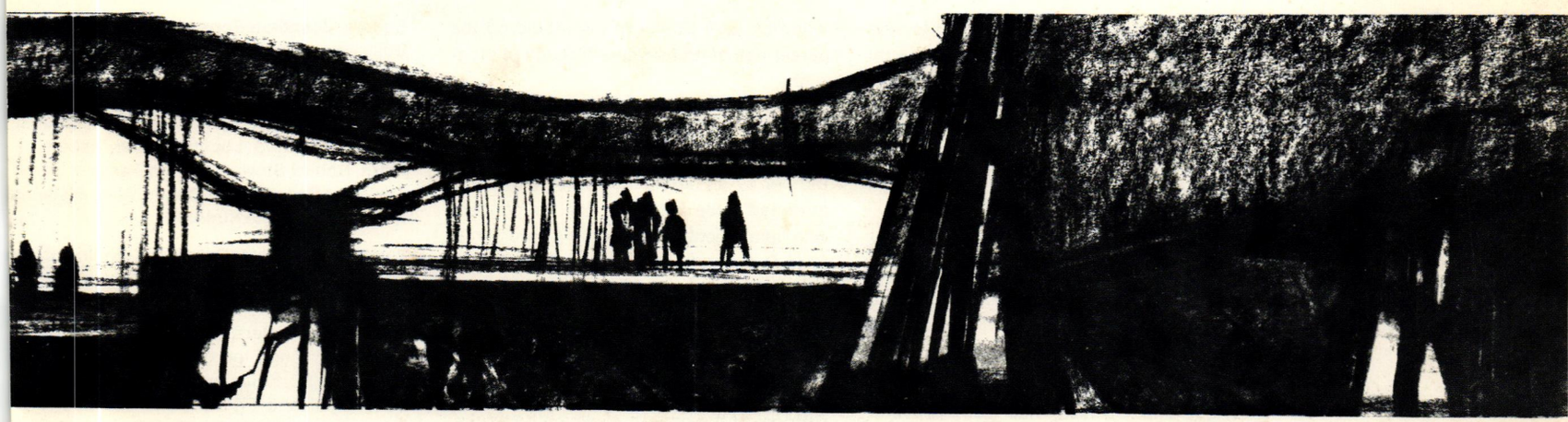
Perspecta 8



This issue of Perspecta is devoted to several questions of continuing architectural concern: the relationship of modern architecture to the other arts, to technology, and to the indigenous building methods of the developing nations; the perception and criticism of architecture; and the problem of urban design.

We begin with a portfolio of recent Finnish architecture, which includes work by Alvar Aalto and the young architect Reima Pietilä, whose church at Tampere appears on our cover.

Edgar Kaufmann, Jr., an authority on Wright and Sullivan, has contributed a study of the relationship of Frank Lloyd Wright's architecture to its contemporary painting and sculpture, a subject that has come to some prominence since the completion of the Guggenheim Museum.

The article *Transparency: Literal and Phenomenal,* by Colin Rowe and Robert Slutzky is an example of a methodology for modern architectural criticism that the authors feel will help to place this notoriously imprecise subject on a more rigorous basis. Mr. Rowe is an English architect and critic presently teaching at Cornell; Mr. Slutzky, a painter, teaches at Pratt Institute.

An additional qualification to the problem of architectural criticism has been provided by Ezra Stoller in his article on the perception of architecture through photography.

The three essays on indigenous architecture treat a subject on which we should eventually hear much more. Edward L. Barnes is an architect whose work has attracted wide attention for its concern with fundamental architectural problems. Jane Drew and her husband Maxwell Fry have designed many buildings for the tropics, and Ralph Erskine, an English architect practicing in Sweden, brings to his buildings the objectivity of the outside observer and commitment of a long-time resident of the country in which he works.

George R. Collins, author of the monograph on Antonio Gaudí in the Masters of World Architecture series, has contributed an important clarification of the relationship between Gaudí's architectural expression and the traditional construction techniques of Catalan masons. Mr. Collins is a Professor of the History of Art at Columbia University.

We conclude with two articles on urban design which were originally part of a symposium at the Museum of Modern Art. Vincent Scully, Jr. is a Professor of the History of Art at Yale and the author of numerous books and articles. Richard Roth is a partner in the firm of Emery Roth and Sons, architects, of New York.

This issue of Perspecta has been made possible through the generous assistance of the Edgar Kaufmann Charitable Trust, the Alumni and Friends of the School of Art and Architecture, The George B H Macomber Construction Company, and Philip Johnson.

Perspecta is a nonprofit periodical published at intervals by the School of Art and Architecture of Yale University, New Haven, Connecticut.

Editorial and business address: 2121 Yale Station, New Haven, Connecticut. Rates: Current issue $3.00, back issues $3.00, three issue subscription $7.50, patron three issue subscription $100.

Cover and title page drawings by Reima Pietilä

Michael Dobbins
The Achievement of Finnish Architecture: Social Responsibility and Architectural Integrity

The architecture of Finland currently reflects an unusually dynamic cultural climate: support for the arts is widespread, and interest in them is almost universal. The people of Finland, presently enjoying one of their longest peaceful eras, have developed a high standard of material advantage and social balance; paralleling this improvement of material standards has been the development of a national culture. The forms and proportions of this culture are strongly influenced by two basic characteristics of the Finnish people: intense individualism and determined utilitarianism. These somewhat contradictory qualities find their artistic unification most comfortably in architecture and the applied arts, in which the opportunities for self-expression are unlimited, while the demands of utility can be satisfied.

Historically, architecture in Finland presents a pattern which has never deviated too far from the course of utility. Unlike Europe, which spent centuries in stylistic refinement of architecture, Finland, because of its remoteness and poverty, considered its building trade in terms of practicality and necessity; its expression was confined to the nature of materials, and its embellishments most often took the form of the corollary applied arts. These characteristics, which satisfied the primitive building needs of Finland until the nineteenth century, are curiously in line with many of the principles of international, twentieth-century architecture. Finland was not completely spared, however, from the inhibiting influences of Europe's sophisticated architectural achievements. As has so often been the case when an emerging nation senses that an established society has a superior art form, Finland, in the early nineteenth century, began to copy the vogue styles of Europe. This activity was spurred by the culture-hungry tsars who, in 1809, had acquired control of the Finnish territory from Sweden. The most notable buildings produced under these influences were those of Carl Ludwig Engel, representative examples of which can be found in the Senate Square of Helsinki. His cathedral, university, and municipal buildings, in spite of their obvious Franco-Russian eclecticism, have the charm so often found in provincial adaptations.

For various reasons, however, the academicism of Europe failed to get a firm grip on Finnish cultural life: the origin and meaning of the forms dictated by academicism were not understood by the Finnish people; the foundations of academicism were already being undermined in Europe; and the rising nationalism of the colonial nation demanded a more self-projecting and innate expression. The architecture produced from 1900 to 1915 effected the break from the weak academic ties and cleared the way for the easy acceptance of functionalist theory. The architects who dominated this transitional period of "national romanticism" were Lars Sonck and Eliel Saarinen, whose contributions to Finnish architecture were many and great. They established an architecture which equaled that of Europe in the value of its aesthetic principles, while remaining independent in its evolution of styles. Responsible in spite of their youth, Sonck and Saarinen set precedents which gave other young architects the opportunity to win important commissions; they demonstrated the value of completeness in their projects with consistent, imaginative, and forceful detailing; and they responded with profound understanding to the conditions imposed by climate, geography, and national spirit. In spite of these common characteristics, Sonck and Saarinen came to very different means of stylistic expression. Sonck's work was characterized by brusque massing emphasized by heavily rusticated wall surfaces, comparable in some respects to the work of Richardson, but adorned with strange, capricious, and highly imaginative details. By contrast, Saarinen's expression depended on a clear definition of forms emphasized by a clean articulation of materials, recalling the works of Behrens. The very difference in their results reflected and reinforced another pattern in Finnish architecture: the freedom for an architect to undertake each new problem from a fresh point of view, unbound by the inhibiting strictures of tradition or fashion.

The era of 'national romanticism' produced a national political consolidation simultaneously with the upspring of cultural life. Years of mounting tsarist oppression, followed by a two-year war against Bolshevist supporters of the Russian Revolution, culminated in 1919 with the establishment of Finland as a free republic. The Finnish war, together with the effects of World War I, brought on a depression which precluded any serious building efforts until the late 1920s. By this time, the precepts of the functionalist revolution were well known in Finland, but the aesthetic vocabulary to express these theories had not yet had a chance to develop. With the resumption of large-scale construction, there was a whole crop of young functionalist architects waiting to apply their ideas; and chief among these was Alvar Aalto.

Aalto's first major projects, the Turun Sanomat building, the Paimio Sanatorium, and the Viipuri Library, are of vital significance in Finnish architecture. All completed in the early 1930s, these buildings mark Aalto's confident transcription of Bauhaus principles into his own vocabulary; as large and important projects, they generated wide Finnish support behind functionalist theory; and they brought Finland into the forefront of modern architectural achievement. More important for the present course of Finnish architecture, however, are the special qualities these buildings embody; for these same qualities continue to distinguish Finnish architecture internationally. Closely bound to the Finnish people and its evolving architecture, the special qualities are appropriateness, thoroughness, and social responsibilitv.

The appropriateness of these buildings is realized at the most conscious level by a

sensitive expression of each building's use and by a sympathetic understanding of social and geographic setting. Less tangible but deeply meaningful is the reflection of the Finnish land and people in each building; apparent placidity gives way to vitality; seeming coldness gives way to receptive warmth; and underpinning each work is a fundamental sense of honesty and determination.

Thoroughness in Finnish architecture, noted already in the works of Sonck and Saarinen, was first incorporated into the vocabulary of modern technology by Aalto. During the course of executing his first three buildings, Aalto developed a positive and imaginative sense of detailing which resulted in an increasingly forceful control of the over-all building. This detailing includes specially designed furniture and fixtures, and extends to the smaller parts. It is clear that such care contributes greatly toward a powerful and complete architectural statement. Many other Finnish architects share Aalto's compulsion to do a thorough job, and certain circumstances make such particularization economically feasible. The savings gained from standardization are less pronounced in this small country; the architects tend to develop their own details for repeated use; and many clients are anxious to attain the superiority of a totally designed building.

The sense of social responsibility with which Aalto undertook these buildings extends beyond the efficiencies and economies of functionalism to include an understanding of the people who would use the buildings and an awareness of their needs. Aalto did not consider functionalism a style, and he has never accepted the aesthetics of technology: the Paimio Sanatorium is by no means a "machine for being sick in." At the same time he did not choose his projects as vehicles for artistic expression. Yet in the sanatorium Aalto, unself-consciously, has taken advantage of the human and material requirement to evolve a useful building of high aesthetic merit. The willingness to accept his social responsibility and do the buildings which need doing places Aalto in an unusual position in the international architecture of the present. In Finland, however, many of his colleagues share a similar attitude, and this has engendered public confidence in architects, which in reciprocity guarantees the availability, desirability, and appreciation of good architecture.

The special Finnish qualities that Aalto first brought together in his early buildings have continued to distinguish the best in this country's architecture over the past thirty years. Yet there is no uniform style to be implicitly drawn from the existence of these qualities; rather, the implementation of personal expression is the architect's prerogative, a privilege which the Finnish architects have freely and variously exercized.

The current pattern of Finnish architecture shows that Aalto's style does not dominate the scene, that there are several other architects producing noteworthy architecture, each in a personal style. Aalto himself, confident in his knowledge and understanding of architecture, predictably has become more and more intuitive in his work. His drive against the misuse of technology has become more vehement as his travels have given him the sense of an emasculation of creative spirit by the materialistic orientation of world society. His own architecture seeks to strike a balance which exploits the genius of man's inventiveness while preserving the integrity of man's spirit. His proud nationalism leads him to consider Finland as an example to the world that such a balance can be attained.

The relationship of younger Finnish architects to Aalto is unusual in the light of his great international status. Elsewhere, the reaction to the giants of architecture is to be found mostly in terms of style; architects are influenced by how a great building looks rather than why it came to look as it does, and architecture degenerates into a search for style. A fashionable architect is assessed on the grounds of his stylistic response to a great architect; he cannot copy, but his work must be directed toward creating an architectural object which is superficially comparable to a great building. In Finland, while a certain amount of style seeking is inevitable, many architects respond to Aalto on more fundamental grounds; they involve themselves with the same special qualities that he has, and evolve their own individualistic styles. Certainly, part of the reason for this independence of stylistic influence is attributable to the intense individualism which is a national characteristic.

A strong countercurrent to some of Aalto's thinking is led by Aulis Blomstedt, a professor and head of the architectural design program at Helsinki's Technical Institute. As a highly abstract and theoretical architect, Blomstedt in his creative output (of which buildings number but a small part) reflects his constant search for basic and universal principles of architectural design. While his actual buildings have the special Finnish qualities, his stylistic results are classicizing and static, in sharp contrast to Aalto. As important as his practice are his theoretical investigations, which include never-ending proportion studies and the evolution of his own modular system. Significant too is his understanding of international developments in architecture, the communication of which contributes toward the removal of Finland's self-admitted status as the 'fourth corner of the world.' In sharing with his admiring students the knowledge obtained from his various architectural pursuits, Blomstedt is establishing his most important legacy to Finnish architecture, a legacy more of learning than intuition.

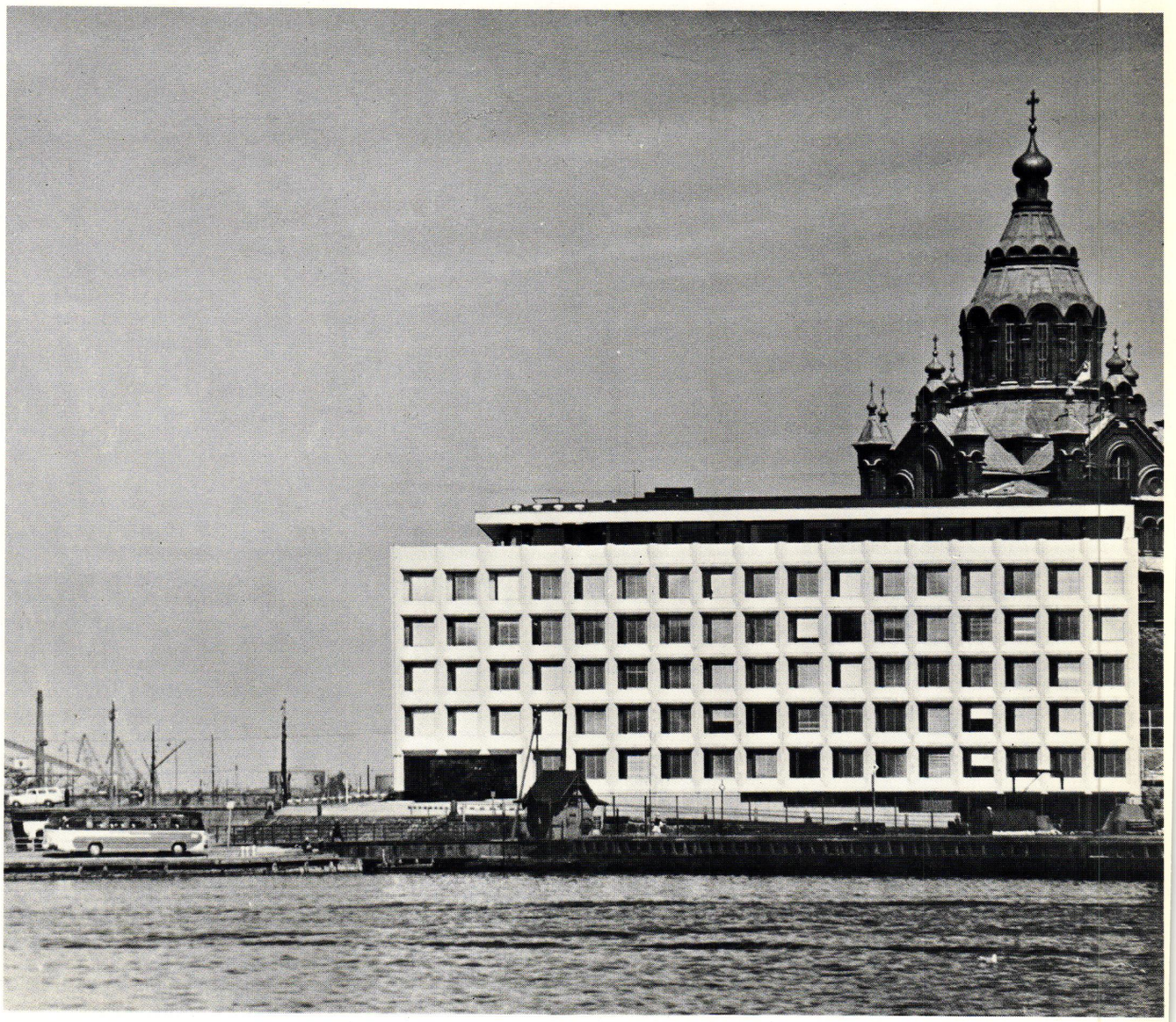
Closely associated with Blomstedt at the Technical Institute is Aarno Ruusuvuori who, although a young man, has already achieved a professorship. In his active architectural practice Ruusuvuori has involved himself in a variety of projects, ranging from a factory to a photographer's studio, from renovations to churches. His first major commission, a church for Hyvinkää, is notable for its exuberant spatial conception; the actualization of his ideas, however, leaves many of the intricate spatial relationships unresolved. His more recent work exhibits an increasing control and restraint, with ensuing clarity; in these buildings he bows more toward the specific conditions dictated by the program, and his style shows regard for the theories of his colleague at the Technical Institute, Blomstedt.

Very different from Ruusuvuori is his contemporary, Reima Pietilä, architect for the Finnish Pavilion at the Brussels World Fair. Pietilä's development has been consistent and balanced, involving an increasingly mature harmony between intuition and system. In regard to the latter, the systems or principles in architecture, he has eagerly sought for a rapprochement between design and mathematical theory, feeling that design has not reflected the intellectual progress of its scientific counterpart. Pietilä too has devoted much time to abstract and theoretical research; his work in this field has been balanced between three- and two-dimensional studies, the former taking the form of disciplined and imaginative wood sculptures and the latter represented by quantities of exploratory sketches and drawings. Another field of deep interest is city planning; Pietilä worked in the Finnish state and the Helsinki architectural planning offices after his graduation from the Technical Institute in 1953, and since then he has won two sizable competitions in this field: one for the new airport city of Arlunda outside of Stockholm and the other for a large housing complex in Tapiola outside of Helsinki. Pietilä's boldness in shaping his architectural conceptions, together with the careful and very personal execution of his work, have gained him the respect and even reverence of his colleagues; his increasing success in Finland bodes well for the continuing international importance of Finnish architecture.

There are other noteworthy architects in Finland. Kaija and Heikki Sirén, a husband-wife team, have produced a variety of fine buildings, one example of which is included in the following pages. Toivo Korhonen has an unmistakable style marked by great thoroughness and consistency of detailing. An architect more internationally oriented in his practice is Viljo Revell whose finest work in Finland is perhaps represented by the Industry Center in Helsinki.

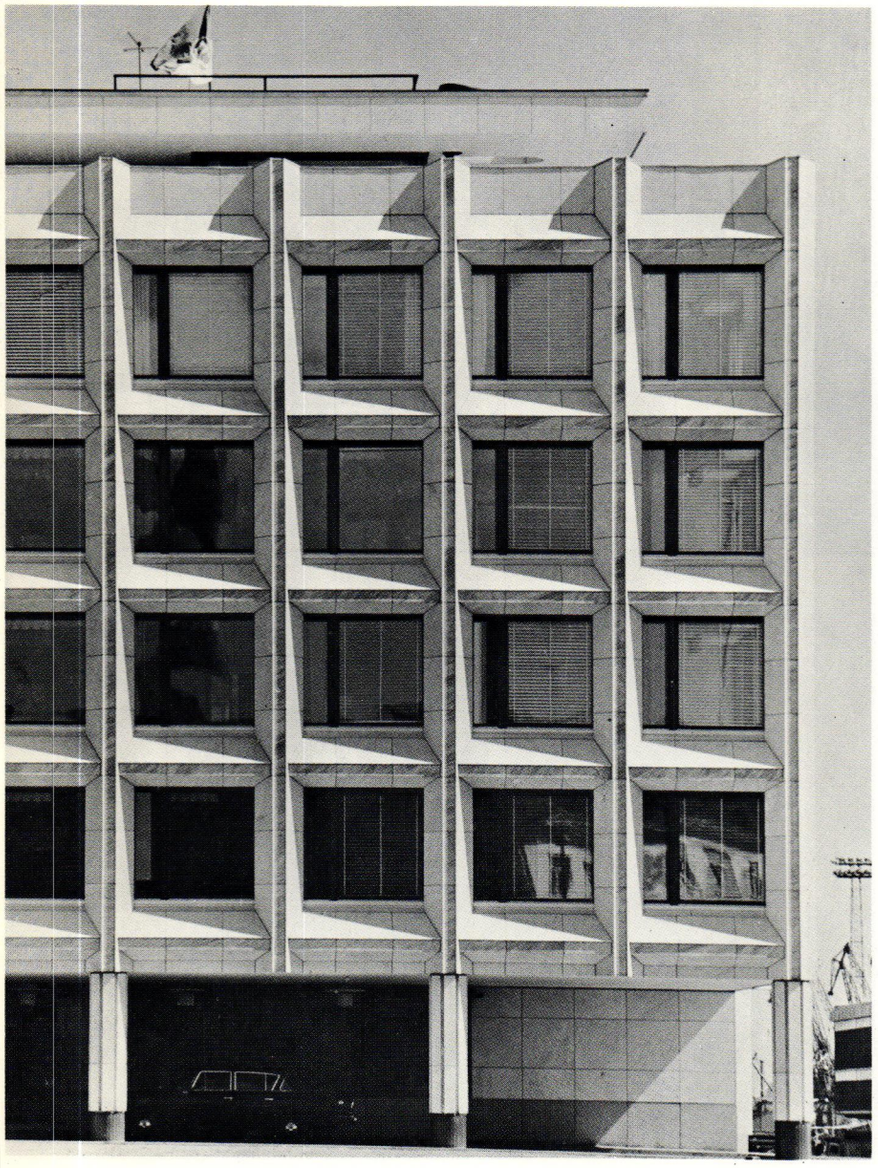
The wide diversity and lively communication among the architects, together with the sympathetic cooperation of allied art fields, ensures Finland a vigorous and flexible future development in architecture. The healthy state of Finland's foremost art, remarkable for its consistently high quality and great variety, is this small country's large contribution to world culture; it is an architecture which pleases, instructs, and inspires.

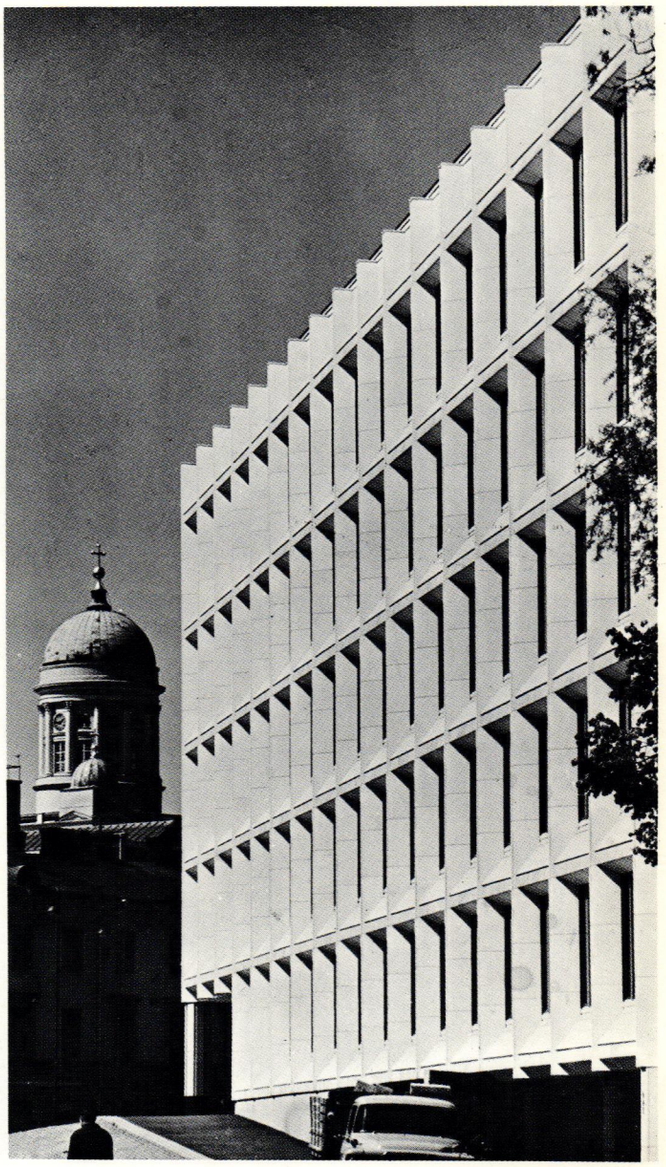
Alvar Aalto:
The Enso-Gutzeit Building
New Center for Helsinki
The Culture Center of Wolfsburg

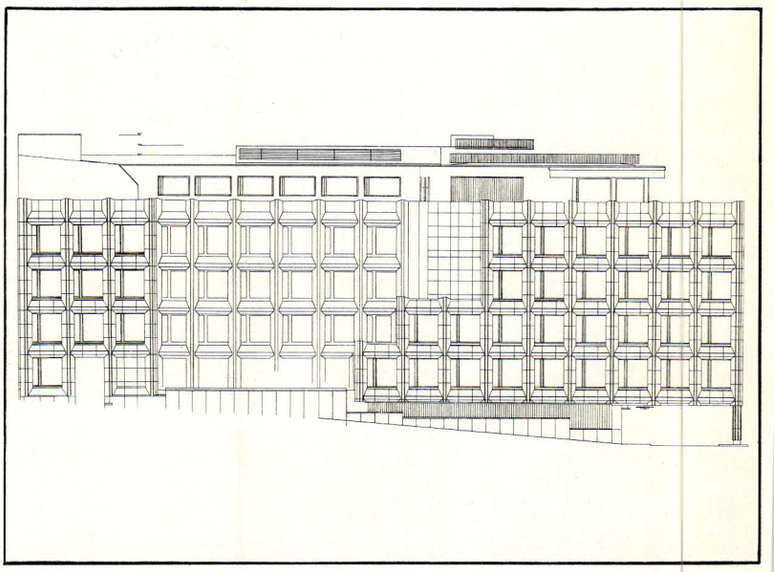


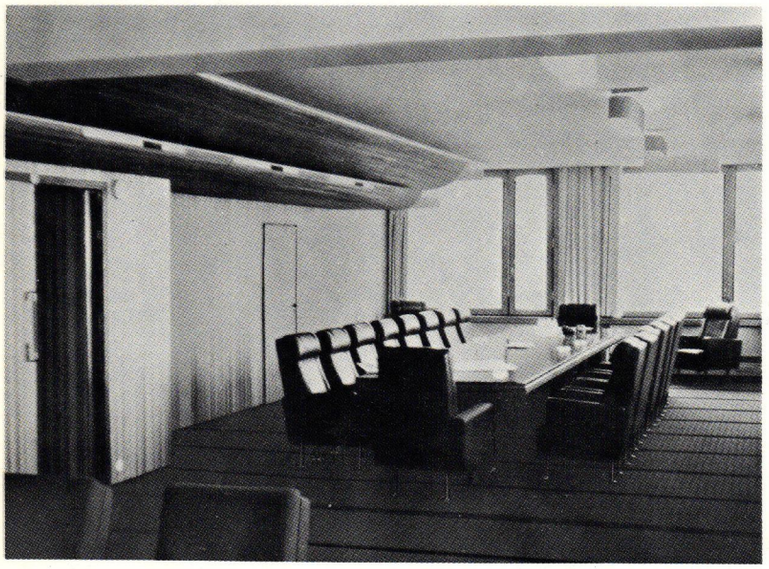
The Enso-Gutzeit Building
This building houses the administrative offices of a forest industries company, one of the largest corporations in Finland. The design approach was stringently qualified by two conflicting circumstances: whereas the prestige of the company demanded an exceptional building, the prominent site was already surrounded with monuments, in the form of government buildings and a Russian Orthodox church. Aalto has organized the building in such a way that regular but elegant façades are juxtaposed against the sculptural surroundings, while the more active elevation, occurring where the basic rectangular plan is cut through to form a light court, is seen against a neutral background. Rather than challenging the existing buildings with the pretentiousness of exhibitionism, this building seeks to achieve harmonious monumentality through a dignity of proportions and a rich and thorough use of materials. On the exterior these materials are predominantly white marble and copper, while the interior is adorned with elegant wood and ceramic combinations (the furniture and fixtures are all of Aalto's design). The floors are all given over to offices except for the penthouse floor, which contains dining and relaxation facilities for personnel and executives.

Left: View from harbor
Center: Detail of entrance elevation
Right: View toward Cathedral

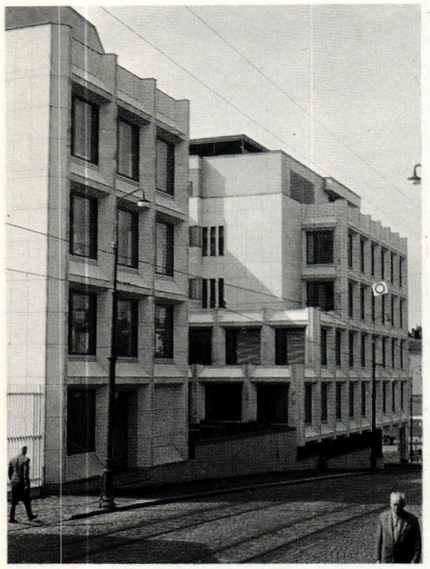


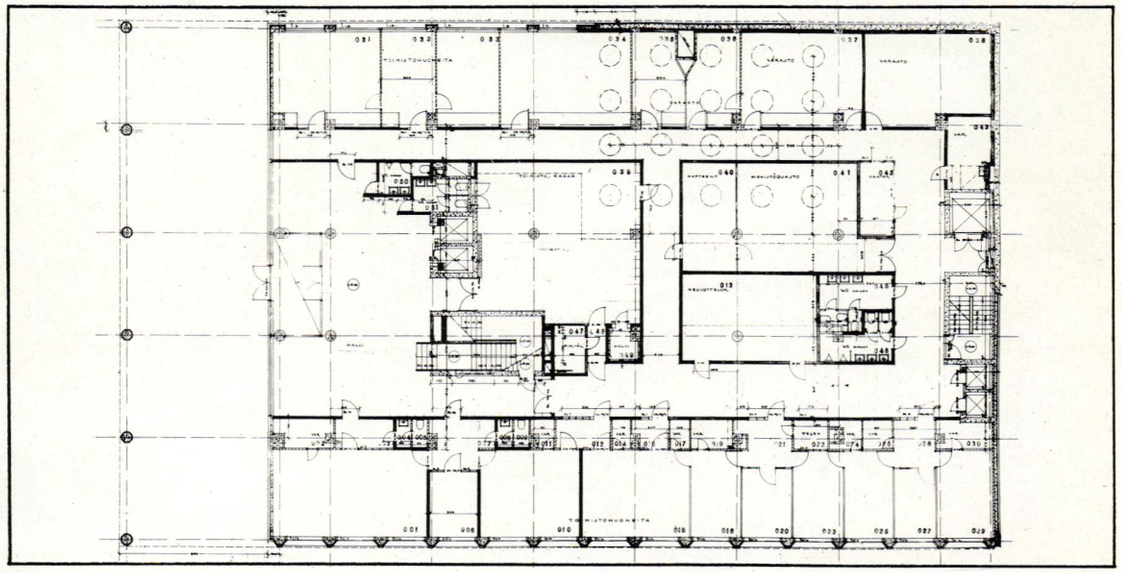


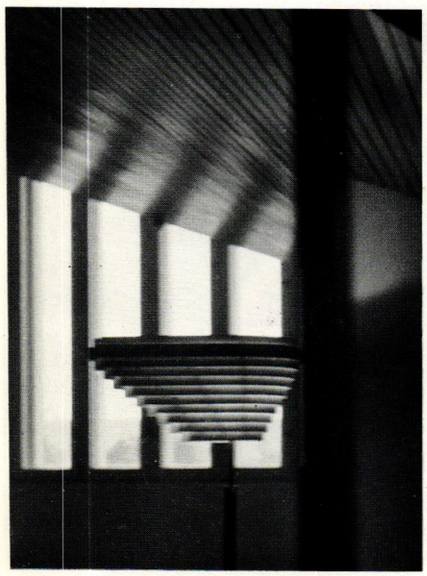


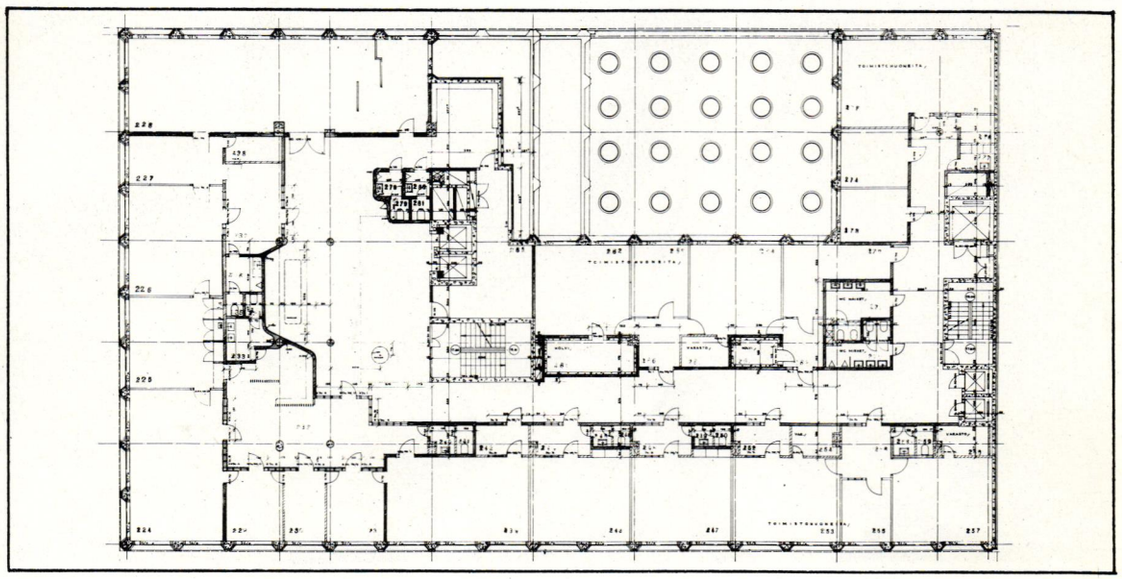


Left page
Above left: Approach from central Helsinki
Below left: Board room
Above right: Light court elevation
Below right: Personnel restaurant
Right page
Above left: View of light court elevation
Below left: Aalto lamp design
Above right: Plan of entrance floor
Below right: Plan of typical office floor



