1.18 Le Corbusier, interior images of the Immeuble Clarté, Geneva, 1930, from the *Oeuvre complète 1929–1934*.

1.19 Le Corbusier, Immeuble Clarté photograph of the façade.

resonate across subsequent decades and around the world (figure 1.18).

At the Immeuble Clarté, Le Corbusier did not attempt a mechanically sophisticated system. Instead, the building deployed a collection of low cost, user intensive, and visually dynamic sun-shading devices: balconies, external blinds, retractable awnings, and interior shutters blocked and modulated solar incidence (figure 1.19).[40] The effect on the interior was dramatic. The photographs that Le Corbusier published in the *Oeuvre complète* clarify and elaborate on the principles he had suggested for modern architecture's relationship to the sun, producing a comfortable living space that allowed for new ways of living in relationship to solar patterns.

His early sketch of the building indicates the effects of this shading system and is likely the first entry in a long series of technical images intended to clarify the principles of the brise-soleil and Le Corbusier's apparent invention of them. The drawing is divided into three parts. First, a top section that shows, on the left, the variation of the solar path—higher in summer (*été*) and lower in winter (*hiver*) (figure 1.20). To the right, a schematic section of the building, shows the extension of the balconies as shading devices, with rays from the summer sun being blocked and rays from the winter sun able to penetrate into the interior. The details of this schematic section are then clarified in the middle part of the drawing, where the purple lines of the balcony extensions are integrated into a more detailed rendering of the façade, with both horizontal and vertical divisions, the latter presumably mostly for privacy but also serving a secondary shading function. The third section of the drawing, on the bottom, shows the volume of the building in perspective, intended to demonstrate that this novel condition is only deployed on the façade that is most exposed to the sun. This basic principle of different treatments for different façades became a major principle of the bioclimatic design strategies proposed in later decades.



1.20 Le Corbusier, sketch indicating the principles of relationship between the façade shading system (brise-soleil) and the seasonal path of the sun, as applied at the Immeuble Clarté.

1.21 Le Corbusier, Cité-Refuge de l'Armée du Salut, after renovation with brise-soleil added, 1947.

Although much more than a brise-soleil, the basic principle was established. As part of the turn away from his faith in the machine age, Le Corbusier proposed architectural elements to manage those interior climatic conditions that the mechanical systems approach had proven too cumbersome to engage. Such a premise is not absolute. The Pavilion Suisse of 1931 contained a sort of middle ground, with mechanical roller shades allowing for selective protection from solar rays, but the turn toward designed façade elements, and away from mechanical conditioning, was, at least temporarily, definitive. As Banham summarizes the story: "however desperate its motivations, the brise-soleil is one of [Le Corbusier's] most masterly inventions, and one of the last *structural* innovations in the field of environmental management."[41] Banham also cites, as proof of the brise-soleil's technical and cultural effectiveness, the renovation of the Cité de Refuge in 1947, after it was damaged during the war. Double-paned insulated windows replaced the *mur neutralisant*, and an extruded grid was placed on the façade, what came to be called an egg-crate shading system, one of a number of typologies subject to elaborate exploration in the postwar period (figure 1.21).[42]

The historiographic and historical consequences are significant. Le Corbusier, prophet of the "machine for living," faced the limitations, however temporary, of a mechanical solution to the problem of the thermal interior. The platonic forms, and the social progressiveness and technological engagement they were seen to promise as part of the *esprit nouveaux*, were frustrated—other means were necessary to produce the architecture of the future. There were at least three essential effects: first, as Frampton has it, Le Corbusier would turn from a purist ideal to the more expressive gestures of his postwar career, his frustration with the possibilities of climate engineering leading, it seems, to a more general interest in the plastic opportunities afforded by the materials that he was exploring.

