

# VIA 6

ARCHITECTURE AND VISUAL PERCEPTION

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**Via 6** ARCHITECTURE AND  
VISUAL PERCEPTION

Editors

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with

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1. Mural, Woonsocket, Rhode Island

## EDITOR'S INTRODUCTION

**I**F A FILM were able to reproduce for us what the eye receives in its normal course of exploration, we would find ourselves confronted by a rhythmic flicker of select but barely related images shifting about in a loose sequential montage. Only the small center of each image would be in clear focus as its periphery softened into a blur of color that finally faded to soft grays near the edge of the frame. Images would succeed one another at a rate of about four each second, a speed too slow to gain the seamless continuity of motion pictures and too fast for us to recognize each scene individually.<sup>1</sup> Normally, each of us gains close to 150,000 of these glimpses of our surroundings every day, and a fair proportion of attention encounters the built environment. This skittering sequence of impressions is the raw material of visual experience that falls away unremembered as we perceive a painting or a building as unified, stable, and contiguous. We literally do not see that which we remember nor remember what we see.

But the act of seeing is mundane. After years of practice in knowing and in maneuvering through buildings, why should architects concern themselves with anything but the end result of visual perception?<sup>2</sup> Painters deal with illusion, we are taught, not architects. Buildings do not restrict us to one viewpoint. They are available on our own terms, holding no visual mystery that we cannot solve by taking a look from the other side. We may feel the cool face of concrete, knock on glass, listen to our own voices return in clear or muffled echo and move about freely without restraint. We may ask to see the details of construction and subject the underlying structure to mathematical verification. In architecture, our freedom to investigate is far greater than any allowed in other arts such as painting, literature, or film-making. Built forms seem so ubiquitous and so familiar that surely any visual ambiguities have been discovered long ago.

But the ease of apparent familiarity breeds haste. In years of practicing our skill, we have cut short the process of seeing by isolating and naming objects until recognition alone seems sufficient for understanding.<sup>3</sup> Too often the order of language has become the order of image. The known world seems to be made up of objects with specific names and purposes, each seeming to possess characteristics of color and form, contrast and outline. Perhaps the relationship may as easily be reversed. The simple description of a visual scene requires students of the visual arts to painstakingly unlearn their skill in objectifying images and strain to trace the light and shadow before them rather than the discrete identifiable features.

Habits of seeing are formed and tested in everyday encounters for everyday purposes. They are fitting to those situations. Yet in the efficiency of habit, the underlying processes and organization of perception are lost to the conscious mind, and the most basic responses of the eye and mind are completely inaccessible.<sup>3</sup> A studied awareness of the paired phenomena of sight and recognition, however, may teach us something of the orderliness with which we approach the visual world. Architects as well as painters, sculptors, and all those charged with shaping the physical world may use such a study to hone their skills of observation beyond the demands of daily response and learn to use their sense of sight more fully.

What may a study of visual perception teach us? More, one would hope, than a repertoire of illusion and clever perspectival tricks to induce and deceive. An earnest study must not

center on what we perceive, but should question how we perceive; how do we make sense out of the parcel of light waves that enter the eye? What are the mechanisms that interpret a limited range of electromagnetic waves as that which we call light and color, and how are these shadows ordered in a system of meaning appropriate to our daily tasks? Once visual perception is loosed from the set of properties of physical objects, light and color may take up residence in the eye and mind as characteristics of our particular sensitivity to the visible spectrum.

The field of perceptual psychology engages the intricacies of visual sensibility at every level from the chemical response of photoreceptors in the eye to the construction of a consistent knowledge of our surroundings. Working within the theoretical structure of the human sciences, psychologists search for a useful model of the mental tools that enable us to recognize, order, and integrate visual information, and debate flourishes over the exact description of this model. Although a rigorous explanation of visual understanding is not forthcoming, current theorists would all agree that perception is interpretive, purposeful, and, by nature, creative.<sup>5</sup> We use our visual information to create, qualify, and modify our understanding of the visual world and in turn use perceived patterns to direct new exploration. This cycle admits no disjunction between perceptual and creative thinking, for vision is meaningful only within an existing framework, and that framework is tied to a constant source of new information. Percept and concept turn as one, spinning the fabric of experience, looking always ahead and always back, "there is no vision without thought."<sup>6</sup>

Perceptual thinking has been the focus of debate in philosophy, art and literary criticism, and esthetics as well as psychology. This juncture in nascent cognition is critical to theories of imagery, and imagination, and their parallel in literature, metaphor. Paul Ricoeur traces visual image and verbal metaphor to a common source, thereby blurring the distinctions between verbal and nonverbal communication, and between the "sense" of an idea and its representation. He identifies each of these functions as aspects of a single process of concretizing ideas or "schematization."<sup>7</sup> As theorists began to draw parallels between perception and the making of mental correspondence between different experiences, they came to an acknowledgment of the interpretive and purposeful nature of perception along a different path than did clinical psychologists interested in the sense of sight. In this unity of percept and concept, we find a common thread that draws together the disparate theories of perception in each of our respective fields. We find, too, the common concern of essays in this volume.

This process of understanding visual phenomena, or "visual thinking," characterizes both the experience of the seen world and the artistic invention of new experiences.<sup>8</sup> Both are ways of "seeing as" or seeing metaphorically in order to understand and communicate.<sup>9</sup> But perceptions change according to the particular place and historical moment, and just as intellectual history is characterized by differing styles of thought, visual thinking is tied to cultural change. Not only do we literally see differently than people of the past, but we hold a different view of the function of sight itself. The changing styles of the visual arts and landscape may be seen in part as a history of exploration into a contemporary understanding of visual perception.

Visual thinking and history touch every aspect of the art and experience of architecture. Our livelihood as architects depends on a visual fluency not only in reading existing spaces, but also in reading the spirit of contemporary activities that have not yet found places of their own. The essays in this collection address aspects of the question of visual fluency ranging from the unchanging psychological base of perception to the changing nature of visual expression in the history of architectural design.

In framing these inquiries, Rudolf Arnheim, the intrepid pioneer of the study of art and visual perception and the first to call our attention to “visual thinking,” examines built form as a perceived phenomenon. Arnheim outlines the specific properties of the three-dimensional world that distinguish the experience of architecture from that of the other arts. His discussion reaches beyond considerations of painterly composition to point out the particular power of buildings to physically involve a moving viewer within a self-contained space or dramatic sequence, and recognizes the power of architecture to develop a sense of timing in pace and sequence much like that of the dancer or musician.

Wolfgang Zucker offers a counterpoint to the first essay by examining the position of the architect as an individual within a society given the power of creative activity. He draws on Greek myth to outline the architect’s often precarious position as a man sought out for the strength of his imagination and quietly distrusted for the same reason. The delicacy of the relationships between architect and patron suggests a profound emotional concern with building reaching well beyond utilitarianism. In approaching the central issue from two directions, these first essays bracket the respective roles of viewer and creator, and gesture toward the unity of the two.

As newcomers to the field of perception, we have much to learn of the specific parameters of the sense of sight. Julian Hochberg offers a careful study of the interpretive nature of sight and of the quality of visual information available to us. In response to our needs as architects, his study is brought to examine the integration of successive glimpses of the three-dimensional world into a coherent, reliable understanding. In reaching this question, Hochberg outlines the history and interests of his own field of perceptual psychology and traces the development of a theory of schemata and memory that closes the gap between perceptual and conceptual psychology. Using examples from the built environment, Hochberg’s detailed essay formulates a lucid program of current issues relevant to architects. Such an effort will clear away years of antiquated and misunderstood notions and perhaps suggest fresh means to responsive design.

Extending the exploration of a universal basis of perception, Anne Griswold Tyng underscores the relationship between perceptual paradigms and the geometry of three-dimensional form. She points out a correspondence based on recurring numerical relationships between fundamental spatial patterns in nature and underlying consistencies in the cross-cultural representation of space. Using examples from her own work, Tyng discusses the application of spatial and numerical archetypes to architecture.

If we share a common means of visual perception, then how do culture, class, family, and individual imagination frame our reading of experience and our art? Herbert Read once wrote that “Seeing is creation and creation is communication.” In all its forms, this process of artistic communication reveals a synthesis of all levels of interpretation from the most basic level of cognition to the most fleeting fancy.<sup>10</sup> Art is vision produced by

the same imagination that strains meaning out of points of light and, as Susan Langer maintains, “imagination is the source of dream, reason, religion, and all true general observation.”<sup>11</sup>

At the service of visual imagination, drawing is the common tool of the visual arts; it is widely available and responsive to the eye, thought, and hand of the draftsman. In his essay, Gilbert Cass argues that drawing serves the architect as spontaneously as it does the painter or the sculptor. Drawing reveals the spirit of intention in architecture that will not be lost in the contractor’s hands, but will gain power as the dominant mood of the completed work. Cass uses examples that bridge the gap between seeing and drawing, revealing an unbroken thread of purpose and interpretation.

Because the nature of vision drives both the creation of drawing and architecture, existing buildings should offer clues not only to the architect’s visual intentions but also to a metaphor for vision tacitly shared by the architect and his cultural contemporaries. Such commonly held ideas contribute to a manner of thinking that reaches beyond the visual arts and imprints upon every form of human endeavor a distinct communicative tenor, which we may call “style.” Susan Sontag suggests reversing the well-worn relationship between style and content so that content, or subject matter, may take its place as simply another expressive agent of style, for, she argues, the existence of content in a work of art is itself a stylistic device.<sup>12</sup> If we consider artistic and intellectual accomplishments as simply different forms of communication, we begin to legitimize visual fluency as an intellectual facility freed from the mire of “artsy” willfulness. Architectural style, therefore, is not just a formal language shared only by the architect and his specific audience but reverberates on a level of belief common to all contemporary expressive forms. On this level, correspondences among the visual arts and philosophy, politics, and science of a historical time are hardly surprising.

During the 1920s, just such a shared esthetic linked the Rationalist movement in architecture in Soviet Russia with the school of Gestalt Psychology begun in Germany. Anatole Senkevitch traces this interdependence through his careful research into the writings and design of the principal figures of both intellectual movements. He draws on the controversial theoretical writings of the teachers of the Inkuk, the first Soviet school of architecture, and on the work of both teachers and students to document the development of a coherent program of design priorities. The influence of the Rationalists is conspicuously underrepresented in most surveys of early twentieth-century architecture, because of long-standing political and linguistic barriers. Through Senkevitch’s work, its full importance again may be felt.

Whereas Senkevitch’s study examines a common line of thought shared by a group of architects, each of the final two articles looks at the visual language of a single architect through a close description of his projects. Each study shows how a conscientious concern with the workings of visual perception is manifested in design, and each suggests the profound influence of a contemporary artistic or scientific metaphor for vision. Using the analogy of language, these essays clearly show how a fascination for a particular aspect of the visual world shared by the architect and his contemporaries becomes a part of an expressive language with which a building “speaks” to its occupants.

Drawing on seventeenth-century documents and first-hand experience, Hamilton Hazlehurst rediscovers Andre LeNostre’s use of perspectival illusion and trompe l’oeil in the gardens of Vaux-Le-Vicomte, Pontchartrain, and Chantilly. These

gardens date respectively from the beginning, middle, and end of LeNostre's career, and together they reveal his increasing skill and subtlety in molding the almost contourless plains of the French countryside into gardens no less dramatic than those of the Italian nobility. LeNostre pleased his patrons with broad landscapes of slow symmetry in which the delights of water and glen alternately unfolded and were concealed in sequences planned to charm the eye of the viewer.

A century later, the romantic vision of Richard Morris Hunt and Frederick Law Olmsted was at work in their design for Biltmore, the house and garden estate of George Washington Vanderbilt near Asheville, North Carolina. A concern for expansive views, picturesque natural landscapes and a continuity between house and garden were priorities for the gracious estate of a nineteenth-century American gentleman. Gerald Allen and Mark Hewitt use this case study to illustrate the range of perceptual issues that all architects considered in their design decisions. The original plans of Biltmore have never before been made public nor considered so closely. Our understanding of Hunt, Olmsted and the American romantic tradition is taken a significant step further.

In both of these case studies, the architects actively formulated an understanding of visual perception within a contemporary model. Those not plundering the scientific journals, as, for example, did the teachers of Inkuk (the school of the Russian rationalists), developed a demanding artistic sensibility that taxed the eye and mind with questions of three-dimensional form analogous to those that occupied their contemporaries in other fields. The visual issues pursued by each architect may be seen as part of a pervasive tone of inquiry that was shared by scientists and artists alike.

If those questions interested artists and architects then, what is the mood of research today? What do we share with scholars and scientists as we each pursue our own paths? Do we single out certain design ideas as exemplary or particularly expressive, and do these have some analogy in the human sciences that may contribute to our own understanding or suggest new principles of formal organization? Although such parallelism undoubtedly exists more pervasively than we can easily see, three concepts will serve as examples of analogies between the two fields: image, the memorable statement of a composition; pace, the rhythm and rate of experience; and synesthesia, our tendency to make connections between the senses. Although science will never offer clear-cut answers or formulae with which to dimension experience, scientists are dreamers and their work can be rich with suggestions drawn from practical experience very close to our own.

In recent years there has been much talk of the image in architecture as well as in the field of perceptual psychology. In both disciplines, "image" has become a catch word used so often and so imprecisely that it has come to suggest a certain polemic or philosophy rather than a specific visual phenomenon. The notion of imagery has played a more or less important role in all theories of perception since the inquiries of Hobbes and Berkeley in the seventeenth and eighteenth centuries. In the mid-twentieth century, theories of perception based on the notion of a remembered impression of the retinal image were discredited under pressure from a behaviorist school of thought.<sup>13</sup> Interest was revived in the 1960s and 1970s by a series of experiments on mental rotation, or the ability to imagine a three-dimensional object and turn it around in the mind's eye as if it were real.<sup>14</sup> This time the mental image or mental structure was identified as a phenomenon distinct from the retinal impression or sensation. Modern psychologists ac-

knowledge the true-to-life appearance of mental images, but attribute this to a purely mental mechanism, not a visual one.<sup>15</sup> The eye could never see an object whole or know the ideal forms, prototypes, and fantasies abounding in the imagination, nor would a percept ever be confused with an image made in the mind. This distinction suggests that the mental image is a phenomenon more akin to a proposition or analogy than to anything purloined from the physical world.

In the writings of contemporary architects, the "image" of a building refers to the memorable or referential qualities of a composition, that which is easily captured in analogy. In fact, the architect's concerns with imagery have closely paralleled those of scientists in the shift away from the Gestalt model of geometric simplicity as the key to imaginability to a more experiential idea based on commonly known symbols or associations. Thus the active geometries of the mid-century are replaced with temples and ducks.

Since the recent flurry of experimentation into the nature of the mental image, scientists have satisfied their initial curiosity and have reintegrated the phenomenon into a general theory of mental structures and schemata. Likewise the interest of architects in specific and relentless associations may wane and the "image" find its appropriate place within a broader approach to design.

Whereas an image is often strongest as a momentary impression of a building's facade or of an interior space, our experience of a sequence in motion is also shaped by the designer's manipulation of pace and rhythm. Architects speak of the visual rhythm of columns or windows and of overlapping sequences of pilasters and free-standing columns in the work of Michelangelo or Bernini. They disparage modernist elevations for their relentless repetition and extoll the sinuous undulations of Antonio Gaudí. Some, such as Aldo van Eyck, speak of the sequential rhythm of an entry or stairhall, and consciously think of design as the structuring of experience. Van Eyck's articulation of the in-between creates a space of both inside and outside, upstairs and downstairs in an effort to allow the space, and hence the time, for an experience of rhythm within the simplest of transitions.