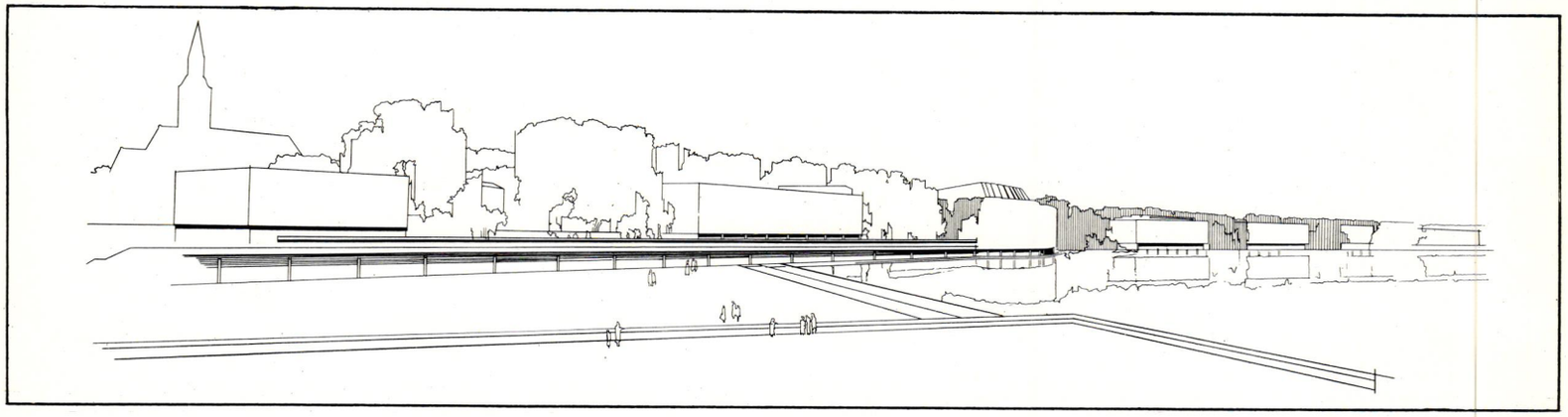


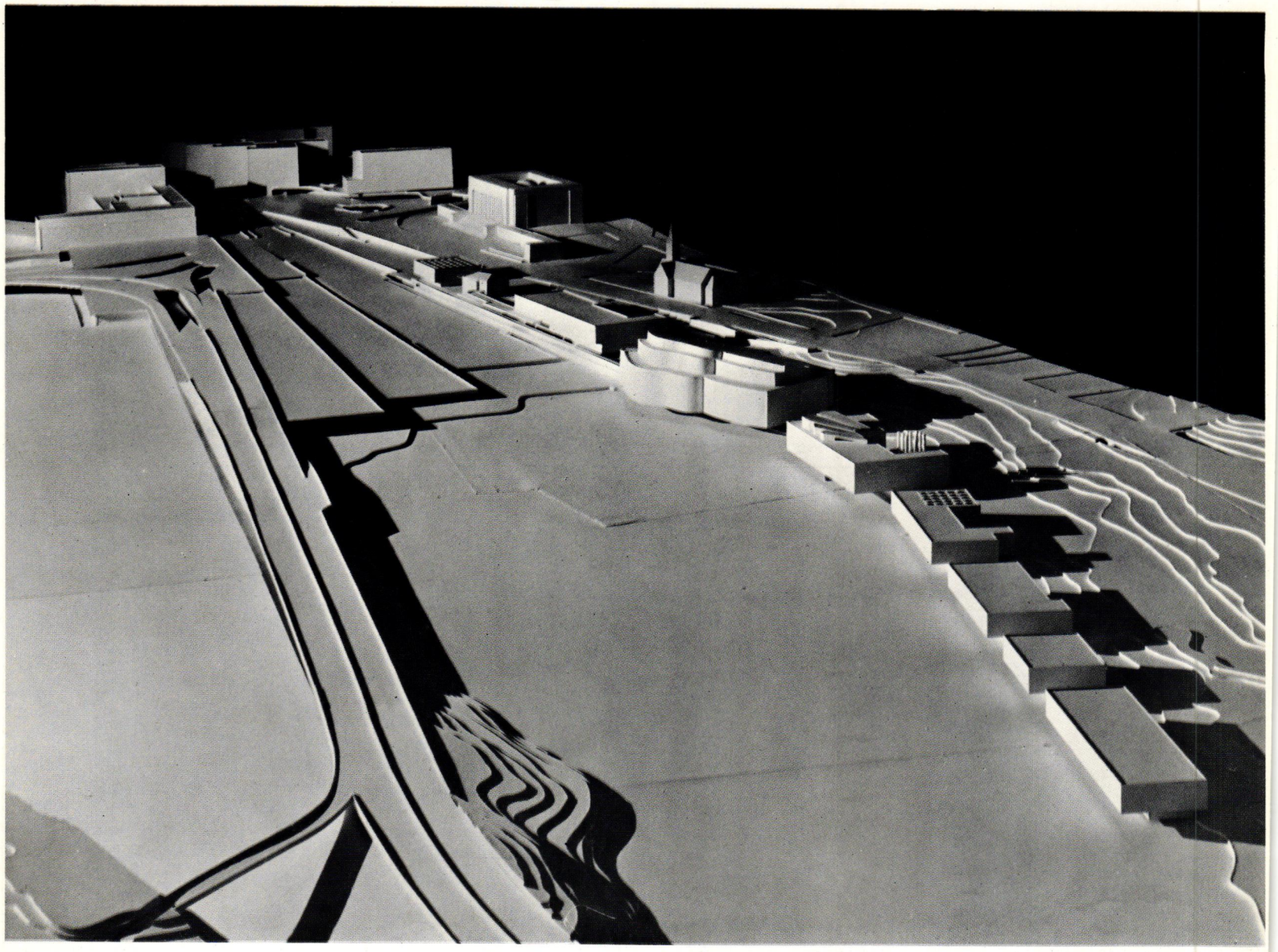




New Center for Helsinki

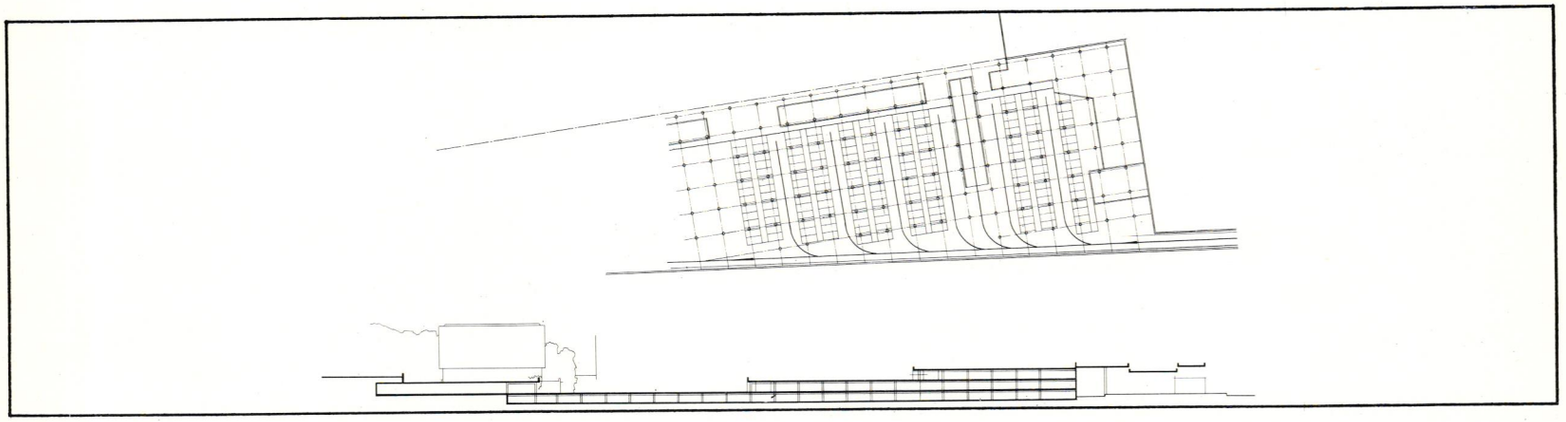
This extensive project seeks to achieve two basic goals of great importance for Helsinki: that of giving the city a public and cultural center fitting for the capital of a nation; and that of clearing up the problems of vehicular access to and through the commercial and business center. The key to the solution of both problems lies in the unusual topography of the city proper. At the present time Helsinki, which covers a peninsula, is divided by an inlet that punctures the geographical center of the city. At one end of the area delineated by this inlet is the House of Parliament, while cutting through the area is the rail access to the city, which terminates in Eliel Saarinen's station as well as in a

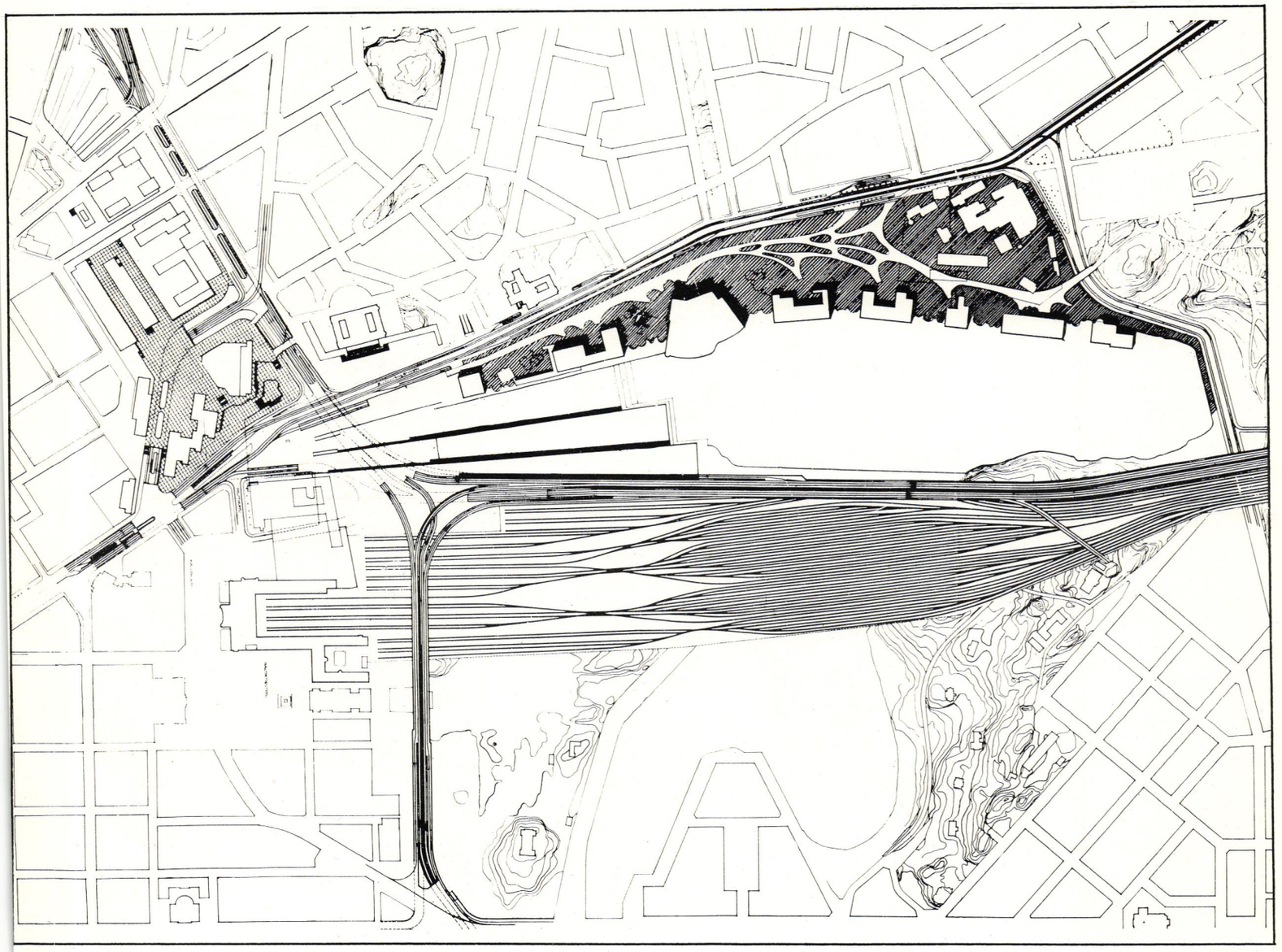




tangle of freight yards. Aalto's scheme proposes to make the shores of the inlet the site for a series of national cultural buildings dominated by the Parliament to the south and terminated by the Olympic Stadium to the north. By so doing, he gives the city an interior focus which will tend to draw the divided parts together. At the same time, Aalto's proposal concentrates the vehicular access to the commercial center by expanding the rail right-of-way to include an eight-lane highway. This highway then either terminates in a terraced, covered parking area (converted from the freight yards) or continues by interchanges to give access to the suburban areas east and west of the city. The unity, cultural focus, and easy access which this plan could bring about recommend it strongly, and it is to the credit of the government that parts of the plan are in the course of realization.

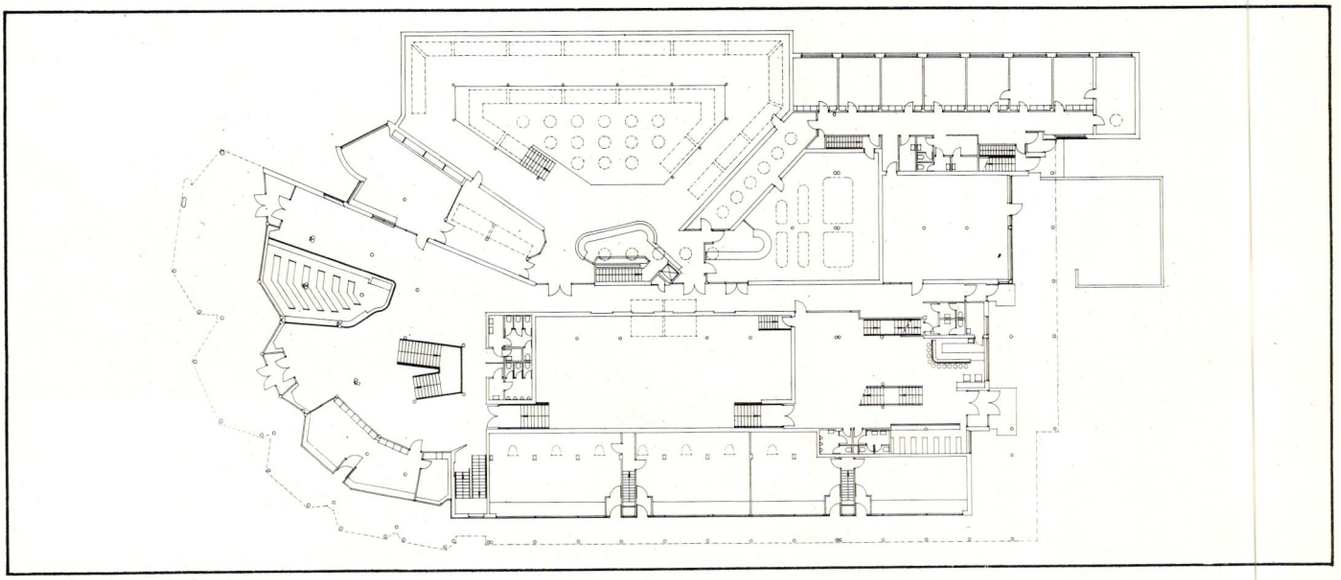
Above left: Drawing by Aalto of cultural center
Below left: Model photograph of inlet area
Above right: Plan detail and section of covered terrace parking
Below right: Plan of inlet area

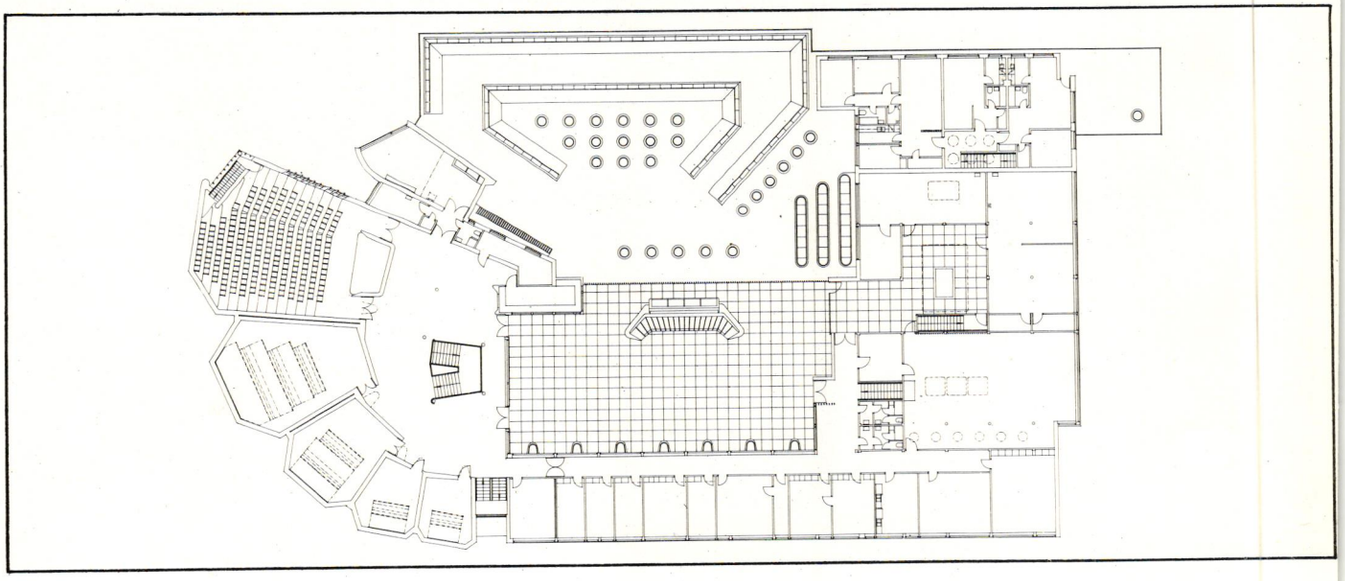




The Culture Center of Wolfsburg

The site of the Culture Center is bordered by Wolfsburg's main street, the Town Hall Square, and a large park where future cultural buildings are planned. The program for the building combines three major functions: a school for working people, the city library, and various hobby club facilities. Aalto has organized these divergent functions around central spaces: on the first floor this space is a reception hall, and on the second it is an interior court. The school is located adjacent to the square, where the various sized lecture rooms fan out to form a sculptural termination of the exterior space. The entrances from this square lead both to the school and to the library, which is located along the park side of the building. The library includes an adult section with 35,000 volumes, a teenager's section with 8,000 volumes, and a children's section with 6,000 volumes. Entrances from the other end of the building provide separate access to the children's section and also constitute the main entrance to the hobby club facilities. These facilities, located at the second-story level, include clubrooms, music rooms, game rooms, and metal, wood, and ceramic workshops. Along the street at the first-story level are shops and offices. The concrete structure is clad in black, white, and gray marble, and inside

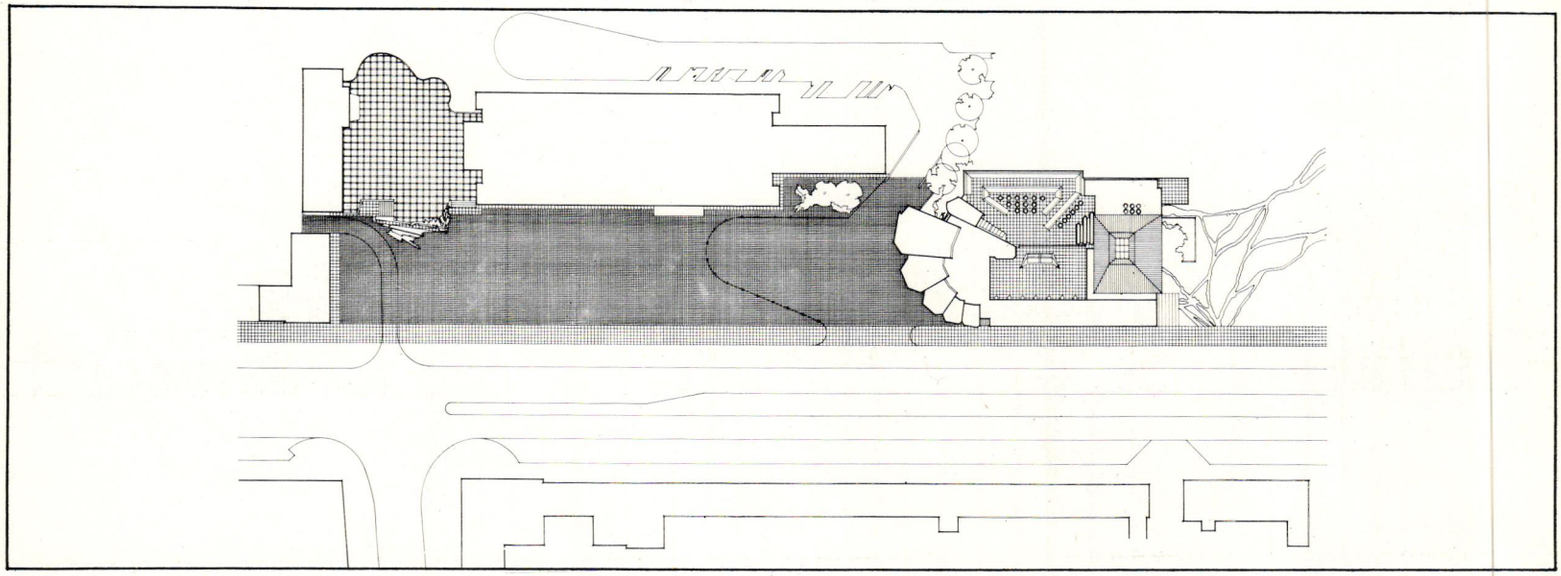


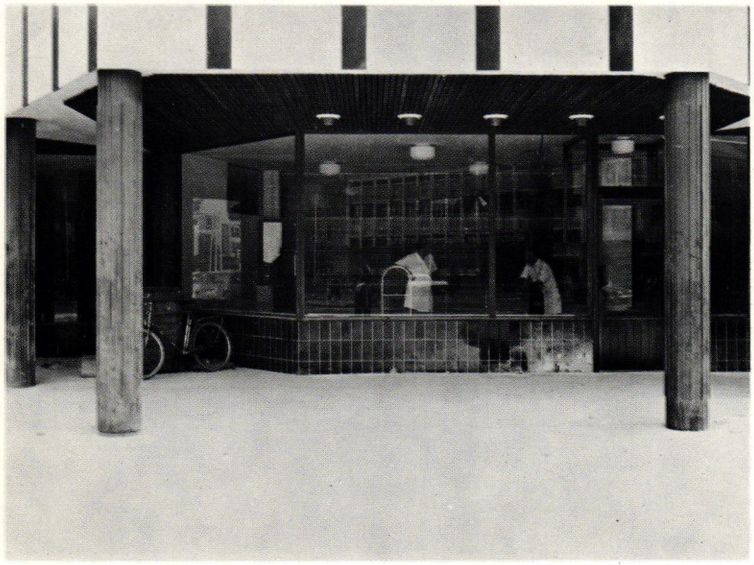


there is a rich use of typical Aalto details, including ceramic wall tiles, copper clad columns, various wooden furniture and trim, and lighting fixtures. The commission for the project was won in a competition, and the building was completed in 1962.

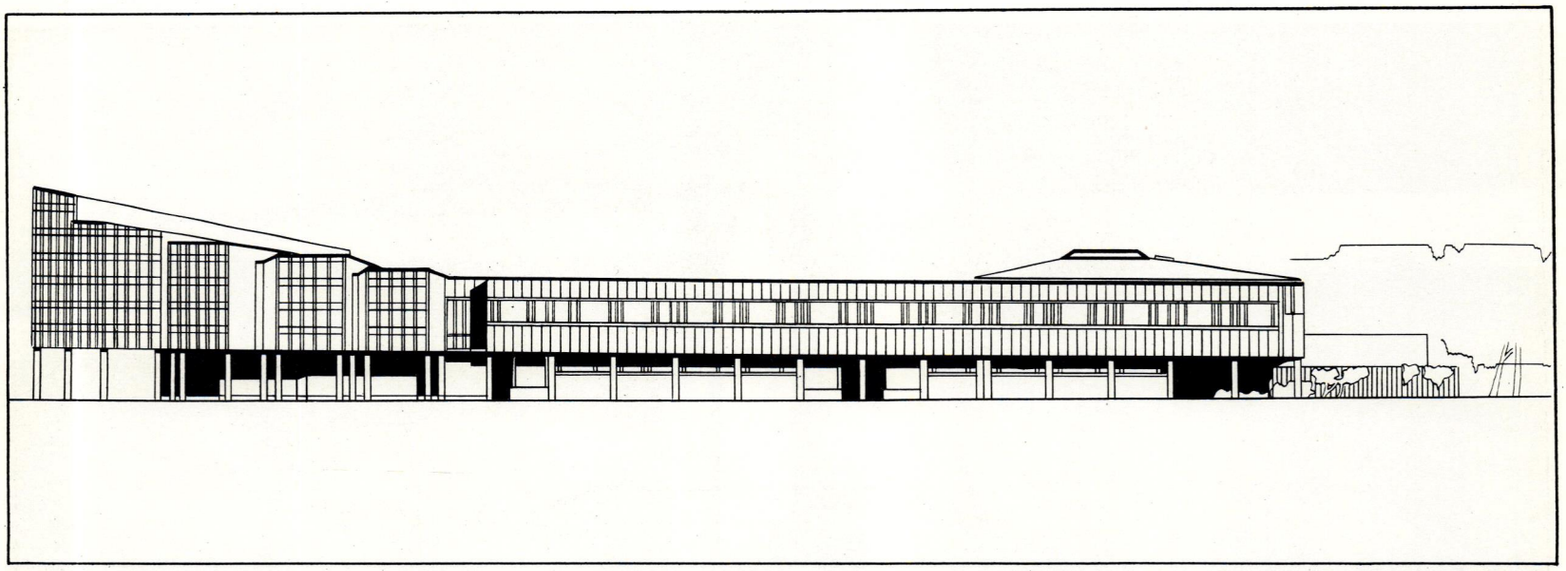
Above left: Plan of first story
Below left: Plan of second story
Right: View from main street

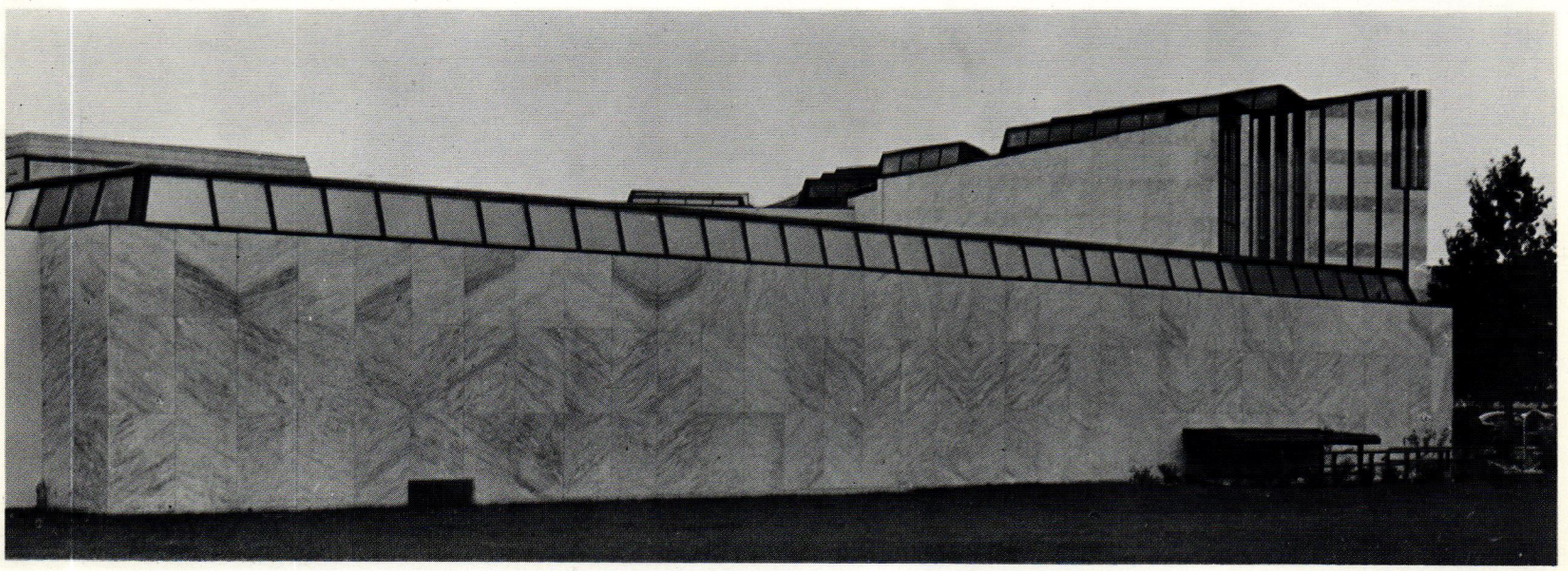
Above: Plot plan
Below left: Street level office
Below right: Library





Above: Elevation from main street
Below: View from park

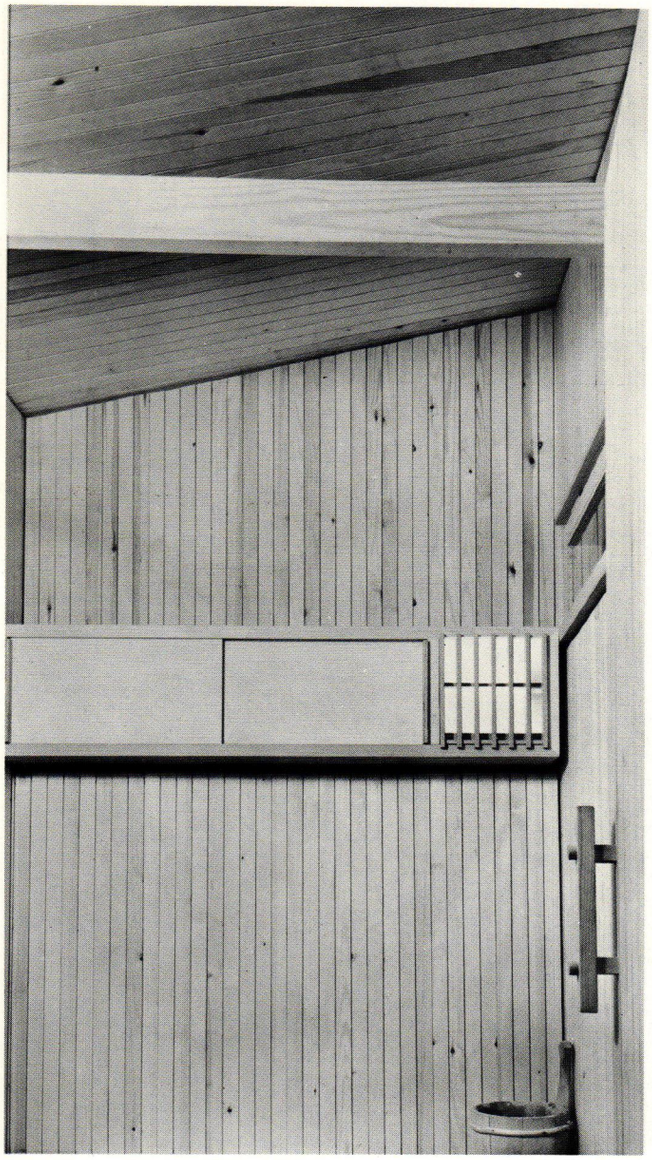


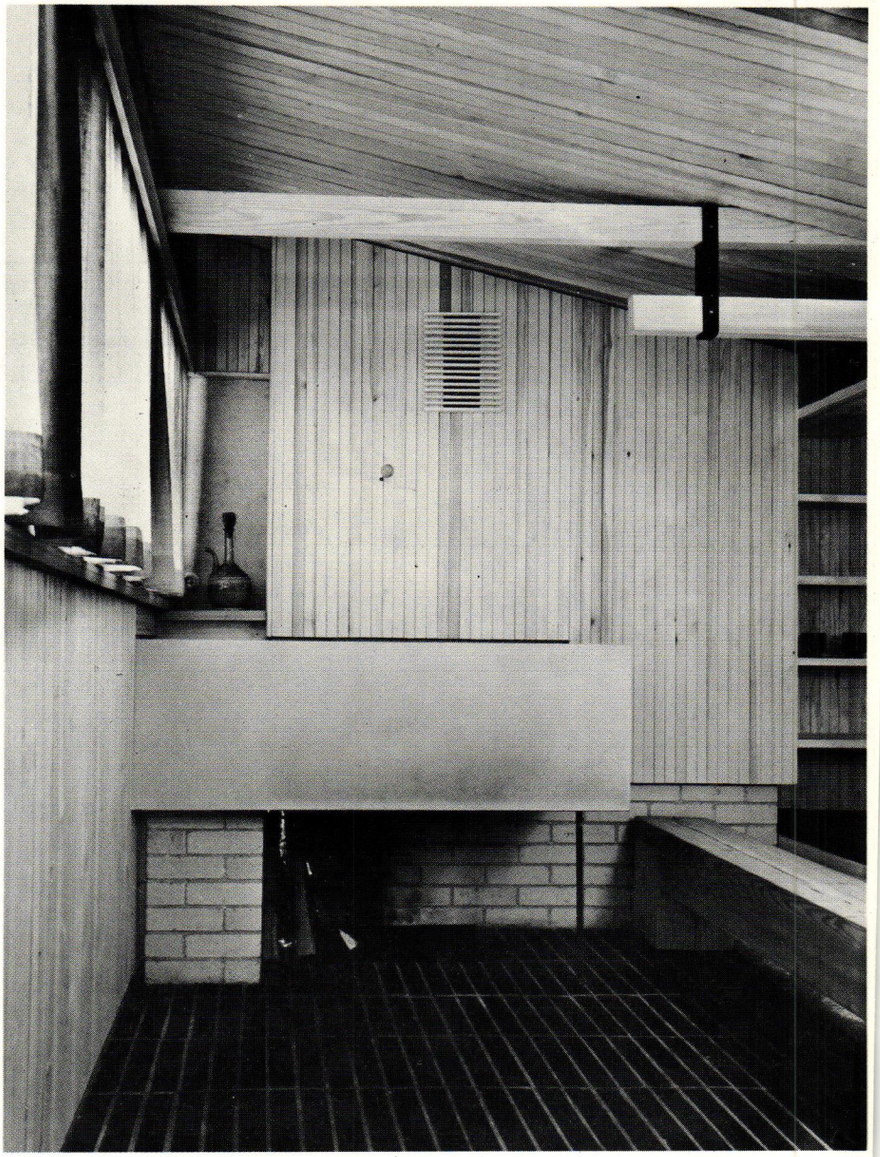


Aulis Blomstedt:
A Sauna

A Sauna

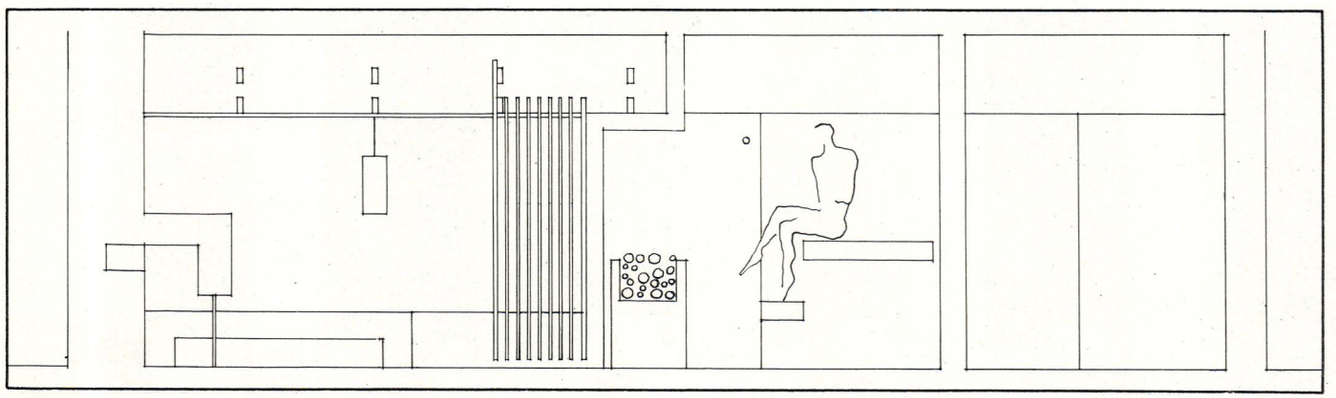
The sauna is a revered institution in Finland; because of its historical importance to the Finnish way of life, the use of it has become a sort of ritual, comparable to the Japanese tea ceremony. A typical sauna complex includes a lounge-dressing room, a shower or wash room, and a heat chamber. The sequence of the ritual begins with undressing and going into the heat chamber; this room is heated by a wood stove or electrical heating element up to temperatures of 220° F. at a low humidity. The sauna-taker sits or lies on benches in this room, and as a result of the opening of all his pores (often further stimulated by slapping the body with a birch twig whisk), he becomes thoroughly cleansed. For a sudden rise in humidity and thus the sensation of heat, water is splashed over hot stones on the top of the heating element. After a few minutes in the heating chamber, the

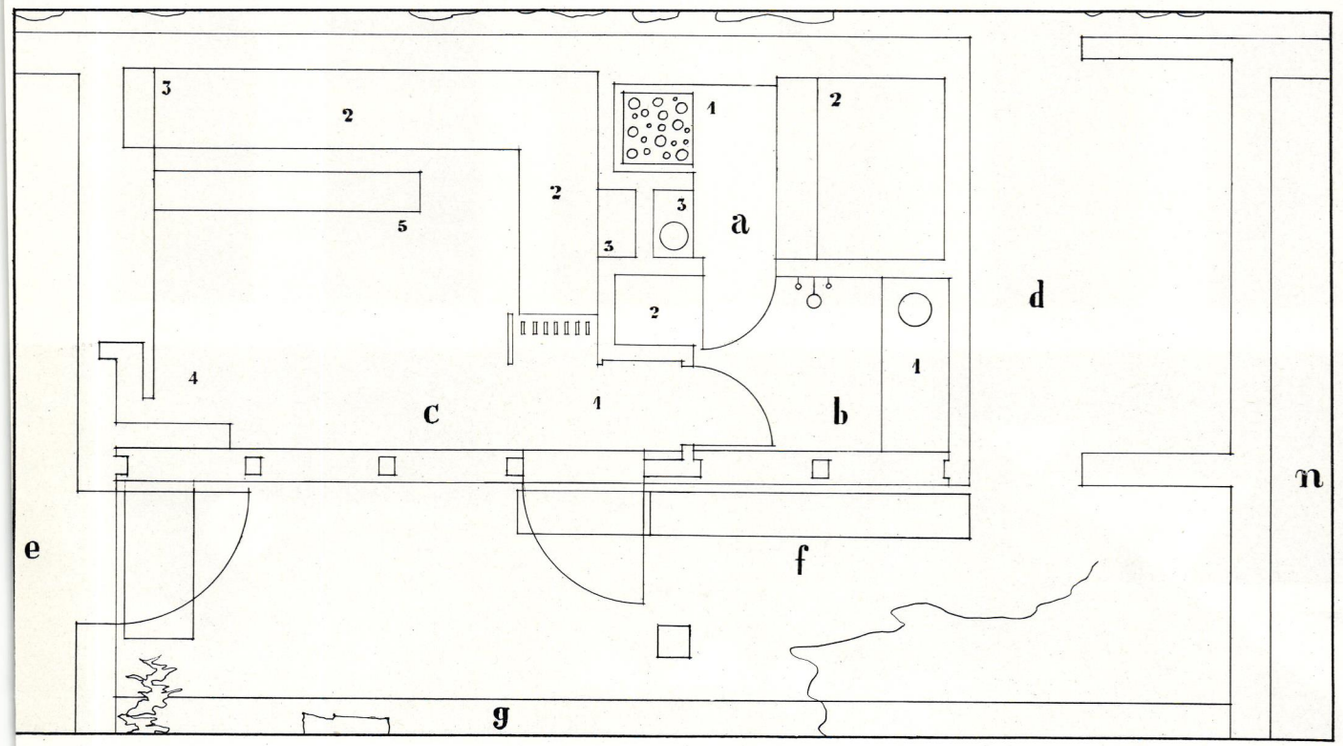




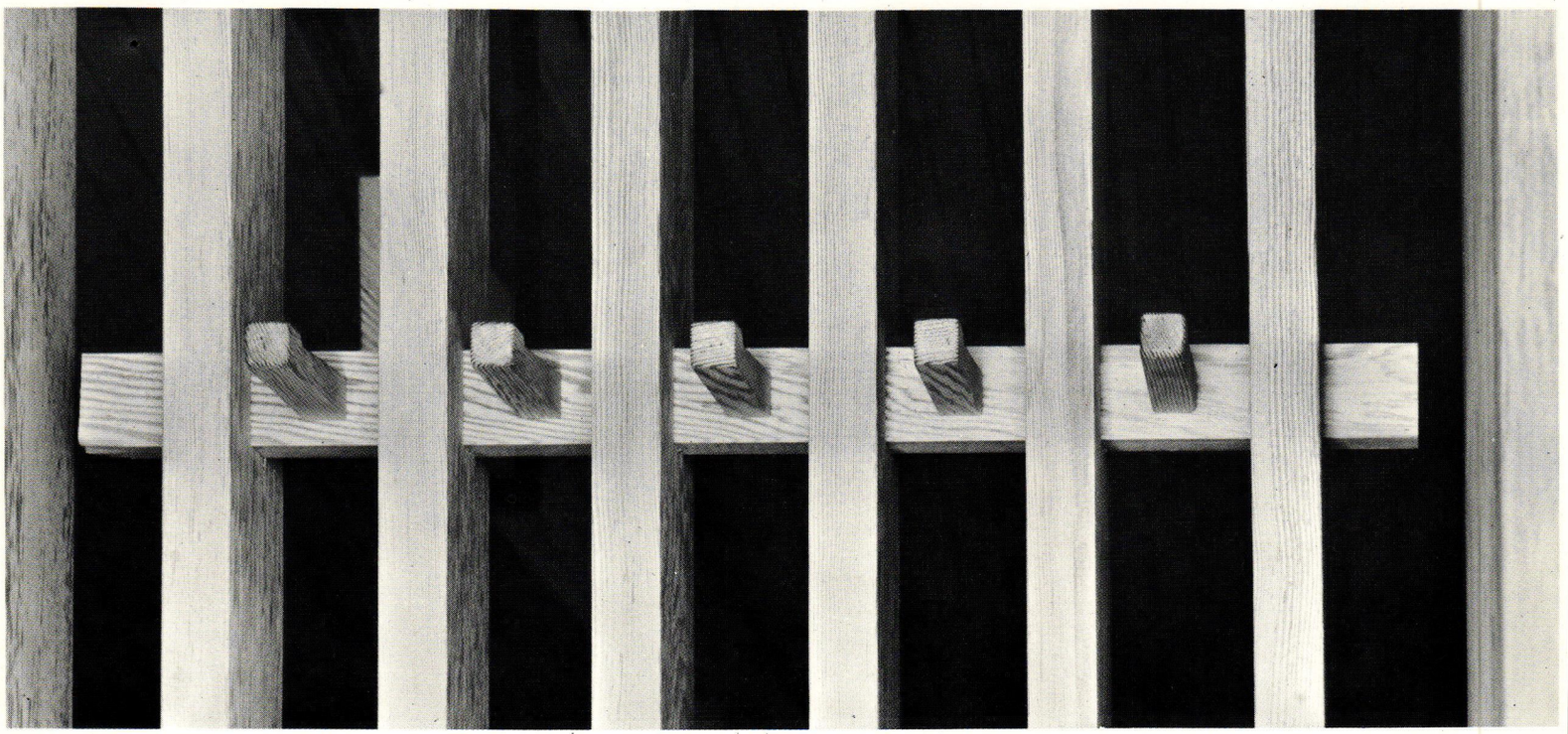
person goes through an abrupt cooling process, either by swimming in a lake, rolling in snow, or simply taking a cold shower. At this point he can either repeat the hot-cold cycle or wash himself with soap and water. After drying, the sauna-taker generally sits in the lounge, still undressed, to cool off, and drinks some kind of beverage. The over-all effect of the sauna, in addition to a tingling skin and a certainty of cleanliness, is great relaxation.