Second, the search for mechanical conditioning would continue in the work of Le Corbusier and elsewhere. The archives at the Fondation Le Corbusier are replete with reports and brochures concerned with early attempts to use mechanical systems to condition interior space (figure 1.22). Le Corbusier continued to collaborate with Gustave Lyon, an engineer he had worked with on the plan for the League of Nations competition and in conceiving the conditioning systems for the Cité de Refuge, the Centrosoyuz, and a number of other buildings in the late 1920s and early '30s. The two worked with the Saint-Gobain glass

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1.22 Brochure from the Sulzer Central Heating Company, 1931, in the Le Corbusier Archives.

laboratory on full-scale experiments in attempts to resolve the difficulties of the system.[43] Urbano Gutiérrez argues that much of Le Corbusier's later work involved a hybrid approach—a combination of shading techniques and versions of the *mur neutralisant*.[44] Le Corbusier's later work in India would intensify his interest in managing climate, leading to a number of collaborations with architects and engineers on these terms, and the development, in the early 1950s, of the *Grille Climatique* as a method of analyzing a building's socioclimatic relations.[45]

Urbano Gutiérrez also emphasizes that, however misconstrued and energy inefficient at the time, the *mur neutralisant* is essentially an early version of the double- and triple-skinned façades at the forefront of energy-efficient building practices developed since this period.[46] By the beginning of the 1950s the technology of insulated, glazed membranes, and of the mechanical systems that could condition the air inside them, had advanced considerably. The basic premise of using both façade and conditioning technology to isolate the building from its surroundings, and producing its own climate, has significant if unanticipated consequences for the future.

The third historical effect was the proliferation of brise-soleil and other shading strategies as part of the global dissemination of modern architecture of the 1940s and '50s—the paired interventions of the dom-ino and the brise-soleil allowed for an adaptive architectural approach to a range of climates and cultures, and they also allowed the more familiar principles of architectural modernism to flourish in the Global South.

Adaptability and Normativity

While consolidating the premise of adaptability, the brise-soleil, as the necessary correlate of the dom-ino, also emphasizes the corollary concept of normativity. The dom-ino and the brise-soleil were paired innovations, one required the other—for what? The glazed, open, and carefully shaded façade aimed to produce a consistent thermal interior. An important aspect of modern architecture, in the midst of its development, was its purported capacity to produce a universal space for improving health and quality of life, for the normalization of ways of living. The production of a normative interior was essential to modern architecture's affiliation with a wide range of seemingly progressive associated trends—the production of a space for global commerce, for example, or the capacity for architecture to improve public health.

The premise of normativity suggests a wide range of transitions and dispositions that hover like a cloud over the development of architectural modernism and over the naturalization of many of its design tropes. Design ideas cannot be separated from political implications, especially when questions about climate and ways of life are kept in the foreground. The normative premise reveals an implicit, general approach of climatic determinism, in the midst of a wider ranging emergence of hegemonic cultural frameworks familiar to the theorization of globalization—frameworks in which the shaded façade operates, again, as a mediating device, and a transitional approach: clarifying dominant trends while also expressing new concerns.

Normativity, as the historian of science Georges Canguilhem argued in this same period, was essential to the conception of culture, and of civilization as such. Michel Foucault, introducing Canguilhem's text *The Normal and the Pathological* in its 1966 publication, wrote as follows: "people began to ask the West what rights its culture, its science, its social organization and finally its rationality itself could have to laying claim to a universal validity"— concerns of course since reflected in a wide-ranging effort to decolonize cultures and spaces.[47] These complications are played out in Le Corbusier's attempts to consolidate his ownership of the shading system as a technique of European modernism, disseminated to the periphery.

The concept of climatic determinism is essential here. Developed by numerous colonial and imperial scientists at the turn of the twentieth century, this attitude proposed that specific weather conditions are essential to the production of a specific kind of culture—with an emphasis on the purported excellence of the climate in the northern temperate zone. For European and American physiologists assessing the conditions of the colonies and the Southern Hemisphere, climatic conditions were determinant in a country's potential role on the world political and economic stage. "One of the reasons," as one such imperialist, Ellsworth Huntington, wrote in 1942, "for the rise of [one] nation [rather than others] in modern times is its control over climatic conditions: that nation which has led the world, leads the world, and will lead the world, is that nation that lives in a climate, indoor and outdoor, nearest the ideal" (figure 1.23).[48] An