This sensitivity to pace finds a parallel in current studies of timing in the recognition of and reaction to new information. The fundamental units of exploration and understanding seem to be firmly fixed in time and to vary little between people.<sup>16</sup> All of us, when confronted with a surfeit of information, absorb at our fastest pace and simply lose the excess; when we do not find enough of interest, we become bored and daydream. In efforts to measure this pacing, experiments on reading have shown that we can manage about four glimpses every second. Only a two percent area in the center of each scene is in clear focus while the large peripheral field quickly fades into a blur only differentiated enough to distinguish color and general form.<sup>17</sup> After this quarter-second glimpse, more time is needed to recognize and relate the new information to a larger view and finally to make sense out of the entire scene. All phases of the perceptual cycle: sight, recognition, and exploration, proceed simultaneously and each new glimpse is planned and executed intentionally. In this manner, the skipstep work of the eye proceeds on expectation and is always a jump or two ahead of the cycle of recognition as we experience the visual world in an undisturbed stream.<sup>18</sup>

Authors and musicians play on expectations, often allowing a pause before a passage of particular insight or intensity, and setting description or modulation at a pace that seems to fit the mood of an event. Timing is a particularly effective device in

film-making as vignettes may be spliced together in a rhythmic sequence to establish the ambience of a scene. Ingmar Bergman was the master of a brooding, sulking pace in film, offering just enough information to suggest a depth of emotional undercurrent. The modulation of pace is a powerful technique in all the arts including architecture, which, even if not conceived in a linear fashion, is experienced serially.

Finally, an interest has been revived in synesthesia, the crossover areas between the senses. Robert Armstrong describes the essential qualities of esthetic experience independent of specific medium or sensation, constructing qualitative oppositions that apply equally to music, literature, and the visual arts.<sup>19</sup> At this basic level, the senses coalesce into a single metaphoric impression rendering all the arts as one. In studies of speech and communication, Raymond Birdwhistell demonstrates the pervasiveness of everyday expression in gesture and movement as well as language, suggesting that information is commonly transferred through a great many channels, all of which we are able to read.<sup>20</sup> A condescending stance, or an insincere tone of voice may be read as clearly as any verbal message—sometimes more clearly, as any practiced liar knows. The messages of buildings also travel in diverse ways so that touch and sound may be powerful allies to a visual statement. Alvar Aalto extended the laws of acoustics to serve his art. The stainless steel fan sculpture and ceiling modulation of the hall for the Institute of International Education was designed to respond to the resonances of speech as well as to add a visual touch to the room. Frank Lloyd Wright's choice of natural materials not only supported his polemic, but enriched his buildings with the sensual qualities of milled oak and rough fieldstone. In a building, the qualities of the many arts of architecture do coalesce whether or not it was the architect's intention, and many an architectural liar has been found out in ways he never considered. In every area of design, we are thus charged to be aware of the analogous senses and build toward a wholeness of experience.

In every instance, we are called upon not to follow the details of scientific literature but to learn to use our senses well and willingly and to seek a fluency in the three-dimensional experiential language that we are creating. In this volume, we try to present some meaningful models for visual thinking and to open the way to new architectural sensibilities. We would do well to heed the words of Josef Albers, "Do not be afraid of the understandable in art."<sup>21</sup>

## Notes

1. Julian Hochberg, *Perception*, 2nd. ed. (New York: Prentice Hall, 1978), pp. 40–44.
2. R. L. Gregory, *The Intelligent Eye* (New York: McGraw Hill, 1970), p. 11. Also Roger Fry, quoted in Suzanne K. Langer, *Problems of Art* (New York: Charles Scribner's Sons, 1957), p. 31.
3. Gregory Bateson, *Steps to an Ecology of Mind* (New York: Ballantine Books, 1972), pp. 478f.
4. Numerous experiments have been done in which scientists wear special lenses that turn the visual world upside down or scramble color vision. In all cases after a few days the scientists became so accustomed to the new way of perceiving that they no longer noticed the reversal, saying that the world looked natural and in order. Julian E. Hochberg, *Perception*, 2nd ed. rev. (Englewood Cliffs, N.J.: Prentice-Hall, 1978), p. 98.
5. E. C. Carterette and M. P. Friedman, eds., *The Handbook of Perception* Vol. X (New York: Academic Press, 1978)
6. Maurice Merleau-Ponty, *The Primacy of Perception*, ed. James Edie (Ohio: Northwestern University Press, 1964), p. 175.
7. Paul Ricoeur, "The Metaphorical Process as Cognition, Imagination, and Feeling," in *On Metaphor*, ed. Sheldon Sacks (Chicago: University of Chicago Press, 1978), p. 147.
8. Rudolf Arnheim, *Visual Thinking* (Berkeley and Los Angeles: University of California Press, 1969)
9. Gaston Bachelard, *The Poetics of Space* (Boston: Beacon, 1964)

10. Robert Plant Armstrong, *The Affecting Presence: An Essay in Humanistic Anthropology* (Chicago: University of Chicago Press, 1971), pp. 59–64.

11. Langer, *Problems of Art* (New York: Charles Scribner's Sons, 1957), p. 70.

12. Susan Sontag, *Against Interpretation* (New York: Delta, 1961), p. 20.

13. Hochberg, *Perception*, p. 186. See also Hochberg, "In the Mind's Eye," in R. N. Haber, ed., *Contemporary Theory and Research in Visual Perception* (New York: Holt, 1968), p. 188.

14. Roger N. Shepard, "The Mental Image," *American Psychologist* 125 (February, 1978): pp. 127–28.

15. Hochberg, *Perception*, p. 189.

16. Mary Potter, "Short Term Conceptual Memory for Pictures," *Journal of Experimental Psychology* 2 (1976): pp. 509–21.

17. Hochberg, *Perception*, p. 40.

18. Ulric Neisser, *Cognition and Reality* (San Francisco: W. H. Freeman and Co., 1976), pp. 13–24.

19. Armstrong, *The Affecting Presence*, pp. 59–65.

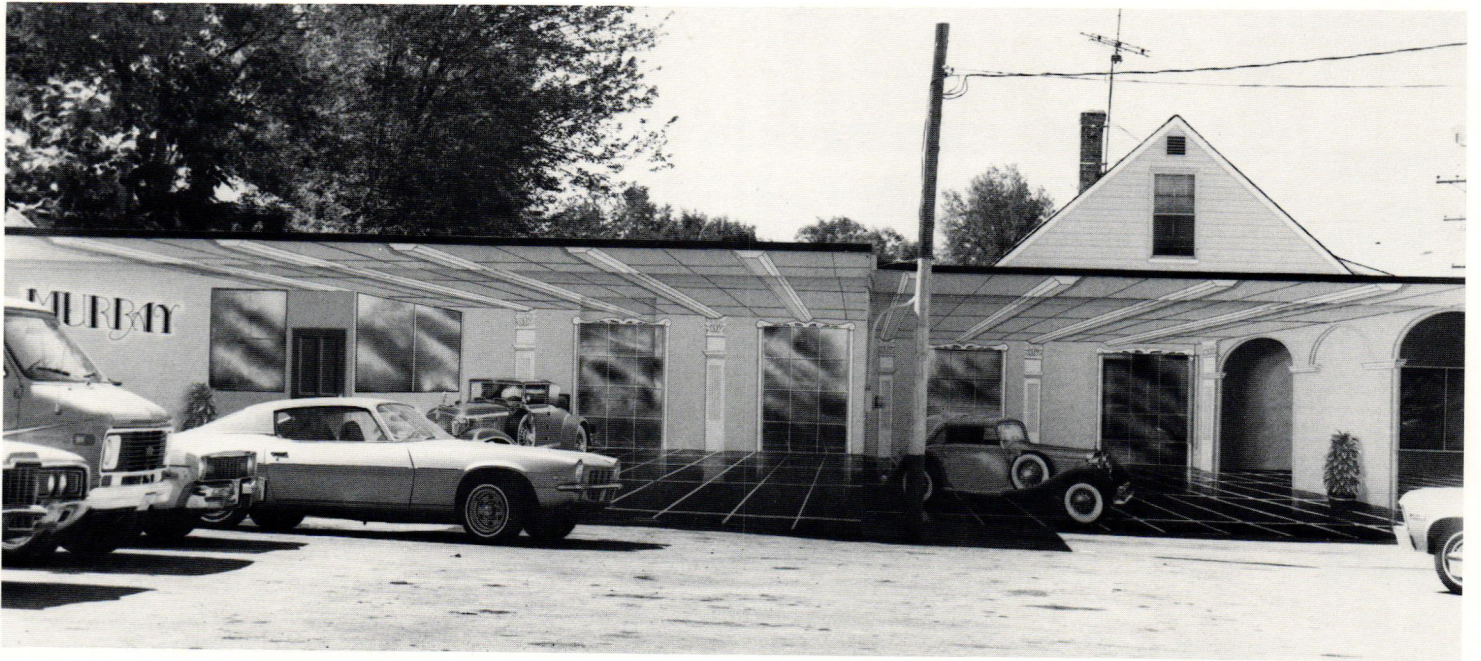
20. Raymond Birdwhistell, *Kinesics and Context* (Philadelphia: University of Pennsylvania Press, 1970).

21. Josef Albers, "Search vs. Research," Three Lectures at Trinity College, April, 1965 (Hartford: Trinity Press, 1969), p. 10.

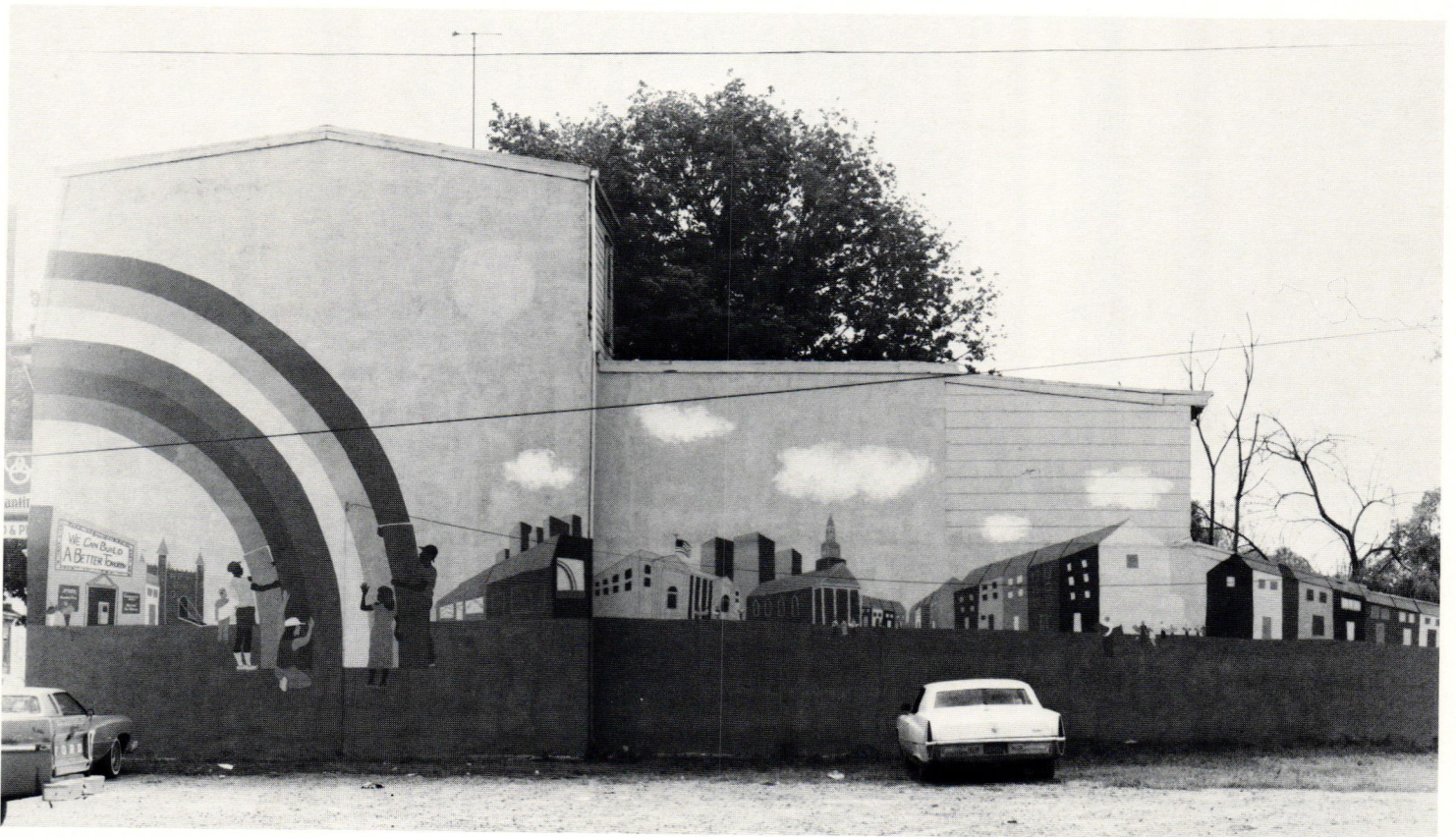
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2. Mural, Woonsocket, Rhode Island



3. Mural, Wilmington, Delaware



1. Francesco Borromini, Pavilion of Palazzo Spada, Rome

# BUILDINGS AS PERCEPTS

Rudolf Arnheim

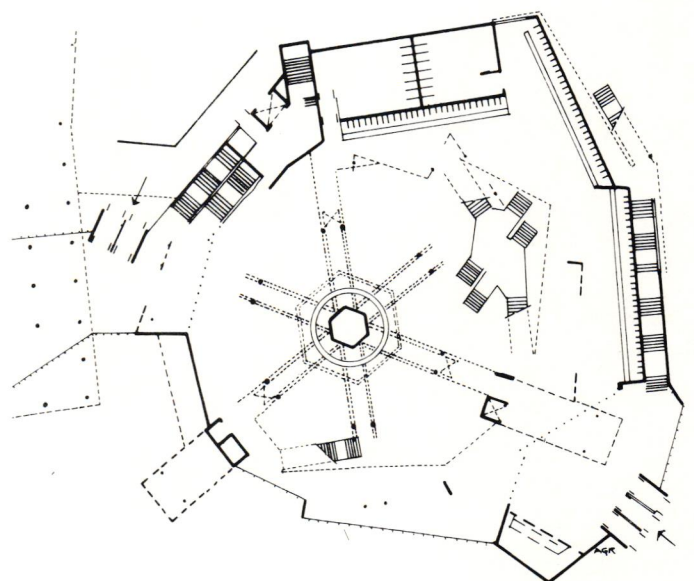
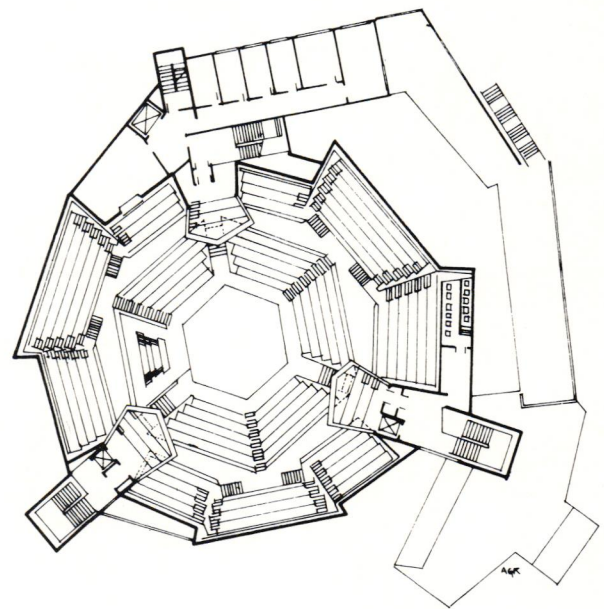
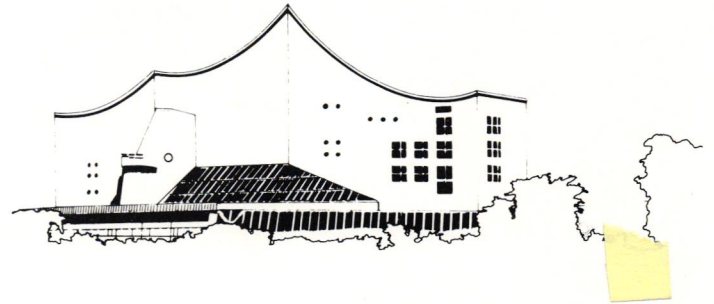
PSYCHOLOGISTS ASSUME AS A MATTER OF COURSE that a building, just like any other object in this world, is available to us only as a perceptual experience and therefore must be dealt with as a sensory object. This premise, however, is not shared by everybody else. So earnest a theoretician as Christian Norberg-Schulz writes: "The theory of architecture . . . cannot take the immediate experience as its point of departure." In a later publication he insists again that "What one describes in this way are subjective architectural *experiences*, and one would have to arrive at the absurd conclusion that 'architecture comes into being only when experienced.' It is, therefore nonsense to say that man is always the center of *architectural* space, and that the directions of architectural space change with the movements of the human body. Architectural space certainly exists independently of the casual perceiver, and has centers and directions of its own."