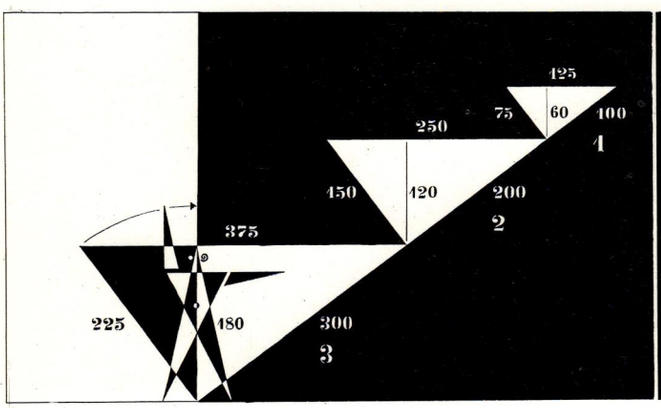
This particular sauna was built into one of the low connecting links in the pictured row house complex, also designed by Blomstedt. He has managed to include all the fundamental rooms of a typical sauna into a floor area of about 170 square feet.
Left: Shower room
Center: Lounge-dressing room
Above right: Section
Below right: Plan; a—heat chamber b—shower room c—lounge-dressing room d—storage e—residence f—covered terrace g—garden n—neighboring residence

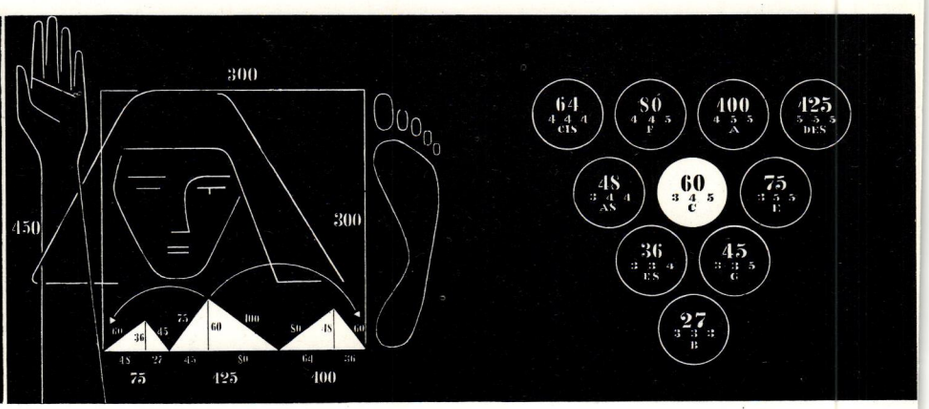




Above left: Detail of clothes rack
Below left: Proportion study
Right: View of row houses in Tapiola, designed by Blomstedt; in the low connecting section to the right is located the sauna







Kaija and Heikki Sirén: Terrace Houses in Tapiola

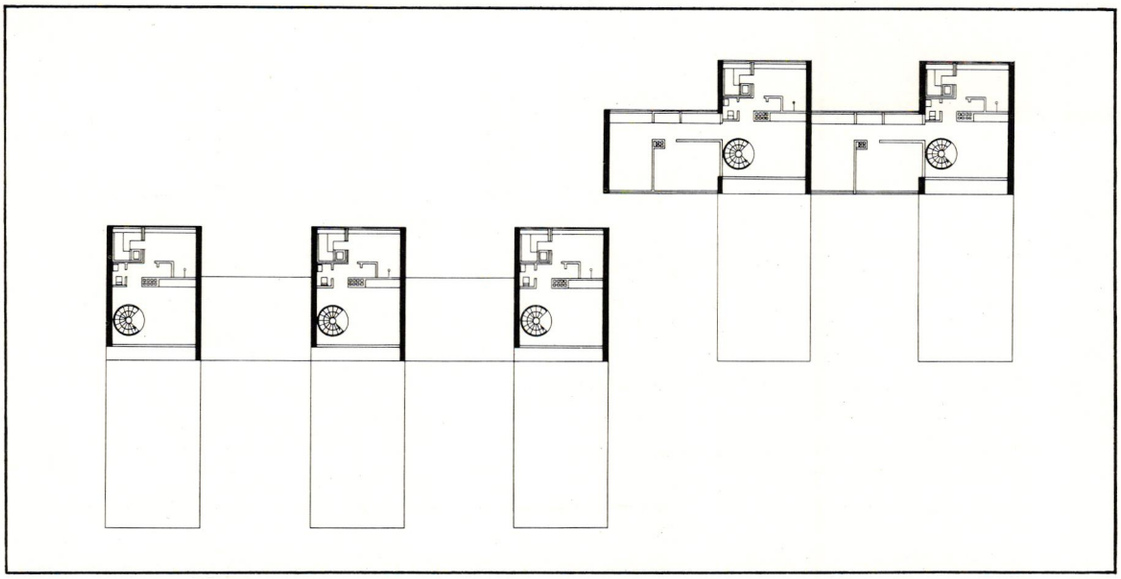
Terrace Houses in Tapiola

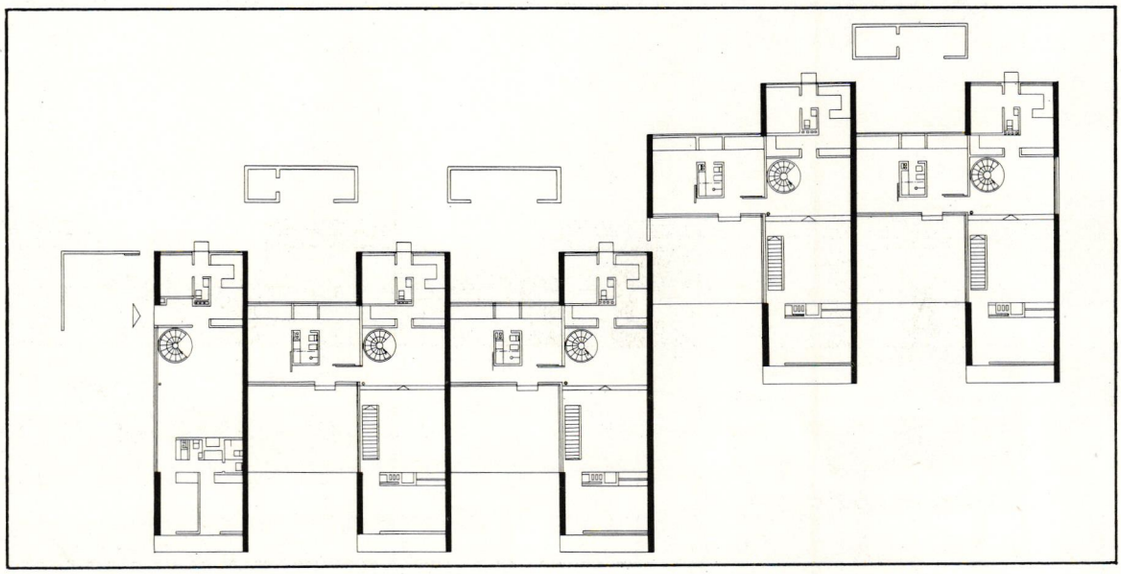
Each house is organized on three levels, with the garage and guest room on the ground floor, the living area on the main floor, and the sauna, its lounge, and a terrace on the top floor. The main floor, comprising living room, dining room, study, bedrooms, and kitchen, is organized as an open, cohesive space; the bedroom section looks over a garden and opens onto the terrace. The various arrangements give a floor space of 1,400, 1,850, or 2,300 square feet. The construction consists of bearing walls spanned by concrete slabs;

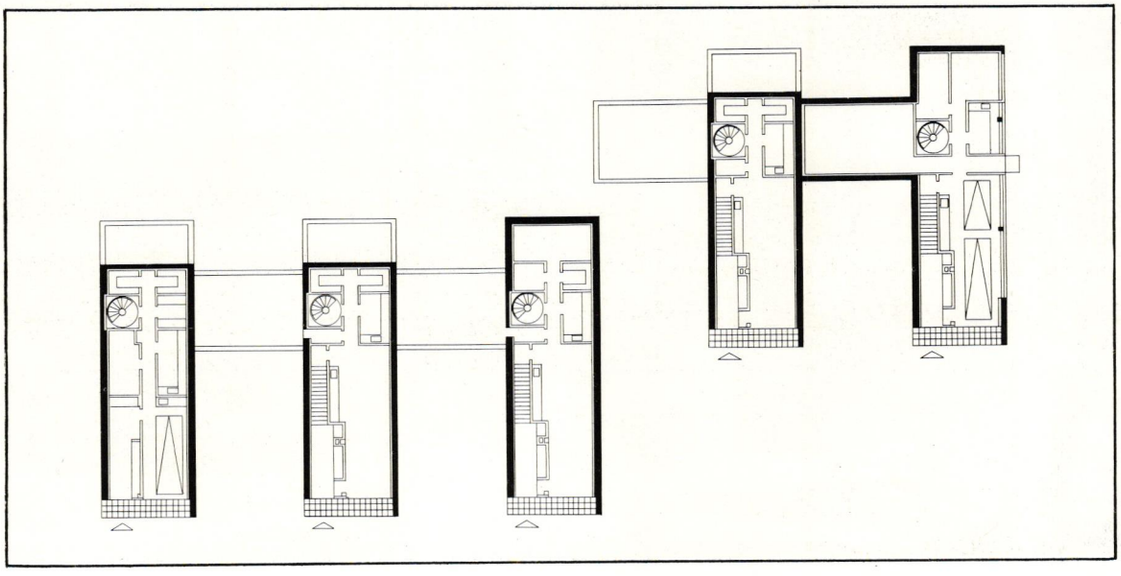
cast into the slabs are the radiant heating pipes and the electrical outlets. The interior materials include white brick or plaster for the walls, white ceramic tile for the floors, and wood for the built-in furniture.

Left: View of rear entrance elevation
Right: View of principal elevation

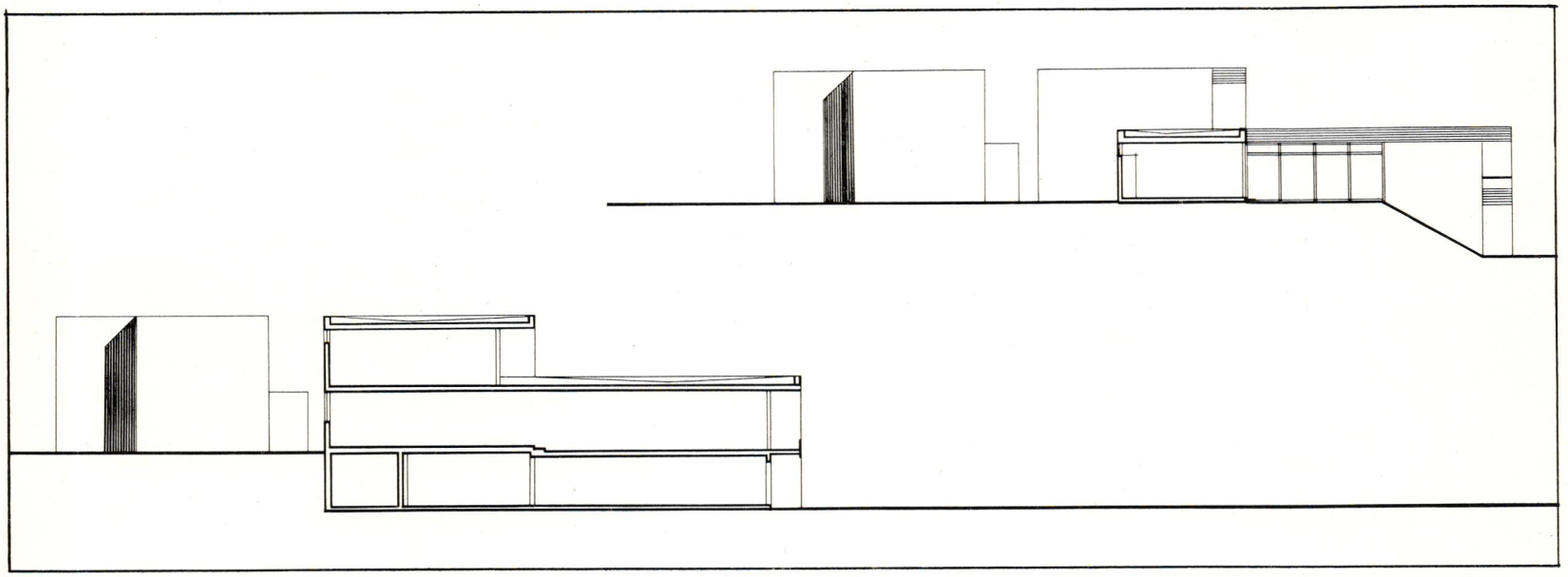
Above: Plan of top floor with sauna facilities
Middle: Plan of main living floor
Below: Plan of bottom floor with garage, entrance, and guest room

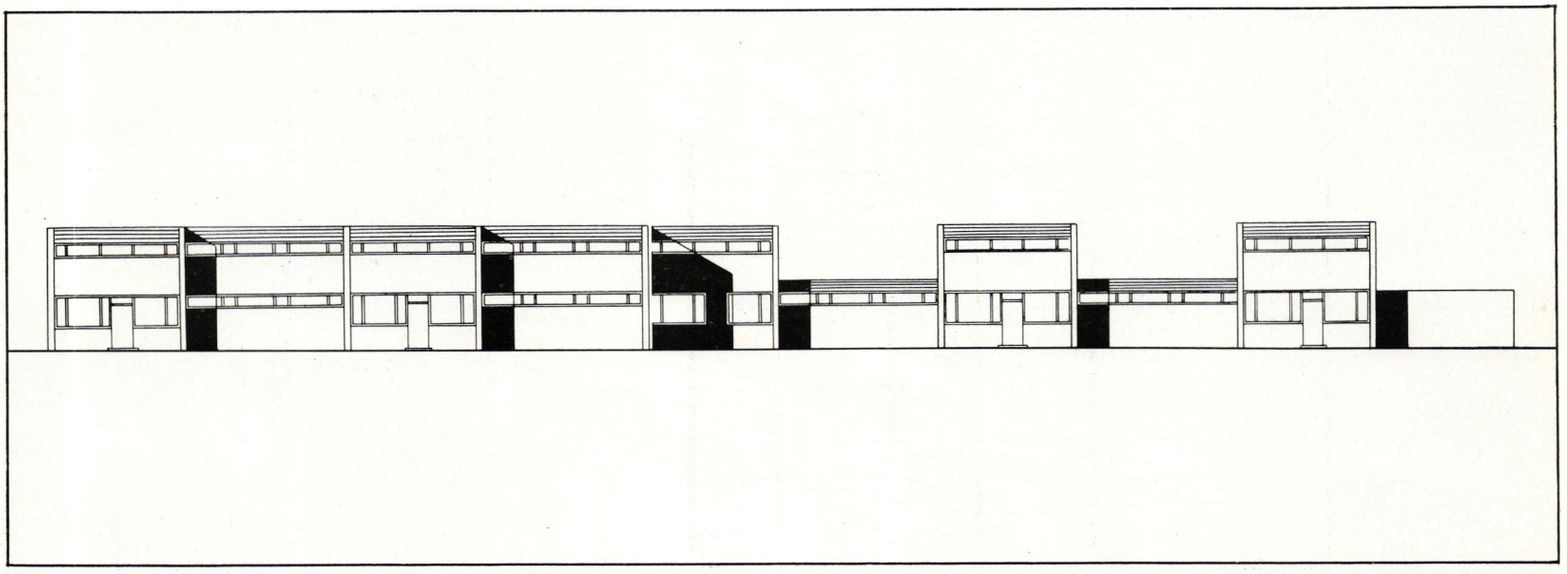


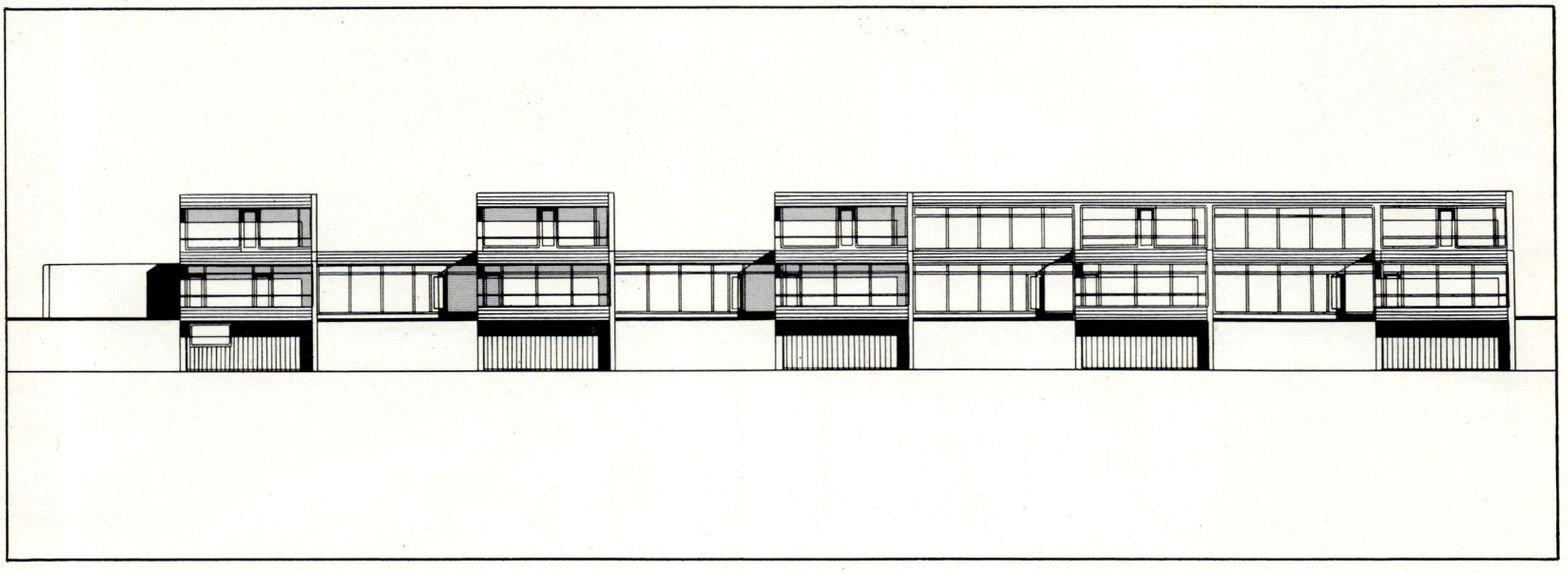


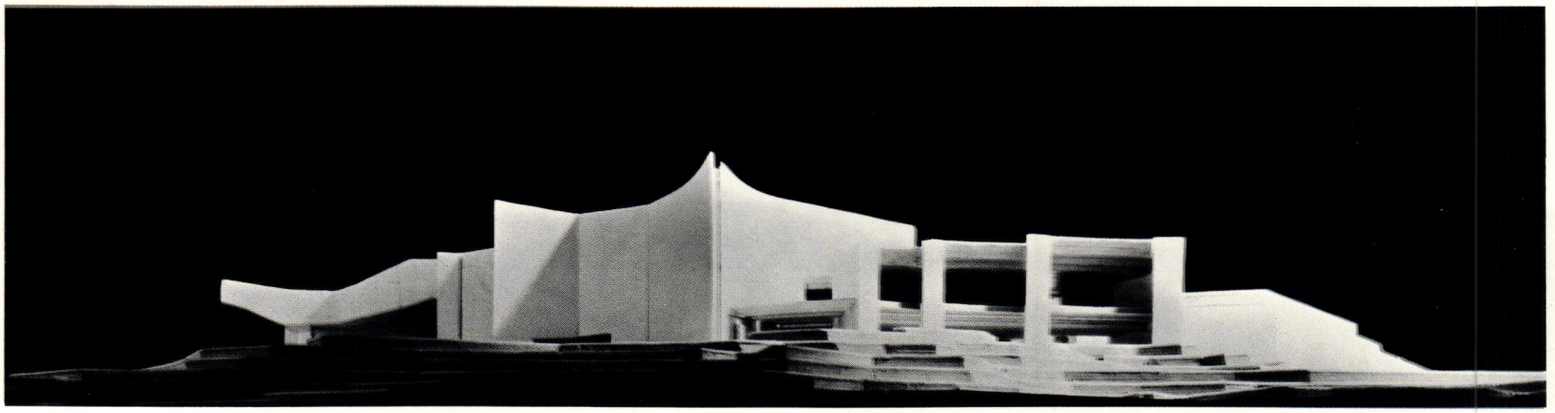


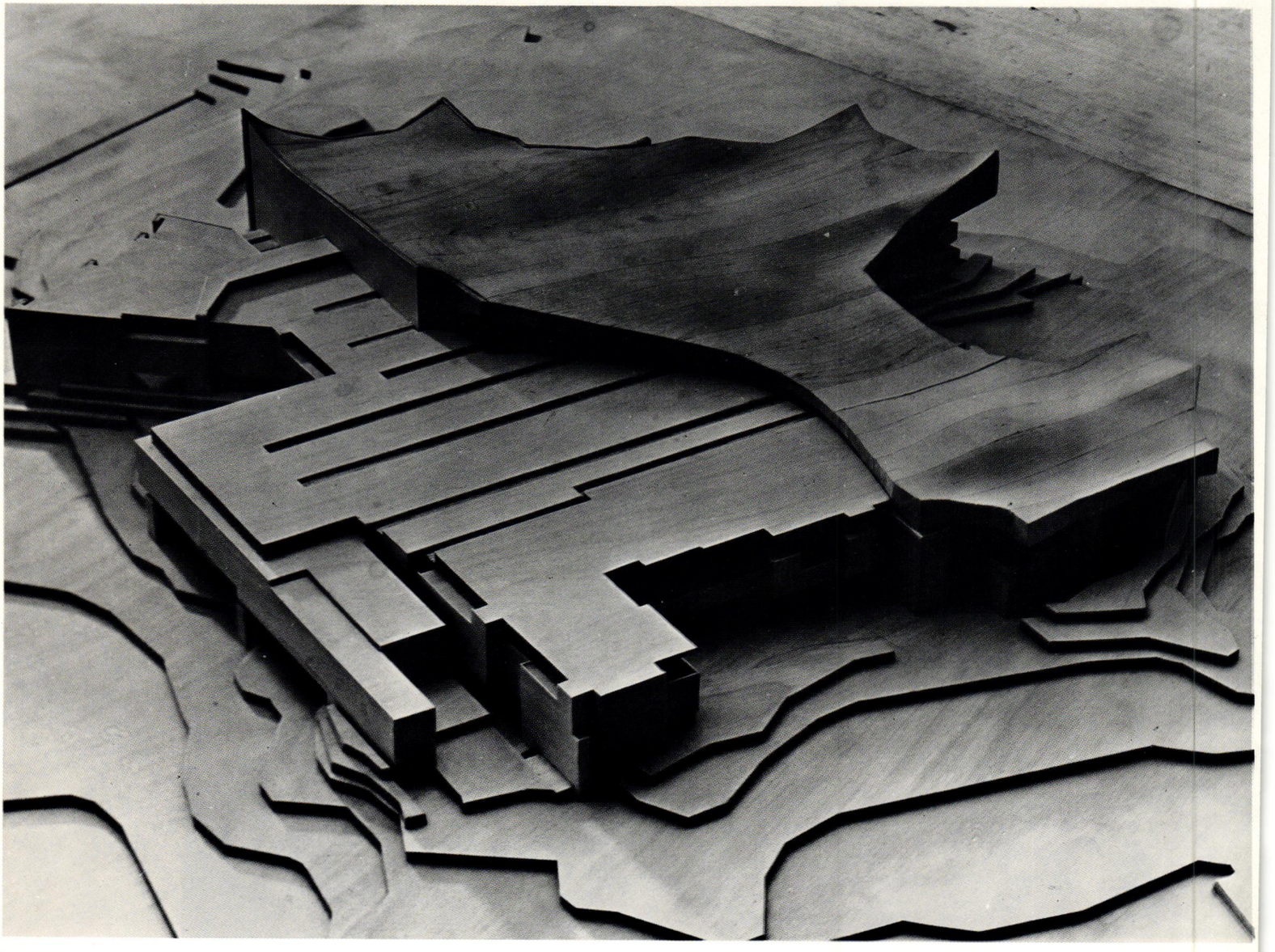
Above: Sections
Below: Elevations



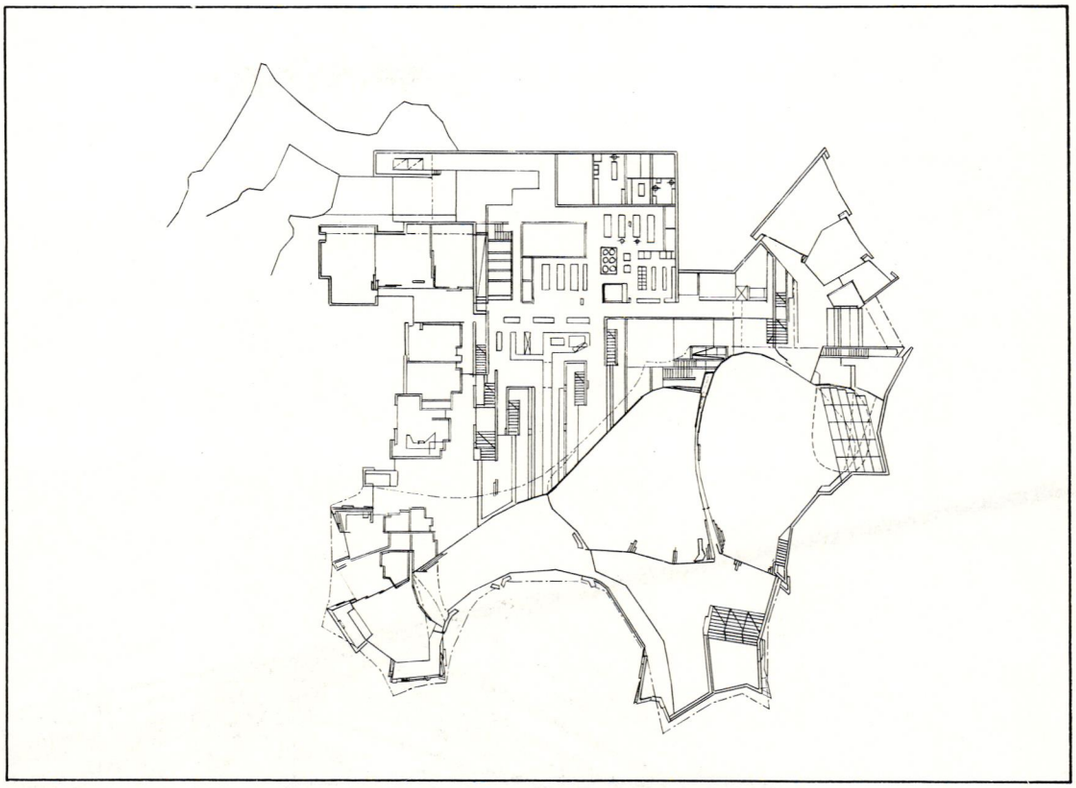


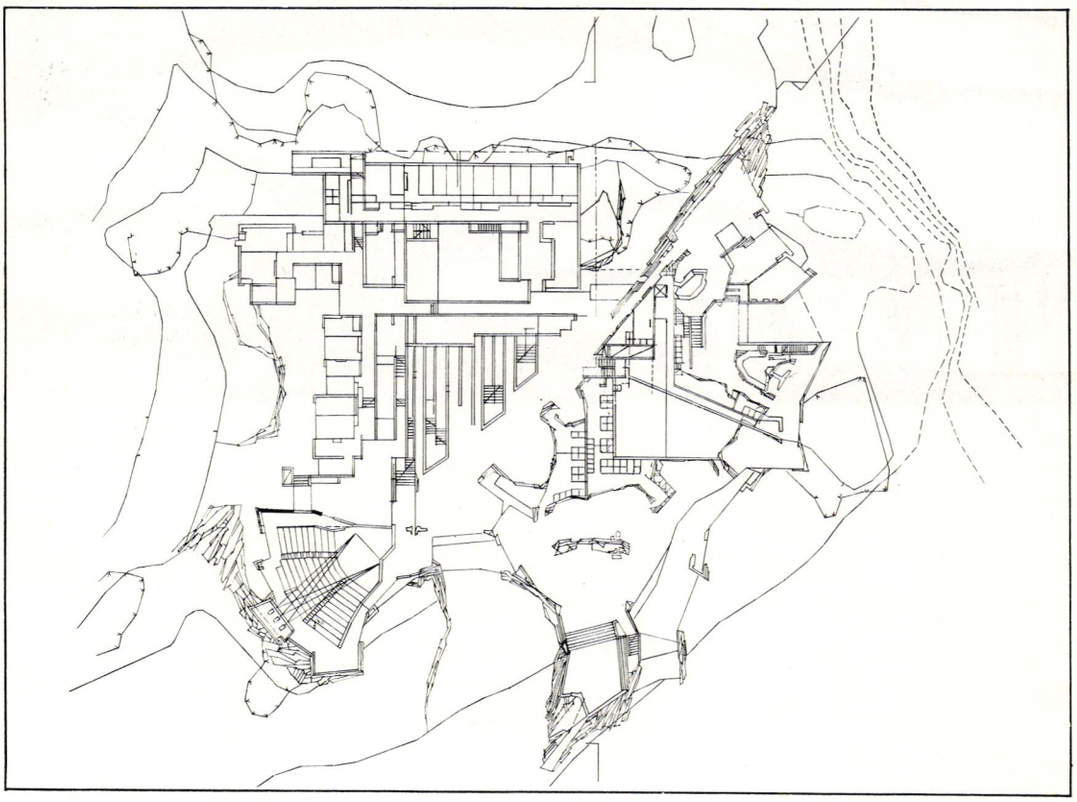




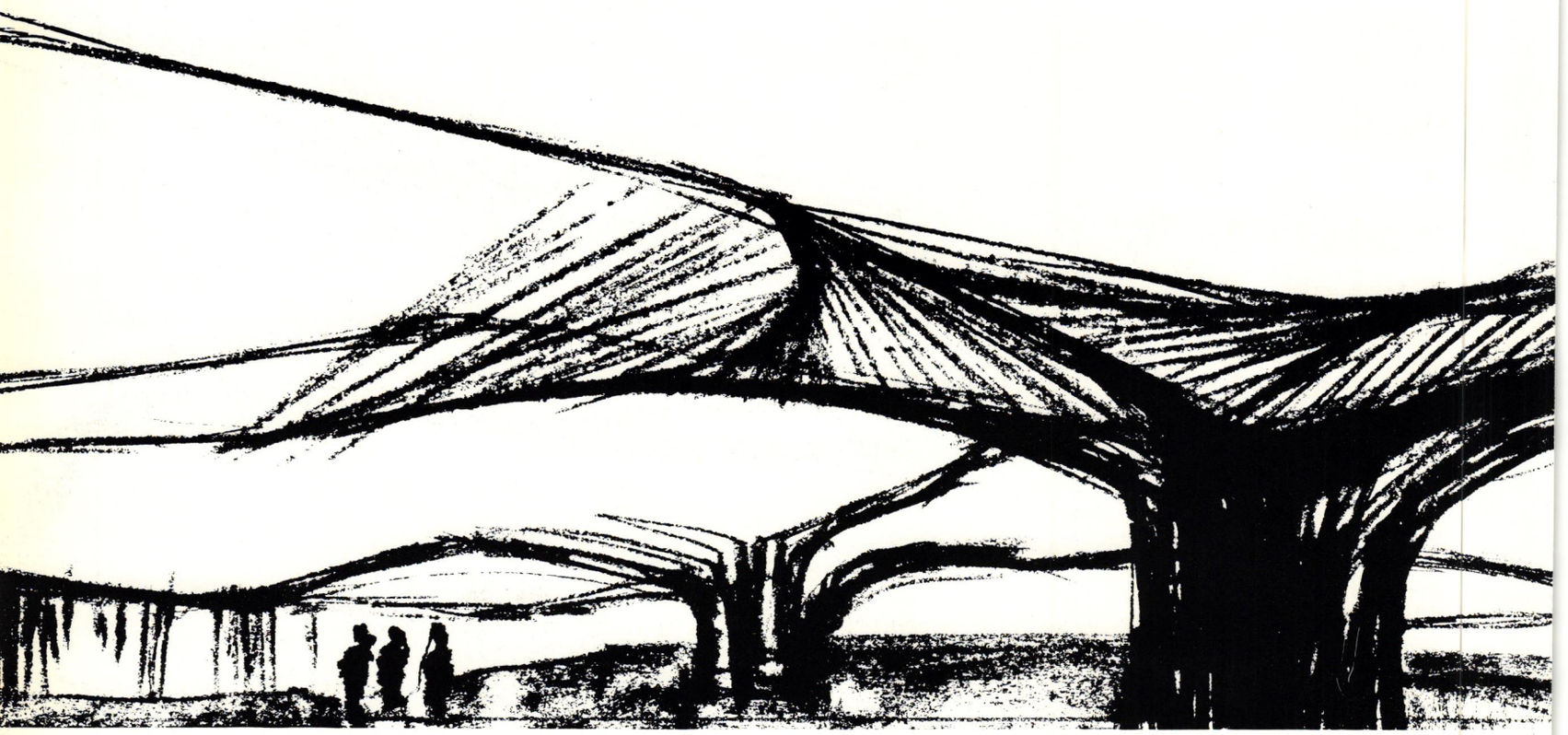


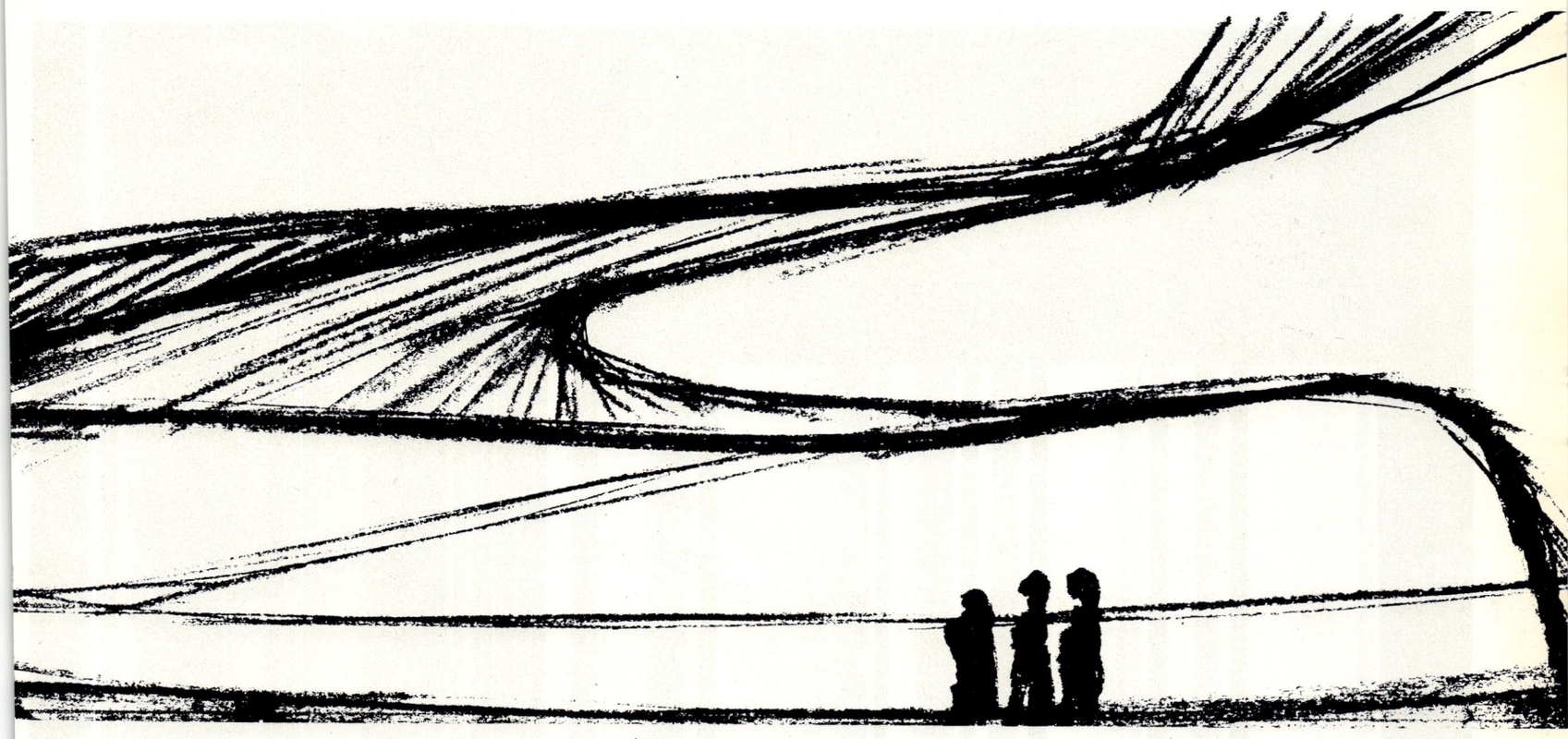
Above left: Elevation view of model
Below left: Isometric view of model
Above right: Plan of upper floor
Below right: Plan of lower floor



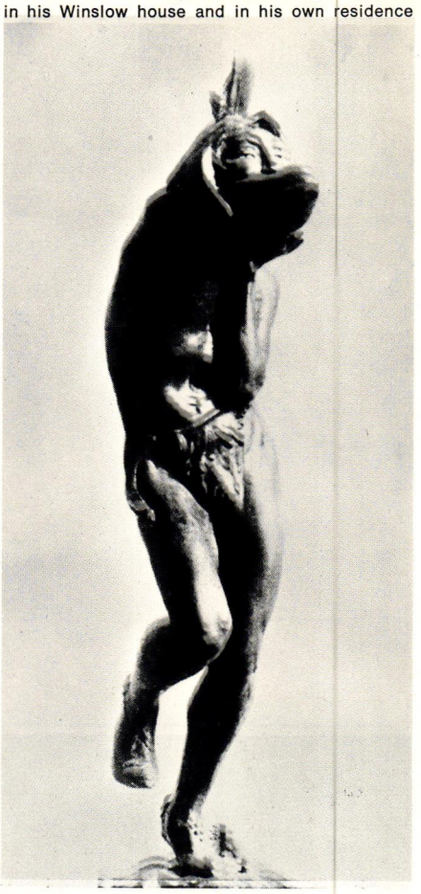


Sketch of student restaurant, upper floor





'Primitive Chant,' by Herman McNeil, indicating the character of sculpture which Wright featured in his Winslow house and in his own residence



Edgar Kaufmann Jr
Frank Lloyd Wright and the Fine Arts

Frank Lloyd Wright spent the last decade of his life blasting away at (among other things) modern art; at the same time he was engaged in a long and eventually successful campaign to build the Solomon Guggenheim Museum for modern art. On these grounds he is accused of designing the museum to show the superiority of his own art – architecture – over the arts of painting and sculpture. Now Wright dearly loved a fight and, even more, a paradox; but it never occurred to him to betray a professional trust. When he accepted a commission it was not to monumentalize himself; else he would have aimed his whole career differently. His original clients for the museum, Solomon Guggenheim and Hilla Rebay, had a specialized, didactic, and developmental program consonant with what Wright considered the hopeful aspects of modern art. With a change of clients after Solomon Guggenheim's death came the clash of purposes which transformed the Guggenheim Museum building, as it opened, into a half-thing. Even so, it has proved astonishingly vital, and in some respects is now being used more nearly as conceived.