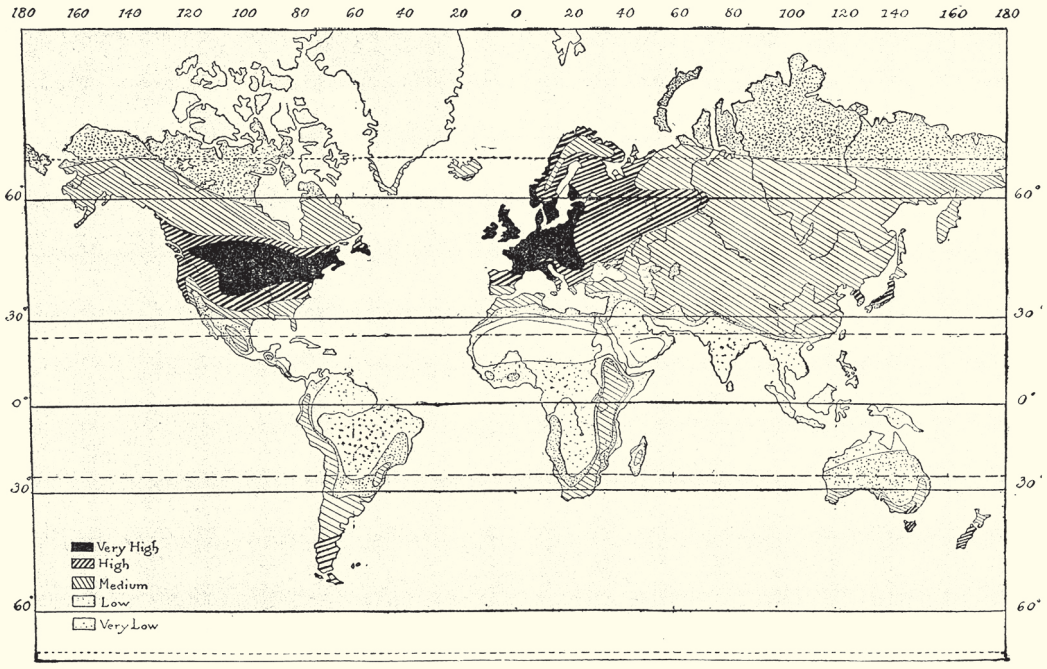


Figure 43. The Distribution of Human Health and Energy on the Basis of Climate

1.23 "The Distribution of Human Health and Energy on the Basis of Climate," from Ellsworth Huntington, *Civilization and Climate* (New Haven, CT, 1924).

ideal that was, needless to say, modeled on optimized European climates. The complex imposition of interior conditions reflecting the temperate climates of western Europe onto a range of regional variants was caught up, on the one hand, in attempts to improve health and eradicate disease and, on the other, with producing a "universal validity, tied," as Foucault put it, to "economic domination and political hegemony."[49]

Canguilhem's demystification of the pathological helps to clarify the intentions and intensity of this determinist notion. Nontemperate climates were seen as inadequate by the determinists, a pathology that was placed against a norm. Canguilhem, posing the maxim that "pathological phenomena are identical to corresponding normal phenomena save for quantitative variations," suggests that the normative emerges as essential for constructing notions of pathology, rather than the other way around. "Every conception of pathology," Canguilhem continues, "must be based on prior knowledge of the corresponding normal state, but conversely, the scientific study of pathological cases becomes an indispensable phase in the overall search for the laws of the normal state."[50] The conditions of a consistent thermal interior were, in this fashion, produced through experimentation in the Global South insofar as those experiments not only served to test design methods for thermal control but also helped to define the parameters of the normative interior. The aim—initially through shading systems and later through mechanical systems—was the construction of a planetary interior in which, it was imagined, thermal conditions were consistent enough to allow for a seamless globalization to emerge.

Architecture, and climatic modernism in particular, becomes an important medium through which claims of cultural value (civilization, western civilization, globalization) became mobile on these terms. The norm was thus constructed, literally, if not in fact imposed, through façade systems conditioning colonial interiors. "Strictly speaking," as Canguilhem concludes, "a norm does not exist, it plays its role which is to devalue existence by allowing its correction."[51] Whatever its other intentions, the elaboration of the brise-soleil encouraged the production of a normative interior on these terms.