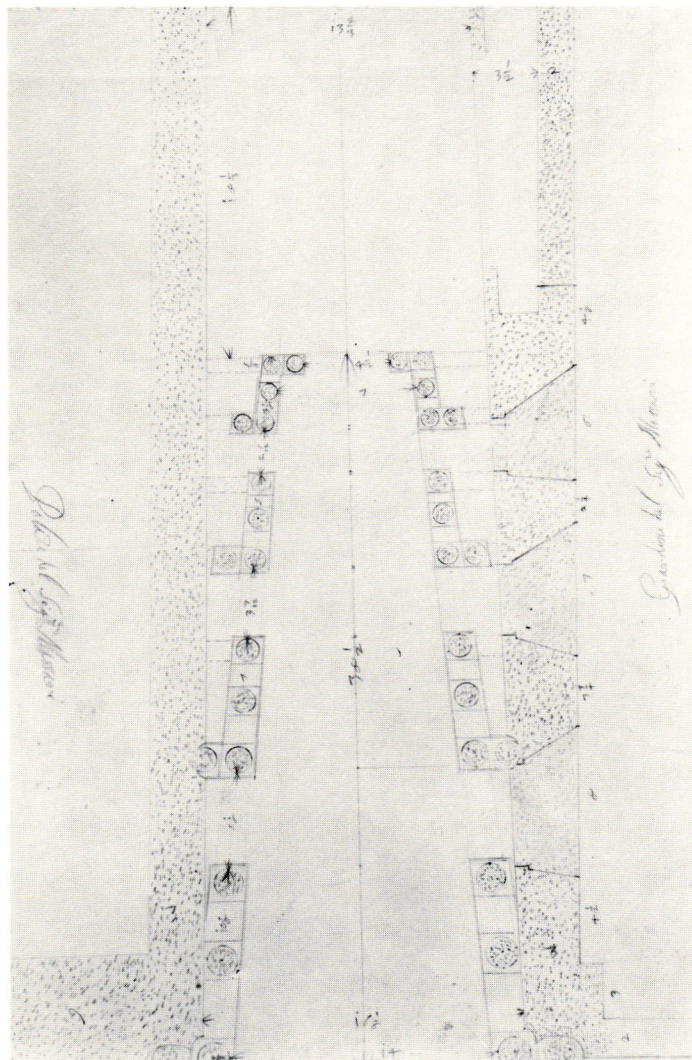
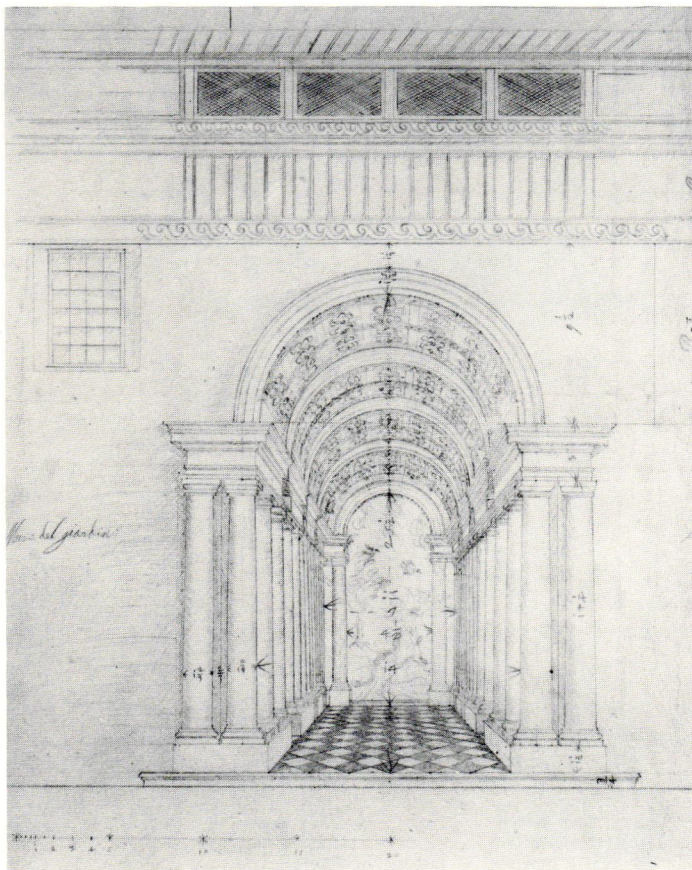
The examples used by Norberg-Schulz make it clear that he thinks of perceptual experiences as nothing but the accidental and momentary observations that enter a person's consciousness when he accepts "literally" what his eyes register as he looks at the world. This sort of perceptual behavior, however, occurs and assumes validity only under very special conditions as, for example, when one looks at a painting. More typically, the percepts of human beings or animals concern the independent existence of things, as it crystallizes in the mind from an infinity of individual impressions. This certainly is the case when one walks toward a building or through its interior. The frequently quite complex total image of an object results from the spontaneous integration of the multiplicity of the particular visual projections. Such a total image, however, is just as concretely perceptual as the individual sensory registrations.

The simple example of a cube may illustrate this point. From no place of observation can one see more than three side-faces of a cube. Nevertheless, everybody operates with the visual image of a complete cube. The particular quality of such a mental image is not easily described, yet we can suggest how it comes about.

To put it a bit strongly: a building or a group of buildings, because of its three-dimensionality, is an object that nobody has ever seen and of which nevertheless one can have a valid image. The coming about of such images presents the psychologist with a twofold problem. First, a mental image of this sort is not simply assembled intellectually from items of particular information, the way geographic maps of the world had to be put together before we were favored with the opportunity to photograph our planet from outer space. Rather the integration comes about as a purely perceptual process, whose nature tells us much about how architecture is experienced visually.

Second, our image of a building is not simply that of a self-contained structure reposing in itself. It must incorporate the sensations generated by the building in the visitor or tenant. This means not only that the intended uses of a building are a





3. Francesco Borromini, Pavilion of Palazzo Spada, Rome: original drawing of plan, perspective view.

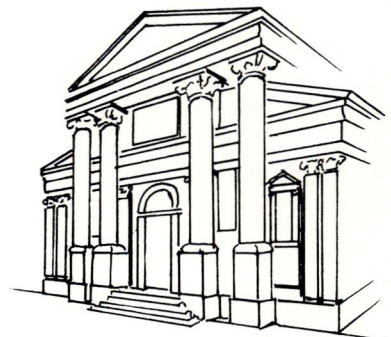
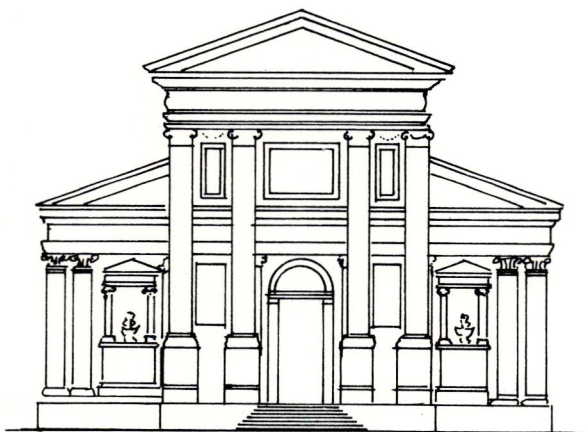
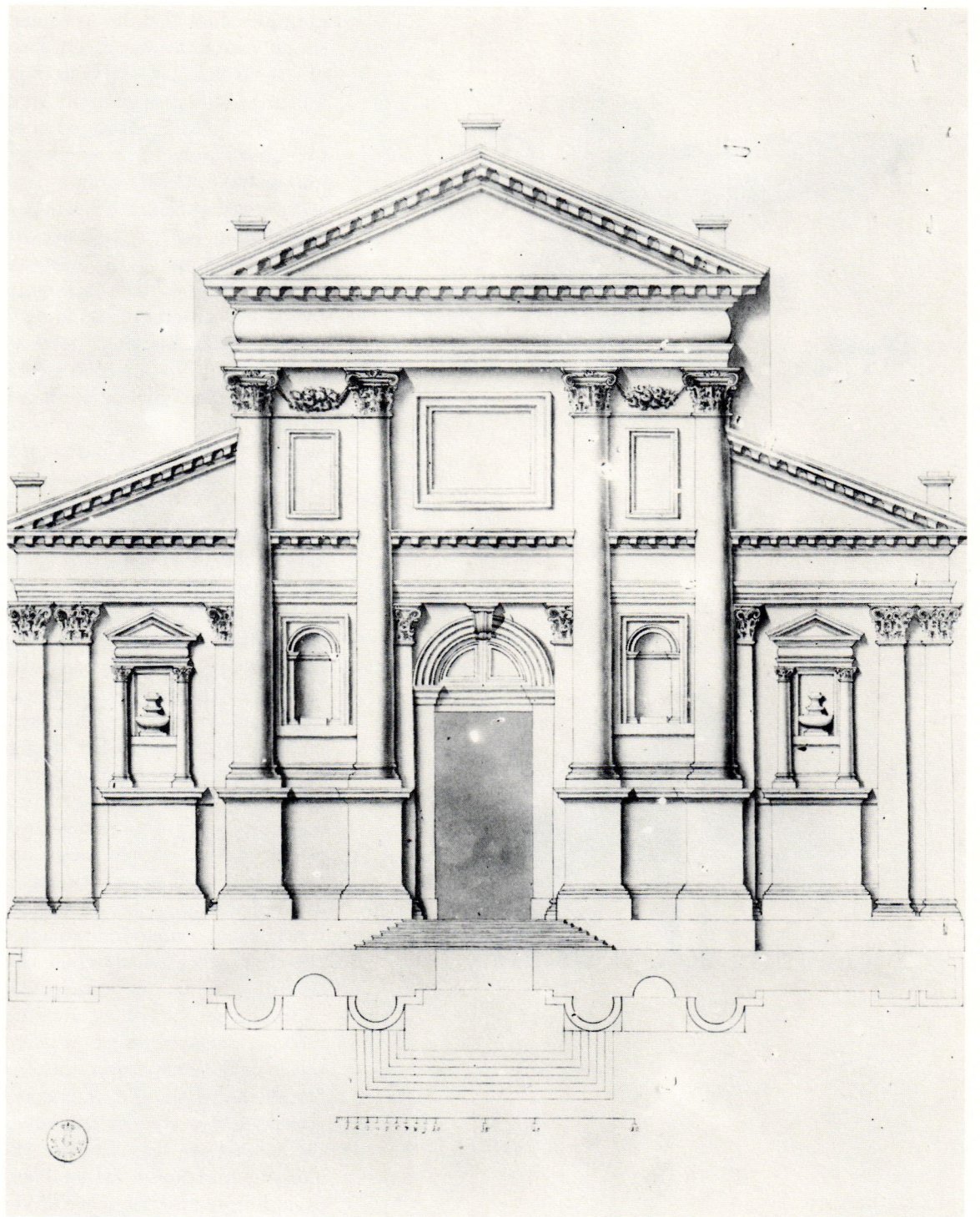
part of its image, as the use of a pair of scissors is an active part of what we see when we look at them, but that the sequence of perceptions activated in the user as he walks from room to room is as genuine an aspect of architecture as the static array of spaces.

Concerning the first of these two problems, we ask which visual properties of buildings help to generate an appropriate "objective percept." All is well when particular views of aspects display essential structural properties of the design as a whole. The orthogonal projection of a cylindrical tower, for example, suffices to supply us with a reliable image of the total shape. This perceptual integration comes about so spontaneously that we say: "I see a tower," rather than, more cautiously: "I see a rounded front." The percept can be rapidly completed even when it is more complex, as, for example, when several towers or cubes are fitted into one another. But when the plan of a building is based on three regular pentagons in irregular superposition, as I believe is the case in Scharoun's Berlin concert hall, the viewer faces a perceptual problem similar to that of a music listener who tries to discover the tone row in a composition based on the twelve-tone system. (Fig. 2)

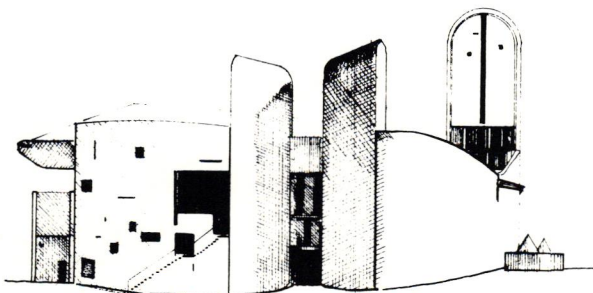
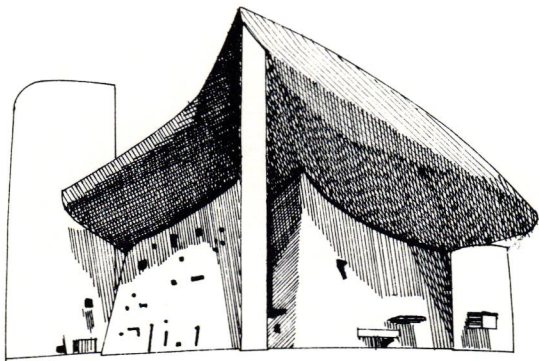
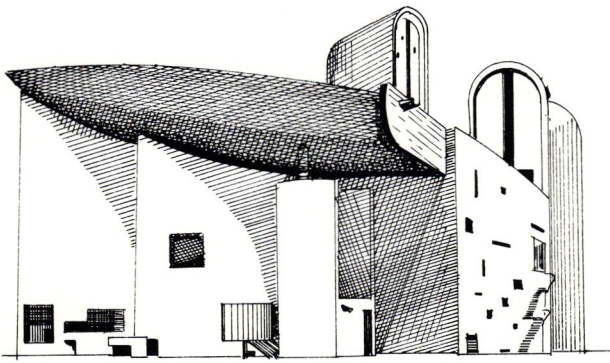
We keep in mind, of course, that a comfortable and reliable correspondence between projective aspect and objective form is not simply desirable in all cases. Stylistic differences, for example, determine whether and to what extent the facade of a building should reflect the design of the interior. The facade of San Giorgio Maggiore in Venice is not what James Ackerman would call "a diagram of the church" but a playful restructuring of the building's section. Instead of the tripartition of central nave and side aisles, the outside presents the interplay of two Greek temple fronts. This is not meant to mislead the approaching viewer but is rather a gourmet's game of *double-entendre*, comparable perhaps to the verbal puns that were so popular in the Baroque literature of the time. Similarly, it seems safe to say that illusory perspectives, such as those in Borromini's little pavilion in the back of the Palazzo Spada in Rome, were not simply intended to provide visual depth where little actual space was available. They present a witty interplay between two mutually exclusive realities. Either of them looks convincing to the eye, and together therefore they teasingly undermine our faith in the validity of our percepts. (Fig. 3)