Did Wright really hate the fine arts as competitors with architecture? A survey of his long practice, which often contrasts with his words, shows that Frank Lloyd Wright loved fine arts, that life without them was inconceivable to him. His was an old-

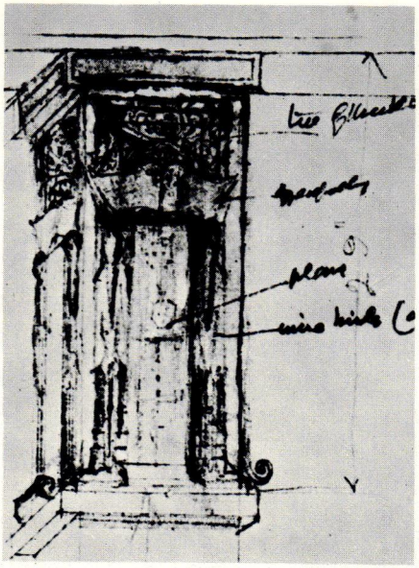
Studio entrance to Wright's own house; the crouching figures are by Richard Bock

fashioned love, however, with manifestations that require elucidation today. To understand them, thought needs be given to ideas of art that were current when Wright was young, particularly among people like his well-read, progressive, pious family. Wright's heritage in the arts centered on ideals common to liberal British intellectuals of the mid-nineteenth century, when many able men and women (like Wright's forebears) found it necessary to leave the overpopulated homeland of the Industrial Revolution. This specific heritage has been encapsuled by one of Wright's favorite authors, Emerson, in his essay on *Art*, published in 1841. Emerson thought that rather than be imitative 'the painter should... give us only the spirit... the gloom of gloom and the sunshine of sunshine'; he should 'convey a larger sense by simpler symbols.' Yet, the writer continued, the 'office of painting and sculpture seems to be merely initial. The best pictures can easily tell us their last secret... painting and sculpture are gymnastics of the eye, its training.... Away with your nonsense of oils and easels, of marble and chisels; except to open your eyes.... Now men do not see Nature to be beautiful.... They reject life as prosaic, and create a death which they call poetic. ... Beauty must come back to the useful arts, and the distinction between the fine and the useful arts be forgotten.' In concluding the essay, he suggests that artists find holiness and beauty in new and necessary facts, in the field and roadside, in the shop and mill.... When science is learned in love, and its powers are wielded by love, they will appear the supplements and continuations of the material creation.' His last point was polemically elaborated years later by William Morris, who said: 'it is allowing the machines to be our masters and not our servants that so injures life nowadays.' Wright followed these thoughts and developed them. In fact, his reactions to modern art are inherent in Emerson's formulation. To understand Wright's hopes and fears for art, one should keep in mind the Emersonian text.

Emerson represented a synthesis of attitudes built up by men like Cobbett and Coleridge, Southey and Owen. Carlyle, John Stuart Mill, Pugin, Ruskin, and Morris followed. Many of these men were read by Wright as a youngster, along with Victor Hugo, penny dreadfuls, the poetry of Blake, and the *Essays* of Viollet-le-Duc. It will suffice merely to mention Wright's early fascination with Froebel's educational toys and the piano music of Beethoven and Bach, for these are well-known aspects of his education. Less notice has been taken of his childhood recreations: painting, drawing, singing, and reading aloud. To these add decorating crockery and making Christmas trifles for pocket money, and you have the very image of a progressive, provincial upbringing in the era of the aesthetic movement. After all, it was while the boy Wright was learning physical and moral fortitude on his uncle's farm that Oscar Wilde lectured America on the beauty of the machine, and *Patience* opened in London. A few years later, when a teen-age Wright determined to seek his fortune in Chicago, his cultural baggage was pretty much that sketched here; he had acquired a knowledge of engineering, to be sure, and an enduring enthusiasm for romantic Maya, Aztec, and Inca ruins.

When he arrived in Chicago, young Wright found his place at Louis Sullivan's elbow. In the Adler and Sullivan office the great Auditorium Building was the center of activity: it was designed to be the most superb center in the new world for grand occasions – opera, concerts, political rallies, etc. It was abundantly ornamented and numerous oil paintings were commissioned as murals. Despite the results, the concept of architecture and fine arts working together was never questioned! About this time, too, the Art Institute of Chicago began to form its collections, but of course Chicago's great Impressionist paintings were just entering local private collections. The Art Institute was then holding regular passing shows of contemporary

Sketch by Wright for pilaster ornaments at studio entrance, executed by Bock



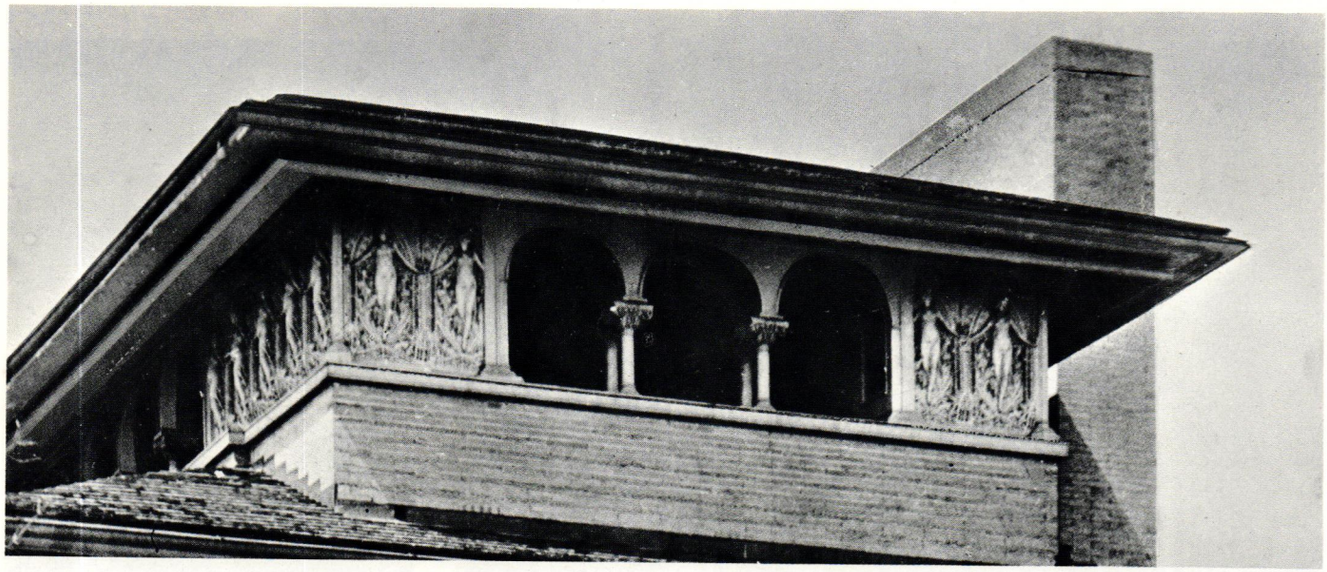
Sculpture at top of Sullivan's Bayard Building in New York

American painting, sculpture, and artistic crafts. A large collection of casts, some architectural, were also to be seen. All this was grist to Wright's mill, but perhaps even more important to him were the opportunities Chicago provided for the enjoyment of full-scale, professional performing arts. Sullivan and his friends were alert to these influences; Wright eagerly went along. Hard after the successful opening of the Auditorium came preparations for the World's Columbian Exposition: Chicago filled with aspiring artist-decorators. In 1892, while this was going on, Sullivan's firm opened the Schiller theatre building, where, not for the first time, they employed a sculptor to complete the decorations. Then, if no earlier, Wright met the sculptor Richard Bock, who later worked closely with him over many years.

Probably in the same year Wright and his friends learned to admire another young sculptor, fresh from a trip to the Indian southwest and, earlier, a student in the Paris *académies*, Hermon Atkins MacNeil. His works may be seen deliberately featured in the entrance hall of Wright's first independent house of great quality, the Winslow, and in photographs of Wright's own home, together with oriental painting and assorted bric-a-brac. Wright's statuette, a Hopi runner, was reputedly modeled at the Villa Aurelia, where it must have looked extra exotic; it probably should be dated 1896, when MacNeil left his brief but successful Chicago career for the American Academy at Rome. In 1895 the sculptor Bock helped Wright complete the entrance to a new studio annexed to the architect's home. Flanking the entry, two covering muscle-men on plinths seem pure Bock; four pilaster caps, however, were sketched and programed by Wright. Some similar collaboration, with Wright guiding a painter, would account for a mural in a new children's playroom added to the adjacent residence about then; the correctly drawn figures seem outside Wright's skills. Within the new studio itself, early photos show a landscape in oils and numerous naturalistic statuettes. There can be no question that at this point Wright was absorbed in an attempt to combine architecture, painting, and sculpture as he had learned to do with Sullivan. Comparing Wright's use of painting and sculpture with examples from Sullivan's works in the years around 1890, one finds that Wright had a more acute sense than his erstwhile master of scale, composition, and rhythm. In 1897, when Sullivan's only New York building was going up with winged, vaguely classical figures modeled in the topmost spandrels, Bock executed very similar figures for a roof loggia on Wright's Heller house. Such ladies, no doubt inspired by Figure 4 of Viollet's *Essay* on Roman architecture, had appeared, in flat paint only, on the Transportation Building, Sullivan's masterpiece at the Fair, and, fortunately for American art, never again flew on the top of a Sullivan or Wright building. Russell Lynes has reminded us that in 1898 Wright gave one of his popular talks at the annual meeting of the Central Art Association, on 'Art In The Home.' He lived with what he talked about; Bock even modeled Wright's young son life-size in bronze, adding wings. It was a volatile period in American sculpture.

At the turn of the century C. R. Ashbee, a leading light of the English arts and crafts movement, spent some time in Chicago; and we know that he and Wright became friendly. Wright agreed to have a committee for the preservation of historic buildings, which Ashbee wanted set up in connection with the English equivalent; and ten years later, when Wright's executed buildings were published in a German volume, Ashbee wrote an enthusiastic introduction. Likely enough, it was provoked by Wright's famous Hull House lecture on "The Art and Craft of the Machine" in 1901. This aired views contrary to Ashbee's. But by 1911, the year of his introduction to Wright's book, Ashbee announced himself ready to work with,

Freize of Wright's Heller house, sculpted by Bock



rather than against, the current of the times, as Wright had done at Hull House. Personal contact with Ashbee may have spurred Wright to consider how far he had drifted from the ideals of his youth, from the concepts of Emerson's essay. Anyway, over the next ten years Wright made extraordinary and remarkably successful efforts to integrate with his architecture the fine arts and the applied. Three great houses testify to this: the Dana, 1902-04; the Martin, 1904; and the Coonley, 1908; to these should be added the unique Larkin office building, 1904. Browne's Bookstore, 1908, and the Thurber Art Gallery, 1909, offered special, smaller opportunities. Even a mid-decade vacation in Japan, the first visit to a land Wright had long admired and now learned to love, exerted no perceptible effect on his work, though his ten- or twelve-year-old passion for Japanese prints increased. A great Wright building of the period, Unity Temple, 1906, was barren of fine arts, no doubt because among the clients funds and interest were equally lacking. In most cases, however, Wright was able to achieve remarkable results in the Midwest in the 1900s, working with artists considerably inferior to those whom architects in the East or in Europe could call on.

Wright's extra-legal nuptial flight to Europe in 1910 was spent largely in Florence working on drawings for a luxurious publication of his works, issued in Berlin, just prior to the more modest volume of photographs that Ashbee introduced. Projects for himself – a studio in Florence and a city house in Chicago–show Wright more ready than ever to make a feature of exterior sculpture. The first country home that Wright built for himself, called, like its sequels, 'Taliesin,' after the Welsh bard, was also fully but less formally embellished. Few records of its appearance survived the fire that destroyed it in 1914. This disaster occurred just at the time of the opening of Midway Gardens, a complex of restaurants and clubs, complete with large garden and music shell; Wright had designed it with wonderful boldness. Sculpture and painting played important roles, setting a festive and exhilarating tone.

Here, significantly enough, Wright seized the initiative, designing murals (and, in part, the sculptures) as abstract and asymmetric as any avant-garde European art of the moment. Midway Gardens was executed in a rush, and this may well have forced Wright to impose, rather than to elicit, the artistic qualities he desired to complete the architecture and furnishings. Whatever the cause, Midway Gardens marked an epoch in Wright's reactions to fine arts. He was forced to see that the painters and sculptors around him felt no intrinsic affinity to his work. The teamwork of the arts that Ruskin and Morris had predicated, that Wright had witnessed in Japan and in Europe's monuments, was gone; art was intent on making "the same effort... to detach the beautiful from the useful" that Emerson had observed three quarters of a century earlier.

Wright's new-found skill at designing his own fine arts for his buildings can be traced back to humble beginnings in colored window compositions, abstract and in that sense derived from his Froebel training, which he had used in his own house at least as early as 1895. The earliest Wright's asymmetric abstractions for glass seems to have been made in 1911 or 1912 for the Coonley playhouse. These are exactly contemporary with the first documented European color-abstractions by Kupka, Larionov, and Delaunay. Wright designed a timidly asymmetric and very nearly abstract relief for a house in Milwaukee in 1916. Nothing prior in modern art is recalled, but an ornamental relief of 1902 in the Sezession by Josef Hoffman may have encouraged Wright, well aware of the Sezession and its works thanks to his admiration for Hoffman's teacher, Otto Wanger.

Now Japan called Wright, and the next years were largely devoted to the complicated commission of the Imperial Hotel.

Ezra Stoller Photography and the Language of Architecture

The true architectural photograph is primarily an instrument of communication between the architect and his audience—an audience with the capacity and desire to understand and appreciate, but lacking the opportunity to experience the work in question at first hand. The camera, ideally, is the anonymous vehicle for this journey; yet the ideal is never quite achieved, for a variety of reasons. Perhaps by examining and understanding them, some of the obstacles can be overcome.

In general, it would seem that our concern is the threefold relationship of the subject, the intermediary medium, and the viewer. And, while we are primarily concerned with photography, it is not possible to ignore the fact that it is but an expository link between the architecture and the student, and its success can only be judged by how well it fulfills its function. Thus the question has three aspects, corresponding to the three participants in the game: the architect, the photographer, and the viewer.

The architect, of course, is subject to another similar but unrelated set of conditions with which we are not concerned at this time. It is the manner in which he has resolved these conditions that is expressed by the resulting building. What does concern us is that he has solved his problem within the framework of his own philosophy and aesthetic. The result, if it is of any significance, is more than just a building: it is an idea, and this central idea is of interest to all. The architect is especially involved in the photography of his work because, as a creative worker, the wide dispersion, understanding, and acceptance of his idea mark its true significance.

Now it is the obligation of the photographer to communicate this idea. To do so he must first understand what the architecture is all about, the statement it represents, and the idea to be communicated. This he digests and interprets by means of a highly restricted medium. While there is no real substitute for experiencing a work of architecture, once this limitation is accepted there seems to be no substitute for photography in aiding the perception of what is essentially a visual experience.

As for the medium itself, it is far from being a perfect tool. The range of light which can be recorded in one sheet of film is limited and far short of what the eye can assimilate; and by the time the image is impressed on a piece of paper, this range has been diminished even

further. To cut down this disparity, light must often be added to the subject, tending to destroy the atmosphere of the space. It is not always possible to add enough light (i.e. a large building at night), and a variety of expedients must be resorted to —often with a tendency to distort the original. The camera is a one-eyed recorder (stereo photography not being generally reproduceable), further forcing us to resort to a variety of techniques to convey a quality of depth, adding more opportunity for the photographer to distort. The camera is static—but this is not too serious if the ultimate viewer is diligent. The camera's capacity to freeze a moment of time can also be a drawback, and a serious one, when dealing with a subject as timeless as architecture. It is one thing to show a building in its best light, but something quite different to see it in a freakish instant. Then, there is the camera's tendency to distort (at least to our ever-compensating eyes). It has not the capacity to perceive and correct that the human brain has; and here again, it is the duty of the viewer to understand and make allowances. When we become involved in color photography, the limitations increase geometrically to the point where all we can hope to achieve is an impression—and it is rarely a strictly accurate one.

It is obvious that the success of a worker in any medium is measured by his ability to turn its limitations into assets, stretching it and increasing its versatility. Actually, how he uses his technique is of no concern to anyone but himself, but what he does with it concerns us all. Every facet of photography is subject to control, and the way in which it is manipulated affects the ultimate record. The quality of light, the perspective, the viewpoint, the relation to other objects, the instant of exposure, the distortion or lack of it, the color—all can be worked to serve a variety of objects, and it is in the use to which these characteristics are put that the results are to be judged. Here we must be guided by our statement of the original problem. The end result can be judged only by the information it conveys, how forcefully and clearly it is projected.

Recently I have read at least three statements by architectural photographers that define two kinds of architectural pictures: one kind is concerned with the factual statement, and the other with the 'creative,' or 'art,' type of picture. Without disparaging their work or the validity of the so-called 'art' photograph, it is my conviction that there is only one kind of architectural photograph, and that is the one which conveys the architect's idea.

It may not be possible, or even desirable, for the cameraman to submerge his personality entirely; but a consciousness of the requirements of the job ought to keep him from indulging in self-expression as an end in itself. This is another area of effort, with its own standards and criteria, but not valid or pertinent to the work at hand. Objectivity may be only relative, but we must be concerned with it constantly, if our pictures are to have any real value. There are few photographers who qualify as critics, and fewer critics who are competent photographers. Most of us should be content not to be critics. Let us assume that the viewer is possessed of his own intelligence and faculties, and would like only some undistorted information on which to base his own conclusions.

While my opening paragraphs have made mention of the problems inherent in the technique of photography, there are some special ones concerning the photographer operating in today's economic framework: the *business* of architectural photography, if you will. Inasmuch as a building is not something which he can take to his studio, the photographer must go and live with a specific job until he has completed it to his satisfaction. To execute his assignment properly often means traveling with an assistant and about four-hundred pounds of equipment. This becomes expensive, and the pressures for speedy completion are hard. A bad day or an uncooperative client can mean the difference between profit and loss. Few architects feel that their jobs merit the required expenditure, and, of the agencies which do profit directly from such work, the client is too often ignorant of the qualities required of architectural photography and the magazines seem unable to pay for it. This leaves a few architects and a few well-advised clients. Fortunately, this is enough to keep the standards where they are.

Of the three elements that produce the effective architectural photograph, we now come to the ultimate one, the viewer, inasmuch as he is the reason for the whole thing in the first place. As is the case with any communicative effort, it comes to nought without some participation at both ends of the channel. In my original definition, I made it plain that the audience was assumed to be an intelligent one, with a desire to know; and the desire to know presupposes an active participation on the part of the viewer. It is unfortunate that the photographer cannot speak to his audience directly (more unfortunate that the architect cannot do it himself). For better or for worse, the message, as formulated by the photographer, is generally filtered, arranged, and explained by an editor, who must then reproduce his own selection of the pictures with varying degrees of fidelity. Here, a whole new set of limitations moves in: the limitations of page space and deadlines, the desire to publish first (even if the building is unfinished), and the cost and quality of paper and printing. To offset them, of course, we now have the benefits of criticism and editing.

The trouble is that the pictures are never seen by the viewer as they are seen by the photographer. Not only is their relative importance changed (and the pictures themselves often cropped and thus distorted), but their sequence is rearranged. It might be argued that this is all an improvement, which it may be, but it is now another obstacle to direct communications. Because, too, the magazine is often concerned with dressing itself up, it will encourage pictures which its art director considers visually exciting, and thus may inflate them out of all importance to the story. True, this makes for an interesting-looking magazine, but my point is that we are concerned with information, unfiltered and unadulterated. Visual excitement is valid in architectural photography when it is inherent in the structure, not as an overwhelming by-product.

Another fallacy encouraged by the space limitations of publication and the literary approach to architecture is contained in the idea that the good photograph is the one which reveals the whole structure in one fell swoop. The building that can be shown completely in one picture is not worth bothering about. Architecture, being a time and space phenomenon, can only have limited aspects when shown in two dimensions. The explanation of a work of architecture with any degree of understanding requires a series of carefully considered and related views—related not only to each other but also to the plan. It is demanded of the viewer that he coordinate all of these in his mind's eye. The strong initial impact of a photograph is not sufficient. To truly comprehend a work of architecture at second hand, one must learn to read the photograph as carefully as a text or a set of drawings. Then, given the appreciation, understanding, and required imagination, it is possible that one might experience the personal, first-hand pleasure of perceiving an idea.

Colin Rowe and Robert Slutzky Transparency: Literal and Phenomenal

'Transparency,' 'space-time,' 'simultaneity,' 'interpenetration,' 'superimposition,' 'ambivalence': in the literature of contemporary architecture these words, and others like them, are often used as synonyms. We are familiar with their use and rarely seek to analyze their application. To attempt to make efficient critical instruments of such approximate definitions is perhaps pedantic. Nevertheless, in this article pedantry will be risked in an attempt to expose the levels of meaning with which the concept of transparency has become endowed.

According to the dictionary definition, the quality, or state, of being transparent is both a material condition—that of being pervious to light and air—and the result of an intellectual imperative, of our inherent demand for that which should be easily detected, perfectly evident, and free of dissimulation. Thus the adjective *transparent,* by defining a purely physical significance, by functioning as a critical honorific, and in being dignified with far from disagreeable moral overtones, becomes a word which from the first is richly loaded with the possibilities of both meaning and misunderstanding.

A further level of interpretation—that of transparency as a condition to be discovered in a work of art—is admirably defined by Gyorgy Kepes in his *Language of Vision:* 'If one sees two or more figures overlapping one another, and each of them claims for itself the common overlapped part, then one is confronted with a contradiction of spatial dimensions. To resolve this contradiction one must assume the presence of a new optical quality. The figures are endowed with transparency; that is they are able to interpenetrate without an optical destruction of each other. Transparency however implies more than an optical characteristic, it implies a broader spatial order. Transparency means a simultaneous perception of different spatial locations. Space not only recedes but fluctuates in a continuous activity. The position of the transparent figures has equivocal meaning as one sees each figure now as the closer now as the further one' (1).

By this definition, the transparent ceases to be that which is perfectly clear and becomes instead that which is clearly ambiguous. Nor is this meaning an entirely esoteric one; when we read (as we so often do) of 'transparent overlapping planes,' we constantly sense that rather more than a simple physical transparency is involved.

For instance, while Moholy-Nagy in his *Vision in Motion* continually refers to 'transparent cellophane plastic,' 'transparency and moving light,' and 'Rubens's radiant transparent shadows' (2), a careful reading of the book might suggest that for him such literal transparency is often furnished with certain allegorical qualities. Some superimpositions of form, Moholy tells us, 'overcome space and time fixations. They transpose insignificant singularities into meaningful complexities...The transparent quality of the superimpositions often suggest transparency of context as well, revealing unnoticed structural qualities in the object' (3). And again, in commenting on what he calls 'the manifold word agglutinations' of James Joyce, or the Joycean pun, Moholy finds that these are 'the approach to the practical task of building up a completeness from interlocked units by an ingenious transparency of relationships' (4). In other words, he seems to have felt that, by a process of distortion, recomposition, and *double-entendre,* a linguistic transparency—the literary equivalent of Kepes' 'interpenetration without optical destruction'—might be effected, and that whoever experiences one of these Joycean 'agglutinations' will enjoy the sensation of looking through a first plane of significance to others lying behind it.

Therefore, at the very beginning of any

1 Cézanne: *Mont Sainte-Victoire*

enquiry into transparency, a basic distinction must be established. Transparency may be an inherent quality of substance, as in a glass curtain wall; or it may be an inherent quality of organization. One can, for this reason, distinguish between a literal and a phenomenal transparency.

Our feeling for literal transparency seems to derive from two sources: from cubist painting and from what is usually designated as the machine aesthetic. Our feeling for phenomenal transparency probably derives from cubist painting alone; and a cubist canvas of around 1911 or 1912 would serve to illustrate the presence of both orders, or levels, of the transparent.

One may be skeptical of those too plausible explanations of cubism which involve the fusion of temporal and spatial factors. As Alfred Barr tells us, Apollinaire 'invoked the fourth dimension... in a metaphorical rather than a mathematical sense (5); and here, rather than attempt the relation of Minkowski to Picasso, it has been considered convenient to refer to somewhat less disputable sources of inspiration.

A late Cézanne such as the *Mont Sainte-Victoire* of 1904-06 (Fig 1) in the Philadelphia Museum of Art is characterized by certain extreme simplifications. There is a highly developed insistence on a frontal viewpoint of the whole scene, a suppression of the more obvious elements suggestive of depth, and a resultant contracting of foreground, middleground, and background into a distinctly compressed pictorial matrix. Sources of light are definite but various; and a further contemplation of the picture reveals a tipping forward of the objects in space, which is assisted by the painter's use of opaque and contrasted color. The center of the composition is occupied by a rather dense gridding both oblique and rectilinear; and this area, apparently, is buttressed and stabilized by a more insistent horizontal and vertical grid which introduces a certain peripheric interest.

Frontality, suppression of depth, contracting of space, definition of light sources, tipping forward of objects, restricted palette, oblique and rectilinear grids, and propensities toward peripheric development are all characteristics of analytical cubism. In these pictures, apart from the pulling to pieces and reassembly of objects, perhaps above all we are conscious of a further shrinkage of depth and an increased emphasis which is now awarded to the grid. We discover about this time a meshing together of two systems of coordinates. On the one hand, an arrangement of oblique and curved lines suggests a certain diagonal spatial recession. On the other, a series of horizontal and vertical lines implies a contradictory statement of frontality. Generally speaking, the oblique and curved lines possess a certain naturalistic significance, while the rectilinear ones show a geometrizing tendency which serves as a reassertion of the picture plane. Both systems of coordinates provide for the orientation of the figures simultaneously in an extended space and on a painted surface; while their intersection, their overlapping, their interlocking, and their building up into larger and fluctuating configurations permits the genesis of the typically ambiguous cubist motif.

As the observer distinguishes between all the resultant planes, he may become progressively conscious of an opposition between certain areas of luminous paint and others of a more dense coloration. He may distinguish between certain planes to which he is able to attribute a physical nature allied to that of celluloid, others whose essence is semiopaque, and further areas of a substance totally opposed to the transmission of light. And he may discover that all of these planes, translucent or otherwise, and regardless of their representational content, are implicated in the phenomenon which Kepes has defined as transparency.

2 Picasso: *The Clarinet Player*

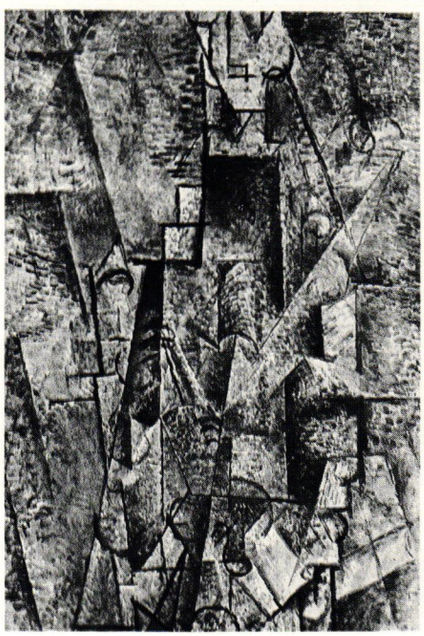
3 Braque: *The Portuguese*

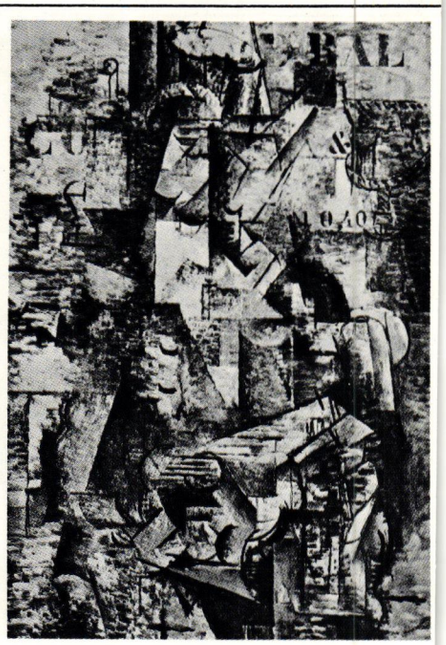
The double nature of transparency may be illustrated by the comparison and analysis of a somewhat atypical Picasso, *The Clarinet Player* (Fig 2), and a representative Braque, *The Portuguese* (Fig 3), in each of which a pyramidal form implies an image. Picasso defines his pyramid by means of a strong contour; Braque uses a more complicated inference. Thus Picasso's contour is so assertive and so independent of its background that the observer has some sense of a positively transparent figure standing in a relatively deep space, and only subsequently does he redefine this sensation to allow for the actual lack of depth. With Braque the reading of the picture follows a reverse order. A highly developed interlacing of horizontal and vertical gridding, created by gapped lines and intruding planes, establishes a primarily shallow space, and only gradually is the observer able to invest this space with a depth which permits the figure to assume substance. Braque offers the possibility of an independent reading of figure and grid: Picasso scarcely does so. Picasso's grid is rather subsumed within his figure or appears as a form of peripheral incident introduced to stabilize it.

In the first we may receive a pre-vision of literal transparency, and in the other, of phenomenal transparency; and the evidence of these two distinct attitudes will become much clearer if a comparison is attempted between the works of two slightly later painters, Robert Delaunay and Juan Gris.

Delaunay's *Simultaneous Windows* of 1911 and Gris' *Still Life* of 1912 (Figs 4, 5) both include objects that are presumably transparent, the one windows, the other bottles. While Gris suppresses the physical transparency of glass in favor of a transparency of gridding, Delaunay accepts with unrestricted enthusiasm the elusively reflective qualities of his superimposed 'glazed openings.' Gris weaves a system of oblique and perpendicular lines into some sort of corrugated shallow space; and in the architectonic tradition of Cézanne, in order to amplify both his objects and structure, he assumes varied but definite light sources. Delaunay's preoccupation with form presupposes an entirely different attitude. Forms to him—e.g. a low block of buildings and various naturalistic objects reminiscent of the Eiffel Tower—are nothing but reflections and refractions of light which he presents in terms analogous to cubist gridding. But despite this geometrizing of image, the generally ethereal nature of both Delaunay's forms and his space appears more characteristic of impressionism, and this resemblance is further reinforced by the manner in which he uses his medium. In contrast to the flat, planar areas of opaque and almost monochromatic color which Gris invests with such high tactile value, Delaunay emphasizes a quasi-impressionistic calligraphy; and while Gris provides explicit definition of a rear plane, Delaunay dissolves the possibilities of so distinct a closure of his space. Gris' rear plane functions as a catalyst which localizes the ambiguities of his pictorial objects and engenders their fluctuating values. Delaunay's distaste for so specific a procedure leaves the latent ambiguities of his form exposed, without reference, unresolved. Both operations might be recognized as attempts to elucidate the intricacy of analytical cubism; but where Gris seems to have intensified some of the characteristics of cubist space and to have imbued its plastic principles with a new bravura, Delaunay has been led to explore the poetical overtones of cubism by divorcing them from their metrical syntax.

When something of the attitude of a Delaunay becomes fused with a machine-aesthetic emphasis upon physical substance and stiffened by a certain enthusiasm for simple planar structures, then literal transparency becomes complete; and it can perhaps be most appropriately illustrated by the work of Moholy-Nagy. In his *Abstract of an Artist* Moholy-Nagy tells us that around 1921 his 'transparent paint-





4 Delaunay: *Simultaneous Windows*

5 Gris: *Still Life*

ings' became completely freed from all elements reminiscent of nature, and to quote him directly: 'I see today that this was the logical result of the cubist paintings I had admiringly studied' (6).

Now whether a freedom from all elements reminiscent of nature may be considered a logical continuation of cubism is not relevant to this present discussion; but whether Moholy did indeed succeed in emptying his work of all naturalistic content *is* of some importance, and his seeming belief that cubism had pointed the way toward a freeing of forms may justify the analysis of one of his subsequent works and its comparison with another postcubist painting. Moholy's *La Sarraz* of 1930 (Fig 6) might reasonably be compared with a Fernand Léger of 1926: *The Three Faces* (Fig 7)

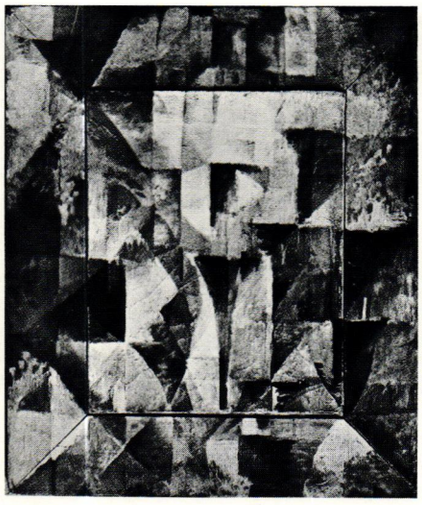
In *La Sarraz* five circles connected by an S-shaped band, two sets of trapezoidal planes of translucent color, a number of near horizontal and vertical bars, a liberal splattering of light and dark flecks, and a number of slightly convergent dashes are all imposed upon a black background. In *Three Faces* three major areas displaying organic forms, abstracted artifacts, and purely geometric shapes are tied together by horizontal banding and common contour. In contrast to Moholy, Léger aligns his pictorial objects at right angles to each other and to the edges of his picture plane; he provides these objects with a flat, opaque coloring; and he sets up a figure-ground reading through the compressed disposition of these highly contrasted surfaces. While Moholy seems to have flung open a window on to some private version of outer space, Léger, working within an almost two dimensional scheme, achieves a maximum clarity of both 'negative' and 'positive' forms. By means of restriction, Léger's picture becomes charged with an equivocal depth reading, with a value singularly reminiscent of that to which Moholy was so sensitive in the writings of Joyce, and which, in spite of the positive physical transparency of his paint, Moholy himself has been unable to achieve.

For in spite of its modernity of motif, Moholy's picture still shows the conventional precubist foreground, middleground, and background; and in spite of a rather casual interweaving of surface and the elements introduced to destroy the logic of this deep space, Moholy's picture can be submitted to only one reading.

On the other hand, through the refined virtuosity with which he assembles postcubist constituents, Fernand Léger makes completely plain the multifunctioned behavior of clearly defined form. Through flat planes, through an absence of volume suggesting its presence, through the implication rather than the fact of a grid, through an interrupted checkerboard pattern stimulated by color, proximity, and discrete superimposition, Léger leads the eye to experience an inexhaustible series of larger and smaller organizations within the whole. Léger's concern is with the structure of form, Moholy's with materials and light. Moholy has accepted the cubist figure but has lifted it out of its spatial matrix; Léger has preserved and even intensified the typically cubist tension between figure and space.

These three comparisons may clarify some of the basic differences between literal and phenomenal transparency in the painting of the last fifty years. Literal transparency, we notice, tends to be associated with the trompe l'oeil effect of a translucent object in a deep, naturalistic space; while phenomenal transparency seems to be found when a painter seeks the articulated presentation of frontally displayed objects in a shallow, abstracted space.

In considering architectural rather than pictorial transparencies, inevitable confusions arise; for while painting can only imply the third dimension, architecture



6 Moholy-Nagy: *La Sarraz*

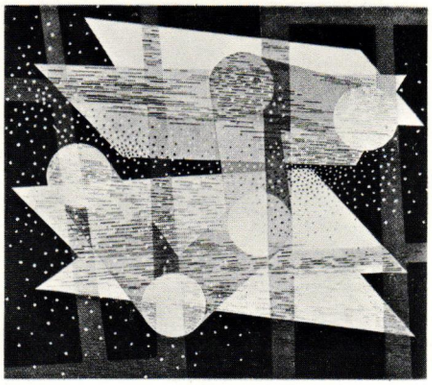
7 Léger: *The Three Faces*

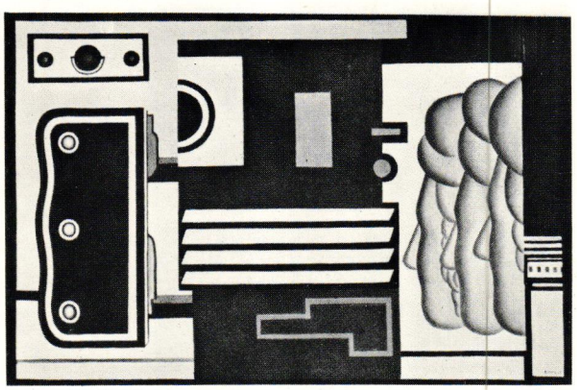
cannot suppress it. Provided with the reality rather than the counterfeit of three dimensions, in architecture literal transparency can become a physical fact. However, phenomenal transparency will, for this reason, be more difficult to achieve; and it is indeed so difficult to discuss that generally critics have been willing to associate transparency in architecture exclusively with a transparency of materials. Thus Gyorgy Kepes, having provided an almost classical explanation of the manifestations we have noticed in Braque, Gris, and Léger, appears to consider that the architectural analogue of these must be found in the material qualities of glass and plastics, and that the equivalent of their carefully calculated compositions will be discovered in the haphazard superimpositions produced by the reflections and accidents of light playing upon a translucent or polished surface (7). And similarly, Siegfried Giedion seems to assume that the presence of an all glass wall at the Bauhaus, with 'its extensive transparent areas,' permits 'the hovering relations of planes and the kind of 'overlapping' which appears in contemporary painting'; and he proceeds to reinforce this suggestion with a quotation from Alfred Barr on the characteristic 'transparency of overlapping planes' in analytical cubism (8).