This imperative was articulated diagrammatically in design methodology, before it was built. When Le Corbusier conceived of methods to produce a consistent thermal interior, he did so according to a vague though considered approach

toward cultural distinctions based on climatic conditions. In his case, the premise of climatic determinism played out in part through the articulation of a specific Mediterranean culture, centered on a number of prominent cities lining the sea.[52] The climate of the Mediterranean was seen to be superior to others—in Huntington's map, the northern rim is classified as "Very High," the north of Spain as "High," and southern Spain and North Africa as "Medium." When he designed the Lotissement in Barcelona, Le Corbusier was seeking to articulate a design method appropriate to this climate—an architectural means to raise it from "High" to the pinnacle of "Very High." When he proposed an office tower in Algiers, on the northern coast of Africa, he similarly sought to extend the optimal climatic conditions—and its attendant norms—to the French colonies. A pattern that is repeated, from Le Corbusier's perspective, across the Global South, though the history of the shading device in Brazil, for example, frustrates this one-way-street model of historical change. The production of and the debates around the conditions of the thermal interior were in large part centered on this perception of precise climatic conditions for a western European notion of civilization.

Evidence

On July 2, 1945, just as the war was ending, Le Corbusier participated in a small conference organized by the Centre National de la Recherche Scientifique (CNRS), concerned with "L'Urbanisme et l'Ensoleillement des Habitations" ("Urbanism and the Daylighting of Buildings").[53] The program included presentations on the physical properties and conditions of sunlight, on the physiological and biological consequences of solar incidence at both the urban and building scale, and on techniques for understanding solar absorption as a source of heat and of light. Le Corbusier presented last, focusing on the consequences of the above types of knowledge "sur l'Architecture et l'Urbanisme."[54] Sketching on the program for this seminar, he began to develop what would later be published as the "petit historique du brise-soleil" (see figure 2.7). It is an indication that he saw the development of the brise-soleil as significant to his historical legacy (figure 1.24).

For the purposes of this book, Le Corbusier's historical importance is not only for his formal interventions, as significant as they no doubt were; instead, the interest here reflects the broader context that the conference implies. Climate, however haltingly, had become a topic of architectural investigation; conversely, architecture began to be formulated, in the decades surrounding World War II, as an important aspect of climatic knowledge. Architectural concerns came to be visible to bureaucrats and technocrats concerned with the scientific knowledge of climatic patterns in new ways, just as architects, urbanists, policy makers, and manufacturers started to think about the building as a device for producing and managing a consistent global climate. Architectural discourse and practice became essential sites for experimentation in the relationship between climatic patterns and the daily life and habits of individuals. Design methodologies activated knowledge on the terms of, and for the application of—the testing of—climate science.

Le Corbusier's talk at the "l'ensoleillement" conference was published in *Techniques et Architecture* in January 1946 as "Problèmes de l'Ensoleillement: Le Brise-Soleil."[55] In it, he walks the reader through the basic premise of shading devices, emphasizing that they emerged as a necessary solution to the overheating characteristic of the *pan de verre*. The drawings begin with basic building types, and then the now-familiar schematic of the seasonal differences of the sun's path across the sky, followed by a brief discussion of the costs and benefits of different shading types (#12a–c on figure 1.24). He discusses the Villa Baizeau at Carthage (#3), where, again, a sort of tic-tac move in section brought the building mass behind protruding floors to allow for shading, and he continues with a sketch of the Barcelona Lotissement façade (#4), and then onto buildings in Algeria and Brazil. He summarizes his interventions as "solutions that are the first to allow modern life to flourish in complete freedom, in a country were the climatic conditions seemed to be imperatives that would impose themselves forever."[56]

In the *Techniques et Architecture* issue, Le Corbusier's article was followed by another presentation from the CNRS conference, a discussion of "Efficacité de l'Ensoleillement" by the engineer France Fradet (figure 1.25). This was likely the first instance of the publication of climate diagrams in the French architectural press. Indications of the solar path and shading charts for the latitude of Paris were accompanied by diagrams of suggested building heights and other design principles.[57] Climate discussions, and images at the interface of science, architecture, and conceptions of culture,

PROBLÈMES DE L'ENSOLEILLEMENT

LE BRISE SOLEIL

PAR

LE CORBUSIER

Conférence prononcée le 2 Juillet 1945, au Palais de Chaillot

On serait en droit d'affirmer que l'histoire de la fenêtre est aussi celle de l'architecture, disons, du moins, d'une tranche des plus caractéristiques de l'histoire de l'architecture.