The illusory perspectives of the Baroque exemplify a further perceptual principle operating in the relation between subjective view and objective form. By what criteria do viewers distinguish between projective deformations and the actual physical shapes of a building? Take the case of a traditional symmetrical facade approached obliquely by a viewer. Perceptually the viewer is presented with the superposition of two structural patterns, each of which is simply shaped in and by itself and which overlap in such a way that the eye can clearly distinguish them. One of these patterns is the objective symmetry of the facade. The other is the "pencil" of converging edges, the perspective transformation of objectively parallel horizontals. In such a situation, the Gestalt tendency toward simplest structure splits the optical stimulus into two components that are simpler than their combination. In consequence, we spontaneously perceive a symmetry tilted in the depth dimension. (Fig. 4)

In the illusory perspectives this separation of the two visual systems does not reflect the objective situation because the physical shape of the building is distorted in such a way as to ape the effect of optical projection. The perceptual tendency toward simplest structure opts under such conditions for an undistorted shape of greater or lesser extension in depth. Such



4. Sketch of San Giorgio Maggiore in elevation and perspective view.



examples show that the “constancy of shape and size” does not simply match the objectively correct proportions and distances of visual things (as textbooks of psychology are wont to assert) but presents the structurally simplest version of their appearance. If a building is shaped in so complex a way that perception cannot reduce it to simple geometrical elements, it is often impossible to decide from a particular viewing station which aspects of the shape are due to perspective and which belong to the building itself. To take an extreme case: it is almost impossible to photograph Le Corbusier’s chapel at Ronchamp in such a way that its objective shape becomes clearly discernible. One has to walk around the building to verify its angles and curvatures. In a case like this it takes a whole range of projective aspects to create an objective mental image. (Fig. 5)

Let me turn now to the other visual problem to which I referred earlier. Although a work of architecture dwells in space outside the dimension of time, it is also experienced as an event or happening. This temporal aspect of architecture is not simply identical with what a person’s sight or a film camera records on a journey through the building. It is not an affair private to the viewer but belongs to the objective nature of the work of architecture. As an event occurring in time, the architectural experience resembles those generated by music, the dance, the theater, or the film. But we note at least three differences which point to particularities of architecture.

First of all, a novel, a musical composition, or a dance remains an event observed from the outside. Even when the reader, listener, or viewer strongly identifies with the work’s action, he does not become a part of it. But the user of architecture does. It is of the essence of architecture that we not only take cognizance of it in a detached way but enter, let us say, the portal of the bishop’s palace in Würzburg, traverse the entrance hall, ascend the staircase, and so on. A decisive stylistic difference distinguishes a building, a garden, or a city plan conceived as a temporal sequence from the Pantheon or a circular baptistery, which repose in themselves as places that may be visited but do not participate in the incursions. (Fig. 6)

In the second place, architecture as a sequence in time modifies the appearance of its components. It is true that in music or the drama, too, the parts are influenced by the context of the whole, but as long as such parts are relatively self-contained they are generally no more than tinged or shaded by the context, as, for example, when the repetition of a phrase alters its function in the total structure. In architecture, however, an intended sequence of views can subject a component of a building to a variety of appearances. Thus Wolfgang Schöne in a paper on the ceiling paintings of the Baroque has shown that a painting in a dome is sometimes not composed simply for the station point that fits it best, namely the place directly below the dome’s center. Rather some aspects of the painting foresee the ways it will appear to viewers approaching the dome of the crossing through the nave of the church. The perspective of the painting “as such,” conforming to the orthogonal sight of a viewer who stands directly below it, serves only as the relatively static center of the composition and mediates between the oblique views that lead toward and beyond it. Similarly, the appearance of walls, windows, niches, and other parts of buildings is changed by perspective as the viewer’s position in the architectural sequence changes.

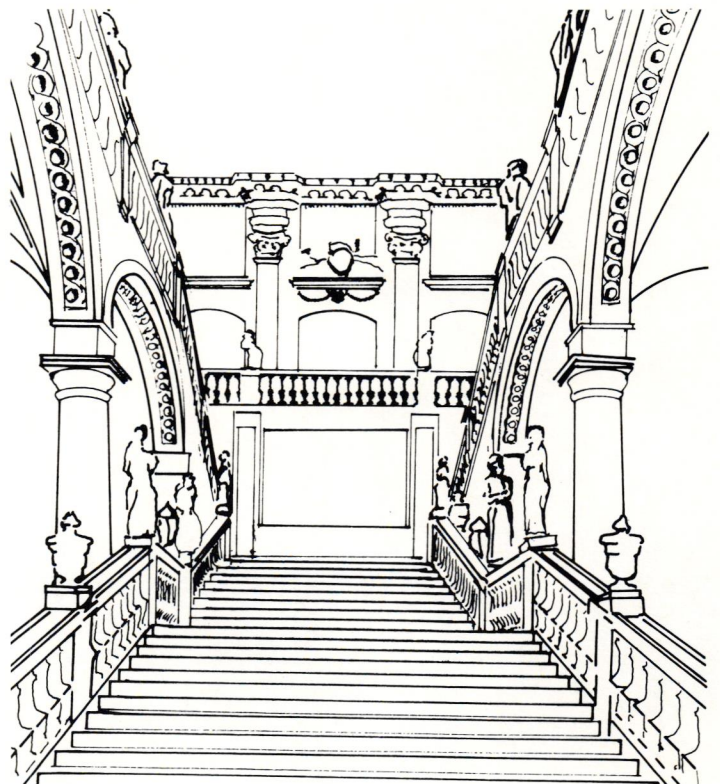
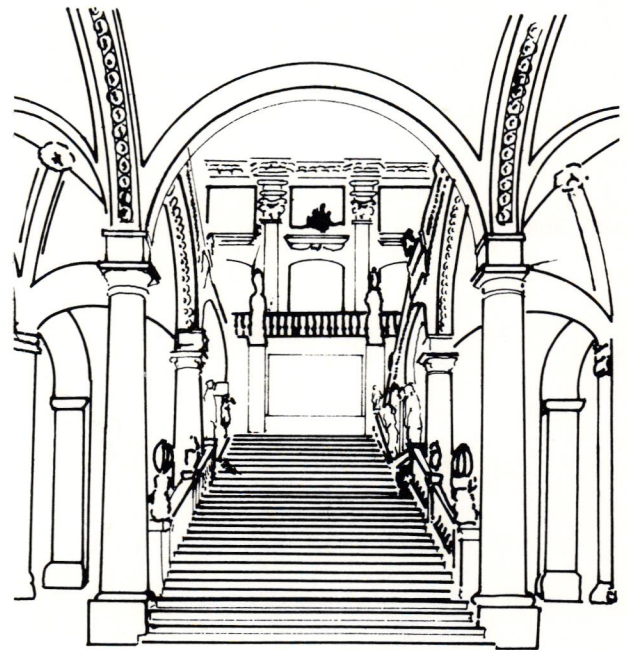
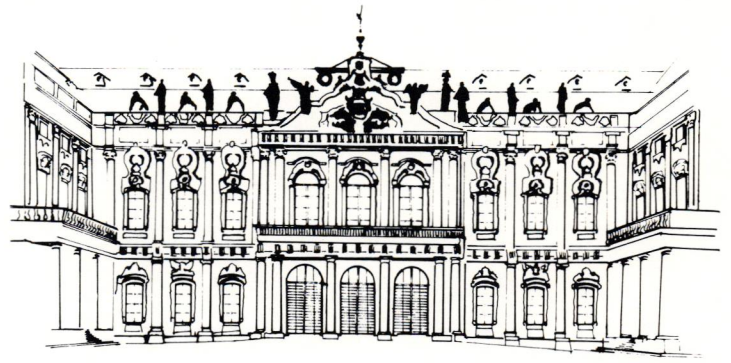
There is a further difference between architecture and the other artistic media that make use of temporal sequence. It concerns the relationship between the course of the events and the overall situation that generates them. The reader of a historical novel may receive a picture of the feudal aristocracy and

the rebellion of the peasants at the time of the Reformation, but such a view of the setting comes about only through a rather piecemeal reconstruction by the reader. In architecture, on the other hand, the experience of traversing the building must be firmly embedded in an image of the building's spatial totality because the sequence makes sense only as an aspect of the building's timeless being. The reasons for this demand are not only aesthetic but also quite practical. A reference to animal psychology may be permissible here: Edward C. Tolman has shown in his experiments that when rats are trained to run a maze, not only do they learn the linear sequence of the path from the entrance to the goal, but they also acquire a "cognitive map," a spatial image of the road system as a whole. Architects are familiar with Kevin Lynch's observation that a meaningfully organized mental map of an urban area facilitates orientation.

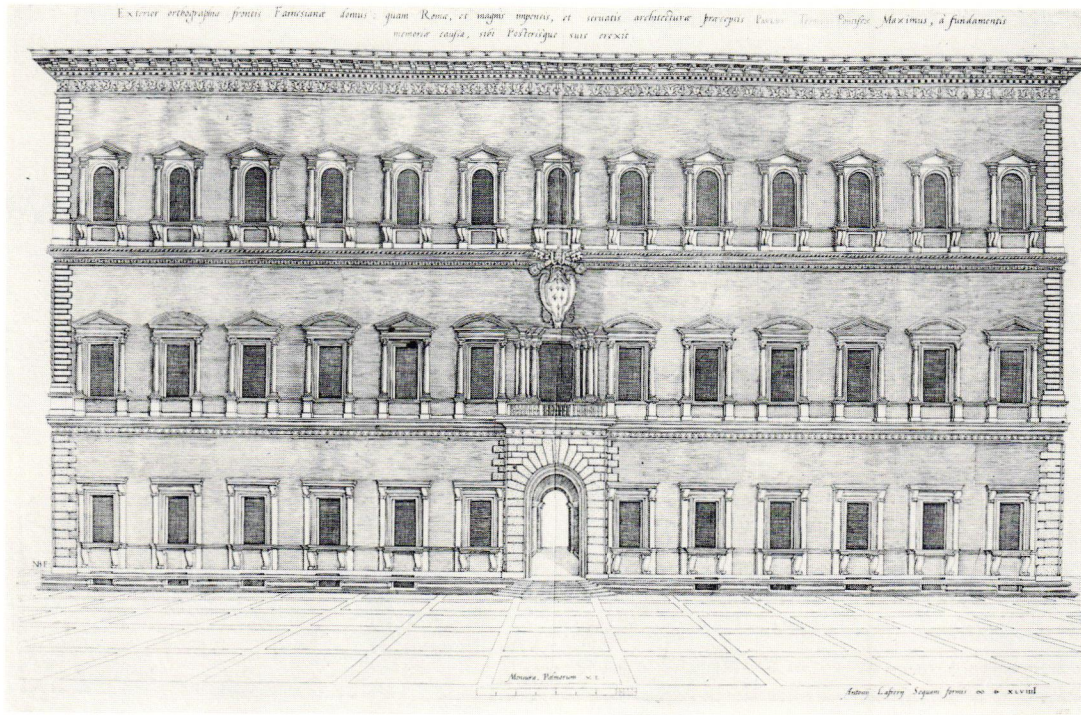
Beyond utility, it is aesthetically indispensable that viewers become aware of the interplay between timeless spatial structure and the time-bound avenues through the building. Certain churches of the late Baroque, for example, can be understood as works of art only when the various sequences and perspectives are perceived as fitting the total structure in a way that is most clearly visible in the building's ground plan. The remarkable order of the skeleton is the indispensable counterpart of the perturbing complexity of the directly given particular sights. It is true that in music also, the listener must fit the elements of a composition to an image of the whole, but in music the whole structure is sequential, as are the parts. The interplay of exploratory action and timeless being is characteristically architectural.

I have tried to show that architecture can be understood only as a perceptual experience. The same is true for the human beings exposed to architecture. In recent decades phenomenologists have insisted that perception is not the mere cognizance of detached objects. The perceiver himself must be recognized as an indispensable component of the perceptual process. Frequent references are made to the "body" of the perceiver—a term that is easily misinterpreted. For example, we read in the preface to Bloomer and Moore's *Body, Memory, and Architecture*: "At the same time we have been observing that the human body, which is our most fundamental three-dimensional possession, has not itself been a central concern in the understanding of architectural form; that architecture, to the extent that it is considered an art, is characterized in its design stages as an abstract visual art and not as a body-centered art." It does not take much thought to realize that the human body as a material entity of some one hundred and fifty pounds of flesh is of concern to architecture only in the limited sense of location, size, weight, temperature, and other physical parameters to be kept in mind by designer and builder. All other considerations refer to man as a sentient human being. The architect has to guard against features that will confuse rather than guide, depress rather than elate—mental effects, in other words. The functioning of the various human senses and the needs of the organism, from the most elementary to the most refined, must be considered.

Furthermore it is necessary to remember that although architecture exists exclusively for the service of man, it differs from most other practical tools by being not merely subordinated to man as an extension of his organs, like a hairbrush or a microscope. Architecture also subordinates its inhabitants to its own nature. It thereby meets a basic need of human beings, who want to fit into a superior order that relieves them of some initiative and some responsibility. Architecture is an ideally



6. Baltasar Neumann, Bishop's Palace, Würzburg: facade, stairball.



7. Palazzo Farnese, Rome. engraving by Nicolas Beatrizet, 1549.

shaped and directly perceivable example of such a superior order. To benefit from it, however, one must not conceive of a building or town egocentrically, as a mere facility to take care of one's needs, but as a meaningful entity in its own right, which assigns each person a particular place and function. In this sense architecture operates as a tangible symbol of the citizens' social obligations.

\* \* \*

Since the present paper deals with buildings as percepts, I will use the rest of it to somewhat amplify and sharpen my presentation of a subject I have discussed earlier in a book on the dynamics of architectural form, namely, the visual aspects of weight and attraction.

Physics tells us that the force that affects a mass by means of gravitation is called weight. This means that physically gravity is the only force that creates weight. In kinesthetic perception also, attraction toward the center of the earth is the most influential force and determines the sensations of weight in the muscles and tendons of the body. Hence the privileged role of the vertical as the fundamental direction, and the decisive difference between high and low, upward and downward.

In the visual realm, too, the vertical dominates, but its dominance is strongly contested. First of all, every visual vector points in both directions, unless special conditions suppress one of them. Thus, a building presses on the ground in accordance with the physical situation; but it also pushes upward like a beam sent out by the earth. Depending on the form and proportion of the building, the ratio of these two antagonistic vectors will vary. The heavy mass of the Palazzo Farnese may be perceived as essentially downward-directed. The wedge shape of the Gothic cathedral of Ulm points mainly upward.

The visual weight of a building or its parts is determined by shape, color, size, surface texture, and so on. The weight of each visual object exerts its influence upon the others, the earth being the most powerful of them. The relation to the ground is best suited to demonstrate the seemingly paradoxical effect of distance on visual weight: in visual space, weight increases with growing distance from the center of attraction. This can be easily observed in paintings, where one and the same element, say a red disk, can assume greater compositional weight



8. Cathedral at Ulm.

when it is placed higher in the picture space. To preserve balance, such a positional gain can be compensated for by the weakening of other weight factors, for example by a reduction of the disk's size. On the façade of a medieval church, the higher a wheel window is placed, the heavier it will look. Physically, of course, the opposite relation would hold: if a distance of a few meters had any effect at all, it would conform to the rule that gravitational attraction diminishes with the square of the distance. More nearly one could think of the relation as analogous to the behavior of potential energy, which increases with the distance from the base of attraction. (Figs. 7 & 8)

I would like to call this phenomenon "the rubber band effect": the larger the distance, the stronger the attraction exerted by the base of reference. Correspondingly, as distance increases, the object has to invest more and more energy to resist the attraction and stay in place—a strength that is credited to the object as an increase in visual weight. A building perched on piloti, for example, can be expected to look heavier than one of the same shape rooted in the ground.