In Picasso's *L'Arlesienne,* the picture that provides the visual support for these inferences, such a transparency of overlapping planes is very obviously to be found. There Picasso offers planes apparently of Celluloid, through which the observer has the sensation of looking; and in doing so, no doubt his sensations are somewhat similar to those of a hypothetical observer of the workshop wing at the Bauhaus. In each case a transparency of materials is discovered. But in the laterally constructed space of his picture, Picasso, through the compilation of larger and smaller forms, offers the limitless possibilities of alternative readings, while the glass wall at the Bauhaus, an unambiguous space, seems to be singularly free of this quality (Fig 8). Thus, for evidence of what we have designated phenomenal transparency, we shall be obliged to look elsewhere.

Le Corbusier's villa at Garches, almost contemporary with the Bauhaus, might fairly be juxtaposed with it. Superficially, the garden façade at this house (Fig 9) and the elevations of the workshop wing at the Bauhaus are not dissimilar. Both employ cantilevered floor slabs, and both display a recessed ground floor. Neither admits an interruption of the horizontal movement of the glazing, and both make a point of carrying the glazing around the corner. But now similarities cease. From here on, one might say that Le Corbusier is primarily occupied with the planar qualities of glass and Gropius with its translucent attributes. Le Corbusier, by the introduction of a wall surface almost equal in height to his glazing divisions, stiffens his glass plane and provides it with an over-all surface tension, while Gropius permits his translucent surface the appearance of hanging rather loosely from a fascia which protrudes somewhat in the fashion of a curtain box. At Garches we can enjoy the sensation that *possibly* the framing of the windows passes behind the wall surface: at the Bauhaus, since we are never for a moment unaware that the slab is pressing up behind the window, we are not enabled to indulge in such speculations.

At Garches the ground is conceived of as a vertical surface traversed by a horizontal range of windows; at the Bauhaus it is given the appearance of a solid wall extensively punctured by glazing. At Garches it offers an explicit indication of the frame which carries the cantilevers above; at the Bauhaus it shows somewhat stubby piers which one does not automatically connect with the idea of a skeleton structure. In this workshop wing of the Bauhaus one might say that Gropius is absorbed with the idea of establishing a plinth upon which to dispose an arrangement of horizontal planes, and that his principal con-





8 Bauhaus: corner of the workshop wing

9 Garches: garden facade

cern appears to be the wish that two of these planes should be seen through a veil of glass. But glass would hardly seem to have held such fascination for Le Corbusier; and although one can obviously see through his windows, it is not precisely here that the transparency of his building is to be found.

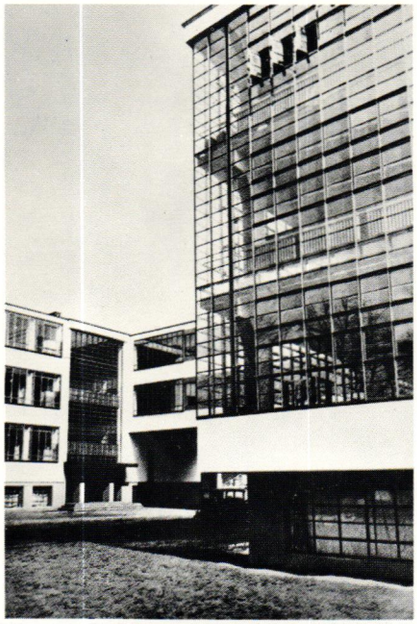
At Garches the recessed surface of the ground floor is redefined on the roof by the two freestanding walls which terminate the terrace; and the same statement of depth is taken up in the side elevations by the glazed doors which act as conclusions to the fenestration. In these ways Le Corbusier proposes the idea that immediately behind his glazing there lies a narrow slot of space traveling parallel to it; and of course, in consequence of this, he implies a further idea—that bounding this slot of space, and behind it, there lies a plane of which the ground floor, the freestanding walls, and the inner reveals of the doors all form a part; and although this plane may be dismissed as very obviously a conceptual convenience rather than a physical fact, its obtrusive presence is undeniable. Recognizing the physical plane of glass and concrete and this imaginary (though scarcely less real) plane that lies behind it, we become aware that here a transparency is effected not through the agency of a window but rather through our being made conscious of primary concepts which 'interpenetrate without optical destruction of each other.'

These two planes are not all; a third and equally distinct parallel surface is both introduced and implied. It defines the rear wall of the terrace and the penthouse, and is further reiterated by other parallel dimensions: the parapets of the garden stairs, the terrace, and the second-floor balcony. Each of these planes is incomplete in itself or perhaps even fragmentary; yet it is with these parallel planes as points of reference that the facade is organized, and the implication of all is of a vertical, layerlike stratification of the interior space of the building, a succession of laterally extended spaces traveling one behind the other.

This system of spatial stratification brings Le Corbusier's façade into the closest relationship with the Léger we have already examined. In *Three Faces* Léger conceives of his canvas as a field modeled in low relief. Of his three major panels (which overlap, dovetail, and alternatively comprise and exclude each other), two are closely implicated in an almost equivalent depth relationship, while the third constitutes a *coulisse* disclosing a location which both advances and recedes. At Garches, Le Corbusier replaces Léger's concern for the picture plane with a most highly developed regard for the frontal viewpoint (the preferred views include only the slightest deviations from parallel perspective); Leger's canvas becomes Le Corbusier's second plane; other planes are either imposed upon, or subtracted from, this basic datum. Deep space is contrived in similar coulisse fashion with the façade cut open and depth inserted in the ensuing slot.

One might infer that at Garches, Le Corbusier had indeed succeeded in alienating architecture from its necessary three-dimensional existence, and in order to qualify this analysis, some discussion of the building's internal space is necessary.

On first examination this space appears to be an almost flat contradiction of the façade; particularly on the principal floor, the volume revealed is almost directly opposite to that which we might have anticipated. Thus the glazing of the garden façade might have suggested the presence of a single large room behind and it might have inspired the belief that the direction of this room was parallel with that of the façade. But the internal divisions deny this statement and instead disclose a principal volume whose primary direction is at right angles to that which might have been presumed, while in both principal



10 Garches: first floor plan and roof plan

and subsidiary volumes the predominance of this direction is conspicuously emphasized by the flanking walls.

The spatial structure of this floor is obviously more complex than it appears at first, and ultimately it compels a revision of these initial assumptions. The nature of the cantilevered slots becomes evident; the apse of the dining room introduces a further lateral stress, while the positions of the principal staircase, the void, and the library all reaffirm the same dimension. In these ways the planes of the facade can be seen to effect a profound modification of the deep extension of space which is now seen to approach to the stratified succession of flattened spaces suggested by the external appearance.

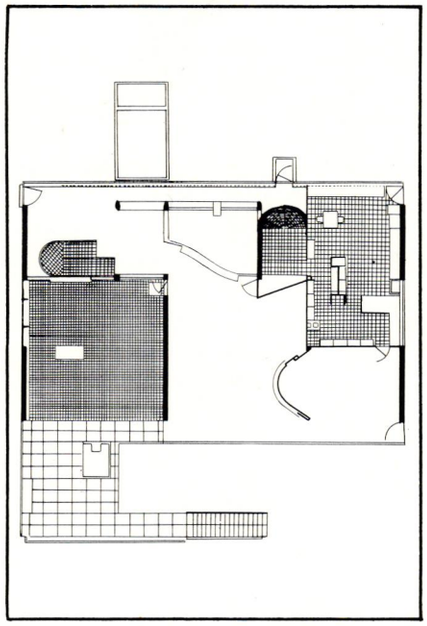
So much might be said for a reading of the internal volumes in terms of the vertical planes; a further reading in terms of the horizontal planes, the floors, will reveal similar characteristics. Thus, after recognizing that a floor is not a wall and that plans are not paintings, we might examine these horizontal planes in very much the same manner as we have examined the façade, again selecting *Three Faces* as a point of departure. A complement of Léger's picture plane is now offered by the roofs of the penthouse and elliptical pavilion, by the summits of the freestanding walls, and by the top of the rather curious gazebo—all of which lie on the same surface. The second plane now becomes the major roof terrace and the coulisse space becomes the cut in this slab which leads the eye down to the terrace below. Similar parallels are very obvious in considering the organization of the principal floor. For here the vertical equivalent of deep space is introduced by the double height of the outer terrace and by the void connecting living room with entrance hall; and here, just as Léger enlarges spatial dimensions through the displacement of the inner edges of his outer panels, so Le Corbusier encroaches upon the space of his central area.

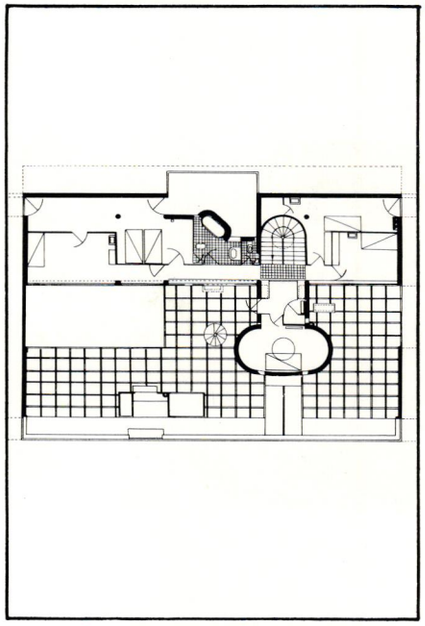
Thus throughout this house there is that contradiction of spatial dimensions which Kepes recognizes as a characteristic of transparency. There is a continuous dialectic between fact and implication. The reality of deep space is constantly opposed to the inference of shallow space; and by means of the resultant tension, reading after reading is enforced. The five layers of space which throughout each vertical dimension divide the building's volume and the four layers which cut it horizontally will all from time to time claim attention; and this gridding of space will then result in continuous fluctuations of interpretation.

These possibly cerebral refinements are scarcely so conspicuous at the Bauhaus; indeed, they are attributes of which an aesthetic of materials is apt to be impatient. In the workshop wing of the Bauhaus it is the literal transparency that Giedion has chiefly applauded, and at Garches it is the phenomenal transparency that has engaged our attention. If with some reason we have been able to relate the achievement of Le Corbusier to that of Fernand Léger, with equal justification we might notice a community of interest in the expression of Gropius and Moholy-Nagy.

Moholy was always preoccupied with the expression of glass, metal, reflecting substances, and light; and Gropius, at least in the 1920s, would seem to have been equally concerned with the idea of using materials for their intrinsic qualities. Both, it may be said without injustice, received a certain stimulus from the experiments of De Stijl and the Russian constructivists; but both were apparently unwilling to accept certain more Parisian conclusions.

For seemingly it was in Paris that the cubist 'discovery' of shallow space was most completely exploited, and it was there that the idea of the picture plane as a uniformly activated field was most entirely understood. With Picasso, Braque,





11 Bauhaus: first floor plan and second floor plan

12 Bauhaus: site plan

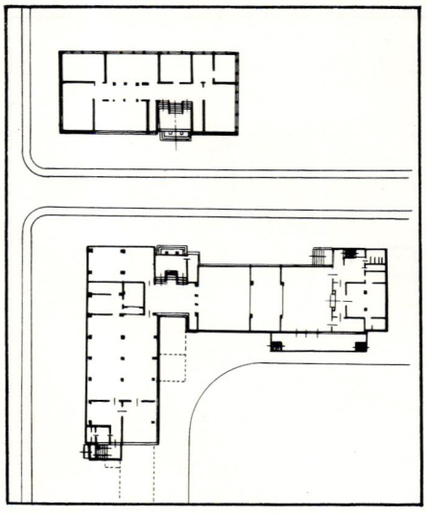
Gris, Léger, and Ozenfant we are never conscious of the picture plane functioning in any passive role. Both it, as negative space, and the objects placed upon it, as positive space, are endowed with an equal capacity to stimulate. Outside the Ecole de Paris this condition is not typical, although Mondrian, a Parisian by adoption, constitutes one major exception and Klee another. But a glance at any representative work of Kandinsky, Malevich, El Lissitsky, or Van Doesburg will reveal that these painters, like Moholy, scarcely felt the necessity of providing any distinct spatial matrix for their principal objects. They are prone to accept a simplification of the cubist image as a composition of geometrical planes, but are apt to reject the comparable cubist abstraction of space. For these reasons their pictures offer us compositions which float in an infinite, atmospheric, naturalistic void, without any of the rich Parisian stratification of volume. And the Bauhaus may be accepted as their architectural equivalent.

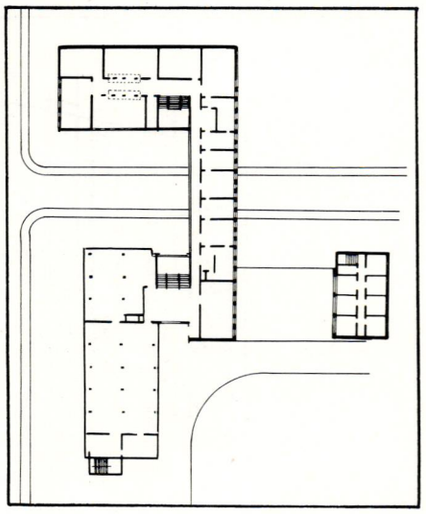
Thus in the Bauhaus complex, although we are presented with a composition of slablike buildings whose forms suggest the possibility of a reading of space by layers, we are scarcely conscious of the presence of spatial stratification. Through the movements of the dormitory building, the administrative offices, and the workshop wing, the first floor may suggest a channeling of space in one direction. Through the countermovement of roadway, classrooms, and auditorium wing, the ground floor suggests a movement of space in the other. A preference for neither direction is stated, and the ensuing dilemma is resolved, as indeed it must be in this case, by giving priority to diagonal points of view.

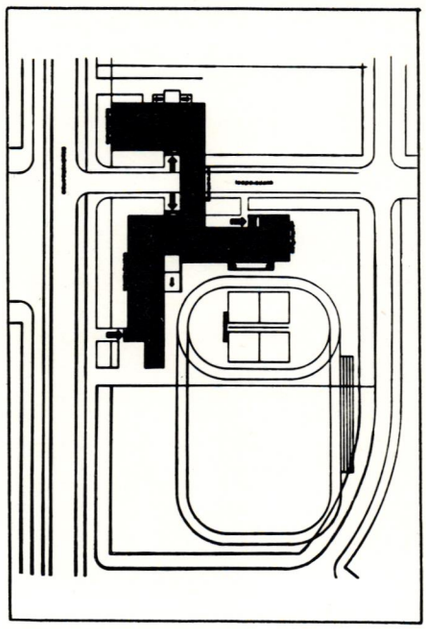
Much as Van Doesburg and Moholy eschewed frontality, so did Gropius; and it is significant that, while the published photographs of Garches tend to minimize factors of diagonal recession, almost invariably the published photographs of the Bauhaus tend to play up just such factors. The importance of these diagonal views of the Bauhaus is constantly reasserted—by the translucent corner of the workshop wing and by such features as the balconies of the dormitory and the protruding slab over the entrance to the workshops, features which require for their understanding a renunciation of the principle of frontality.

The Bauhaus reveals a succession of spaces but scarcely 'a contradiction of spatial dimensions.' Relying on the diagonal viewpoint, Gropius has exteriorized the opposed movements of his space, has allowed them to flow away into infinity; and by being unwilling to attribute to either of them any significant difference of quality, he has prohibited the possibilities of a potential ambiguity. Thus only the contours of his blocks assume a layerlike character; but these layers of building scarcely act to suggest a layerlike structure of either internal or external space. Denied the possibility of penetrating a stratified space which is defined either by real planes or their imaginary projections, the observer is also denied the possibility of experiencing the conflict between a space which is explicit and another which is implied. He may enjoy the sensation of looking through a glass wall and thus perhaps be able to see the exterior and the interior of the building simultaneously; but in doing so he will be conscious of few of those equivocal sensations which derive from phenomenal transparency.

Le Corbusier's League of Nations project of 1927, like the Bauhaus, possesses heterogeneous elements and functions that lead to an extended organization, and to the appearance of a further feature which both buildings have in common: the narrow block. But here again similarities cease, for while the Bauhaus blocks pinwheel in a manner highly suggestive of constructivist compositions, in the League







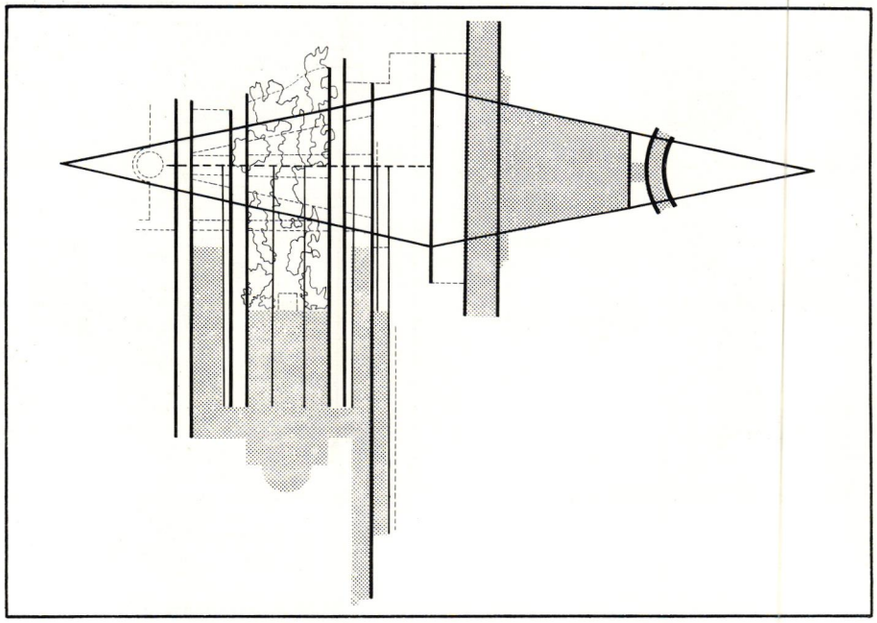
13 League of Nations: plan

of Nations these same long blocks define a system of striations almost more rigid than that at Garches.

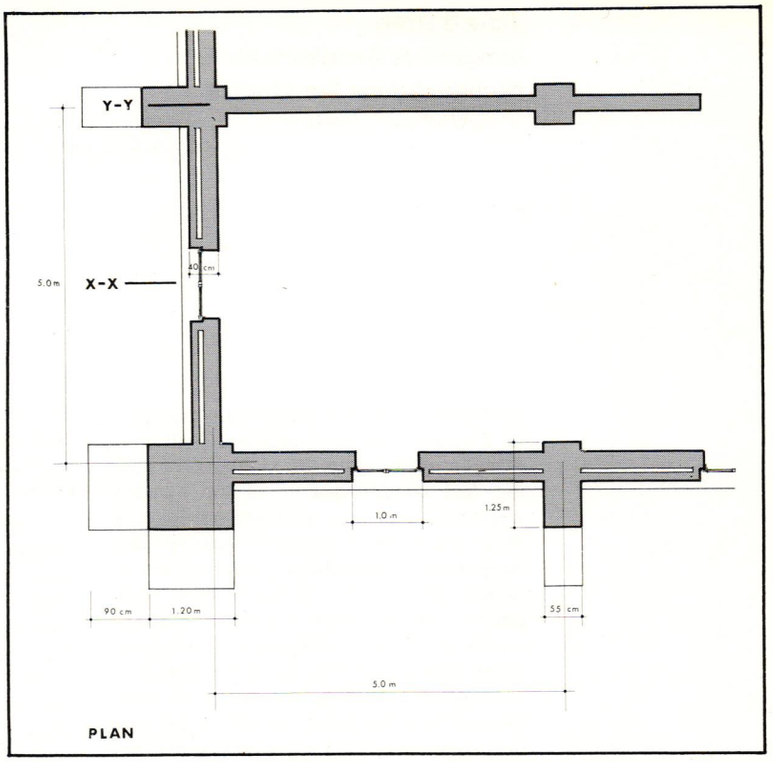
In the League of Nations project lateral extension characterizes the two principal wings of the Secretariat, qualifies the library and book-stack area, is re-emphasized by the entrance quay and the foyers of the General Assembly Building, and dominates even the auditorium itself. There, the introduction of glazing along the side walls, disturbing the normal focus of the hall upon the presidential box, introduces the same transverse direction. The contrary statement of deep space also becomes a highly assertive proposition. It is chiefly suggested by a lozenge shape whose main axis passes through the General Assembly Building and whose outline is comprised by a projection of the auditorium volume into the approach roads of the *cour d'honneur* (Fig 13). But again, as at Garches, the intimations of depth inherent in this form are consistently retracted. A cut, a displacement, and a sliding sideways occur along the line of its major axis; and as a space, it is repeatedly scored through and broken down into a series of lateral references—by trees, by circulations, by the momentum of the buildings themselves—so that finally, through a series of positive and negative implications, the whole scheme becomes a sort of monumental debate, an argument between a real and ideal space.

We will presume the Palace of the League of Nations as having been built and an observer following the axial approach to its auditorium. Necessarily, he is subjected to the polar attraction of its principal entrance. But the block of trees which intersects his vision introduces a lateral deflection of interest, so that he becomes successively aware, first, of a relation between the flanking office-building and the foreground parterre, and second, of a relation between the crosswalk and the courtyard of the Secretariat. And once within the trees, beneath the low umbrella they provide, a further tension is established: the space, which is inflected toward the auditorium, is defined by, and reads as, a projection of the book stack and library. While finally, with the trees as a volume behind him, the observer at last finds himself standing on a low terrace, confronting the entrance quay but separated from it by a rift of space so complete that it is only by the propulsive power of the walk behind him that he can be enabled to cross it. With his arc of vision no longer restricted, he is now offered the General Assembly Building in its full extent; but since a newly revealed lack of focus compels his eye to slide along this facade, it is again irretrievably drawn sideways, to the view of the gardens and the lake beyond. And should the observer turn round from this rift between him and his obvious goal, and should he look at the trees which he has just left, the lateral sliding of the space will only become more determined, emphasized by the trees themselves and the cross alley leading into the slotted indenture alongside the book stack. If the observer is a man of moderate sophistication, and if the piercing of a screen or a volume of trees by a road might have come to suggest to him that the intrinsic function of this road is to penetrate similar volumes and screens, then by inference the terrace on which he is standing becomes not a prelude to the auditorium, as its axial relationship suggests, but a projection of the volumes and planes of the office building with which it is aligned.

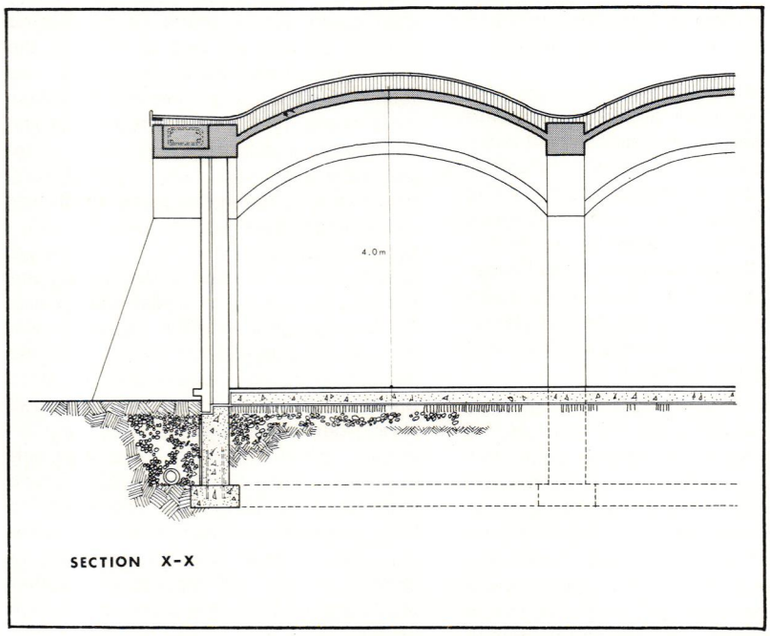
These stratifications, devices by means of which space becomes constructed, substantial, and articulate, are the essence of that phenomenal transparency which has been noticed as characteristic of the central postcubist tradition. They have never been noticed as characteristic of the Bauhaus, which obviously manifests a completely different conception of space. In the League of Nations project Le Corbusier provides the observer with a series of quite specific locations: in the Bauhaus



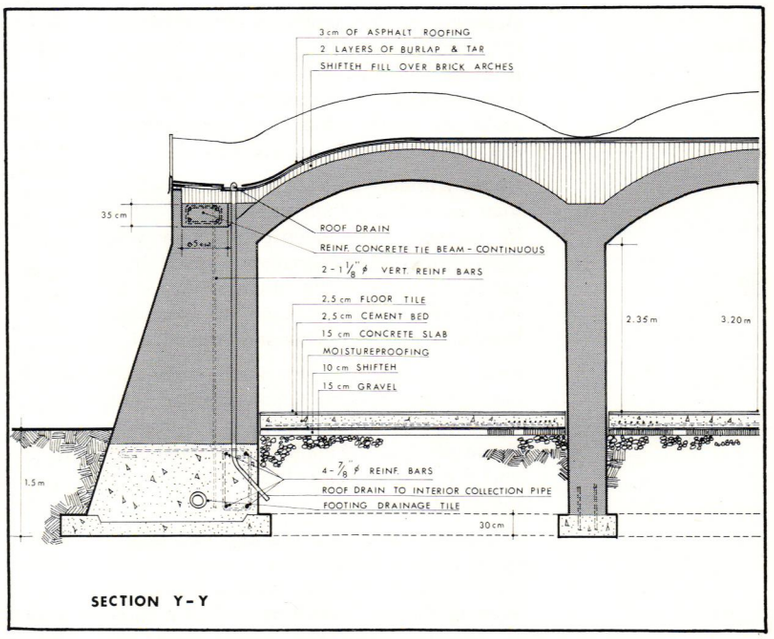
Left: Example of indigenous construction
Drawings: United States Consulate for Tabriz, Iran, designed by Barnes



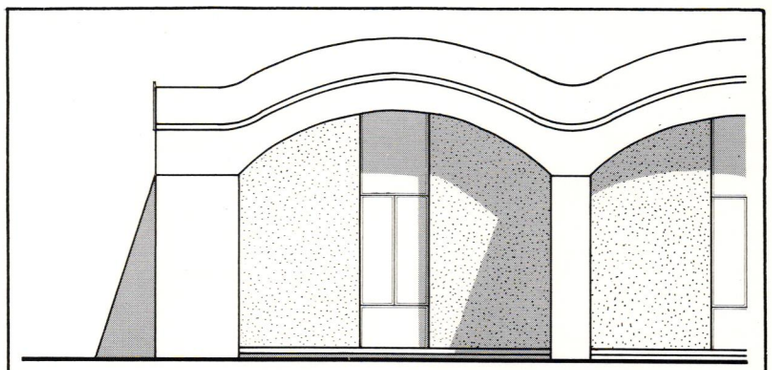
PLAN



SECTION X-X



SECTION Y-Y



ELEVATION

Jane B Drew
Indigenous Architecture: Architecture in the Tropics

Architecture for the developing peoples, as they are now well called—the millions of India, Africa, and the Middle East who are fast becoming part of the modern world—is a very great problem, particularly since education is acquired more quickly than wealth. An architect, if he wishes to devote part of his life to helping such people, should know the basic requirements of tropical building and the great difference in building for a hot–dry or a hot–wet climate. The subject is a complicated one, for there are differences not only in housing but town planning and the methods of siting buildings.

Grasping all the technical difficulties is only the beginning of the problem, because it is likely that poverty will rule out modern methods of construction, and that stabilized earth, rather than curtain walling, will prove the right answer.

In many areas labor costs are so low that men are cheaper than machines. In India, for example, even much of the employed labor is really disguised unemployed labor. We found in India that it was cheaper to use seven hundred people to excavate than to employ an excavating machine!

I do not mean that first-quality scientific and artistic thought is not required; but the mind that is most useful in the tropics is one which can think from first principles and can readily grasp the possibilities of local materials.

The person who first realized that Basra reeds could be stapled by a machine and turned into an efficient thermal insulating material did very useful work. This capacity for the adaptation, rather than the adoption, of local practice is one of the abilities required by any architect undertaking work in the underdeveloped territories.

It need not mean backward-looking architecture. Le Corbusier's High Court and Secretariat were built with the aid of donkeys, men, women, and children. For our own work in West Africa, mammies, as the mothers are called, often laboriously broke the stones used as aggregate for the concrete. In India we used brickwork, which was cheap and available for almost everything—including roofs, for which we used brick in combination with pencil prestressed-concrete beams. We insulated with earth. We built houses for $473.76.

Building for the poor means building close together. This is an architectural opportunity. It means that streets can be thought of as total design in a fashion difficult to achieve in richer countries where housing is often detached. We therefore designed services and housing together, with street lights, for example, attached to the houses themselves, and with cables along eaves and on crossover connections between houses, the cost of underground cabling being out of the question.

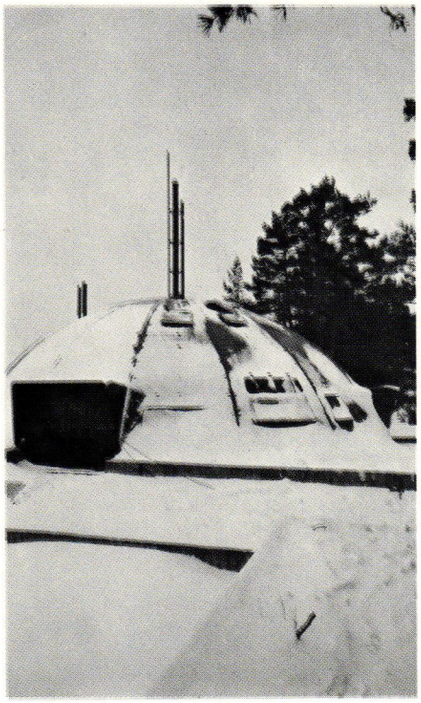
Good modern technique can be combined with old tradition. For example, we found no difficulty in making shell concrete or prestressed concrete, or in stabilizing earth. Aesthetics are to a large extent dictated by climatic needs (I am not speaking of air-conditioned buildings). The dry tropics require small openings and thick walls and ceilings. The humid tropics require plenty of openings and ventilated roofs. Sun angles and shading devices are common to both kinds. Beyond this, there are adjustments which the harsh sunlight makes essential.

One of our more difficult problems was to find out how people wanted to live: which habits were part of their lives and which were changing, and at what speed. In India we found that the traditions regarding untouchability and sweeper access were breaking down; also, the large Indian joint-family was not regarded with much favor by the young. We found that modern kitchens were welcomed, but that *chapatis* (a traditional food used every day) could not be made on an electric cooker, so that we had to improve the traditional wood-fired *chula*. In Iran we found that, although certain traditions were changing, the carpet room was still sacrosanct, and that the way of life meant that halls were important. These factors, which vary from place to place, mean that the architect does well to study the architectural traditions, but he should always question them. The task is demanding and requires something of a missionary spirit, for the foreigner is often regarded with distrust. One should not assume that the West is, in all ways, better than the more primitive countries. To eat with a washed hand from washed leaves, beautifully arranged, is not worse but better than eating from a badly designed piece of china with some horrid cutlery. The ability to imagine how one's customs seem to someone else is rare. One can do little to change oneself, but respect for another man's way of life makes working with him easier.

Ralph Erskine
Indigenous Architecture: Architecture in the Subarctic Region

The exchange of impulses has always enriched a culture; the transcribing of forms has always debased an art and the symbols it uses. Can it be right that an office building should look like a palace, or a medical school like a temple? Should a modern building try to evoke an ancient one? Architecture can sometimes acquire a symbolic value in the mind of the observer, but such experiences can never be an adequate basis for an architectural philosophy. An office building is an office building, good or bad, and not a temple or a palace.

The individual artistic belief must always be tested against the specific functional situation. My own attempt to arrive at an architecture appropriate to the subarctic region sometimes produces forms into which critics have read 'action' or 'movement.' I have hoped that such forms result directly from climate and function, and that the doing may be accomplished with some artistry; but the act itself arises out of human and technical needs in a specific situation in place and time, and not out of formalism, and where this is not true it is a sign of weakness in my work, not of strength.



In my first buildings for the subarctic I was still involved with the forms of the current idiom—that is, with preconceived ideas. Some of them proved to be expensive and inefficient, although I still find that visually they are relatively attractive. Technical, organizational, and economic untruths had been built into the aesthetics. To find a way out of this unsatisfactory impasse I had to try to understand the specific needs of the people, the technique, the land, and the climate with which I was working.

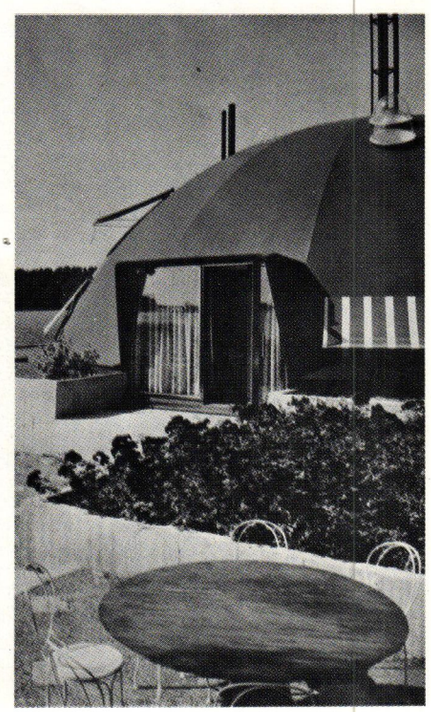
The design illustrated was my first fairly indigenous building. It is very much based on the seasonal rhythm of life in the north: the completely protected winter cell, the surrounding semiprotected spaces for spring and fall, and, beyond them, free summer life in a natural landscape.

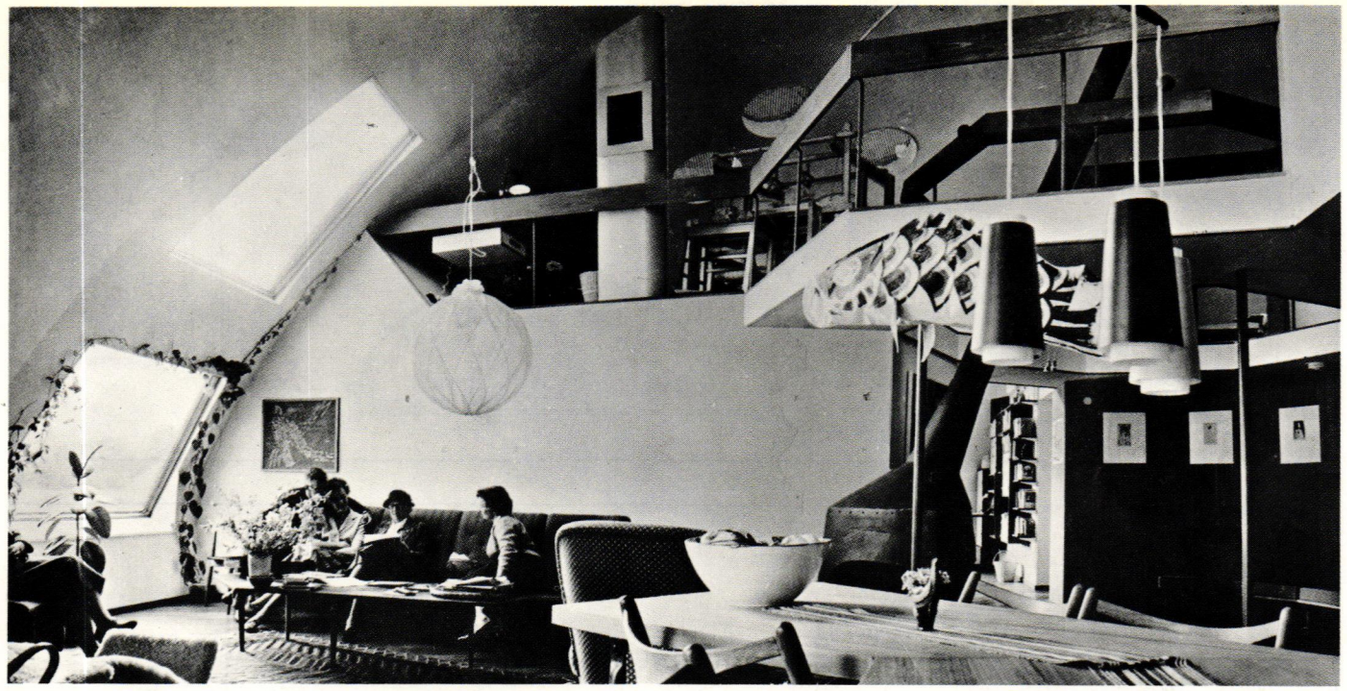
One hundred years ago the subarctic was inhabited by Lapps and Eskimos. Today it is growing rapidly in importance and attracting more and more settlers. They are moving from populous areas to small towns in an isolated land and must be given the amenities they previously enjoyed.

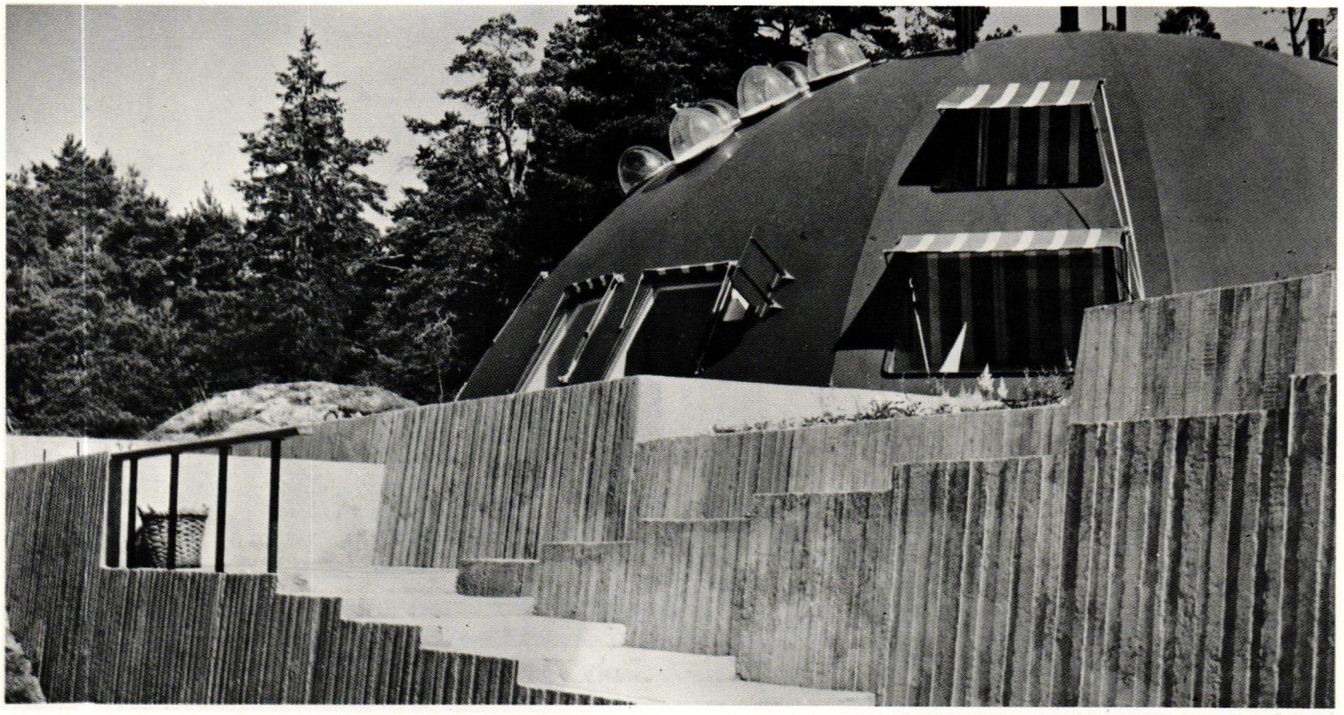
Northern towns must become free of the 'colonial' attitude and base their culture on their own way of life. Even more than other cities they need rationalization and standardization, as building costs are enormous; but in this landscape, where nature is dominant and the 'human' the exception, human choice, both rational and irrational, should be intensified and protected.