Je dessine la maison traditionnelle : elle est faite de murs portant des planchers; ces murs sont percés de fenêtres et ces fenêtres, pour des raisons diverses, ont été plus ou moins grandes à travers l'histoire.

1 *On peut même prétendre que la grandeur des fenêtres était un signe de richesse, du moins d'opulence, peut-être bien de joie de vivre.*

Percer les fenêtres dans un mur portant des planchers est un geste antagoniste à la fonction précitée : percer le mur de fenêtres, c'est l'affaiblir. Et l'on assistera à la lutte entre le plein et le vide au cours de l'histoire. Et la proportion s'établissant entre les pleins et les vides constituera une part plus déterminante qu'on ne croit de ce que beaucoup aiment à appeler les « styles ».

J'ai donc dessiné rapidement la petite maisonnette traditionnelle et tout à côté, l'immeuble Haussmann où l'ouverture des fenêtres atteint la limite du possible; pousser au delà serait dangereux.

2 *Ceci est de la petite architecture. Voici par exemple sur le plan de la plus grande architecture,*

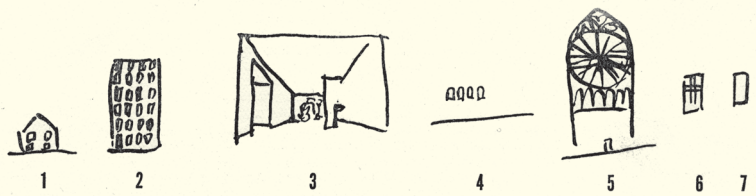
3 *la grande ouverture de l'atrium de la maison antique.*

4 *en 4, je dessine la petite fenêtre romane à plein cintre et en 5,*

5 *la grande et magnifique fenêtre ogivale avec ses roses éblouissantes.*

6 *en 6, la fenêtre Renaissance avec ses meneaux de pierre.*

7 *en 7, la fenêtre Louis XIV, Louis XV, Louis XVI...*



Passons directement à aujourd'hui : nous disposons de l'acier et du béton armé; tout est transformé, c'est la coupe qui nous le révèle.

8 *Voici la coupe d'un bâtiment moderne de bureaux, d'habitation ou de manufactures : on y voit des planchers superposés portés non par des murs mais par des poteaux.*

Une bonne économie de la construction veut que les planchers portent en cantilever sur les poteaux, si bien que, d'un coup et subitement, le constructeur réalise ce rêve, réputé inaccessible, d'éclairer les locaux à 100 0/0.

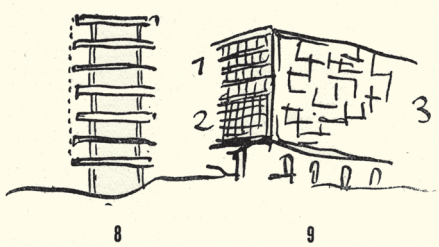
Et dès lors, ce sont les planchers superposés qui portent eux-mêmes *le mur, et ce mur peut être une membrane de verre, un* « pan de verre ». *En 9, j'exprime diverses attitudes de ce pan de verre.*

9 *La solution 1 souligne la présence des planchers tandis que la solution 2 n'hésite pas à faire passer le pan de verre au devant des planchers; la solution 3 montre une mosaïque toujours possible de casiers du pan de verre où la plus grande fantaisie peut se donner libre cours.*

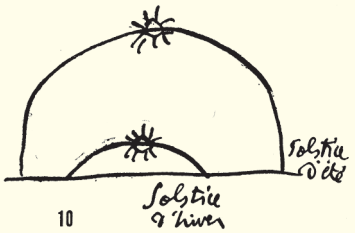
Il va de soi que, désormais, se poseront de nouveaux problèmes : le chauffage des locaux, leur ventilation et surtout — ce qui sera le thème de cet exposé — les conditions de l'ensoleillement, de l'entrée bienfaisante du soleil en hiver, de l'entrée catastrophique du soleil en été. Ces conditions affectent l'habitant, qu'il soit le locataire d'un appartement, l'ouvrier derrière une verrière d'usine ou l'employé de bureau derrière sa fenêtre.