The effect, however, works only as long as the rubber band holds. When the band snaps—that is, when the viewer ceases to perceive the object as anchored in the base of attraction—the effect turns into its opposite. As soon as the viewer focuses upon the visual object in and by itself, increasing distance liberates the object from the tyranny of the base and enables it to float freely in space. The object now exhibits a tendency to shed all ballast or to carry it away in soaring flight.

My description may sound strange, and I will therefore illustrate it by an example. The principal mass of the Romanesque Palazzo Vecchio in Florence is a compact cube, which may be said to press downward more than to strive upward. In its relation to the ground the corbeled gallery of the top floor seems to increase the weight of the building. By its distance from the ground the gallery contributes much weight; it presses the building downward like a heavy cover. But as soon as one views the gallery as a self-sustained center of weight, the dynamics of the visual situation reverses. Owing to the gallery's size and compactness and its distance from the ground, the building now displays considerable freedom. The gallery looks as though it wanted to deliver itself from the adherent mass of the building or carry it aloft. (Fig. 9)

The tower of the Palazzo shows this twofold effect even more clearly. If that tower had a simple prismatic shape, it would furnish the building, like a smokestack, with a sort of outgrowth, an outlet for the centrifugal tendency to beam into the sky. The passive dependence of such a shape upon the main body of the building is modified once more by a corbeled gallery, which, because of its great distance from the ground, is not easily perceived as depending upon that center of attraction. By its height, that gallery does possess considerable visual weight, but it uses its dynamics mostly as a striving to rise freely. It pulls the tower skyward like the tail of a kite and thereby enhances the upward-directed vector in the main mass of the building. Through the influence of the tower, the visual balancing center of that mass comes to lie higher up than it would otherwise.

These two versions of viewing a building do not simply fuse in a unitary percept. They work in opposition to each other and are mutually exclusive in the same way as, for example, the two versions of a figure-ground relationship. One cannot hold both views together. Even so, they influence each other in oscillation. In the case of the tower gallery I noted that it gains weight by its distance from the ground but uses this increase to pull away all the more strongly from that base.

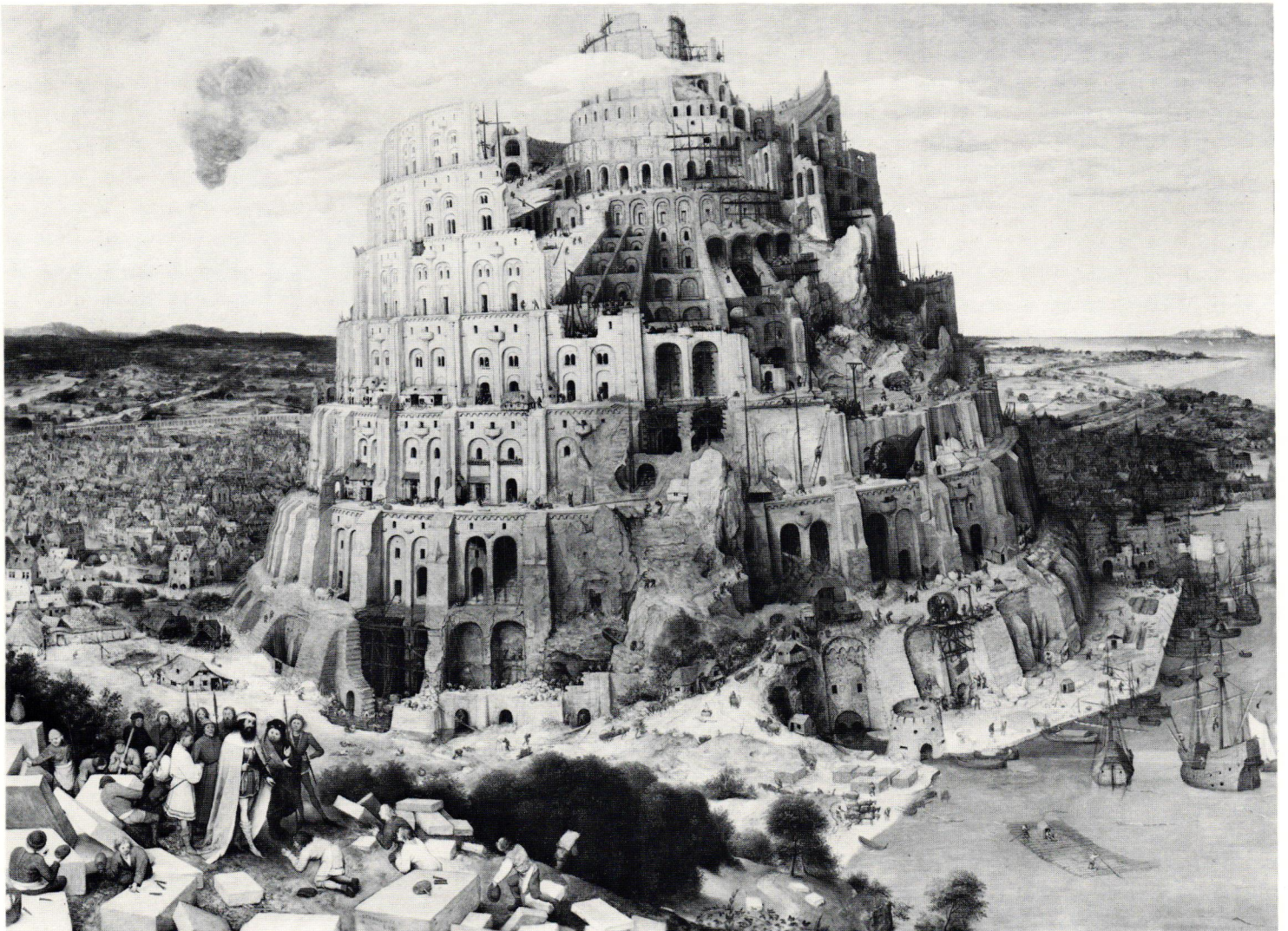
My examples will have shown that the dynamic relations governing perceptual shape constitute the core of architectural expression. Without this play of forces, the building would be a dead heap of stones. All the other components, the practical functions of the building, its historical significance, its stylistic characteristics, must translate into aspects of the immediate expression if the building is to look alive.



9. Palazzo Vecchio, Florence.

### Note

This paper is based on an earlier one, written in German for a publication to be issued by the Eidgenössische Technische Hochschule in Zurich. It is related also to my book *The Dynamics of Architectural Form* (University of California Press, 1977) and to a forthcoming treatise on composition in the visual arts, *The Power of the Center*. Perceptual aspects of perspective are discussed in my *Art and Visual Perception*, New Version (University of California Press, 1974), pp. 261 ff. The statements by Christian Norberg-Schulz are taken from *Intentions in Architecture* (MIT Press, 1965), p. 86, and *Existence, Space and Architecture* (MIT Press, 1971), p. 13. On San Giorgio Maggiore see James S. Ackerman's *Palladio* (Penguin Books, 1966), p. 144. Wolfgang Schöne's paper "Zur Bedeutung der Schrägsicht für die Deckenmalerei des Barock" was contained in Martin Gosebruch (ed.) *Festschrift Kurt Badt* (de Gruyter, 1961). E. C. Tolman's paper "Cognitive Maps in Rats and Men" appeared in the *Psychological Review* 55 (1948): 189–208. See also Kevin Lynch: *The Image of the City* (MIT Press, 1959). On the human body in perception and architecture see M. Merleau-Ponty: *Phénoménologie de la perception* (Gallimard, 1945), translated as *Phenomenology of Perception* (Humanities Press, 1962), and K. Bloomer and Charles W. Moore: *Body, Memory and Architecture* (Yale University Press, 1977).



1. Pieter Breugel, the Elder, "Building the Tower of Babel"

# THE IMAGE AND IMAGINATION OF THE ARCHITECT

Wolfgang M. Zucker

WHAT IS THE ARCHITECT AND HOW IS HE SEEN BY HIS CONTEMPORARIES? Since the rise of the cities in the Renaissance many different types of people have been characterized by the occupations in which they are engaged. Thus, between the 16th and the 18th century we find innumerable artistic representations of the various professions in their typical dress with the tools and instruments they use: the soldier with his weapons; the goldsmith with his fine chisels and weighing-scales; the pharmacist with his bottles and containers, their contents labeled in Latin; the astronomer with astrolabes and telescopes; the schoolteacher with books and cane; the weaver at his loom; the mariner with ropes and anchors; tanners, saddlers, actors and clerics, surgeons and peddlers, woodsmen and chimneysweepers, wheelwrights and gardeners. There is hardly any profession of which we cannot find a representation—except the architect.

It almost seems that the artists who produced the paintings, woodcuts, and etchings found it difficult to visualize what the architect really did and what specific tools he needed for it. Surely, there were portraits and busts of dignified gentlemen known and famous for their architectural skill, and some art historians have even tried to identify some figures in cathedrals or carvings on choir stalls with the architects who built the church, but in general it does not seem that architects were presented in their work. Apparently there was no public image of the architect, no emblematic representation of his personality and his work. Was his task and his role in society too mysterious and ambiguous to be understood by the general public?

In Breughel's painting "The Building of the Tower of Babel," we may perhaps be allowed to recognize in one of the small human figures the architect as the 16th century in the Netherlands may have imagined him. The scene depicts the still incomplete tower; the top row of arcades, which resemble those of the Roman Colosseum, already reach the clouds, while parts show at the same time the unavoidable decay. King Nimrod, who has ordered the construction, has arrived to inspect the progress of the work. He is guided by the architect, a middle-aged man in the dress of a comfortable, though not rich, burgher. He apparently is not quite at ease in the presence of the king, to whom, with eager gestures, he explains some technical detail. Both he and the king disregard some craftsmen who have humbly thrown themselves in the dust, imploring the king for benevolence or mercy. Obviously the architect is of different class and social stratum from the workmen. The artisan workmen are specialists in their craft: the architect may criticize them but he does not surpass them in skill. Probably, behind his back, they even shake their heads about him. But he walks at the side of the ruler, and, in spite of his deferential attitude, his words are listened to by Nimrod. It is obvious that he enjoys authority and respect, even if he remains always at the king's beck and call.

Where do the social status and reputation of the architect come from? In our time he or she usually has had an academic education. In Germany, for instance, a clear distinction is usually made between the architect with a university degree, and the *baumeister*, the contractor, who probably was once a manual worker himself. The *baumeister* is not eligible for membership in the Association of German Architects whose members are entitled to the letters VDA behind their names on their stationery and calling cards. To obtain official permission to build a house one does not require the examinations and degrees of an academic institution—If he knows and follows the regulations and ordinances of the local authorities, the *baumeister* may submit his blueprints. Nevertheless, the commission for any prominent project—a theatre, an airport, a school, or even the private residence of a man of substance—will usually be given to a "real" architect, who has credentials that assert more than merely his craftsmanship.

The criteria for the acquisition of such occupational and social status are rarely absolutely defined. Even in the democratic societies, where status is dependent on academic and governmental examinations, that is, where it is achieved, status is still surrounded by an aura of mystique and irrationality. Not only has the architect, like an artist, abilities that defy rational analysis, but also his relationship to his clients, formerly princes, now just rich and influential men, is of a strangely ambiguous character. On the one hand, it may have been difficult to persuade him to accept the commission, and the client certainly has not spared money, flattery, and sometimes even personal humiliation, in order to secure his services. On the other hand, once the architect has committed himself, he is exposed to constant complaints, nagging, and reproaches from the client, who has to make greater monetary sacrifices than he had planned, who more often than not changes his wishes and ideas, and who, nevertheless, always seems to feel that the architect has not fully understood him.

This double role that the architect has to fulfill is, of course, difficult. On one day he receives high praise and rewards and enjoys the trust and confidence of his master, on the next he is subject to reproaches and even insults. Nobody is so intimately familiar as the architect with the ambitions and dreams of the ruler; nobody knows like him his goals and his hopes, but also his anxiety, his secret fears, and the dangers of his position. Thus, the completed building, palace, park, or even city, displays not only the plans of the architect, but also the whole life of the man who has paid for it. In truth, often he had to pay more than he had originally planned, and so he may take out on the architect his displeasure at the gradual realization that putting a dream into reality is always more difficult than the dream itself. The task of the architect, therefore, does not end even with the completion of the project. He will be kept on as an advisor on a variety of things, in an ambiguous position of power and humiliation. (The position of Albert Speer in the last years of Hitler's dictatorship illustrates this quite clearly: when the vicissitudes of the war forced the postponement of

Hitler's far-reaching plans for a new government center in Berlin, Speer was made boss of the total production of armaments. That was not quite the assignment that an architect of monumental buildings and plazas for the display of triumphal parades would expect, yet it was a task for a man in whom the dictator had confided and to whom he had revealed himself totally.)

One may wonder who is the more dependent: the architect or his patron. After all, the master builder needs somebody to commission him, but the powerful ruler agrees to be forced by the architect into a living framework of spaces for private enjoyment or public display. By this framework, a vague dream will be materialized in stone and wood and metal. Both are captives of this mutual dependency and will become more so the longer they work together, never quite satisfied yet unable to shake off the bonds that restrict and define, or delimit, their respective freedoms.

In an essentially traditional society there is a place neither for the audacious projects of a creative architect nor for a ruler who requires—and can pay for—his services. The typical Italian village church or Friesian farmhouse, is like innumerable village churches or farmhouses that have been built before by local workers under the command of an experienced *baumeister*-craftsman. The architect with new ideas or the rich man who wants “something else” have no place in such projects. One or both of them will be inclined to deviate from the usual and familiar; they will be extraordinary, out of order. Traditional architecture is perceived by traditionalists as “natural”; the innovator using new forms and materials is “unnatural”. The never-ending controversy between conservatives and innovators is not about esthetics or about technical preferability, but about reality itself. Men do not argue about forms of life. One does not say what one's understanding of life is; one shows it by living it. The architect manifests his understanding of his client by providing the kind of dwelling place that suits somebody who understands life in that and no other way.

The relationship between the architect and his client is reflected in the conventional image that the architect presents to his contemporaries. He necessarily is an outsider who does not share the *Weltanschauung* of the society he serves. Therefore, the ordinary member of traditional society does not need an architect at all, as he does not require innovators and their unusual ideas. As outsider, the architect is simultaneously admired and abhorred. The client, during his long-lasting relationship to the master architect, will gradually reveal what he is and how he is; but will really never be fully “at home” with him. The architect comes out of another world. To a greater or lesser degree he has already emancipated himself from the unquestioned traditions of his society; and the master could not be the ruler if he did not share, to a degree, such emancipation. Thus, the architect remains always somehow “uncanny,” strange, mysterious, *unheimlich*, one with whom one does not share a common home (*heim*). He could be, and in the history of architecture often has been, a foreigner coming from an unknown background of mores, taste and skill. As such, he is attractive and fascinating, but also strange and suspect. What separates him from the craftsmen he will direct, but also from his client, is his “imagination,” his ability to visualize the completion of a project that goes beyond what tradition knows, likes, and feels unquestioningly at home with.