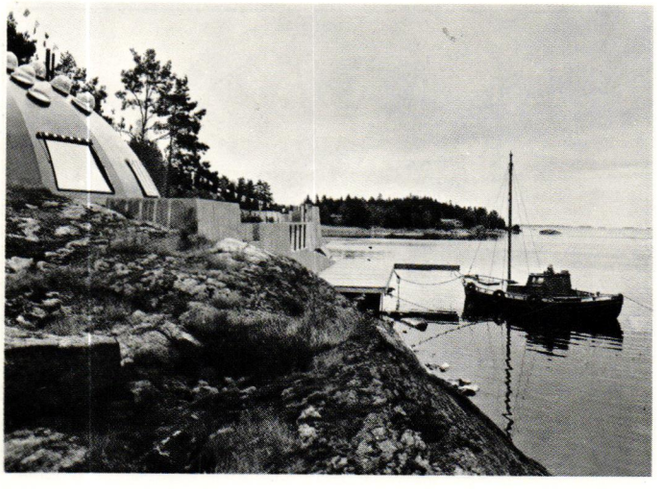
It is natural for settlers who move to a new country to attempt to recreate their old homes; but in the subarctic this can never be successful. Modern man, like the Eskimo before him, must use his resources to arrive, by analysis and synthesis, at an indigenous culture.

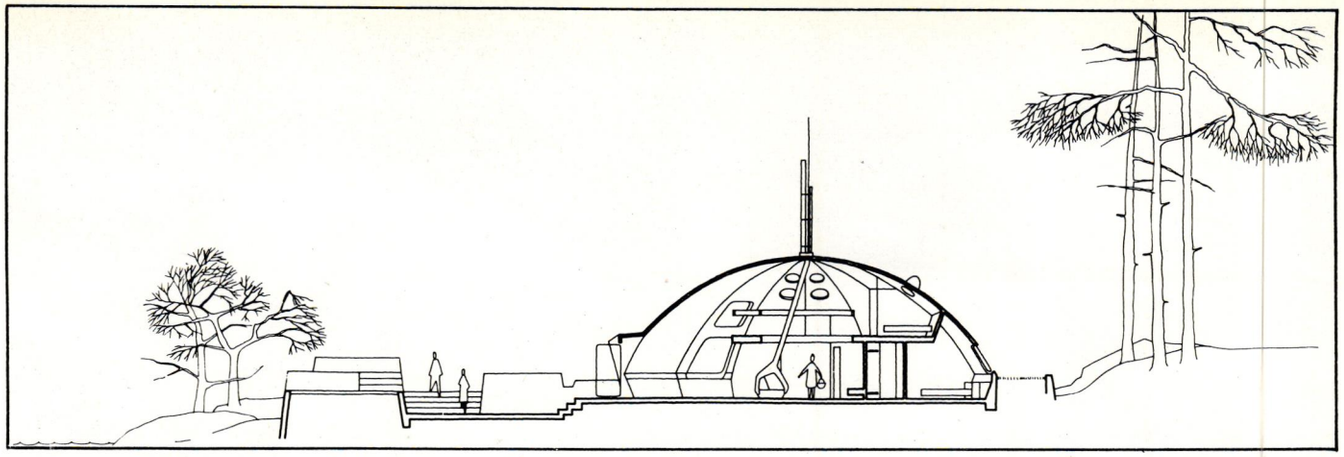
Left: Terrace entrance, winter
Center: Terrace entrance, summer
Above right: Living room
Middle right: View from pier
Below center: View along shore
Below right: Living room from entry

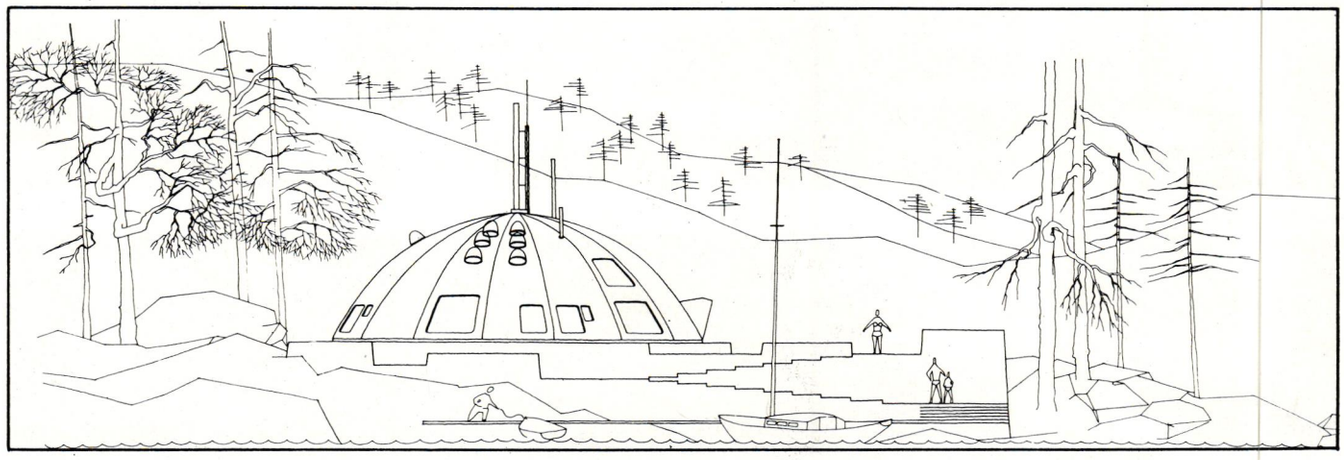


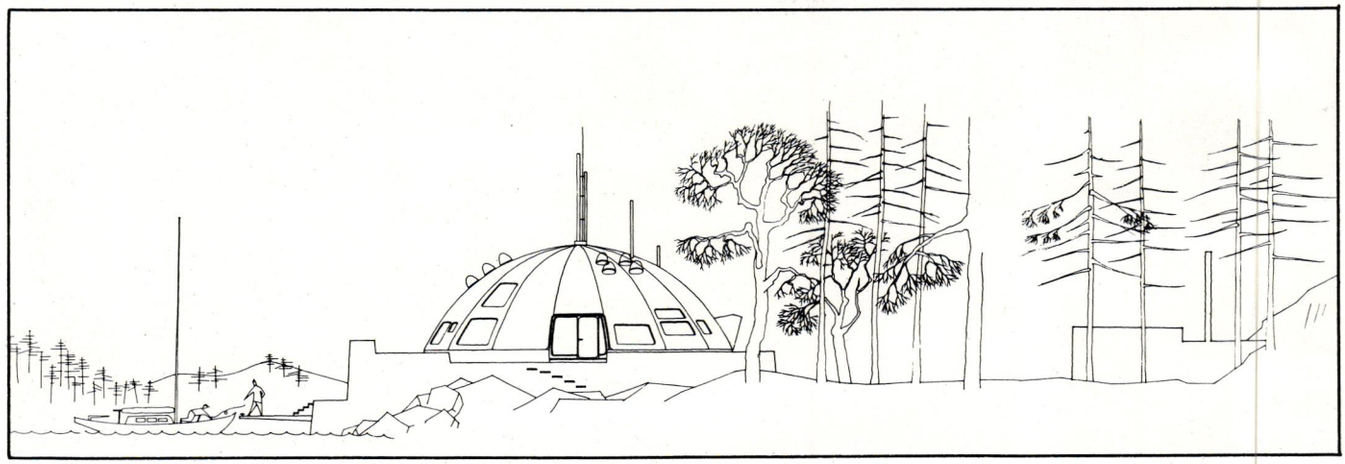


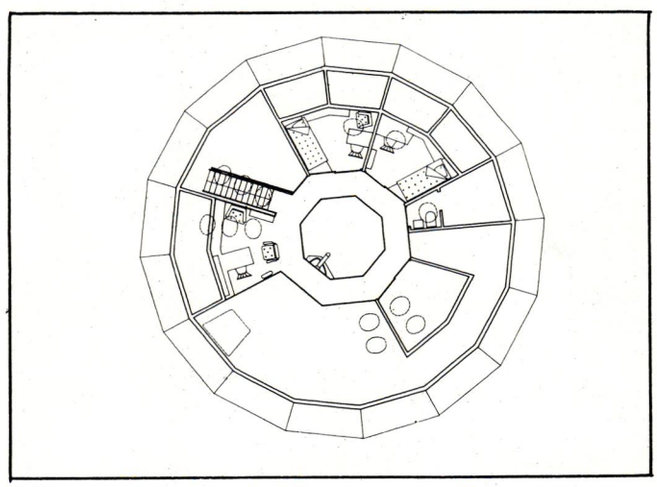


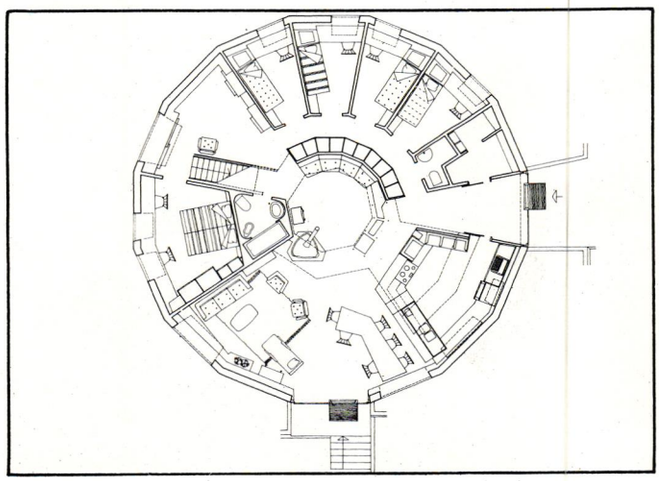


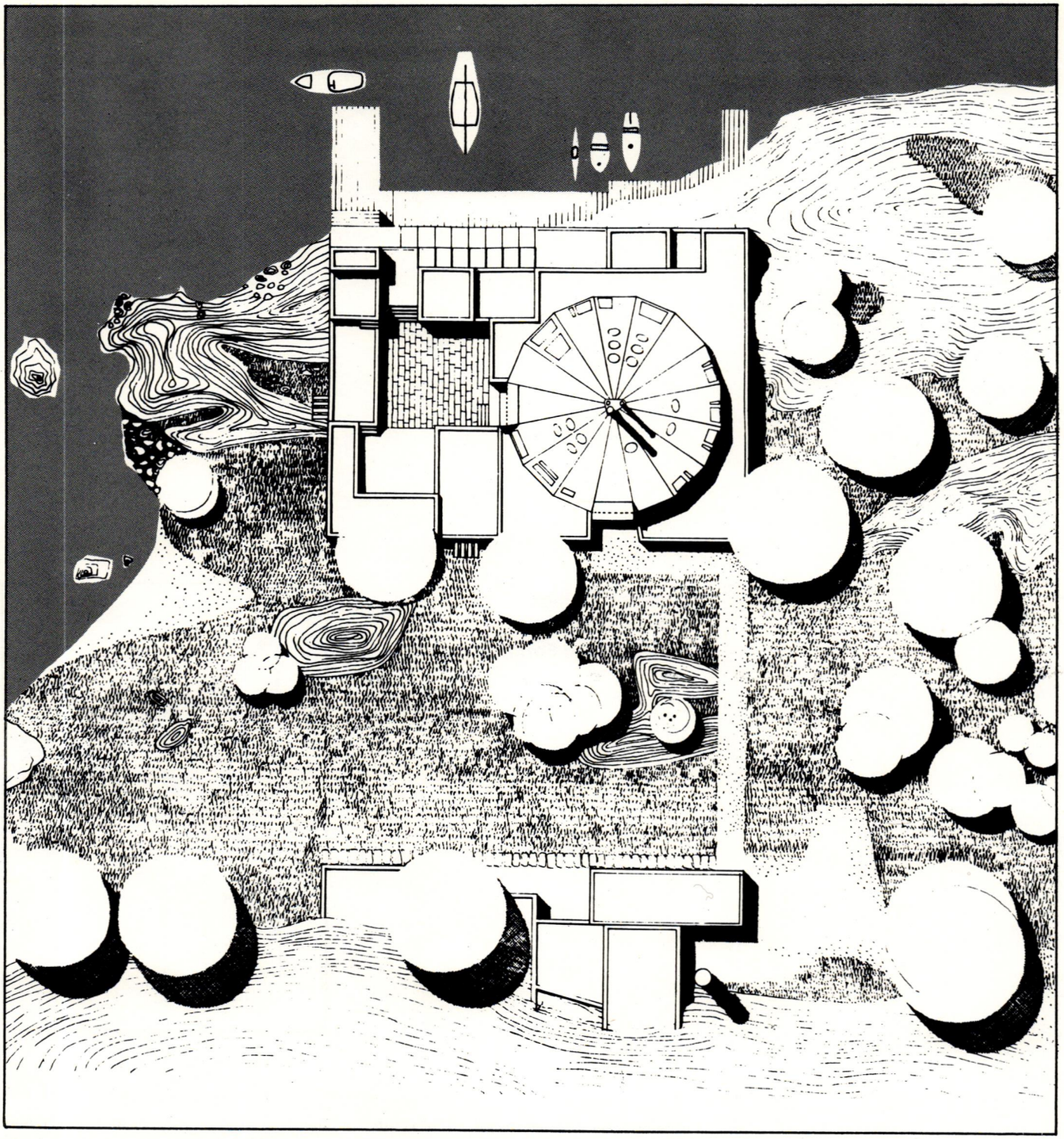








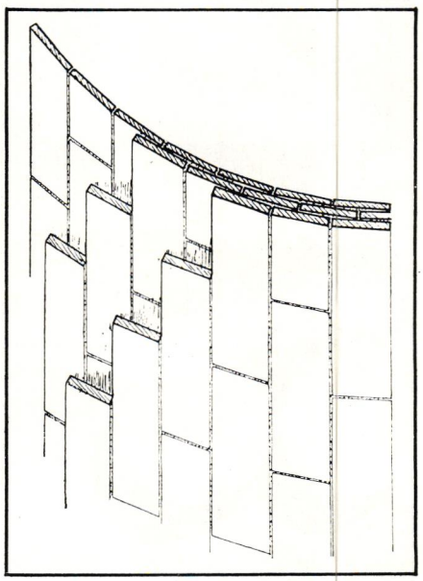




Above left: Section, seaside elevation and entrance elevation
Below left: Upstairs plan
Below center: Downstairs plan
Right: Plot plan

George R Collins

Antonio Gaudí: Structure and Form



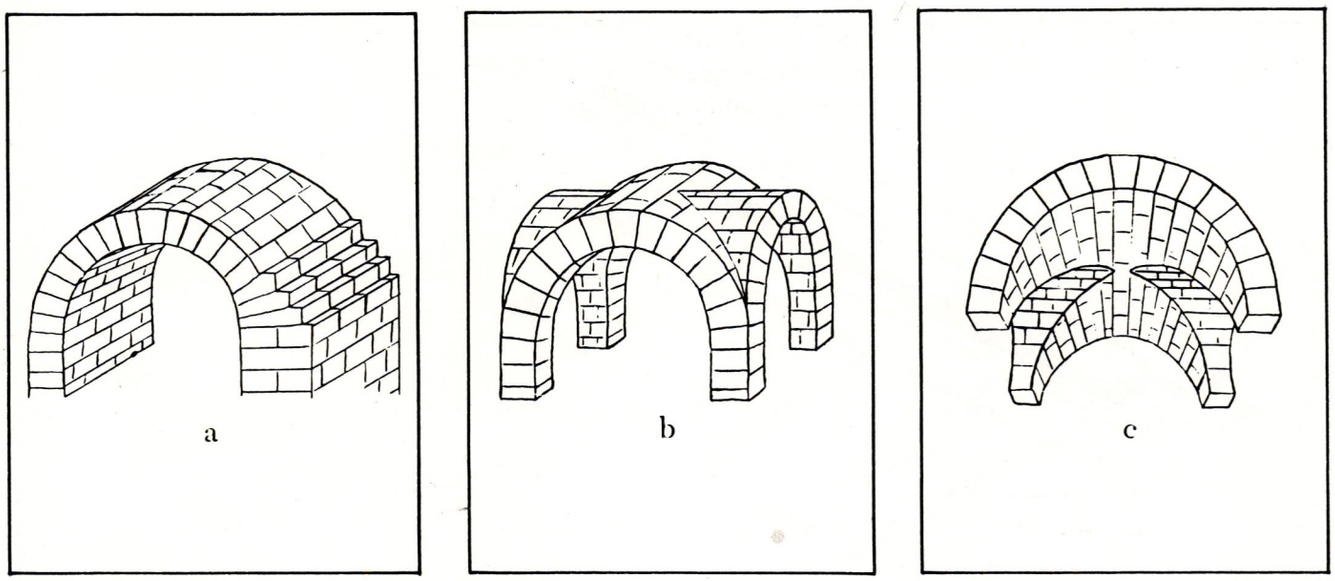
1 *Bóveda tabicada*—method of assembly

Contemporary interest in the architecture of Gaudí has arisen in part from a realization that the unusual structures and shapes that he employed have something in common with our own remarkable shell-vaulted forms of today. However, the precise nature of this connection has never been stated. We have not, on the one hand, had available to us a clear and comprehensive exposition of Gaudí's structural theory and practice, nor have architectural historians taken sufficient notice as yet of those changes in modern ideas about structure which underlie the very buildings that most 'resemble' Gaudí's.

The matter is not entirely confined to the single architect Gaudí: it has its roots in a resurgence of methods of building in late nineteenth-century Catalonia that were simultaneously ancient and prophetic—methods that actually spread from Valencia and Barcelona to our own doorstep, in the form of the vaults of Pennsylvania Station, the Boston Public Library, the New York subways, a score of cathedrals, and hundreds of other edifices. The structural aspect of these American buildings has never received serious historical study.* However, the particular fascination of Gaudí for us lies in the fact that his buildings, drawing upon the same Catalan traditions, did not resemble Pennsylvania Station or the Cathedral of St. John the Divine, but look more like the buildings of today.

In order to understand the structural component of Gaudí's architecture, we must familiarize ourselves with the traditional Catalan building methods which he inherited and furthered. These were quite sim-

2 Normal voussoir vaulting



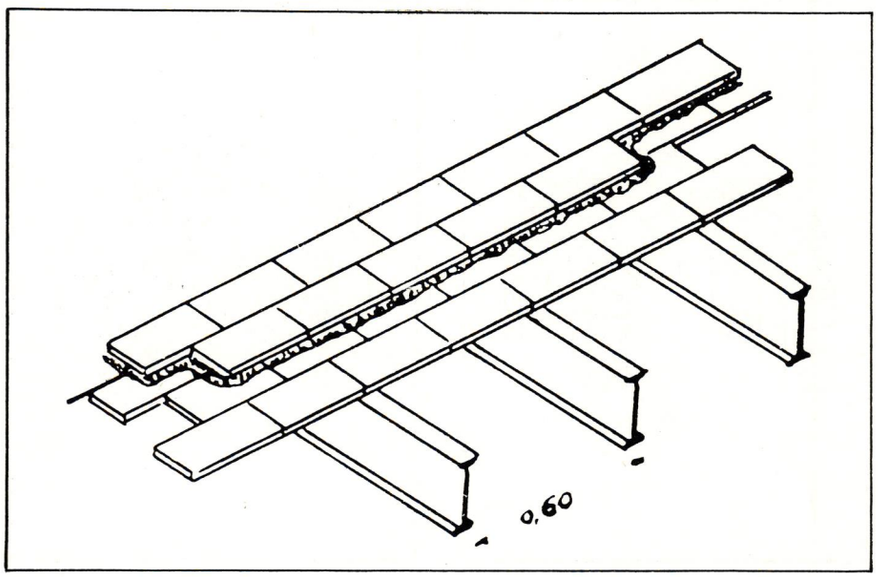
ple and very reasonable, but as they seem to flaunt our usual ideas about structural function, it would be useful to indicate here certain of their basic—and unique—aspects.

The Catalan procedures with which we are concerned are all based on the use of a specially resistant, broad, flat tile, about an inch thick and 6 by 12 inches in area. It is laid flat—that is to say, with narrow edge to narrow edge (Figs 1, 9), rather than with the broad sides against each other in 'voussoir' fashion (Fig 2). These tile courses are usually laminated in sufficient layers to resist the moment of stress at any particular point; homogeneity is achieved by breaking joints, often doubly in a herringbone pattern such as one sees in Widener Library or the United States War College. Part of the efficiency of this masonry derives from the excellence of the tiles, which are frequently stronger than stone and of such hardness that they ring when struck with a trowel. The Spaniards employ a variety of types of tile, bearing different names according to their thickness; they may or may not be hollow.

However, the character of the mortar employed is fully as crucial. It is quite thick, occupying up to 50 per cent of the depth of the masonry. Except in the first layer, where plaster of Paris is used in order to achieve an immediate 'set,' the cement mortars employed in modern times have been so strong that the masonry usually breaks or pulls apart across the tiles (not at their joints) as would occur with plywood or wood stuck together by joiner's glue. In fact, a simple way to distinguish Catalan from other brick or tile masonry construction is that in Catalan work the fragments of a wrecked building cannot be used over again, whereas ordinarily bricks can be cleared of adhering mortar and largely reused for the next structure.

A final characteristic of Catalan methods is the dramatic manner in which the masonry takes shape in the hands of a skilled artisan. Templates may be used when the surfaces are of complicated geometrical form, and scaffolding is sometimes needed for the workers, but the setting of the first, plaster-of-Paris layer is so quick that ordinarily no centering is necessary in the erection of vaults. The cement in the upper layers is so excellent that vaults can be walked upon within 24 hours; thus masons can work 'overhand,' supporting themselves, as work continues, on the previous day's masonry. If we add to this the fact

3 A *solera* laid on I-beams to form a floor



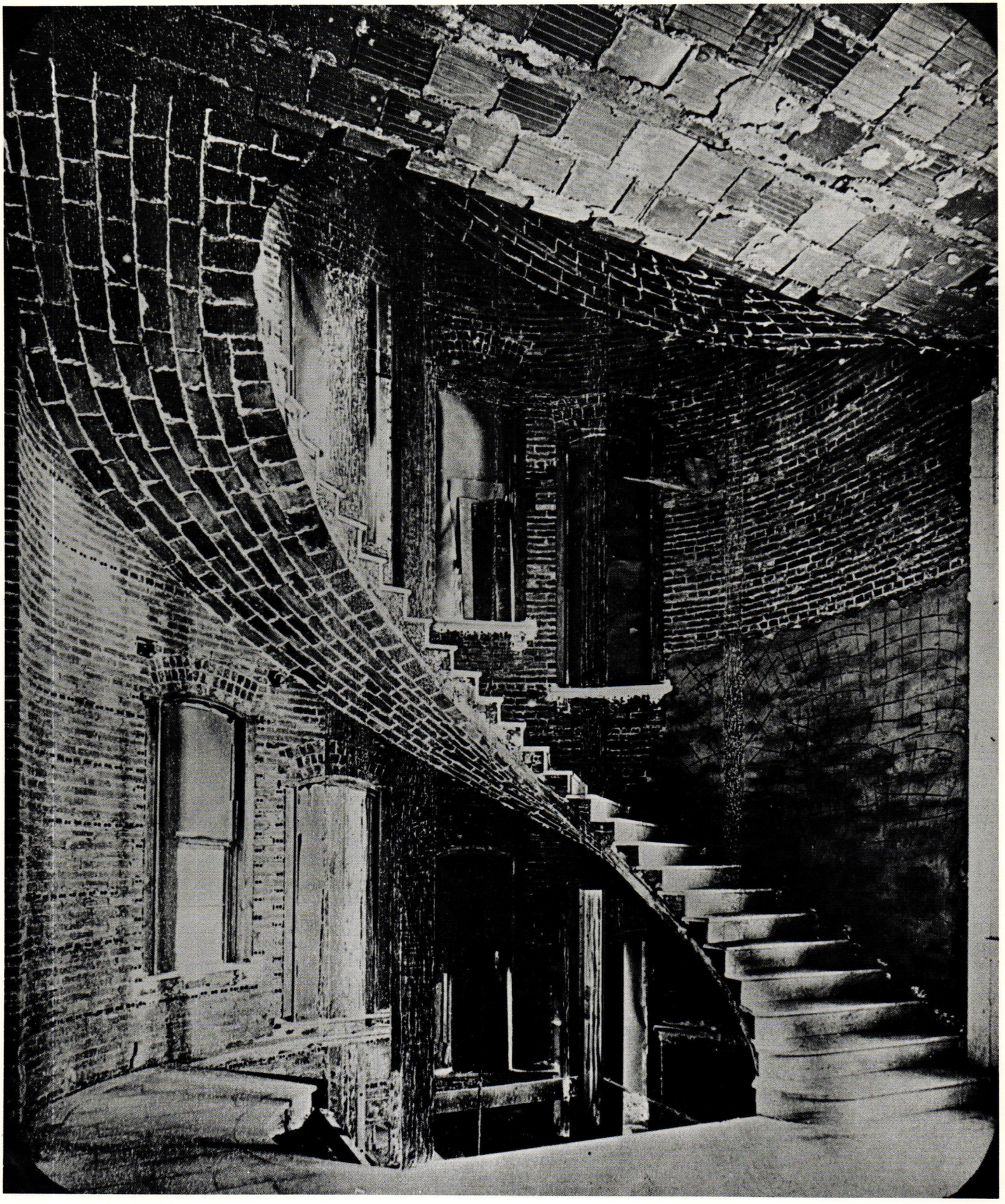
that Catalan masons tend to proceed from experience, following a simple gesture from their foreman rather than blueprints, and the fact that the resulting vaults possess the appearance and many of the gravity-defying properties of our modern thin-shell vaults, it then becomes clear why Catalan masons have been thought to be the magicians of the building trades, and why they have been exported in gangs to many lands to erect their famous vaults and stairs.

Simplest of their devices is the *solera,* or 'deck' surface, laid directly upon beams or on diaphragm arches to serve as a floor, a ceiling, or a roof (Fig 3). This may be flat or it may undulate, thereby deriving additional strength from its doubly-curved surface. As observable in the diagram, the span between supports does not exceed two tile-lengths, so that an appreciable number of the tiles actually lie athwart the beams. However, to visualize the device properly, one must think of it as possessing the cohesive homogeneity of a piece of thick cardboard and not as being made up of a series of tiles, any one of which might fall out if released by its neighbors.

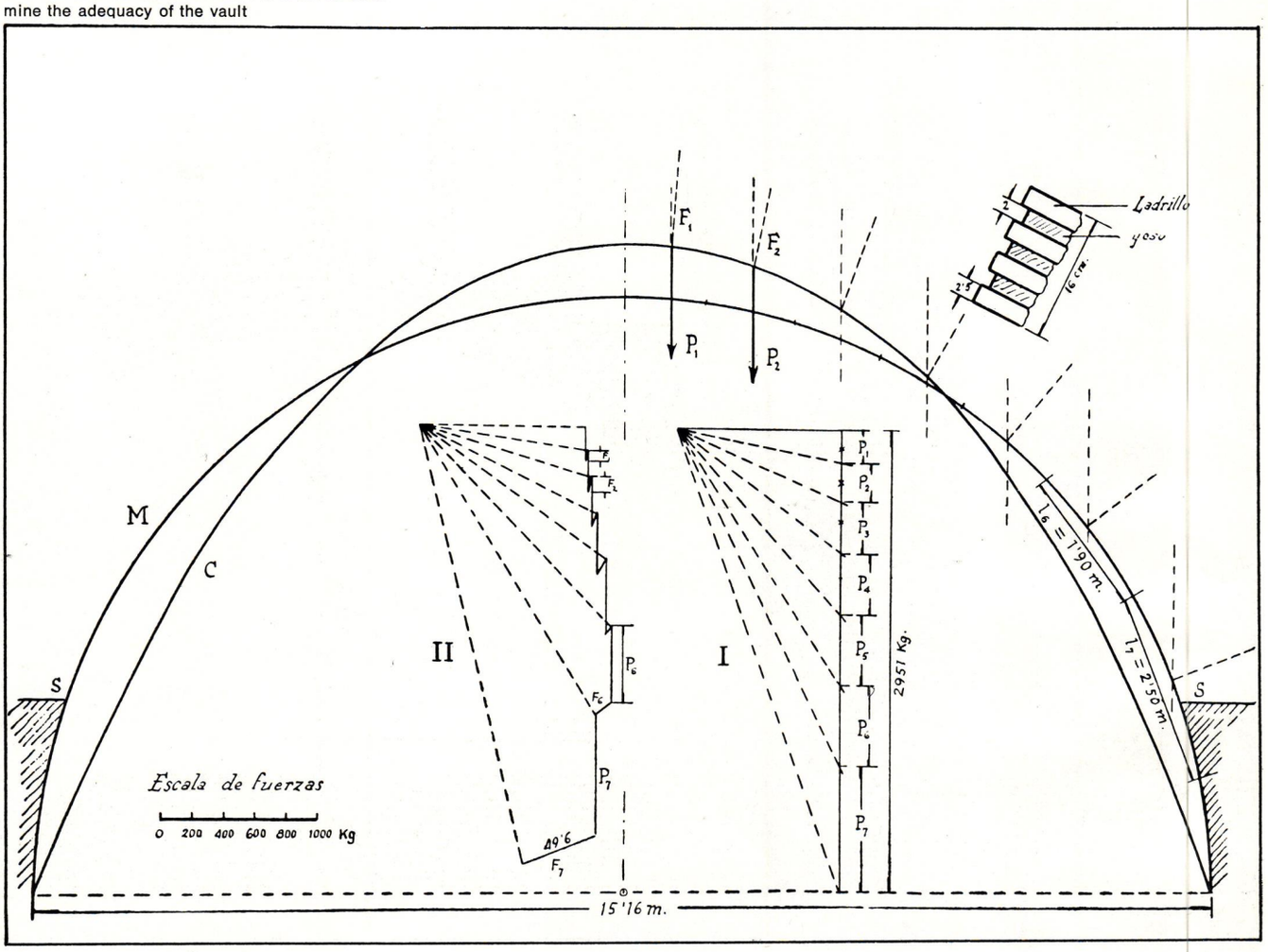
A second element is the *tabique de panderete,* a thin wall of tiles laid edge to edge, one tile thick. Although this is customarily employed in a flat, non-bearing capacity as a partition wall, Gaudí used it in exceptional fashion: undulating so as to take on greater rigidity (Fig 17) and as a supporting diaphragm arch (Fig 14). The word *panderete* (tambourine) gives a clear sense of the structural refinement and tautness of this device. *(Tabique* means partition.)

Most typical element of the Catalan structural vocabulary is the *bóveda tabicada,* or 'broad vault,' i.e. a vault of the thickness and properties of a bent or molded board (Fig 1). Its curvature is usually slight, only about one foot in ten, so that the vault does indeed seem flat and boardlike. It is composed of laminated layers of tiles running concentrically to its line of pressures, instead of perdendicular as in a voussoir arch. It is in connection with these vaults, which he called *bóvedas de panderete* (timbrel or tambourine vaults), that Rafael Guastavino made the interesting distinction between what he called gravity and cohesive types of construction. Gravity construction is any structure, trabeated or arcuated, in which the individual parts are held together primarily by the force of gravity; it is of no consequence whether

4 Elliptical spiral stairway in First National Bank, Paterson, N.J., c. 1890. Guastavino system



5 Parochial church of St. Augustine, Barcelona. Catalan tile vaulting has resisted solution by theories of elasticity, plates, etc., and has generally been handled by simple empirical formulae. Gaudí treated such vaults as stone arches: he laid out a catenary (C) of equal length and span as the vault M. The polygon of forces I corresponds to this funicular C, its strings being parallel to the midpoints of the vertical divisions of the funicular. The strings of polygon II have the same relation to the semi-circular vault M. The F forces are those that would be necessary to make the funicular pass through the vault; the critical one, F_7, is checked mathematically against the resistance of unit l_7 at the haunch of the vault in order to determine the adequacy of the vault

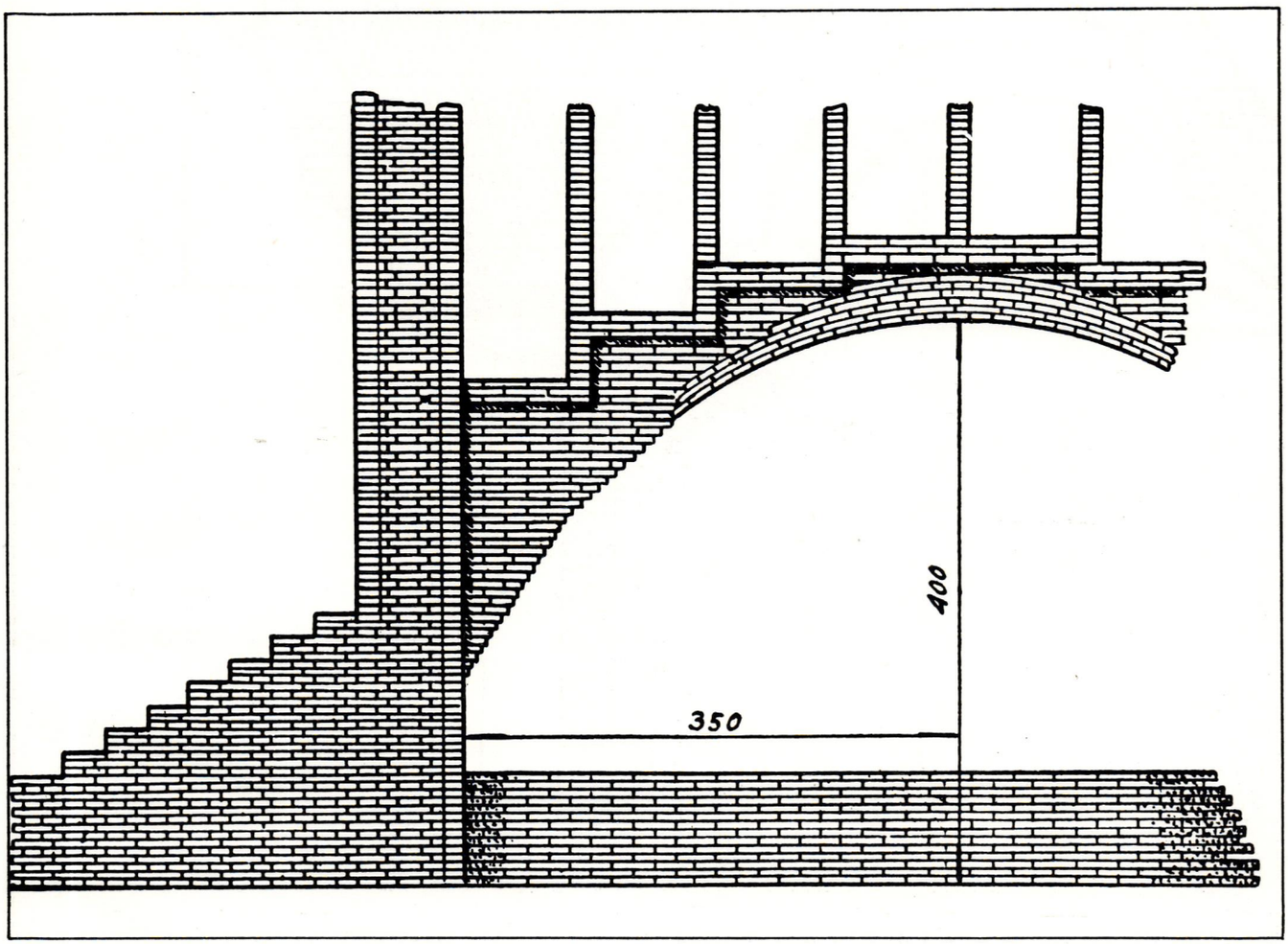


the part be supported by a post or block between itself and the ground, or if it be a voussoir supported by the friction of its own surfaces against the surfaces of its neighbors. In either case, whether or not mortar is employed as a cushion, the parts obtain their stability chiefly from the force of gravity. Cohesive construction, on the other hand, consists of a stuck-together mass, whose elements have lost their independence and adhere to each other, even in defiance of gravitational pull. Needless to say, our histories of architecture have until now restricted themselves almost exclusively to the development of gravity systems, except for certain discussions of concrete. The cohesive aspects of Sassanian, Byzantine, Moslem, Turkish and medieval brick vaults have received almost as short shrift as has the Catalan tradition with which we are concerned here. John Fitchen's recent book on vaulting is an exception.

The *bóveda tabicada* may assume almost any shape and, like modern thin shells, it derives its strength from the properties of its particular geometric form rather than from the thickness of its fabric, which should be minimal. While it may be employed as a single cylindrical vault, it is more efficient in surfaces of double curvature. A favorite is the *bóveda vaída tabicada,* a domical vault that is actually a spherical segment and, like most Catalan vaults, has a very low rise. Gaudí is remarkable for the variety of forms he imparted to the *bóveda tabicada.* He observed, 'The *bóveda tabicada* is the most precious element of our construction; it permits us to execute with simplicity and rapidity the most complex forms, it does not require centering, and it has great resistance in comparison with its lightness and the simplicity of its components.' It is not merely a covering surface, but can carry great loads, as witnessed by the approaches to the Queensborough Bridge in New York City.