Je vais vous montrer une suite de petites découvertes successives qui m'ont permis de devenir et de demeurer ami du soleil et d'apporter, même à certains pays comme le Brésil et sous le soleil tropical, des solutions qui sont les premières à laisser s'épanouir en toute liberté la vie moderne dans un pays où des conditions climatiques impératives avaient institué des traditions qui semblaient devoir s'imposer à jamais; d'ailleurs, le mot employé ici — le brise-soleil — stipule qu'on s'est rendu maître d'un élément.

Mais revenons à notre bref historique : le pan de verre est acquis et la lumière est à 100 0/0; nous nous en sommes emparé avec joie estimant que c'était une chance inespérée. En 1933, le congrès C.I.A.M. d'Athènes fixait ce point de doctrine fondamental : les *matériaux de l'urbanisme sont le soleil, l'espace, la verdure. J'avais appelé ces matériaux :* « les joies essentielles » *et en les incorporant à la vie même de l'individu, abstraction faite bien entendu de toute situation sociale ,le problème cardinal de l'urbanisme se trouvait dès lors posé : donner à chacun le bénéfice des joies essentielles — soleil, espace, verdure — et personne n'a osé, depuis, faire opposition à ce postulat.*



1.24 Le Corbusier, "Problèmes de l'Ensoleillement: Le Brise-Soleil," from *Techniques et Architecture*, January 1946.



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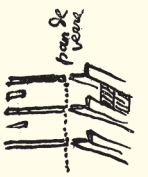

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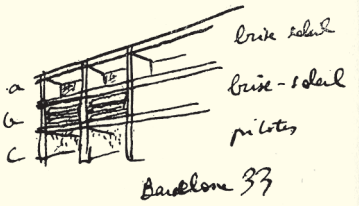

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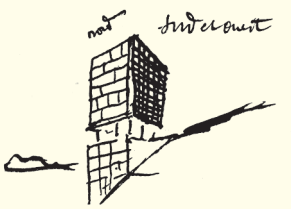

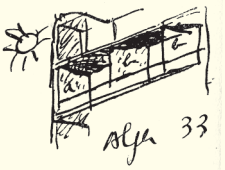

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Le soleil se lève, la lumière se répand, l'homme se réveille, il se met à agir : penser, travailler, etc... L'homme moderne qui bénéficie par ailleurs des fruits irrécusables du progrès tels que le livre, le journal, l'imagerie de toutes sortes, qui a appris à travailler de ses doigts avec habileté, met à contribution incessamment ses yeux au cours de la journée; il a un besoin impératif de lumière solaire. Et celle-ci est une fonction directe non seulement de sa joie de vivre mais du rendement de son activité. On peut alors bien dire : l'architecture consiste à construire des planchers éclairés. Bien-être et utilité sont ainsi comblés.

10 *Le jeu des saisons apportera une gamme nuancée de bienfaits et de méfaits : au solstice d'hiver, le soleil est bas sur l'horizon et ses rayons sont bienvenus à l'intérieur du logis où ils réchauffent moralement et physiquement; les mi-saisons, printemps et automne, se satisfont fort bien d'un soleil doux à la créature. Mais le solstice d'été et la canicule avec ses températures intenables ont fait du soleil l'ami, un ennemi implacable; à ces heures chaudes, le besoin d'ombre devient impératif : il faut obturer les fenêtres, il faut « diaphragmer » le pan de verre.*

11 *Quels sont les moyens disponibles ? Ce sont les rideaux de tissu mince et épais superposés, les volets de diverses natures, intérieurs ou extérieurs, les écrans qui peuvent être des systèmes nouveaux à introduire dans l'économie de la façade et de son pan de verre.*

12 *Nos premières constructions de 1921 à 1928 manifestèrent cette conquête du pan de verre par les étapes de la fenêtre horizontale simple, puis de la fenêtre horizontale double, puis de la suppression définitive de l'allège. Et ce fut alors le pan de verre.*

Mais dans l'immeuble « Clarté » de Genève, baptisé ainsi par les usagers, nous avions amorcé instinctivement des travaux d'approche vers le brise-soleil. Je dessine les planchers, ils se prolongent au delà du pan de verre par un balcon d'une assez forte saillie d' 1 m. 50 muni de son parapet. Une première ombre était provoquée; on y ajouta pour la canicule le complément de volets roulants installés au droit des parapets des balcons, créant ainsi des conditions très satisfaisantes d'admission du soleil en hiver (soleil bas sur l'horizon) et d'obstacle au soleil en été (soleil haut sur l'horizon) (11).