Greek mythology has faithfully preserved both the image and imagination of the architect in the person of the legendary Daedalus. He is not simply a culture hero, an inventor of tech-

niques and forms that have become general tradition, as is his counterpart in Chinese mythology. While the captive of King Minos of Crete, Daedalus is both a friend and a deadly enemy of his master. According to the legend, he has built the palace of Knossos and the labyrinth where the monstrous son of the queen and the bull are kept. Some authors report that he has been the illicit lover of both the wife and the daughter of Minos. He and his son, Icarus, flee from imprisonment by flying with artificial wings that Daedalus has constructed. Some authors credit him with having built some of the Seven Wonders of the world.

The meaning of these fairytales is obvious: the architect is a miracle worker, simultaneously good and evil. As innovator, he transcends with his boundless imagination the natural limitations of cosmic and civil order: by constructing a cow-like armor for the queen, he has made possible her unnatural mating with the bull; the labyrinth itself is not just a cage for the Minotaur, its confusing design also serves to catch human victims to be killed and devoured by the monster; even the flight with artificial wings is an unnatural escape from the limitations of the human condition.

Imagination distinguishes the architect from the craftsman. All imagination is somehow unnatural. It tries to make an image of the yet unseen, and even of the unseeable. But since every image must be composed out of known and visually experienced elementary parts, albeit in new arrangements, imagination is eventually a re-ordering of experienced reality. The imaginative architect, in his preliminary sketches, as well as in his scale elevations or three-dimensional models, creates visualizations of something that is previously unseen but yet is composed of familiar parts. The presentation of “how the project will look” is, at the same time, free and restricting. Such projections seem to be to a certain degree unreal, like the views of a factory on the letterheads of Victorian business correspondence.

What makes them so stiffly unreal? It is their constructed orderliness, their clean, straight workshops, overtowered by the smokestacks whose plumes of exhaust are never disarranged by local up- or side-drafts. When we look at the drawings of a proposed library or school building or theater, we admire how clean and orderly they look, with trees in the street and well-trimmed bushes in the front garden. Automobiles of an old-fashioned type have stopped at the entrances and release equally old-fashionedly dressed ladies and gentlemen, who walk up the always clean-swept stairs, stiff yet somehow dignified. There is something touching about this imagination of a well-ordered world in which misery, sickness, poverty do not exist. In the stage of ideal planning, the project is not yet an object of the real world, nor does any visualization of it (*Architekturbild*) except the drawings or paintings of it, attempt to show it as if it were so, by surrounding it with people, trees, vehicles, scenes of everyday life. This creates a strange discrepancy of viewpoint, a conflict between abstract ideal and concrete existence. Nobody sees, in technical designs, like blueprints and ground plans, a special subdivision of the graphical visual arts, but, conversely, the fantastic *Carceri* of Piranesi are certainly not sketches for prison projects soon to be built. The problem to which we are led is whether architecture belongs at all to what now is called “visual arts”.

The question is not merely academic, because the various and contradictory answers to it have decisively influenced the image of the architect and the limits of architectural imagination, especially after the romantic idealization of the “artist” as the perfection of human development. Any object of the world,

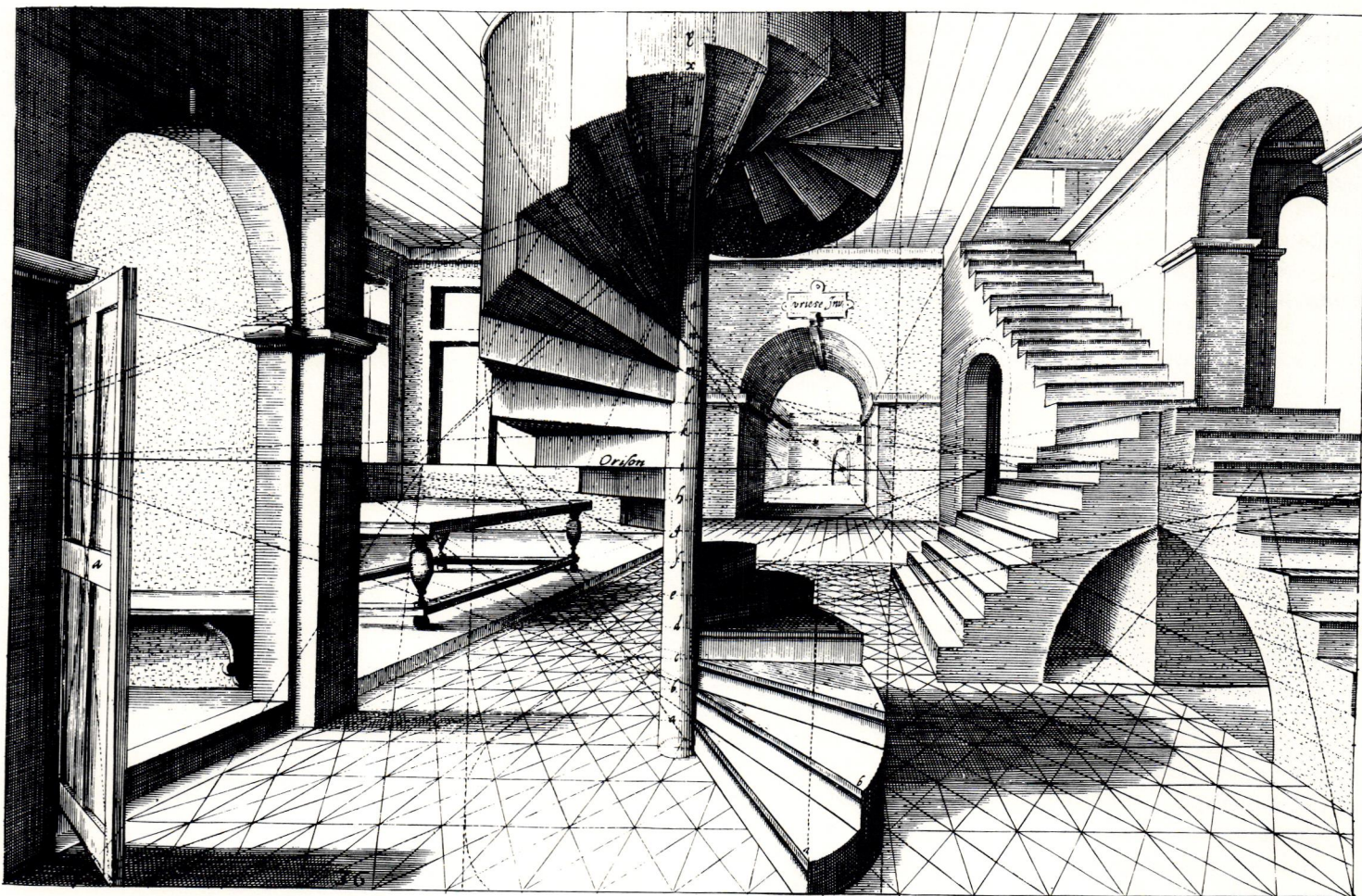
natural or artificial, can be the object of an esthetic vision, a tree or a bunch of vegetables as well as a building or a machine. But this does not make any of the depicted objects esthetic objects in themselves: the men who handle or manufacture them are not necessarily artists.

Architectural objects attracted the interest of graphic artists and painters in the seventeenth and eighteenth centuries. Whereas in earlier visual presentations, buildings had been part of the general scenery or action that was the actual theme of the picture—the stable in presentations of the Adoration, for example, or the fortified cities and castles in battle scenes—they now become of interest in themselves. Hans Vredeman de Vries (1527–1606), who himself published books of ornamental patterns for the use of architects, influenced the paintings of Dutch artists in the following centuries with his etchings of specific buildings. City prospects of the kind published in the nineteen volumes of Merian's *Teatrum Europaeum*, forerunner of our picture postcards, became popular as souvenirs for (mostly English) travellers and are now valuable documents of the architectural history of European cities.

The pictorial presentation of architectural objects, however, was not simply a new fashion, but the result of a new discovery in the visual arts: the theory and practice of linear perspective. As developed in the Renaissance by artists like Uccello, Leonardo, Dürer, and many others, the theory was a remarkable mixture of sense experience and mathematical abstraction. Elementary awareness of effects like the diminution of size due to distance, the foreshortening of lines leading away from the

observer, or the spatial distortions of shadows by obstructing objects, was of course, as old as all imagery, but the Aristotelian mood of Renaissance thought was needed to bring such awareness into a system. In the subsequent centuries the system dominated not only the visual arts, but soon also the practice of architecture. *Trompe l'oeil* effects are increasingly used in the early Baroque; the architecture of the supports of the vaulted ceiling is continued by paintings of the open heaven with clouds and angels. The *Scala Regia* in the Vatican, constructed and painted by Bernini, even shortens the objective distances between the walls or columns so that they give the impression of converging to an infinitely distant vanishing point; a most striking demonstration that principles of perspective determine not only the two-dimensional representation of an illusionary architectural object, but even the real object itself. The same inversion of the relationship between representation and object is inherent in Bernini's magnificent design of the Piazza San Petri. Undoubtedly, the victory of linear perspective has become so complete that it is now understood by naive viewers as a law of nature, and any deviation from it in the visual arts is rejected as distortion.

Maybe it is not redundant to emphasize once more that architecture deals primarily not with the artistic representation of buildings, but with the buildings themselves. Arnheim's distinction, in his *Dynamics of Architectural Form*, between how an architectural object "looks" and what it "really is" would, of course, be meaningless if representation and object could ever be congruent. They are not, alas, except when the architect



2. Perspective figure from Jan Vredeman de Vries, *Artis Perspectivae . . .*, 1568

thinks of his work as something to be viewed like a painting. And, possibly, this has been happening more and more frequently in the architectural history of the last centuries.

In the experience of the real world before him, the post-Renaissance painter is located in a clearly defined point, and the viewer of the painting is presupposed to share this point of view. The architect, on the other hand, does not have such a "station point," as it is called in the technical language of the perspectivists. One does not physically and esthetically experience a building simply by looking at it—perhaps least of all by looking at a facade, because the facade very often most resembles the plane of a painting—one experiences it by being in it, living in it, being a part of its reality. Products of the visual arts are additions to our life, whether we call them beautiful or not; our identity remains the same when we, for whatever reason, are removed from it; but the space in which we have our being is our being itself. The presupposition of perspective, of a two-dimensional projection of a three-dimensional reality, is that the viewer and his location are implied in the work of art itself. The artist, though invisible, is contained in the image and, simultaneously, by it. He may not move, change his point of view, without destroying the image. When the viewers of Picasso's or Bracque's paintings rejected them as unnatural or distorted, they only expressed the extent to which they had been trained by Post-Renaissance art to identify what an object "really is" with how "it looks."

The consequences of this historically conditioned prejudice are enormous for architects who have obediently bowed to it. Their creations want to be, in reality, what they look like as observed from a preferred point of view. It may be regrettable that we know most masterpieces of architecture only from pictures, photographs, etchings. In most cases we lack the living interaction that only an actual being, in and with the building, can provide. Linear perspective restricts the experience of the represented object to the experience of its appearance: that is, to the one and only preferred appearance. Even modern functionalists, with their rejection of the "picturesque," the ornate facade with its decorative embellishments, have unconsciously accepted the dictates of the perspectival prejudice. The outside of the building should, so they preach, reveal the internal functional structure, as if the experience of a work of architecture were the experience of a painting.

It seems that the first great triumphs of linear perspective were achieved in stage architecture. The theatre was an ideal place to show what the new principles could do. Not only did they provide the illusion that what happened on the stage was happening in the world of the spectator, but they also forced the spectator to look at it from an immovable seat which gave him the same fixed viewpoint as the stage designer. The world of the scenery, though created by the stage architect, was to be taken by the viewer as identical with the ordinary world of living interactions from which he had come to immerse himself in the enchantment of the auditorium. Illusion, the acceptance of an artificial world as the continuation of the real one, is the means and the end of the theatre, and this illusion is greatly aided by linear perspective. The stage can be infinitely enlarged by backdrops presenting a street or a square; equally, it can be reduced by other backdrops to the intimacy of a small living room; yet always the same "real" space is used.

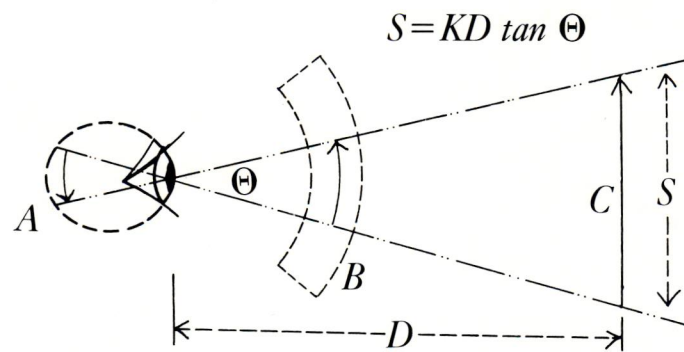
Architecture eagerly used the magic of stagecraft. It too began to apply the optical tricks of linear perspective, letting what was small appear larger, and what was large, smaller. In short, it became itself illusion. By adopting the consistency of a fixed viewpoint architecture became one of the visual arts.

These considerations are in no way intended as arguments for or against the recently revived traditionalism in contemporary architectural theory, or as pleas for modernism against the despised historicism. Rather, they are meant as warnings against the normative claims of any theory that sees architecture as one of the so-called "fine arts." The architect is neither exclusively artist nor exclusively engineer. As one of the most influential makers of the texture of a particular society, he is not free to transport his clients into a magical world of his own dreams and esthetic preferences. The result of such liberty would do something like one of the castles of the mad Ludwig of Bavaria. But equally, he is not called to prevent his clients from dreaming and to bend them forever into an equally artificial world of technical practicality.

All innovation of which architectural imagination is capable is simultaneously an act of liberation and the display of a framework of a new form of life, which, in time, will yet prove to be a new form of bondage. The applauding acceptance of a new form of architecture may be sometimes just a passing fashion. At the same time, it demonstrates a healthy uneasiness with the dictatorial powers that try to bind us to a specific esthetical, as well as social, system of concepts. But it is not proof of an already completed change in the human condition. The sterility of the official architecture of absolutist governments may serve as a strong warning. Changes in the imagination of the architect, and of his public image, are not always indications of changes in the social climate of a culture. Only when people are no longer interested in esthetical praises or condemnations and have tested out the innovations through being, living, with them for years, have found them adequate or inconvenient, may we dare judge whether any kind of change has occurred in us and our understanding of our world.

The architect is not, by his calling, the leader to a new social order, nor is he to pass pontificating judgements of taste. He is a critical observer of his time and of his contemporaries. As such, he accepts, willingly or not, a certain amount of unpopularity and solitude, abuse and humiliation, rejection and mockery, accusations of irresponsibility from all those who feel vaguely threatened by his imagination.





1. The perceptual process starts with (A) the image on the retina of the eye, as focused from (B) the optic array of light projected to the eye by (C) the object in the world. The visual angle,  $\theta$ , not the object's size,  $S$ , determines the size of the retinal image.

# VISUAL PERCEPTION IN ARCHITECTURE

Julian Hochberg

THERE ARE MANY SPECIFIC VISUAL ISSUES, relevant to architecture, that concern the perception psychologist as well, and that in some cases can be addressed by the data of visual or perceptual science. There is, however, something of a mismatch between the perception psychologist's purposes and those of the architect. This mismatch often results in the overgeneralization or misapplication of perceptual findings and conclusions, and the architect is to a great degree captive to the particular perspective and period within which the perception psychologist is writing. Even more limiting, the perception psychologist sees an array of problems as being of interest for reasons that usually do not concern the architect, therefore providing an irrelevantly biased selection of issues and findings, approaches, opinions, and purposes.

I am easily as partisan as anyone: my own bias is that our perceptions of space—and, *a fortiori*, the perception of architectural volumes and objects—depend fundamentally on our perceptual intentions and on the sequential acts by which those intentions are realized over time. Before explicating that viewpoint, however, I will try to lay out the broad range of perceptual issues that concern proponents of each of the other major perceptual theories, touching on their possible interest to architects at each point, and only then indicate more specifically where my own prejudices lie and what paths of architectural and perceptual inquiry seem most promising to me.