There are two special applications of the *bóveda tabicada* that deserve mention here. One is the *bovedilla,* a little vault set in between metal I-beams or into metal frames. This is a standard way to construct the floors of a multi-storied building. If these vaults are flat enough so that their rise does not exceed the distance between upper and lower flanges of the I-beams, they will nestle neatly into the metal floor-framework and, because of the very slight vertical component in their thrust, they will

6 Cascade in the garden of the Casa Vicens, Barcelona, 1878-80 (After Bergós.)

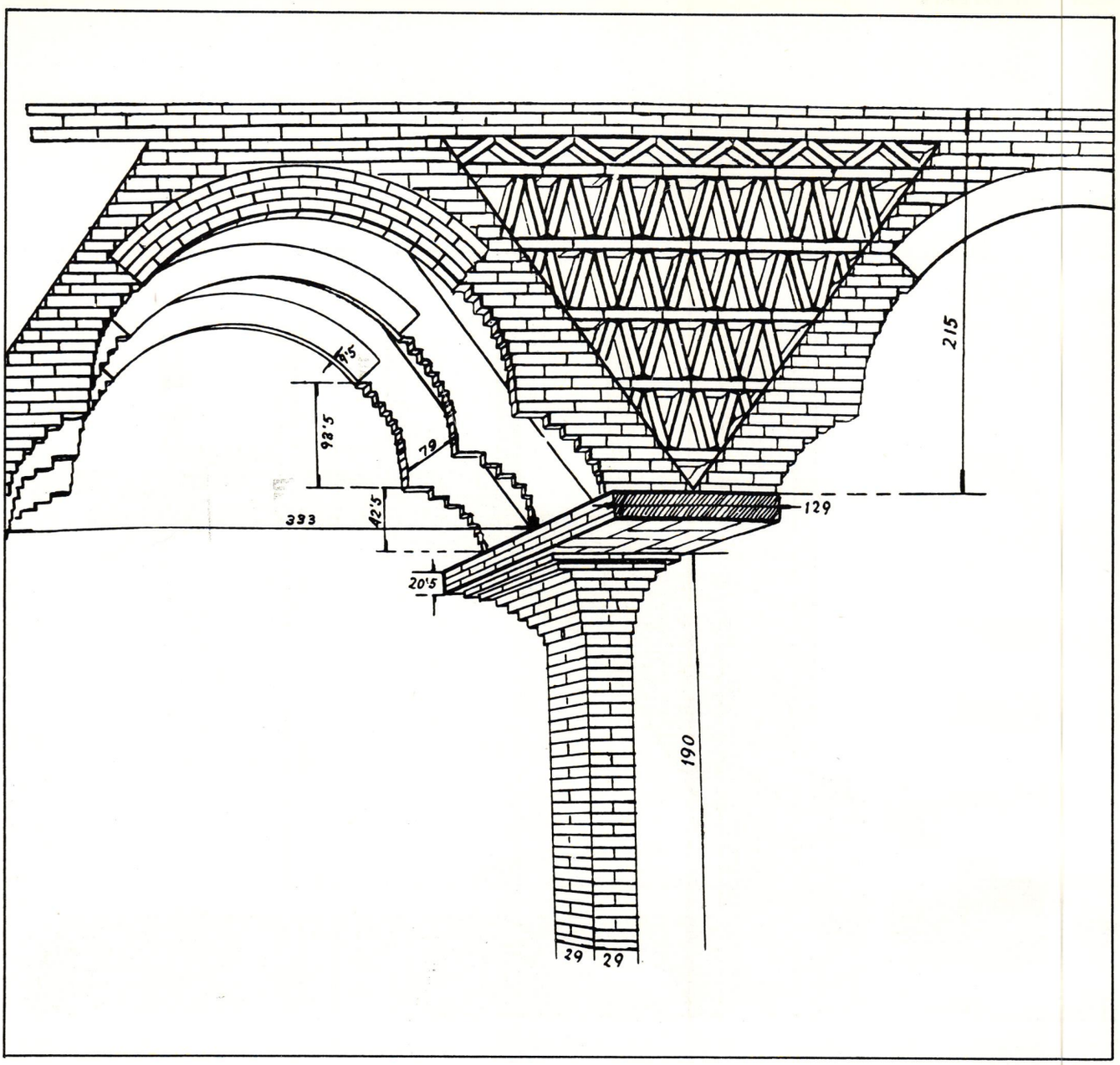


not, after completion of the entire floor, depend on the framework of metal beams for their support. Hence the floor becomes a flat canopy of low vaults supported by the piers at their corners, anticipating somewhat Maillart's pier-and-slab method of construction. If these piers be well protected, the result is an almost entirely cohesive and fireproof structural-system for modern office and industrial buildings. It is also common to support the *bovedillas* or even wide *bóvedas vaídas* on sturdy multi-ply arches of the *tabicada* type, thus eliminating the use of metal except, perhaps, for hidden tie-rods; this was a favorite Guastavino device as seen in the Taunton Court House basement, the Columbia University Chapel crypt and numerous other buildings.

Last, the most unbelievable and most famous element in the Catalan repertory is the *volta d'escala,* or 'Catalan stair.' This is, essentially, a series of narrow and vertically ascending *bóvedas tabicadas.* It may be of continuous helical form (Fig 4) or it may leap up daringly in a succession of ascending parabolas around the sides of a rectangular stair-well. In either case our experience with voussoir arches makes the inner rim seem to be entirely without support; in the latter case each successive rise appears to take off from the unsupported edge of the previous one, and, when the stair-well is open on one side, that unit seems to be carried on thin air. The fact is that the stair vault is set well into a skewback in the wall, or otherwise maintains its shape by shear forces along its edges and so functions as a rigid longitudinal beam or shell.

One is naturally curious about the historical origin of these techniques. Although the Spanish-speaking world has always considered them to be unmistakably Catalan, and the Catalans are themselves proud of this uniquely vernacular tradition of building, they have never claimed the original invention of it for themselves. As historical and archaeological research on the matter is almost completely lacking, it is impossible at this point to trace the development back through history; we can do no more than relay the opinions, largely intuitive, of some of the more informed practitioners of the methods, such as the Guastavinos. And we restrict ourselves to only a few salient characteristics of the tradition, namely: the laying of the vault elements tangent *(de plano)* rather than perpendicular *(de canto)* to the curve of

7 Roof structure of Bellesguard, Barcelona, 1900-02 (After Bergós.)



the vault; dependence on monolithic cohesion rather than on voussoir action; and the erection of vaults overhand without centering.

The Catalans presumed that their techniques went back to the cohesive brick vaults of Mesopotamia and Egypt (the Ramesseum), which were constructed without the use of centering by corbelling out the springing and then slanting back the first courses of each arc so that they stuck to their predecessors. This tradition was later taken up by the Sassanians (c. third century AD). The drawings that appeared in engineering and archaeological publications of the 1880s reporting the Persian expeditions must have fascinated Catalans, although the tiles are not, of course, laid *de plano* in their manner. A closer approximation to the Catalan system was to be seen in the Roman use of laminated tile vaulting as a permanent centering for their great concrete vaults of Imperial times, e.g. in the Baths of Caracalla. Although these tile layers did not constitute an independent structure but only the under-surface of the concrete mass, it is the opinion of some individuals (such as Choisy) that the procedure persisted on its own after concrete technology had lapsed and was therefore the ultimate origin of our method. There is no question that the major use of tile-vaults has always been in areas of strong Roman antecedents: Italy, Southern France, and Catalonia.

It was thought by many Spaniards that the later middle ages inherited these techniques via the Byzantines and Moslems. Although both these cultures employed cohesive masonry of brick and rubble, it is not clear how common the thin *de plano* brick vaults were among them. But from wherever they sprang, Gothic instances of thin tile-vaulting (as thin as 1½ inches) abound in Catalonia. Renaissance and Baroque examples seem to be plentiful along the Mediterranean littoral from Italy to Valencia; Blondel described their use in southern France in his *Cours* of 1777.

There seems to be no question that the method had been very prevalent in Italy, perhaps since Roman times. It has been suggested that the Catalans took up the old tradition with renewed vigor in the Renaissance, owing to a new importation of the method from Italy for large church naves; it came with a certain authority, having apparently been used in the Sistine Chapel and other Roman buildings. To

8 An upper floor in Teresan school, Barcelona

mention only two Spanish examples: the famous church of the Desamparados of Valencia and the parochial church of St. Augustine in Barcelona (Fig 5) of which we illustrate a graphic analysis of forces by Gaudí's method.

This proto-thin-shell system of building was then revived, intensified, and industrialized in late 19th-century Catalonia. The elder Guastavino, who played such a pivotal role in this process, ascribed it to the burgeoning textile industry in Catalonia, which, modeling itself in so many ways on the machinery and methods of contemporary England, also sought to fireproof its new plants. Desiring a less expensive system than the English one of heavy brick arches, the Catalan industrialists fell back upon their own tradition of *bóvedas tabicadas* and *tabiques de panderete.* Hence the stimulus to find new, quick, waterproof mortars — i.e. Portland cement. Guastavino's first important commission was a spinning mill, the vast plant of Batlló Hnos., a structure that was much studied by the students of the Barcelona School of Architecture when Gaudí was in attendance there.

There was, however, a totally different and generally unappreciated aspect of modern Spanish culture which contributed to this development. That was the precocious state of Spanish mathematical science. (Eduardo Torroja comes from a family of mathematicians.) Histories of technology, engineering, and architecture, concerned as they have been with the industrial use of iron and concrete in the Western world, have largely bypassed Spanish science. There existed, however, a lineage of

9 Basement of Bellesguard, Barcelona

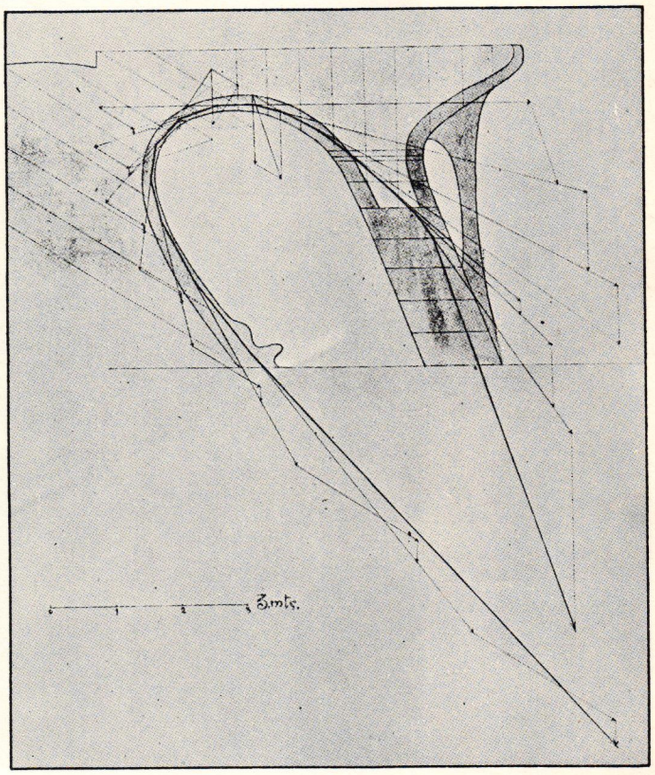
Spanish engineers and architects whose mathematical genius was not appreciated abroad, perhaps because of their tendency to associate the beauties of that science with those of nature or with religious symbolism (as Ramón Lull had done), instead of with the machine or with rationalized mechanical processes.

For instance, the Spanish engineer Juan Torras ('the Spanish Eiffel,' 1828-1910) remarked: 'The architect of the future will construct by imitating nature, because it is the most rational, durable, and economic method.' The elder Guastavino observed on entering a great subterranean cavern that 'all this colossal space was covered by a single piece... no centering or scaffolding... without heavy girders... all being made of particles set one over the other as nature had laid them. From that time I became convinced that there was much to be learned from the immense book called Nature.' The admiration of Gaudí for both natural process and divine symbolism is well known, although it is not so generally understood that he had recourse more to the *laws* of nature than to its actual appearance in evolving his architectural forms.

The history of the Catalans' theoretical speculations concerning the functioning of their vaulting methods is too intricate to go into here, but it might be mentioned that such studies have persisted down to the present, and it is not inconceivable that in countries where handwork is not prohibitively expensive, the Catalan method of tile vaulting still today offers some competition to reinforced-concrete shells. Today some Spanish architects

10 Underneath a viaduct of the Park Güell, Barcelona, c. 1900-03

11 Graphic analysis by Gaudí of the viaduct in Figure 10. He divided this problem into three units. The left half is treated as a retaining wall, so the divisions are made diagonally at an angle of 32° representing the angle of sliding of the earth fill. The upper part of the right half of the main arch is divided vertically, as is usual for a masonry arch. The horizontal divisions of the right side are conventional for an inclined wall or pier. One can follow his determination of the heavily-drawn line of pressures of the structure by starting at the crest-polygon and working either to right or left. For a clear explanation of the methods of graphic statics as used in his day see L. de Coppet Berg, *Safe Building* (various editions from 1886)



claim that it is unnecessary to laminate the tiles in *bóvedas tabicadas,* that single-ply vaults are more efficient and easier to calculate because they more closely approximate modern shell theory; such single-ply vaults must, however, be spherical segments (vaídas). These modern Spanish vaults are, pound for pound, far stronger than metalbeam flooring.

Turning now to Gaudí, for whom the matters we have discussed were standard practice, it is proper to inquire what special use he made of these building traditions of his region.

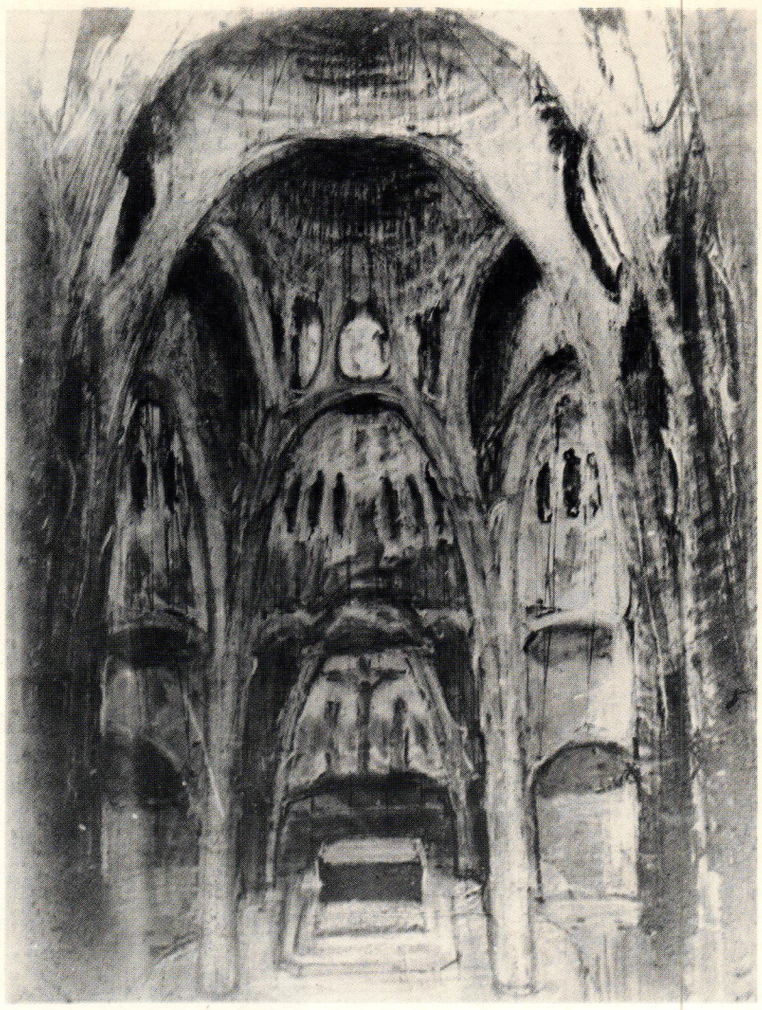
We find that, although some of his most important buildings were constructed in stone masonry rather than in brick and tile, Gaudí thought instinctively in terms of the 'cohesiveness' of the Catalan tradition, and he actually anticipated a number of our own mid-twentieth-century conceptions of 'continuity' in structure. In so doing, he broke very early with such traditional Western structural metaphors as the 'Orders,' designing instead in terms of the elemental forms and elementary laws or forces of nature. His buildings tend to be monumental representations either of diagrams of graphic statics (by which the forces of nature were visualized in his time) or of surfaces of higher mathematics (which exemplify nature's efficiency for us today).

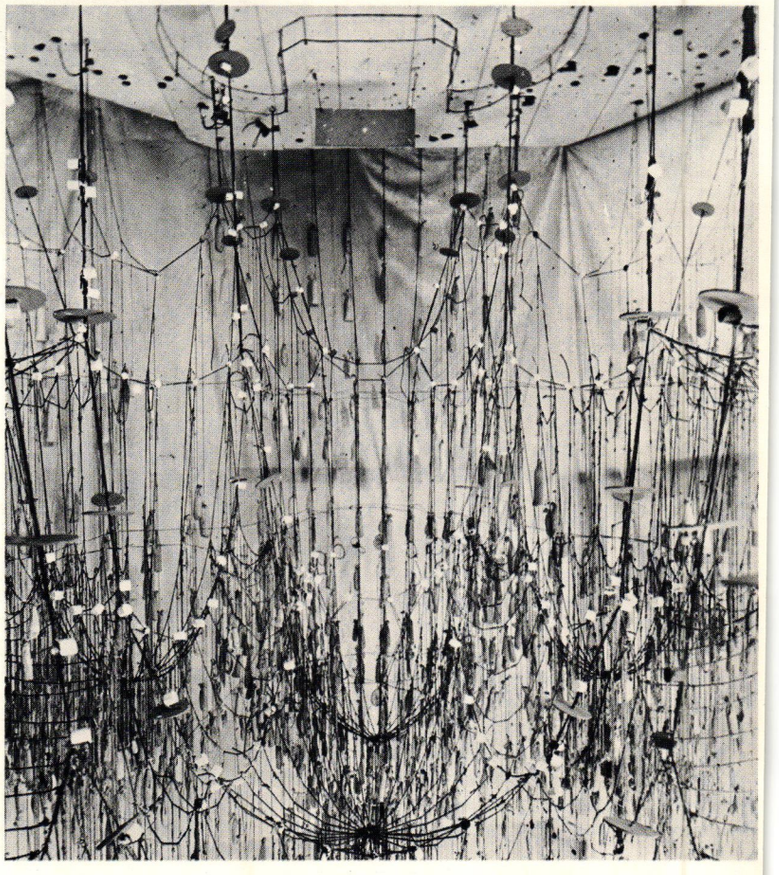
His most characteristic structural devices seem to issue from a desire to eliminate horizontal thrusts in his structures and to keep all forces within the safe center-section of the material employed.

1 He preferred not to span voids by voussoir arches but by a corbelling outward of courses of brick within a monolithic, laminated system. In the cascade vault of the Casa Vicens (Fig. 6) this corbelling extended out precariously, to be joined by means of a short laminated Catalan arch of low rise to its mate, which counterbalanced it. Under somewhat similar circumstances, in the Teresan school he was forced to use a voussoir arch at the crest, because the span was too short and the curve too acute to allow the bricks to be placed *de plano.* A nicely orchestrated example is the attic ceiling of Bellesguard (Fig 7). Here a slate-covered *solera* of tiles rests partly on lobed, corbelled arches such as we have seen in the Vicens cascade and partly on openwork spandrels. These supporting diaphragm arches are set in turn on remarkably resistant *soleras,*

19 Sketch of the projected interior of the Colonia Güell church—not of the finished crypt. It is clear from the wire-lines to be seen here that Gaudí drew this sketch directly on an inverted photograph of the interior of the model

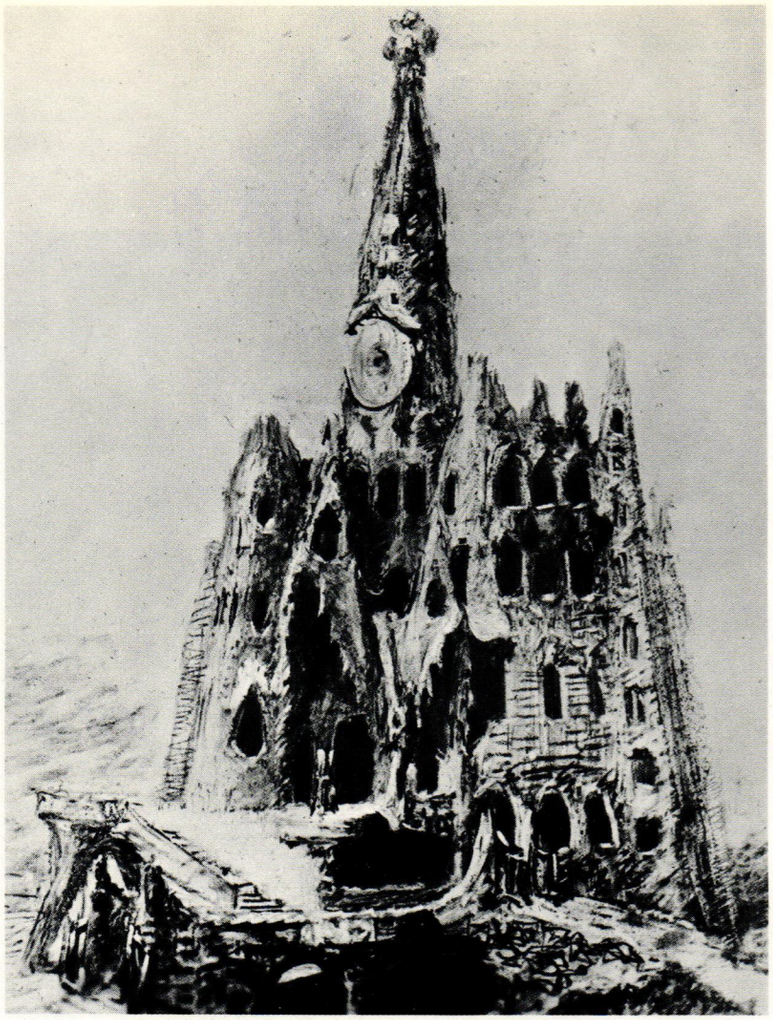
20 Interior view of same funicular model. It might be noted that at about this time Gaudí recommended the use of a hung roof for the new Barcelona railroad station, 600 feet in span and designed as a reticulated net





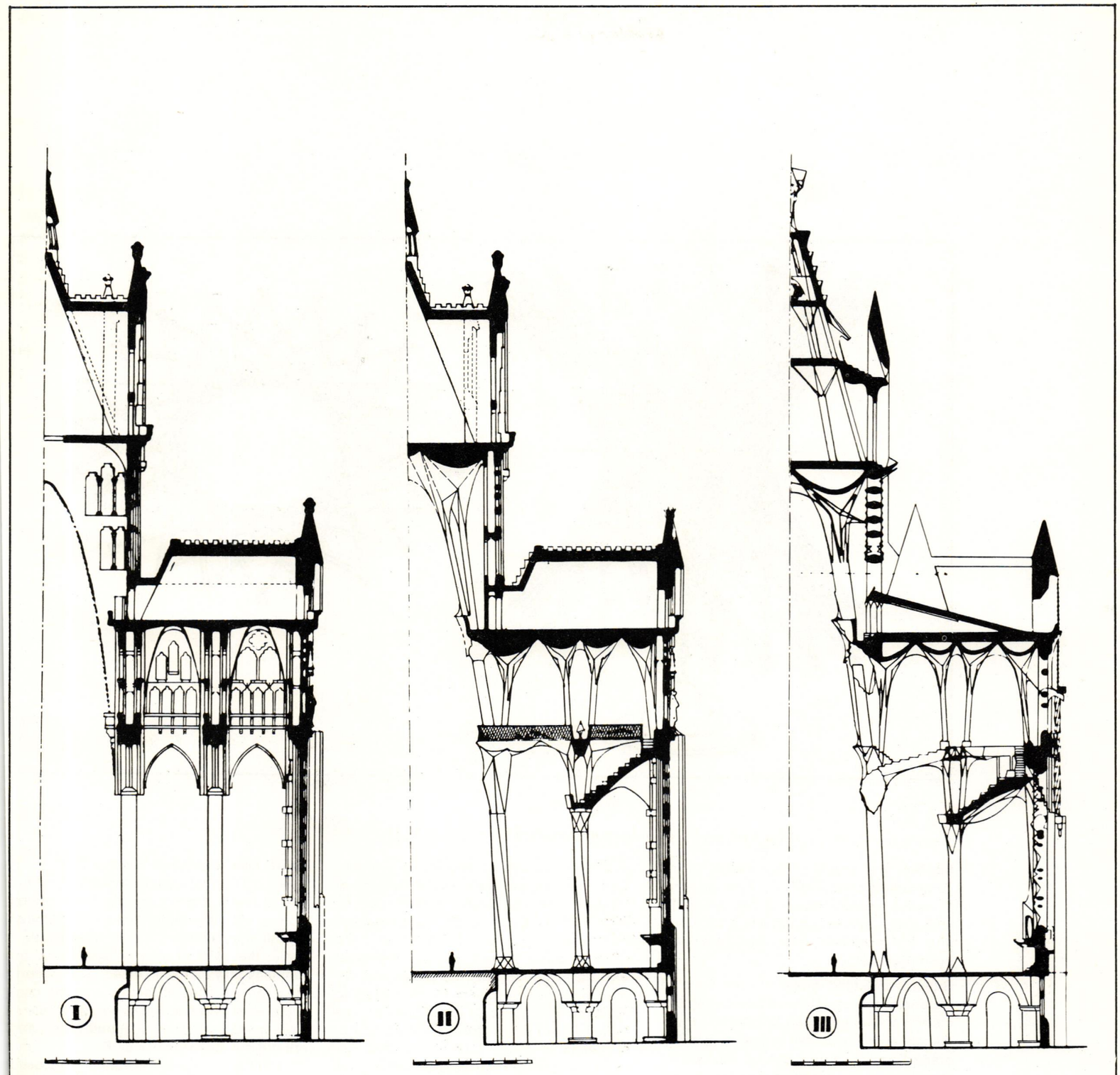
21 Sketch of projected exterior of the church made in the same way as Figure 19

22 Exterior of the complete funicular model for the Colonia Güell chapel near Barcelona (o. 1908). The employment of sheets, warped by cords and weights, gives a sense of the wall surfaces of the projected building

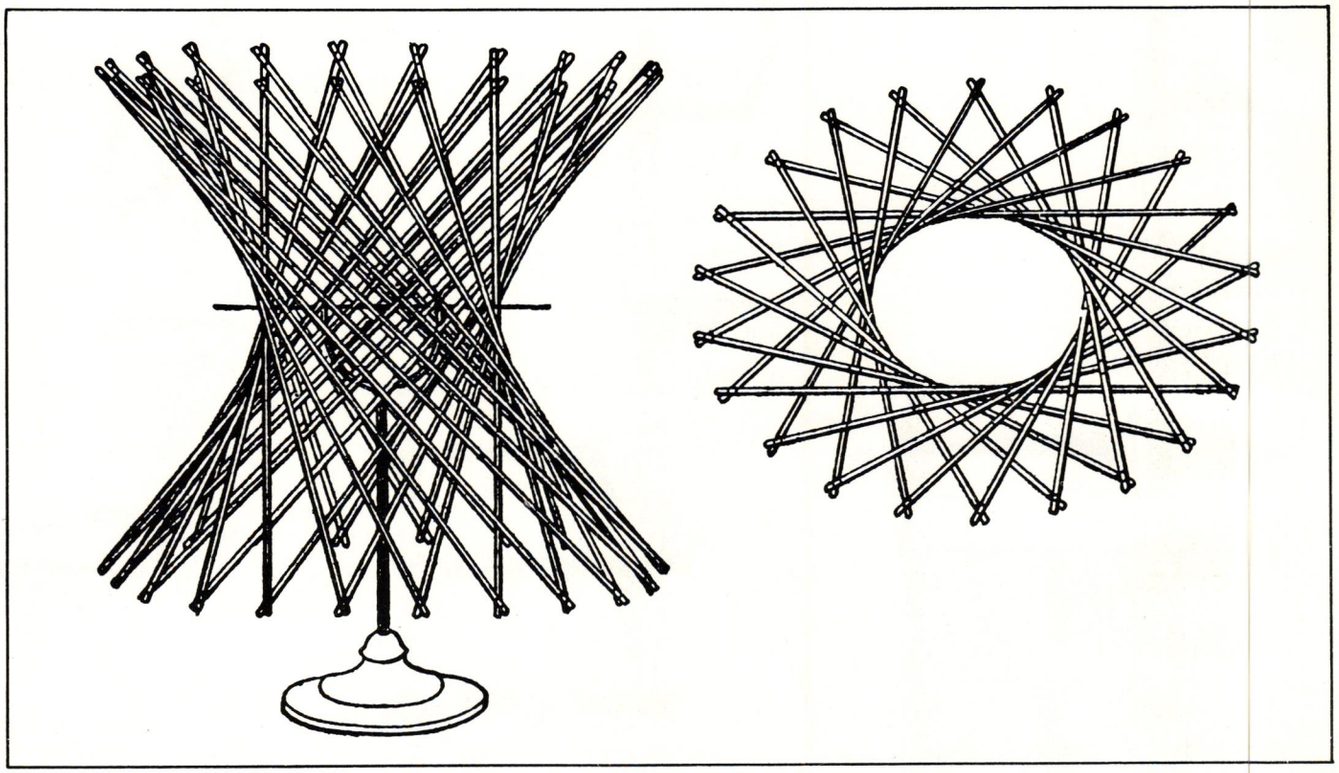


23 View into the interior of a model of the projected nave of the Sagrada Familia church. This is the latest version (c. 1925)

24 Three successive versions of the nave section of the Sagrada Familia church: I, c. 1898; II, c. 1915; III, c. 1918. These show the evolution of Gaudí's project from an essentially neo-Gothic edifice with certain parabolic features (I), to a parabolic design with piers of single helical revolution and paraboloid vaults like the Colonia Güell chapel (II), and then to a much more fluid, arborescent conception (III) with doubly-helical



25 Diagram of a hyperboloid of one sheet and a model demonstrating its character as a ruled surface



the like, that should be the delight of the contemporary engineer, as well as a resounding demonstration of the versatility and adaptability of such surfaces for structure and enclosure even with traditional building materials.

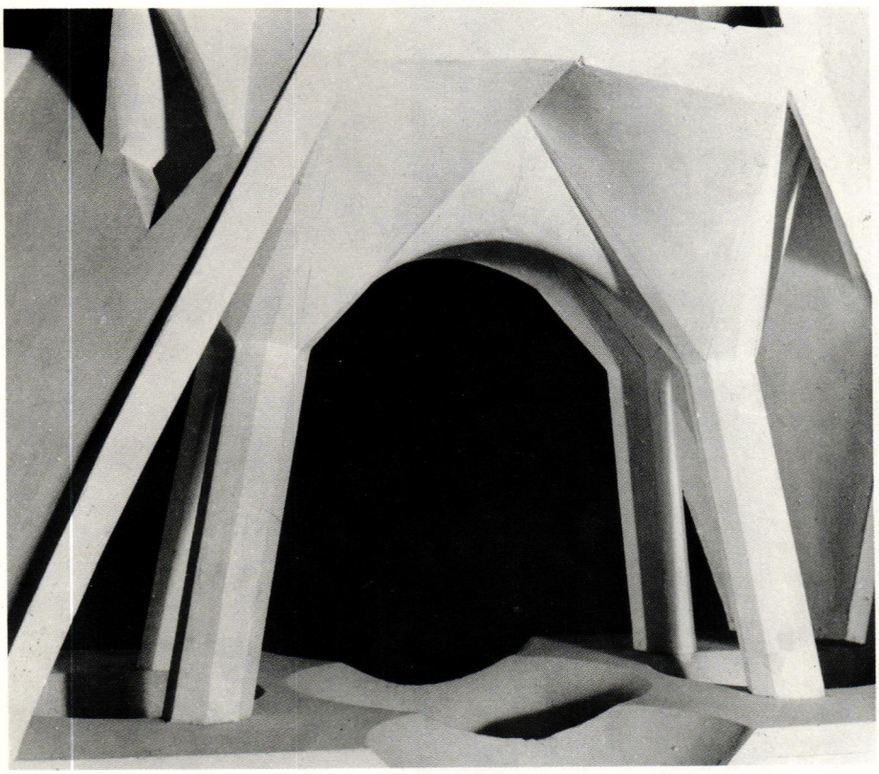
Gaudí conducted many similar tests of materials and structural types during the course of his more than forty years' association with the construction of the Sagrada Familia church, but his final determination of its architectural forms was more abstract and a priori—less empirical—than in the designing of the Colonia Güell chapel. His associates have always described the latter chapel as a laboratory device for his all-consuming project of the Church of the Sagrada Familia (Fig 23).

Such matters as the proper inclination of the piers and their branching superstructure, as well as certain calculations of thrusts, were probably worked out by means of funicular models and tensiometer readings as he had done with the Colonia Güell chapel, but for the most part he seems to have employed instead a combination of his customary graphic methods with the use of equations for the various geometrical forms: helicoids, paraboloids, and hyperboloids. In fact, his universal employment here of surfaces of double curvature probably made it possible for him to 'solve' certain of the structural problems through an intuitive choice of form rather than by laborious calculations—a procedure thoroughly in keeping with his usual elegance of method and form.

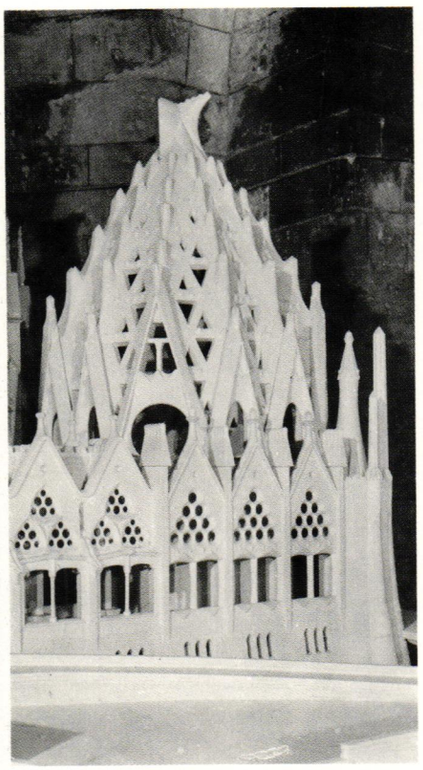
So the Sagrada Familia church became a more classic solution to structural problems, a fact that can be sensed by simple visual comparison of its crisply crystalline forms with the rather rough and almost brutal effects of the Colonia Güell crypt.

From the point of view of statics, his intentions may be summarized as the effort: 1) to get all lines of force within the centroid of supporting members; 2) to eliminate flying buttresses, wall buttresses, and all other supplementary contrivances; and 3) to attain a structural fabric composed of stable, independently functioning units. This last means, for instance, that each nave pier with its superimposed columns and colonettes and the portions of vaults and galleries that attach to them would be quite self-sufficient, like a tree or a parasol. Gaudí adopted this last principle in order to avoid the uncontrollable collapse

26 Model of the nave superstructure, showing hyperbolic paraboloid vaults above and pierced hyperboloid vaults below



27 Model of the Sagrada Familia sacristy



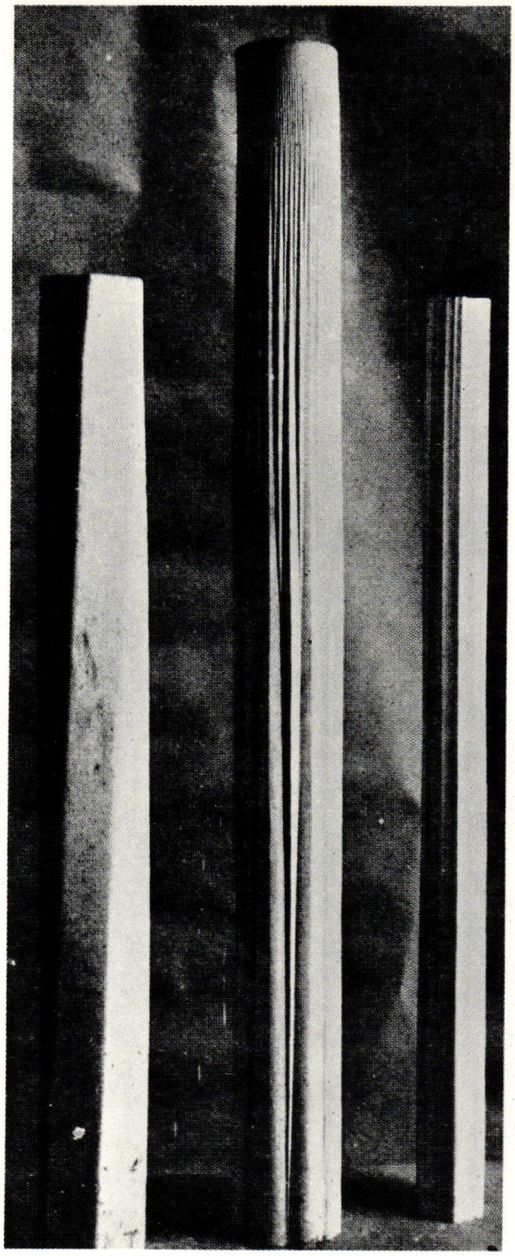
that occurred among vaulted churches as a result of the bombardments of World War I, and which he attributed to the intricate horizontal interdependence of their elements. The principle is that of Torroja's Quince Ojos viaduct.

The synthesis of these structural ideas came about slowly over a period of decades, as can be seen in Figure 24. His ultimate purposes were already clear, however, in stage II. It has been suggested that Gaudi's final designs represented a reversion to the more simple supporting-system of early basilicas.

More interesting to us today, perhaps, was his employment of complex warped surfaces which are arrived at by simple geometrical rules, as we have seen above, and can be shaped by workers employing rather elementary templates. From 1918 on, Gaudi's plans called for vaulting composed of hyperboloids of one sheet (Fig 25), which would cover all but the apex of the vault—at which point their gorges would allow illumination through from above (Fig 23). The walls were also to be formed of such hyperboloids, the gorges enlarged in this case to serve as windows. In the vaults, smaller hyperboloids shaped like egg cups were to be suspended in the gorges to diffuse the light. All these hyperboloids were to be translational surfaces, their directrices being serrated or starlike figures which imparted a pleated form to their surfaces. The capitals of the piers as they fan out to meet the vaults were also to be hyperboloids. It follows that the junctures of all such hyperboloid surfaces in vaults and walls are actually hyperbolic paraboloids, although this is not immediately perceptible. Owing to his concern over the World War I catastrophes we have mentioned, Gaudí decided to construct his vaults of reinforced concrete instead of masonry, inserting the reinforcements *as generating lines of these ruled surfaces.* Thus there are no ribs on or within the masonry, nor did he use his customary supporting diaphragm arches; any resemblance to the Gothic style of building here is purely coincidental.