En 1932, l'immeuble de Molitor comportait une façade de verre intégrale; nous savions qu'il y ferait chaud à la canicule, mais baste! les Parisiens prennent leurs vacances à cette époque. Un barrage sérieux aurait été dressé par des volets roulants installés à l'extérieur de la façade. Il n'en fut pas fait ainsi volontairement; les volets roulants furent installés à l'intérieur, maintenant ainsi la façade dans sa précise proportion de fer et de glace, lui assurant sa dignité : nous n'admettions pas que chacun à sa guise, comme c'était le cas pour Clarté à Genève, pût caricaturer, par une obturation purement accidentelle du pan de verre, une façade. Nous nous mettions en tort avec nous-mêmes, nous le savions. Nous l'avons voulu pertinemment ainsi afin qu'au moins, un pan de verre existât, intact, propre, et de bonnes proportions.

CARTHAGE

En 1928, le problème du soleil nous était impérieusement posé dans la construction d'une villa réalisée à Carthage.

13 *L'ossature de la maison était complètement indépendante de la forme des locaux qui se trouvaient en retrait. Ainsi courait tout autour une partie plus ou moins profonde constituant en fait des brise-soleil de diverses efficacités. Les locaux étaient éclairés par de grandes parois vitrées.*

Je viens précisément d'avoir la visite du fils de notre client. Il me disait que la lumière, à l'intérieur des locaux, était admirable, affirmation intéressante à enregistrer à ce point de la démonstration puisqu'elle démontre que la visière constituée par le plancher supérieur de chaque étage et qui pourrait être considérée comme un adversaire sérieux à l'introduction de la lumière, se trouve utilement compensée par le vitrage à 100 0/0 ouvert sur l'horizon.

En effet, le pan de verre fournit un afflux de lumière jusqu'ici inconnu, les solutions traditionnelles limitant à 20, 40 50 0/0 en général les surfaces éclairantes.

BARCELONE

14 *A cette époque, à Barcelone, nous avions à dessiner de grands lotissements affectés à une main-d'œuvre de fortune venue des campagnes : il s'agissait de paysans n'ayant eu aucun contact encore avec la vie citadine Le problème du soleil est impératif et s'étend sur de longs mois. Le logis fut aménagé pour assurer la fraîcheur dans les appartements et, sans que rien fût prémédité, les maisons furent munies de dispositifs qui devaient représenter plus tard des éléments de doctrine: en a, une profonde loggia — en b, des lamelles de béton formant jalousies et pivotant horizontalement — en c, la maison est surélevée sur un vide où l'ombre règne :*

a constituait donc un premier brise-soleil;

b un autre brise-soleil et cela servirait plus tard;

ALGER

15 *La même année, à Alger, le problème se posait à nouveau.*

Un immeuble locatif construit de poteaux de béton portant plancher en cantilever, structure qui nous fournit quatre façades diversement exposées et par conséquent, tenues de recevoir des formes du pan de verre appropriées. Au nord, et peut-être à l'est, nous pouvions conserver purement et simplement un pan de verre intégral, mais au sud et à l'ouest, il fallait installer un brise-soleil.

Celui-ci était fait d'alvéoles constituant des caissons d'environ 80 cms de profondeur sur 70 de hauteur environ, capables de provoquer une ombre efficace. Dispositif s'installant à quelques cms au devant du pan de verre et maintenu par un accrochage aux planchers qui faisaient saillie à chaque étage.

La difficulté résidait à l'ouest puisque le soleil le plus pénible est à l'heure du couchant car il projette des rayons lumineux horizontaux; notre brise-soleil s'avérait inefficace et devait être remplacé par des lames cette fois-ci verticales et disposées perpendiculairement (a) ou obliquement (b) à la façade, le tout étant réglé par l'orientation de la façade. Les écrans ainsi créés constituaient un prolongement architectural significatif, une espèce de balcon ou de loggia.

(continued...)

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