## I. Perceptual Research of Possible Use to Architectural Practice

I start with questions of sensory acuity and resolution and of the physical bases of our dimensions of visual experience, and work up to the less tangible properties of meanings and esthetic response.

### A. Sensory limits, thresholds and psychophysical scales

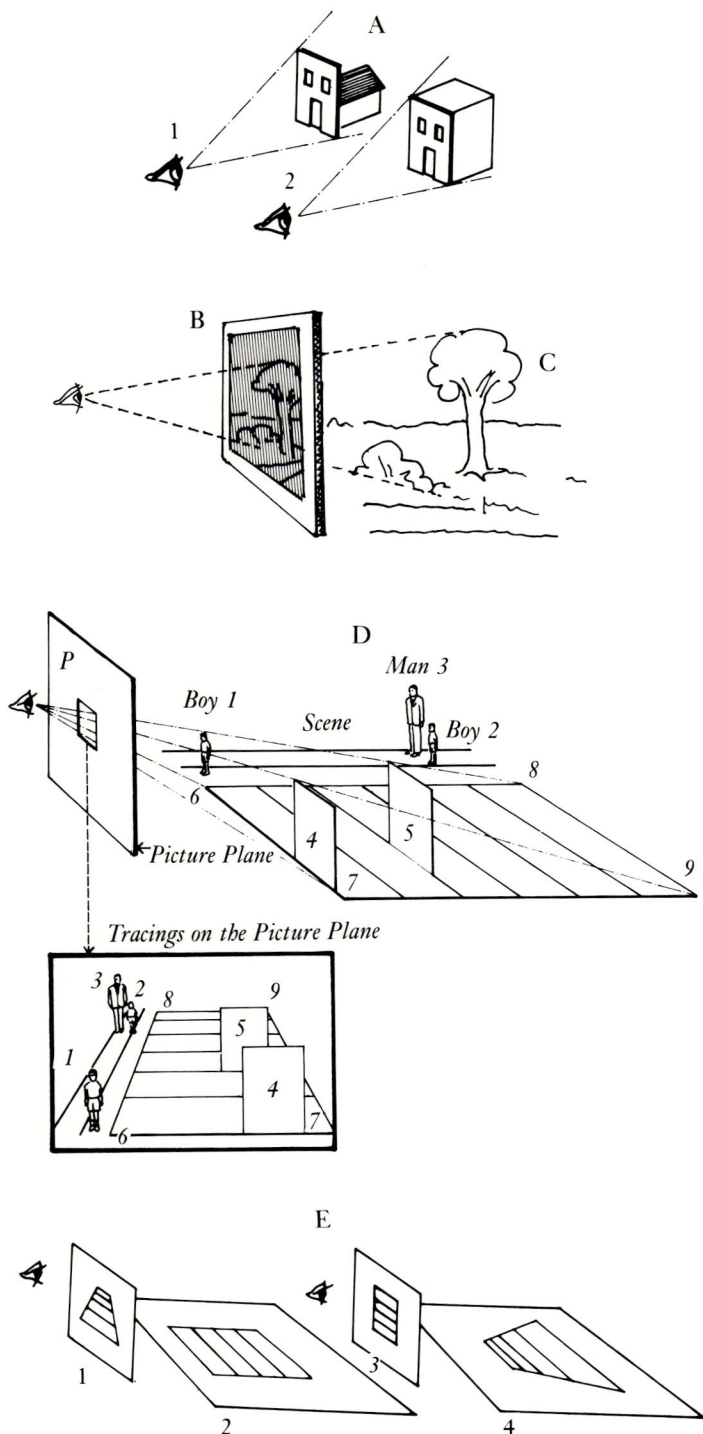
The earliest psychological research was the study of the limits of what our senses can detect. Sensory limits or *thresholds* are levels of intensity that a specific stimulus (or the difference between two stimuli) must exceed if it is to be responded to reliably. Thresholds have been studied quantitatively for well over a century, and some of the resultant data can be of use to architects and urban planners. The data address such questions as these: What is the faintest light, the smallest detail, the slightest difference in color or texture (on the average) that can be detected? How large must letters be, and how intense the illumination, for comfortable reading? Will a particular traffic light in a given setting be detected 98 percent of the time? How deep must a texture or a bas-relief be in order to be detectably more three dimensional than a flat but painted surface that only simulates such relief?

Answers to such questions serve three quite different purposes. They have practical application wherever man-environment and man-machine interactions are important (for example, in ophthalmology, illumination engineering, color specification, and so on). They provide information about the sensory organs and nervous system, and as such are the familiar tool of sensory physiologists and visual scientists in general. Finally, they are a major source for what are called *psychophysical scales*, or equations of the form  $p' = f(P)$ , where  $p'$  is some dimension of sensory experience, and  $P$  is the corresponding measurable physical dimension. Most traditional work has been done with scales that were thought to be fundamental in some sense, for example, how apparent brightness varies as a function of the intensity of photic energy. The methods developed to obtain such scales are also used to devise scales for qualities that are supposedly of greater interest to architects and environmental planners, qualities like "openness" (as opposed to closedness or enclosure), or even qualities like "pleasantness" or "interestingness."<sup>1</sup>

The application of such scaling methods to architectural questions has been increasing in recent years. My own prejudice is, first, that one should have a very direct practical or theoretical purpose for inventing such scales because there is an indefinitely large number of things one might investigate in this manner and only rarely does a scale designed for one purpose turn out to be useful for another. My second reservation is this: the very same quality that people scale with confidence and reliability *when they are asked to do so* may never enter their minds, or color their experiences, when their attention is not so constrained. Other and more indirect means must therefore be devised in any case to study the architectural qualities in question.<sup>2</sup>

### B. Retinal Image and Optic Array: Scenes, false fronts, and pictures

Our perceptions of the objects and layouts in the physical world start with the image (*retinal image*) on the light-sensitive tissue, or retina, at the back of the eye, as we see in Figure 1A. What is not adequately imaged in the eye is without sensory consequence. For example, the letters on this page, which can be clearly discerned from a distance of about 1.5 feet, become an undifferentiated visual *texture* when viewed from 10 times that distance, even though the sizes of the letters themselves remain unchanged in the operation. Only a very small part of the retina, moreover—the *fovea*, which will become very important to our discussion in section I,D. below—is sensitive to small detail, so the eye must move continually in order to pick up detailed information from scenes or from objects of normal size. Because the retinal image itself is extremely difficult to measure, we usually measure instead the visual angle subtended by any object since that angle determines the size of the retinal image produced by that object. The pattern of light provided to the eye by the scene is the *optic array*; the visual angle that each object or part of the scene subtends within the optic array is a simple function of the object's size and its distance from the viewer (Fig. 1B).



2. Surrogates, false fronts, and pictures. (A) Objects that present the same face to the eye, as do 1 and 2 from the viewpoints shown, provide the same retinal image and therefore the same appearance. A picture or mural (B) that presents the same light to the eye as some scene or layout (C) (which can only be done under certain restricted conditions) is indistinguishable from the scene. (D) Some of the primary depth cues that make a flat picture a surrogate for space (to a static, monocular viewer): (i) linear perspective: lines 6-8, 7-9, which are parallel in the scene, converge in the picture plane; (ii) the homogeneously dense texture on field 6-7-8-9, in the scene, provides a gradient of texture density on the picture plane; (iii) interposition: the occlusion of part of 5 by 4 in the picture indicates that the latter is nearer in the scene; (iv) relative size: boys 1 and 2, of equal physical height in the scene, differ as shown in their projections on the picture plane; (v) familiar size: the known size of man and boy, and the fact that boy 1 and man 3 are equal in the picture, indicates that the man is further away in the scene. (E) Normally, a texture-density gradient in a picture, 1, is perceived as a homogeneous texture, 2, at the slant that would project such a homogeneous texture to the gradient in the picture; in corresponding fashion, a texture-density gradient at a slant, on the ground at 4, will tend to be perceived as a homogeneously textured surface in the orientation that would project that texture gradient, as at 3.

The retinal image is given by the pattern in the optic array and by how the eye is directed, that is, what part of the array the eye is pointed at. The translation from scene to optic array is a matter of straightforward geometrical optics. Both the retinal image and the optic array are completely specified as two-dimensional patterns of light energy, and the two-dimensionality of this interface between perceiver and world is the most important fact of perception concerning architecture and the other visual arts. We now see why.

(1) *Scenes, pictures and vistas.* We perceive the world by means of the retinal image that light carries to our eyes. A flat picture, false front, or theatrical flat, therefore, can be successfully substituted for a three-dimensional scene if the two situations provide the same retinal image (Fig. 2A). In order to induce the viewer to perceive an additional story in height in a rotunda, or an additional room at the end of a corridor, one needs only a mural painted on the ceiling or far wall, respectively, which gives the eye essentially the same optic array as would the missing architectural space (Fig. 2B, C).

Since Brunelleschi and Leonardo Da Vinci first laid down the rules for producing such surrogates for scenes, and *trompe l'oeil* painting became fashionable, the procedures have been very well worked out. In photography, of course, they are fully automatic.

Scenes and such surrogates as false fronts, murals, and paintings, however, share the same optic array from only one viewing position, to which the architect must somehow constrain the viewers. Indeed, unless the mural is at a distance of many yards, the absence of even the slight parallax provided by either the disparity between the views of the two eyes or by a slight movement of the head would, in principle, suffice to inform the alert viewer that only a painted surface confronts the eyes rather than a tridimensional scene. Thus, the *trompe l'oeil* is usually playful trickery rather than intended deception. Conversely, in the presence of a real depth, the viewer may not elect to make those movements that will provide him with the information about space, and the architect must then arrange things so that the viewer is so constrained to particular paths and velocities that the desired plasticity and spaces are perceived.<sup>3</sup>

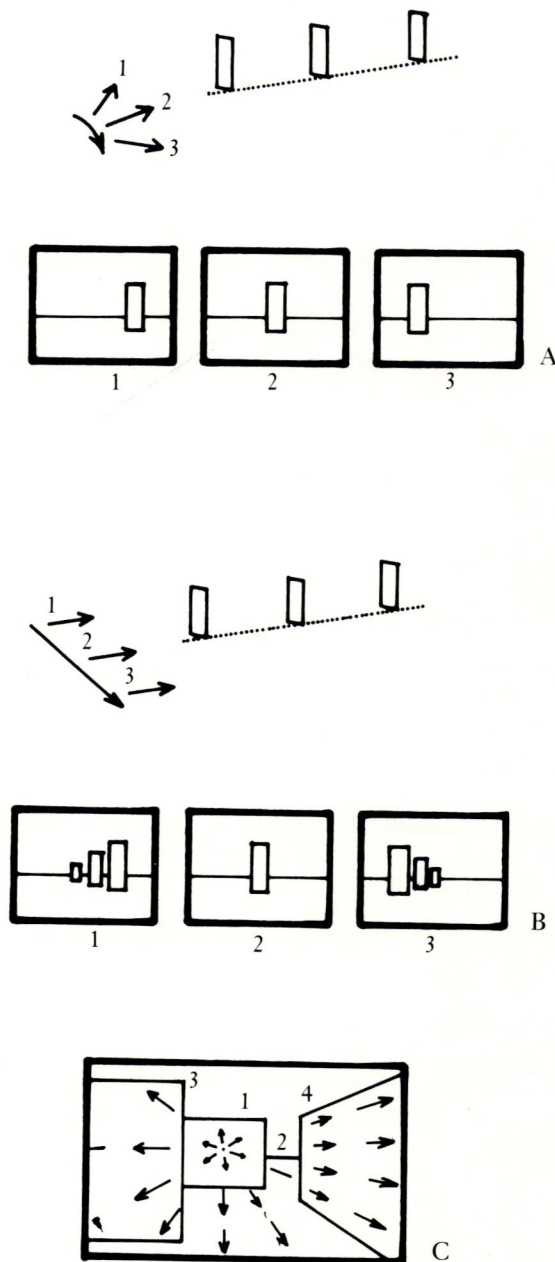
For static viewers, there is a reasonably well worked out "language" of pictorial representation, called the *pictorial depth cues*, some of which are shown and named in Fig. 2D. What makes them of more than pictorial interest is this: if the scene itself does not provide these cues within the optic array, then the stationary viewer may fail to perceive even the real scene as a tridimensional space. For example, if the parallel lines that would produce linear perspective (i in Fig. 2D) and the homogeneous texture that would produce a texture-density gradient (ii in Fig. 2D) are missing from the scene, or indeed are replaced by misleading angles and texture distributions (3, 4 in Fig. 2E), the space will be incorrectly perceived. That is, the pictorial depth cues are depth information about real spaces, not only a language of pictures. Moreover, as we will see in connection with Fig. 9, these factors are usually so strong in their effect that the viewer will often overlook information that movement parallax provides about the real three-dimensional disposition of surfaces and spaces, if that information is at all weak. Notice that these static depth cues can dramatically affect what a painting as a flat object can look like. Painters of this past century have found these cues increasingly interesting as points of departure or variation rather than as tools.<sup>4</sup>

Unlike the painter, of course, the architect must *in general* make provision for what the viewer will see after moving, that is, must design the changes in views that motion will bring. The optic array received by a moving viewer—what J. J. Gibson calls a *vista*<sup>5</sup>—comprises the interface, between the viewer and world, that must concern the architect.

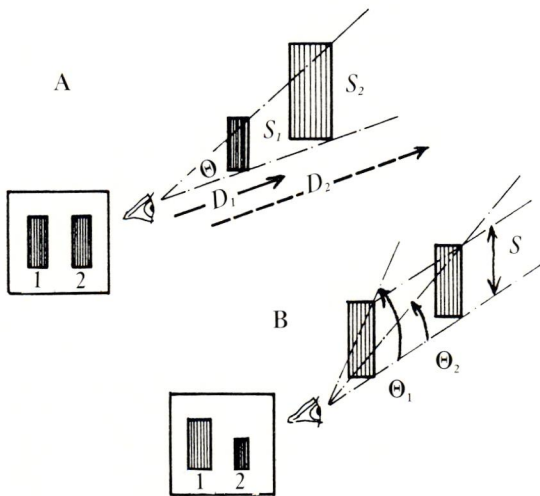
It is a much more formidable task to devise a “language” that will describe the kinetic optic array—the flux of patterned stimulation that confronts a viewer moving through spaces—as the pictorial depth cues describe the static optic array.

There are scattered programs for approaching this problem. In architectural theory, Michael Benedikt has proposed measures that quantify certain features of *isovists* and *isovist fields*<sup>6</sup> in a way that relates to the possible transformations of a view in a particular scene or architectural space. The classification system used for motion picture shots may be developable into useful analytic categories for the architect as well: for example, although a *pan*, in which the camera swivels from one view to another (Fig. 3A), and a *tracking shot*, in which the camera actually moves its stationpoint (Fig. 3B), are superficially similar in terms of the space that they traverse, they differ greatly in the degree to which they can disclose new vistas with each change in direction, and in the motion parallax information about three-dimensional spatial layout that they offer.<sup>7</sup> Finally, in a field of perception known as *ecological optics*, explored recently by J. J. Gibson and his colleagues,<sup>8</sup> there has been a concerted effort to analyze the information given in the changing distribution of the light at the eye (the flow pattern) of the moving observer, information that is specific to the way the surfaces are laid out in the three-dimensional space in which the viewer moves (Fig. 3C). The idea that such extended sequences of parallax information might in themselves be units of analysis has also been noted by architects and environmental planners,<sup>9</sup> but we should note two things about this last approach: though it may seem promising, there are virtually no data as to whether and how accurately such information is picked up, and there do exist some data to make us concerned about that issue (see Fig. 9). Furthermore, Gibson’s theoretical thrust is to support what is sometimes called the *direct theory* of perception, a theory holding that we respond directly to the mathematical invariants in the transforming light to the eye. What is invariant despite changes in viewpoint is of course the set of unchanging relationships between stationary surfaces in the world, so that in principle this statement sidesteps entirely the question of retinal image and optic array and places the perceiver in direct, veridical (as opposed to unveridical or illusory) perceptual contact with the surfaces and spaces of architecture. We shall see that although there probably is no arena of perception in which this theory can be maintained in its characteristic form, it is least applicable in the range of sizes and distances that are of concern to architects and environmental planners.