Hyperbolic paraboloids, those handy roofing surfaces which he had intended to use to vault the nave in his earlier plans, were in the final design to be used only where a closed roof is necessary, as in the upper superstructure (Fig 26). A particularly tricky use of paraboloids was to be in the attached sacristy (Fig 27), whose gored

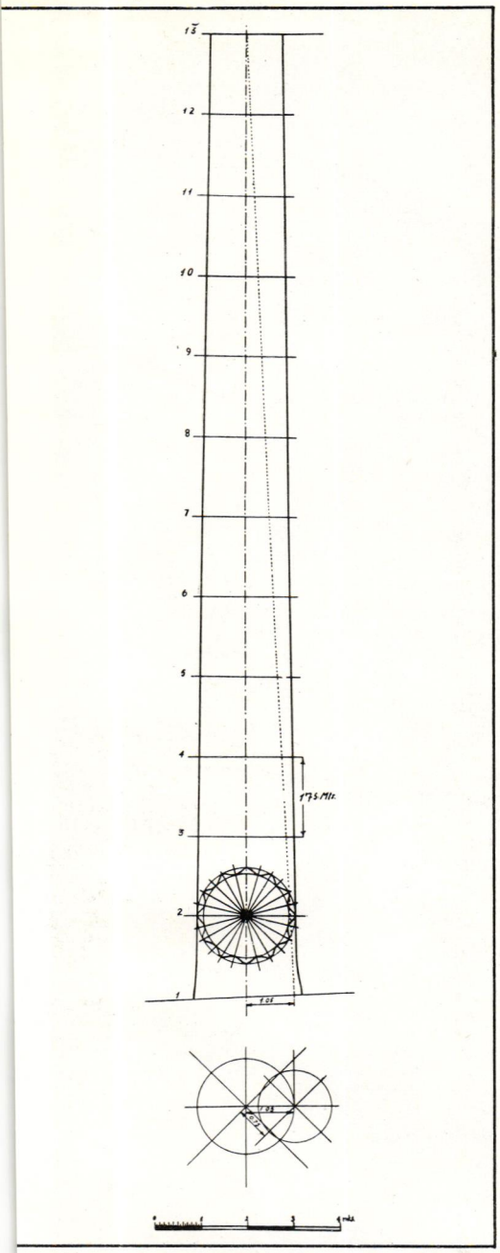
28 Experimental models of columns for the Sagrada Familia church. Left is of single helical revolution, the others of double revolution

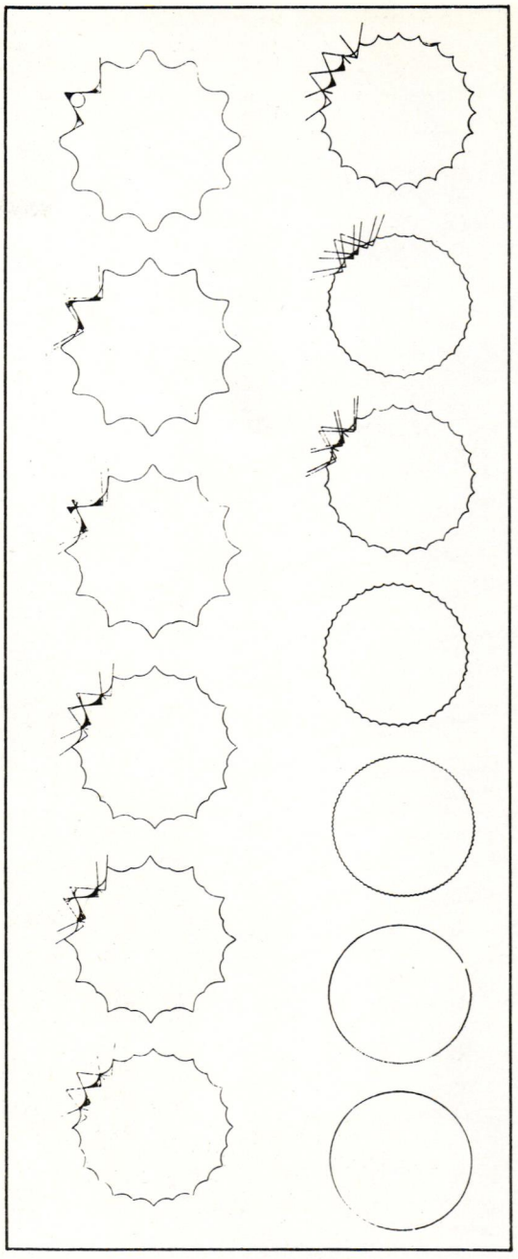


roof was to be constructed of them. Eduardo Catalano has suggested that Gaudí's are the first buildings ever to be designed of hyperbolic paraboloids, and has noted that this anticipated by many years the calculations on which our modern structural use of that surface depends.

The third class of higher geometrical forms which plays a crucial role in this building is that of the helicoids. The idea of helocoidal evolution found employment principally in the piers and columns. The way in which such a column can be formed by its base-shape making a partial helical revolution in one direction is seen in Figure 28 (left); these were to be used in some parts of the structure. But that the big, fluted, tapering piers of the nave are actually formed by the partial helical revolutions of their base-shape simultaneously

9 Elevation and horizontal sections of an inlined pier of the crossing of the Church of the agrada Familia (After Puig Boada)



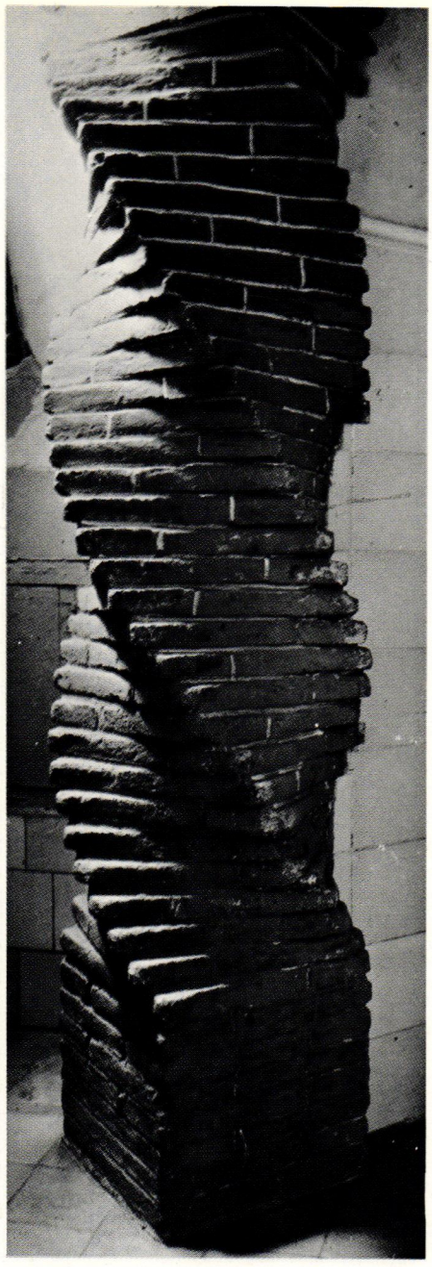


in opposite directions is a little harder to visualize. Figure 29 attempts to illustrate this process. Imagine two thin cardboard patterns of the serrated perimeter of the column-base laid on top of each other. If rotated very slightly in opposite directions, the combined silhouette of them both will undergo the following transformation: what was the arris will split and sink, becoming a valley between two peaks; what was the flute will rise slightly into a small peak; very soon there will be twice as many flutes and arrises, and the entire perimeter of the pattern will be slightly reduced. If a cardboard pattern identical to this is now laid on it and the process repeated, there will be another doubling of fluting and a further shrinkage in perimeter. Repeating it again, we end up with a very slightly serrated circle as the final pattern. If this counterrotation were to take place in vertical (right-helical) movements, there would be traced out the form of the other columns in Figure 28 in which there is a continual doubling of the quantity of arrises and a gentle upward taper – in underlying (modular) harmony with the other, twisted, columns of the nave that were arrived at by single helical revolution.

It is clear that we have now left predominantly structural considerations and are concerned with matters of architectural form. However, with Gaudí the interrelationship between these two factors was so intricate that there is scarcely ever a boundary to be found between them. For instance, he had throughout his career used cylindrical helices (the machine-bolt thread) and conical helices (the wood-screw thread) in a number of ways. The

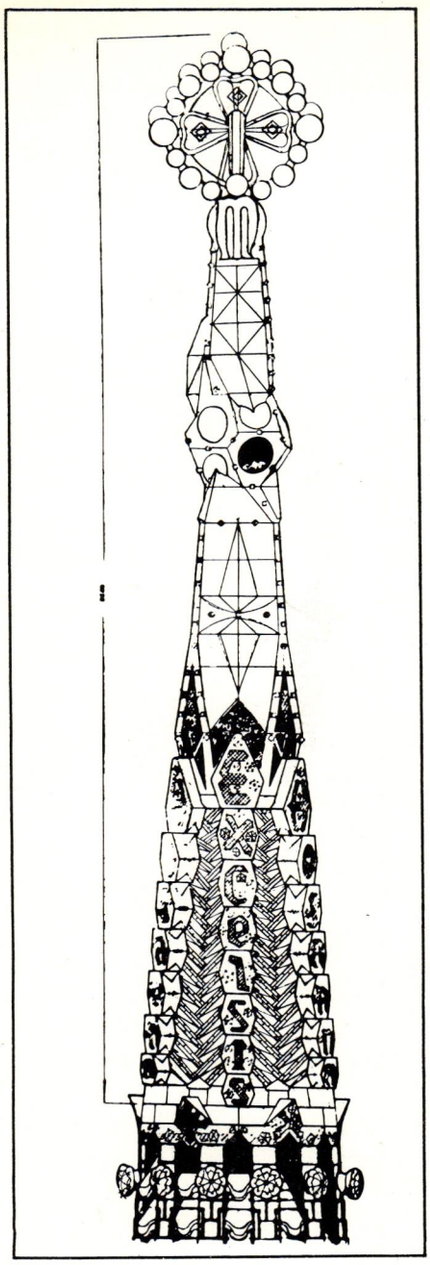
30 Cellar of the Palacio Güell, Barcelona, 1885-89

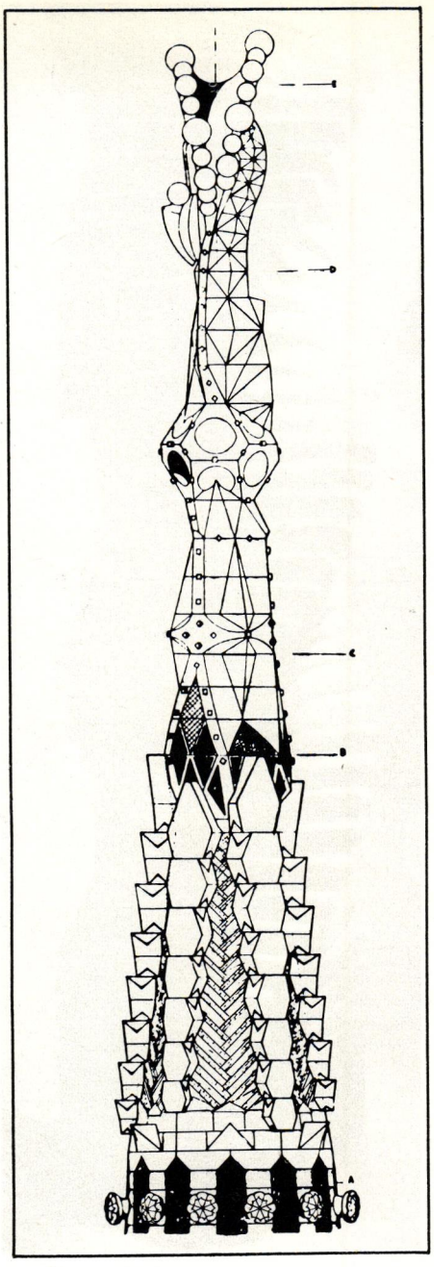
31 Pier in the Teresan school, Barcelona, 1889-94



former are seen in the Palacio Güell structurally—the horse ramp (Fig 30)—and decoratively—the escutcheon on its facade. Is the Teresan school pier (Fig 31) structural or decorative? The Casa Batlló interior illustrates different usages of the conical helix, as do the snails sculptured on the Sagrada Familia church. The turret of the Park Güell gatehouse was formed by double revolution of a conical helix. The ventilator of the Casa Milá (Fig 15, left), by double (opposed) revolution of a cylindrical helix in which the crisscross helical lines are stressed instead of the arrises—a pattern that Gaudí also used in his grilles. Others of the Milá roof structures that appear to be the eccentric products of a pastry cook are actually compound helical revolutions in the same direction but of different points of origin, of varying angular direction, etc. If these seem to be somewhat complex, one has only to keep in mind Webster's definition of a helix, which tells us that it can be produced on any cylinder by a straight line on a plane (say, on a piece of paper) that is wrapped around the cylinder. Simple. A straight line or net of straight lines carefully drawn on a piece of paper of the right size could be handed to a workman for him to carry out by wrapping the paper around the object to be so executed. If instead of straight lines a sine curve is drawn on the paper, it will, when the paper is made into a cylinder, produce the curve that is followed by the roof edges of the Sagrada Familia school (Figs 16, 17) and the Casa Milá mansard (Fig 15). Thus the roof of the school is helicoidal as well as conoidal. A network of sine curves on the paper will result in the form of the left-hand ventilator in Figure 15.

Gaudí and his circle of associates considered fully as important as the intricate structural character of the Sagrada Familia church the simple (and therefore for them divine and highly symbolic) derivation of the complex geometrical forms of the building. Complex, but harmonic and always rational! Gaudí's follower Juan Bergós commented, 'As elements of construction, Gaudí abhorred arbitrarily curved forms, the 'curves of sentiment' so much in vogue in the prevailing Art Nouveau. He found pure geometric forms to be superior to hybrid ones: ellipses more beautiful than basket-handle arches, parabolas more than ogees. He preferred, furthermore, curves which, while obeying a geometrical law, followed mechanical law as well—those which at the same time as being sculptural, resolved with elegance the exigencies of gravity.'





However, after acquainting ourselves somewhat with Gaudí's usage of warped surfaces of double curvature—ruled, translational, rotational, synclastic, anticlastic, etc.—we are entirely unprepared for the totally different geometric basis of his very last work, the finials of the Sagrada Familia church (Fig 32). Proceeding from top to bottom here, we find: round-cornered quadrilaterals bordered by spheres of varying size and leaning apart from each other; truncated pyramids from which other pyramids project sideways; pseudo-regular polyhedra formed by cutting off the corners of cubes or octahedra; triangular pyramids evolving from hexagonal pyramids, which sit in turn upon downward-projecting pyramids. Except for the paraboloid saddle at the top, there is not a flowing ruled-surface in the lot. They are instead an additive and interlocked series of crystalline forms looking for all the world like rock candy on a string—or an architectural synthetic-cubism.

There is no clearer proof than this of the fact that to the end of his career Gaudí's ideas were always changing, always in flux, and that he was constantly creating anew—not unlike his compatriot Picasso.

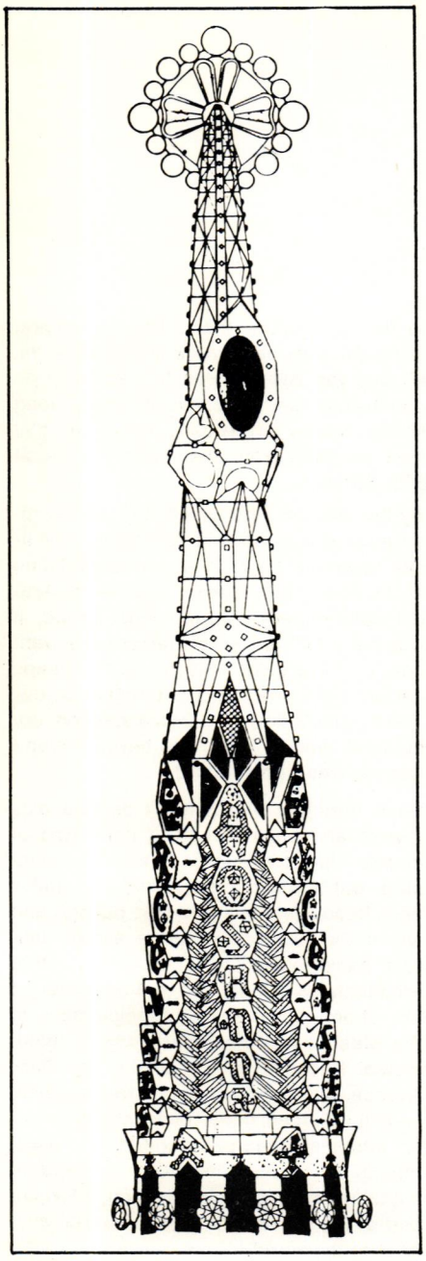
We are led, then, to three general conclusions:

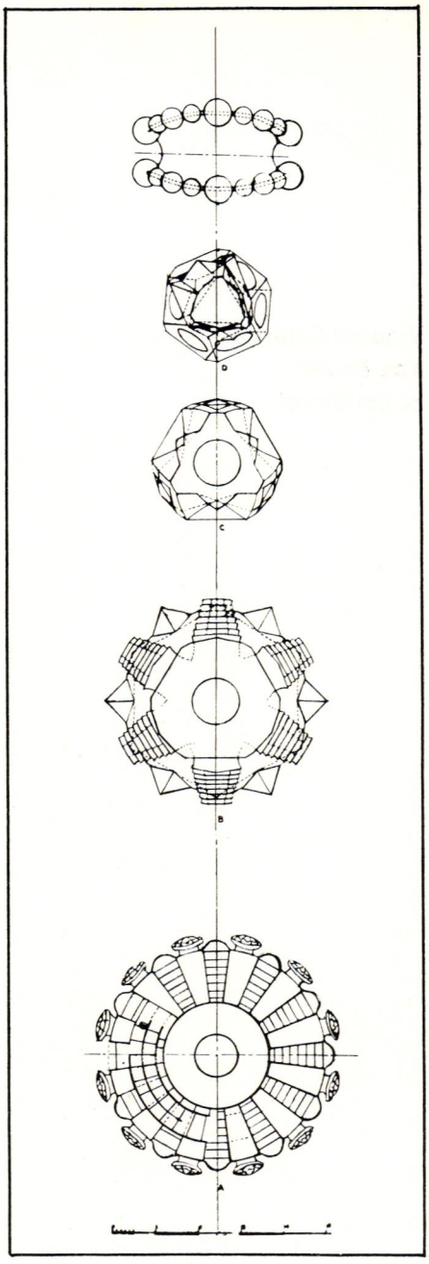
First, that in the work of Antonio Gaudí there is a near identity of structural design and architectural (viz., artistic) form—a phenomenon that is virtually unique in the history of architecture. Our suggestion is that this derives in part, at least, from his effort to be guided in his buildings by the forces of nature and by the underlying geometry of nature's own forms.

Second, that nothing in his work is really arbitrary: all is calculated, orderly, consistent within itself, and—to repeat—is in harmony with the geometrical and physical laws of nature, *not a copy after nature* as was so prevalent a practice in his day.

Finally, that much in the work and in the intuitive procedures of Gaudí is prophetic of what actually concerns us in architectural design today. The work of Catalan builders, and Gaudí in particular, is an antecedent of modern thin-shell construction—the most direct line of descent being, in this case, through Torroja and Candela and the forms and structures which Gaudí had envisaged are re-emerging today after a long hibernation during which the steel cage roamed at large and dominated our ideas about building.

32 Elevations and sections of a crowing spire of the Church of the Sagrada Familia (After Puig Boada)





*The American buildings that are mentioned in this article were vaulted in the Catalan manner by Rafael Guastavino (1842-1908) and his son, also Rafael, (1872-1950). Born in Valencia and active in Barcelona, the elder Guastavino contributed spectacularly to the vaulting traditions of his native Spain before emigrating to this country where he devised, perfected, and patented the 'Guastavino System' of fireproof construction. He published two fundamental books on the subject, *Cohesive Construction* (1892) and *The Function of Masonry* (1896-1904). His son was, in turn, responsible for many of the remarkable constructional feats of their company—such as the dome of St. John the Divine's. He developed their ceramic soffit tiles and, together with Professor Wallace C. Sabine of Harvard University, invented two different types of extremely effective masonry acoustical tiles.

The inventory of buildings with Guastavino vaults reads like an outline-history of American building from the 1880's down to the Depression and World War II when their popularity began gradually to wane in the face of rising labor costs, improved concrete technology, and, perhaps most important, a universal preference for flat ceilings. By that time the Guastavinos had accounted for about a thousand edifices throughout the United States and foreign countries, including blue-ribbon buildings by the best known American architectural firms of the era. Thus the reader may study Catalan vaults at firsthand here in this country in a variety of public and industrial installations, churches, banks, business and institutional structures, private residences, etc.

This article is a summary of lectures delivered at the Yale University School of Architecture in February of 1962 and at the New York Chapter of the Society of Architectural Historians in May of 1962. An exhibition of these materials was displayed at Columbia University during May, 1962. The writer is preparing a more detailed and annotated version of this study.

For further discussion of the matters treated here consult the publications listed in Notes 74 and 77, and in Bibliography D of the writer's book on Gaudí (Braziller, 1960). The materials used in this article have been drawn from the Catalan Archive of Art and Architecture ('Amigos de Gaudí —USA'), Columbia University.

Vincent Scully Jr
The Death of the Street

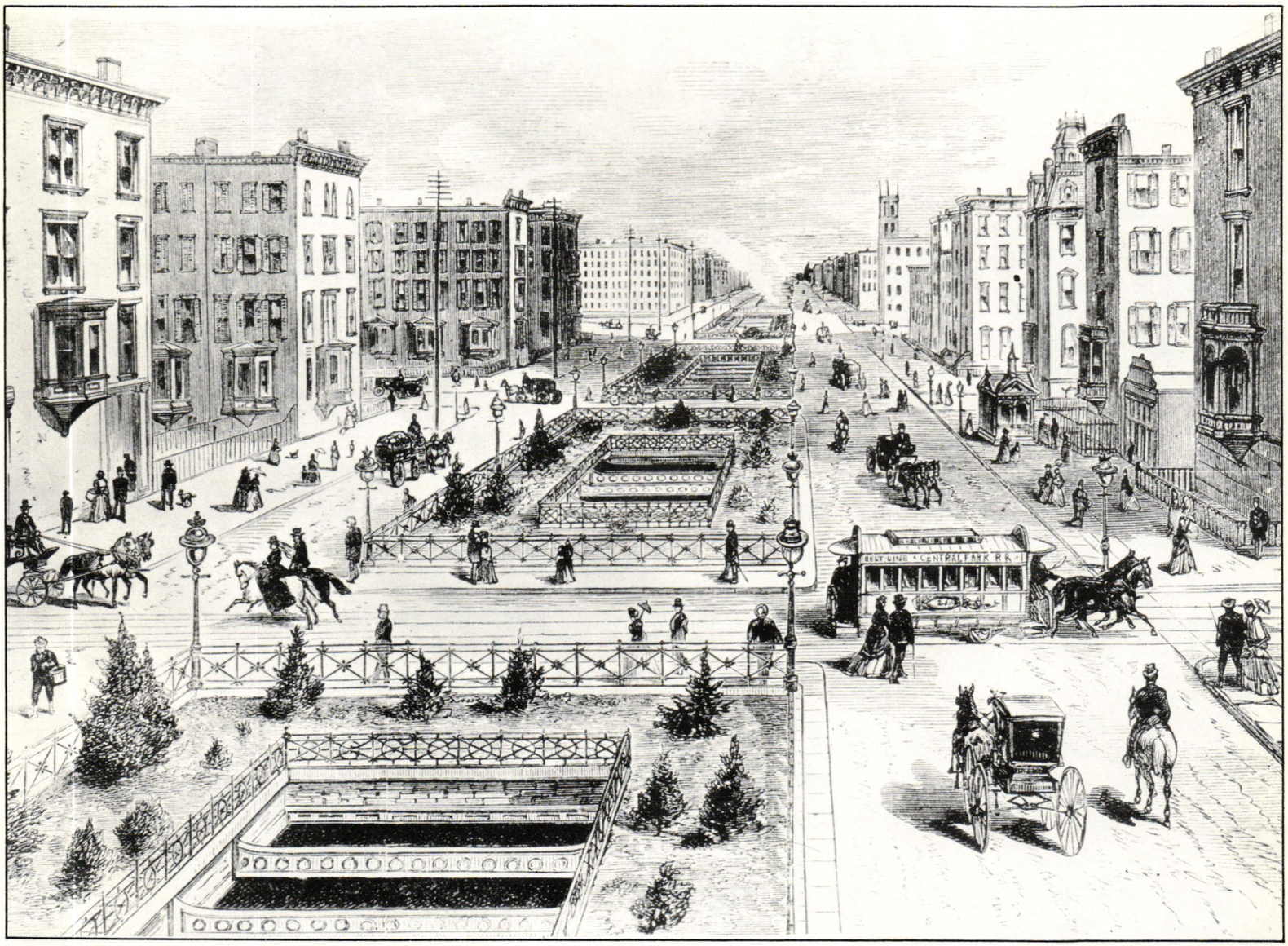
I should like to start with a word about how Park Avenue got to be what it once was. It and the surrounding blocks at its southern end were once a great hole in the ground that stretched as far as 59th Street, filled with acres of railroad tracks and steam engines belching smoke. This expressive but perhaps rather satanic urban feature was finally filled in when Reed and Stem built the new Grand Central Station at the beginning of this century. The blocks were then built up and a new avenue, the present one, left open between them. But the width of this avenue was in function with its length, so that it never seemed overly wide. Instead, its long axis always had a kind of velocity, in accord with the scale of the city and its automobile traffic. It came swooping down from the northern highlands with the rush of a great river, until it branched around Grand Central in the channels Reed and Stem had imagined for it. Like a river, it could move with that velocity because it was contained by banks or, like a rapids, by walls. These were formed by the buildings which defined it on both sides. Perhaps no one of them (with the possible exception of McKim, Mead, and White's Racquet Club) was overly distinguished itself, but they all had two things in common: they were built side by side in one plane, most of them contiguous, and they had solid, opaque façades, pierced by windows but sustaining the barrier plane. They were also high enough to control the street's width, but not generally so high as to deny it. Therefore, they were true walls for the street; they defined and directed its flow. At the same time, they were all fairly weighty and static, with a certain plastic depth and variety of scale, creating appropriate points of subsidiary focus on the river's banks. Thus they did not rush themselves, but allowed the street to do so between them. Though varying in height, they still struck a kind of norm, so that the Avenue was formed in three dimensions and became a single long space, whose shape as a whole can still best be seen from the military crest at 68th Street.

By the twenties, the axis of that space received a visual focus in the tower of Whitney Warren's New York Central Building at the end of the Avenue. This was a vertical point-marker. Though fairly broad, it was not a full barrier, so that the eye went past it at the sides, exactly as the ramps carried traffic around the terminal below. The Avenue's flow was thus enhanced, not blocked, and its continuity beyond Grand Central was underscored.

Such direction of a clearly defined axis toward and beyond a fixed point was of course characteristic of Beaux-Arts planning; but it would be a mistake to call it only Beaux-Arts. Its specific background was in the European baroque, and its general background lay in all preindustrial architectures, where the defined river of the street, the essential complement to the wide lake of the square, was a fundamental factor in the life of the city. Park Avenue, by covering over its trains, which had up till then never been anything but an urban nightmare, extended that tradition to the era of the motor car and of megalopolitan scale. In so doing, it formed one of the few convincingly imperial avenues in the world.

Some of the buildings built on it in the following decades did little to sustain that concept of the Avenue, but it was in the 1950s that its lower reaches began to be destroyed. The process got under way with Lever Brothers. When that building was designed, it was hailed as a humane step away from the crowding of the build-

Park Avenue in the nineteenth century, looking north from 59th Street



'The Avenue was formed in three dimensions and became a single long space whose shape as a whole is best seen from the military crest at 68th Street'

ing line characteristic of most large New York buildings. But such crowding may sometimes be essential rather than deplorable and so it had been here. True enough, Lever's attempted to acknowl- the Avenue's direction with its first two floors, which were themselves almost as high as the building it replaced. But in turning its tower and leaving much of its defined air-space free, it cut a hole in the wall that defined the Avenue. Instead of being trapped by a façade which wholly respected the street—like that created by the Racquet Club next door—the eye was not purposefully led out of the Avenue above the second floor to fall upon the undesigned side walls of the buildings on the cross street to the west. So Lever's broke up the street by breaking its facade, and, in so doing, questioned the validity of the concept of the street façade. It is true that, seen against the incoherent masses westward or against the older solid buildings to the north, Lever's was an elegant, pristine object, and might have been considered a special adornment to the Avenue, the breaking of whose continuity might thus have been condoned. But when the building to the north of it was reclad in a glass and plastic skin imitating Lever's, it became apparent that Lever's itself had owed everything to the pre-existing civility of the street. No longer seen against the contrasting solid backdrop which the older buildings had made, Lever's cool cube instantly lost something of its elegance and most of its point.

Much the same is true of the Seagram Building, perhaps the outstanding monument on the Avenue. Here the original attitude of its architects toward the street seems to have been less ambivalent than had been the case with the designers of Lever House. And since the whole block

'The eye was now purposefully led out of the Avenue . . . to fall upon the undesigned side walls of the buildings on the cross street to the west'

Park Avenue before the widening of the traffic lanes, with a bazaar in progress on the island area

money necessary to acquire and maintain non-profit producing property. We find that politics can save landmarks but that sentiment alone almost always fails.

When the vast apartment houses were first designed for Park Avenue, they met the demand of a money rich aristocracy, a social money class. Today's architecture in office buildings is meeting the demands of a tax structure, a corporate society which is now faced with the demand for decent working space for its many employees.

On the Avenue, many fine examples of architecture made way for the new demand for large corporate space. The requirements were for maximum areas with air conditioning, proper modern elevators, adequate light, attractive and impressive lobbies, and sound construction. All of these demands have been met in the very successful buildings that have been erected on the recently transformed Park Avenue. Today the facade has to fit around these requirements; layout in this realm of architecture cannot be secondary to design. No one is satisfied any longer with a palace without adequate toilet facilities; by the same token, adequate toilet facilities do not a palace make.

The economics of commercial building in out present social structure make corporate architecture possible. In New York, after the war, the Uris Brothers gambled and built. In construction circles, a Uris Building has a certain connotation. It means good working space and facilities, with a certain stereotyped design, and, among the 'patrons,' a lifted eyebrow. Yet I doubt whether Union Carbide or the Seagram Building would have been erected if the Urises had not been there first. The spate of buildings that have been created and developed, not only in New York, but throughout the country, has been based on economics—the price of land, the cost of building, the availability of loans, and the potential of tenants. The 'monuments' followed later.

The basic rule of supply and demand governed the building boom naturally. Now a subtle change is taking place and supply will of course have to meet it. Our society now has the time and money to ask for art in architecture. Yet on the whole the public is apathetic toward architecture. It becomes the duty of the architect to educate that public, and of the government to encourage the fight against the corporate mind. If good design is to prevail, and if good design means a loss of income for certain parcels, then the government and loaning institutions must be prepared to grant a dollar bonus for this sacrifice.

For a period individually was allowed only to the architect commissioned by a client who was building a monument to himself or his product—a Lever House for soap; a Seagram Building for liquor. On the other hand investment builders who were erecting buildings for multiple tenants were interested only in proper size and layout, in order to convince the potential tenant to move from inefficient but familiar $3.00 space, to $6.00 space in prime quarters. Certain basic ingredients had to be 'triple A'; the savings made were primarily on the exterior materials. Bulk, shape and form had to be designed to conserve rentable space, rentable space being income, the sound basis for all construction. I do not mean to be derogatory. In fact, I would like briefly to state the case for these builders, particularly New York builders. Directly after the war these men gambled their money, their time and their future. They did not wait for a building to be rented before they started construction. They won their gamble and only recently have builders in other cities followed.

Now that the 'gamble' has paid off, they can turn their mind to aesthetics. The architect now has a chance to lead. He can suggest that a building would be more palatable if it did not make full use of its potential zoning envelope; he can emphasize that a particular area requires a plaza; he can demand that a facade use a certain material. But he can never forget that he is governed by zoning resolutions and building codes, by the eventual function of the building, and, above all, by budget and the social and tax structure. He is creating and designing a building for people: the investor, the tenant and the general public. If the cost of construction is excessively high, the rent is beyond the means of the tenant—attractive as the structure might look to the layman.

This is the society in which we live: on the one hand a rigid society that controls our lives and our money; on the other an uncontrolled society that allows speculation to run rampant. We are living in an age in which we are frightened by our own conformity, in which we listen to the prophets tell us that we must fight this machine society and defend our democratic life. And then we ask: why doesn't the government give us a city plan, who doesn't the government insist that we not bring our cars into the middle of cities, why aren't working hours staggered to relieve public transportation? Why don't we make up our minds that we cannot have it both ways?

We are accustomed both to our conformity and to our free enterprise. And what the architect cannot do is drastically change a way of life. He cannot plan the same building for New York City as he can for Boston and Baltimore. There is no room for the low rambling open office building, surrounded by parking space in

the large cities. In New York space is gained by going up, and no matter how the crities carp, that is the way New Yorkers want it, that is the way the entire Metropolitan area (the commuters) want it; and I dare say the rest of the country loves New York the way it is!

Not too long ago, there was a 'push' toward the suburbs among some larger corporations. Their offices were planned in bright, airy, open spaces; academically, perhaps, the theory was right. The push did not succeed. It did not succeed because people did not appreciate it. It was difficult to employ an office staff, because even girls who lived nearby did not want to work that close to home. Employees were forced to eat in the company lunchroom, because there was no other choice. Friends did not work within easy transportation distance, therefore luncheon dates could not be made. Shopping facilities were not convenient. The result was a feeling of sterile isolation. There is an excitement engendered by a large city. There is a sophistication and a social vista that goes beyond a social welfare plan.

Therefore we create buildings and areas to suit the needs of the tenants and to give a profit to the owners; once again, architecture mirrors the society in which we live. Whatever I say here is merely a comment on our day and age. Great architecture has only come out of great ages, and even the most sanguine of us cannot claim that this is a great age. We are living in trying and uncertain times, going faster scientifically, economically, politically, and socially, while unable to keep up physically or aesthetically. We are in a developing period, and the architecture we are attempting to create still leaves much to be desired. We may never achieve a developed new architecture but this does not prevent us from seriously working toward a goal that future architects may achieve.

For large cities, this is an architectural period of verticality and bulk spaces. The vertical city has advantages for big business. The insurance district, the financial district, and the cloak and suit district are successful because of their high occupational intensity and the closeness of client to market. In the vertical city a business man does not have to travel far and wide to call on an account. He does not have to rely on his car, he does not have to worry about parking, he need not spend money on cabs. In New York, the widest part of Manhattan can be walked without too much effort. In an area such as Rockefeller Center, an outstanding example of partial urban planning, calls can be made without any concern for transportation. New York City is congested, but this congestion makes for good business, because orderly congestion is also concentration. The Wall Street area, which is narrow and hemmed-in, could not function properly any other way.

It is the old controversy of a vertical against a horizontal city. Harvey Wiley Corbett, F.A.I.A., was an early advocate of the vertical city, and I have always been an admirer of his theory. I have for over two decades advocated the intense, high density city plan for the business sections of New York City. The argument of course could be carried to the point of the ridiculous: how high can a vertical city go! But large scale urbanistic effects are achieved by verticality. A truly urbanistic city is composed of vertical areas, self-contained but contiguous.

To produce such a city and still retain 'humanistic' feeling, the architect must be concerned with more than the design and plan of the particular building for which he has been commissioned. He is concerned with the proximity of public transportation, of restaurants, both inexpensive and luxurious, of places of relaxation, and of minor shopping facilities. He is concerned, too, with the harmony of the surrounding neighborhood.

The building which best illustrates a response to these concerns is the Pan American Building. The proximity to public transportation is obvious; one of the reasons for the large size of the Pan American Building is its location in an area where people from various points can reach it with ease, by rail, subway, bus, and even air: a sizeable heliport is being provided. It is a bustling building in the center of a busy, bustling district. Within the confines of its three acres, a complete, if narrow, life could be lived.

I believe that architects produce functional answers to functional problems. If the answers are not always 'urbanistic' or 'humanistic' it is because no one thinks of himself as an adjective. He is an individual who conforms, but he conforms because his demands have been met. His home, his office, his playground are being built for convenience and use. The commercial development of New York has met his demands in this respect.

If it is true that modern architecture is being examined against the practices which threaten our destruction, it is true because modern society is being threatened with destruction.

If our cities, our country, or, for that matter, our world, are to remain habitable, the art of humane living must prevail; only then can the art of architecture prevail.

'When the vast apartment houses were first designed for Park Avenue, they met the demand of a social money class'

Photograph Credits:

Pages 5 and 6: Federico Marconi
Page 9 : Pertti Ingervo, Helsinki
Pages 15, 17, 20, 24, 27, 29, 33, 34, and 36: Pietinen, Helsinki
Pages 18, 19, and 23: Heikki Havas, Helsinki
Pages 92 and 102: Brown Brothers
Pages 93, 98, and 99: Underwood and Underwood

Transparency: Literal and Phenomenal

Figure 1 from *History of Impressionism,* by John Rewald, Museum of Modern Art, 1946
Figures 2, 3, 4, and 5 from *A History of Modern Painting, from Picasso to Surrealism,* by Maurice Raynal, Editions Albert Skira, Geneva, 1950
Figure 7 from *Léger,* by K. Kuh, University of Illinois Press, Urbana, 1953
Figures 8, 11, and 12 from *Walter Gropius,* by S. Giedion, Architectural Press, Ltd., London, 1954
Figure 10 from *Oeuvre Complete de 1910-1929,* by Pierre Jeanneret, Editions H. Girsberger, Zurich, 1943

Antonio Gaudí: Structure and Form

Figure 1 from *Art through the Ages,* by Helen Gardner, Harcourt, Brace, and World, New York, 1959
Figures 8, 9, 13, and 14: Foto Mas, Barcelona
Figures 10, 15, 17, 23, 26, 27, 30, and 31: Foto Aleu, courtesy of Archivo Amigos de Gaudí, Barcelona
Figures 19, 20, 21, and 22: Foto Archivo, courtesy of Archivo Amigos de Gaudí, Barcelona

Printed in Japan

Perspecta: The Yale Architectural Journal
is published at intervals of approximately 18 months by the students of the Yale School of Art and Architecture. The schedule of rates is as follows:
Single issues $3.00
Three issue subscription $7.50

The following present and past issues are available:

Perspecta 5: 1959

Edgar Kaufmann Jr Architectural Coxcombery or the Desire for Ornament
Mario G Salvadori The Engineer and the Artist
Edward Larrabee Barnes The Design Process
Matthew Nowicki A Letter
King Lui Wu Notes on Architecture Today
William W Wurster and Catherine Bauer Indian Vernacular Architecture: Wai and Cochin
Robert Osborn The Client and the Architect
Paul Nelson Design for Tomorrow
George Izenour An Experimental Theatre
Vincent Scully Jr Louis Sullivan's Architectural Ornament

Perspecta 6: 1960

Henry-Russell Hitchcock Food for Changing Sensibility
Francois Bucher A Failure of Architectural Purism
Charles Moore Hadrian's Villa
The Work of Charles Edouard Jeanneret (Little Known Early Work of Le Corbusier)
Walter Dodd Ramberg Some Aspects of Japanese Architecture
George Kubler Machu Picchu
Edgar Kaufmann, Jr Nineteenth Century Design
Isamu Noguchi (Photos) The Observatories of the Maharajah Sawai Jai Singh II
Paul Mitarachi and Robert Ernest Mykonos and Patmos
James Stirling The 'Functional Tradition' and Expression

Perspecta 7: 1962

Philip Johnson Selected Projects
Louis I Kahn A Recorded Discussion of Three Projects
Eero Saarinen Selected Projects
John Johansen Act and Behavior in Architecture
Paul Rudolph For Perspecta: Selected Projects
Sibyl Moholy-Nagy The Future of the Past
James Gowan Notes on American Architecture
Walter McQuade The Exploded Landscape
Peter Collins Form Givers
Colin St John Wilson Open and Closed

Perspecta 8: 1963

Michael Dobbins The Achievement of Finnish Architecture
Selected Projects by:
Alvar Aalto
Aulis Blomstedt
Kaija and Heikki Sirén
Aarno Ruusuvuori
Reima Pietilä
Edgar Kaufmann Jr Frank Lloyd Wright and the Fine Arts
Ezra Stoller Photography and the Language of Architecture
Colin Rowe and Robert Slutzky Transparency: Literal and Phenomenal
Edward Larrabee Barnes Modern Technology and Native Tradition
Jane Drew Architecture in the Tropics
Ralph Erskine Architecture in the Subarctic Region
George Collins Antonio Gaudí: Structure and Form
Vincent Scully Jr The Death of the Street
Richard Roth The Forces that Shaped Park Avenue