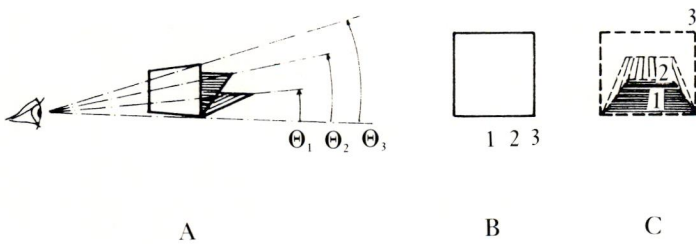
We should not think (as direct theorists sometimes imply) that given a moving viewer, the three dimensional world is correctly seen, that the flat picture is automatically distinguishable from the three dimensional scene, and that we can then ignore the retinal image. Indeed, were that true—were perception always or even mostly correct, free from illusion and error—there would have been little impetus to study it in the first place. Before we can proceed farther in the discussion of the perception of architectural structure and space, there are four arenas of research findings, and a brief discussion of the competing perceptual theories, that we should consider.



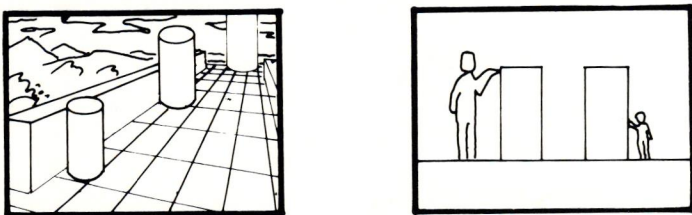
3. Motion parallax and spatial layout. (A) If one pivots in place to change one's view, as in the film maker's pan shot shown by the curved arrow at P, the successive views in the directions of the short arrows 1,2,3 will look something like the three numbered boxes: An equal translation is imposed on all objects in the field of view, and objects that are hidden from view remain occluded throughout the motion. (B) Changing one's viewpoint from one place to another, as in the film maker's tracking shot shown by the long arrow at T, imposes a gradient of motion on objects at different distances in the scene, as shown in views 1, 2, and 3 (note that the furthest post has moved least and the nearest post has moved most), and objects that are hidden in one view will be disoccluded in another. (C) The motion parallax within a scene provided by forward motion of the viewer; note that the flow pattern is different for different distances of surfaces and different slants to the line of motion.



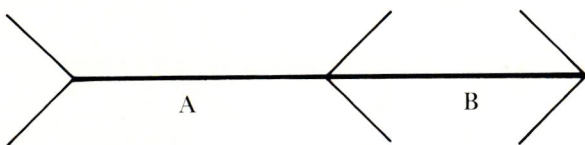
4. (A) Objects of different size ( $S_1, S_2$ ) and distance ( $D_1, D_2$ ) can project the same visual angle ( $\theta$ ) and therefore produce the same retinal image. (B) Objects of the same size ( $S$ ) and different distances ( $D_1, D_2$ ) project different visual angles and therefore different retinal images.



5. (A) The same rectangle, at three different slants to the line of sight, provides three different images to the eye. (B) If shape constancy were perfect, the shape would appear the same in each case, whereas if shape constancy failed completely (C) the apparent shape would change precisely as the retinal image changed.



6. (A) Linear perspective, texture-density gradient and height in field make 2 look more distant than 1, even with equal height. (B) Only the familiar size of the two human figures acts to assign distance and scale to 1 and 2.



7. Typical robust geometrical illusions.  $A = B$ .

C. Perceptual research issues and their architectural implications

From Figure 1 it might be thought that the retinal image (and the optic array) determines our perceptions of the world of surfaces and space. We will now discuss three ways in which the optic array fails to predict or explain what indeed we perceive.

(1) *The constancies.* As viewing distance increases, an object's retinal image decreases in extent, as does the visual angle it subtends at the eye—hence the rules of optical perspective attributed to Brunelleschi. Given those rules, objects of very different physical size can produce the same retinal image size (Fig. 4A), and objects of constant size can produce very different retinal images (Fig. 4B). Despite the geometry, however, a man at 10 feet simply does not look like a dwarf half the size of a man at 5 feet. Retinal image size alone does not determine perceived size. *Size constancy* refers to the tendency to perceive an object as maintaining a single size even though its retinal image changes with the viewer's distance. Similarly, in Figure 5B the object appears rectangular—that is it manifests *shape constancy*—despite the changing retinal image. The degree of constancy is indicated by an index in which 1.0 indicates that the perception of an object agrees perfectly with its physical attributes, and 0.0 means perfect agreement between the percept and the retinal image (Fig. 5C).

Architects should know that constancy is rarely absolute, usually falling between 0.0 and 1.0. If constancy were generally at or near 0, sizes and shapes of the surfaces of buildings, and the relationships between them, would appear to change with each motion of the viewer, with greater apparent changes occurring in foreground than in middle regions or background (Fig. 3B, C). Under these conditions, the rectangle in Figure 5A would look rectangular from one and only one viewpoint, and the perception of a building's symmetry would depend on where the viewer stands. *Each and every possible viewpoint would require separate design consideration, and these could probably not be reconciled.* We know that such perfect inconstancy is not indeed a general perceptual fact, and that table tops do not appear obviously narrower at their far ends. (If they did, the rules of perspective would themselves have been obvious, needing no Brunelleschi to elucidate them.)

On the other hand, were constancy generally at or near 1.0, pictures and murals would look only like flat varicolored surfaces; the moving viewer would perceive only his own movement and no change in the form of the scenes and buildings around or within which he was moving, losing the rhythm and visual interest that the architect expects will be gained from movement.

In general, the more effective the depth cues, the closer the constancies are to 1.0. In Figure 6A, we have used both linear perspective and texture-density gradient (see *i* and *ii*, respectively Fig. 2D) to indicate depth; Figure 6B uses only familiar size (see Fig. 2D). The difference in effectiveness of these kinds of depth cues is important. Both in renderings and in actuality, architects often depend on human figures and other objects of known and familiar size to provide scale to scenes and buildings. Whether or not familiar size will act as a depth cue *at all* was in question for years; it is now known to work at least under certain conditions, but it is by no means a strong depth cue, as Figure 6B illustrates.

The perceptual constancies are names for the fact that we normally have approximately correct perceptions of the world. Two other massive perceptual phenomena must be mentioned: illusions and the demonstrations of figural organization explored and presented by the Gestalt psychologists. Neither of these appears at first sight to be related to the perceptual con-

stances, but they both have importance in the real world, and both must be accounted for in any general theory of visual perception. I merely mention and illustrate the illusions at this point, and then consider figural organization and its role in Gestalt theory at somewhat greater length.

(2) *The illusions.* Known to architects since at least the Hellenic period, illusions like those in Figure 7 have been well explored and quantitatively measured in the psychological laboratory and are easy to demonstrate in the world of architecture and design.

(3) *Figural organization.* The same shape can be presented by means of different elements (Fig. 8A i, ii) and the form that is depicted by any set of elements can be completely changed by its context. Such examples led to the Gestalt proverb that the whole determines the appearance of the parts (sometimes rendered as "the whole is greater than the sum of the parts"). As we shall see, this saying is untrue.

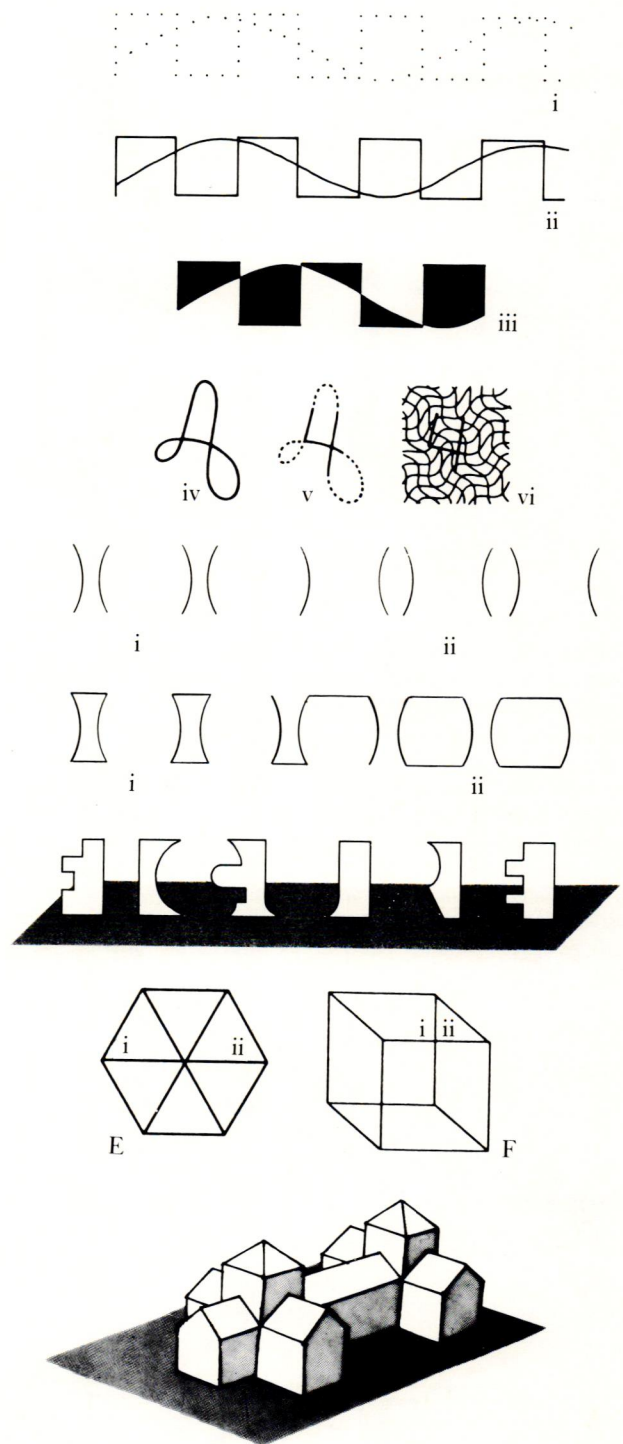
(a) *Determinants of organization.* One of the most characteristic arguments of the Gestalt school is based on the "figure-ground" demonstrations: perceived "figure" appears to have a hard surface, with recognizable shape and definite boundaries; whereas "ground" is less surface-like, without definite boundary or shape, and appears to extend some indefinite amount behind the contour that belongs to the figure. For a shape to be perceived, it must be figure: the same outline can be perceived as different, alternative figures, with very different forms. The perceptions of objects and buildings, of depth and spaces, of patterns and scenes—all of these rest on shape perception.

Given the ambiguity of contours, then, which alternative organization will be perceived? That appears to depend on Gestalt "laws," demonstrated with reversible figures (Fig. 8A, B) or reversible-perspective outlines ("wire cubes," for example) that are perceived either as flat patterns or as tridimensional objects (Fig. 8C). From such phenomena psychologists derived the "law of good continuation" (we perceive organizations that interrupt the fewest lines); the "law of enclosedness" (the enclosed region tends to be figure); and so on. Very many such "laws" were proposed. They would be of immense practical importance if they could in fact be used to predict which of the many shapes that could be seen will actually be perceived. They have been taken to be of architectural significance, both in determining what will be seen and as an esthetic "preference,"<sup>10</sup> a point to which we return later. And as we will note below, they have been identified with prescriptions of "purist" architectural schools and periods.

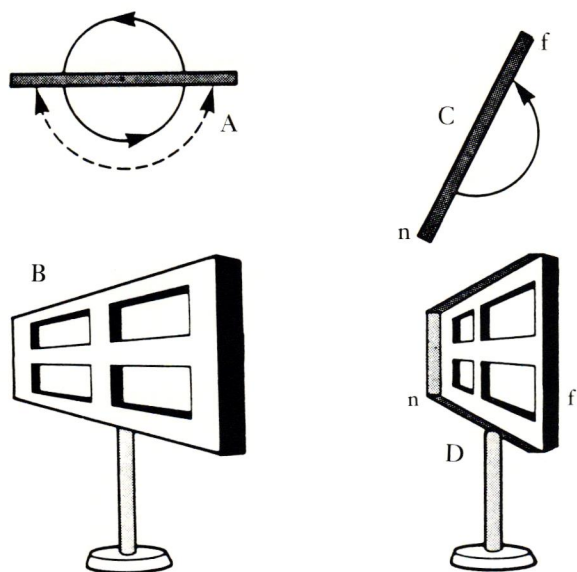
Although proposed more than sixty years ago, these "laws," for the most part, are to this day only subjective demonstrations of quite unknown reliability. One cannot explain the architectural use of "pure" geometrical forms, as in St. Michaels (Fig. 8G), or as in Le Corbusier's Maison Savoye, as manifestations of the Gestaltists' "good forms" (as does Prak),<sup>11</sup> because we have no independent definitions of what these good forms might be. Moreover, because the so-called Gestalt laws can conflict with one another and because their relative strengths are unknown, we cannot use them to predict what figure-ground organization will result in any but the simplest cases.

There are two points that we should consider next, both critical to any attempt to apply the Gestalt findings (such as they are) to the perception of architecture.

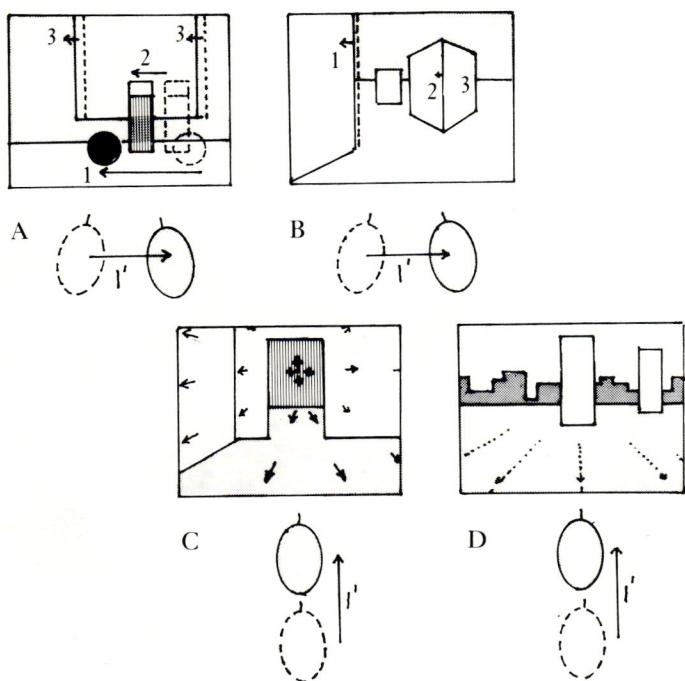
(b) *Are questions of organization applicable to the world of space and solids?* As has been argued in recent years,<sup>12</sup> if the relative motion between viewer and world provides the viewer with visual information that fully specifies (that is, that is specific to, or



8. Whole and parts, figure and ground, flat and tridimensional. (A) As parts of the smooth curves at i and ii, the components at iii are invisible. Unless it is specifically pointed out to them, few viewers detect the 4 that is embedded in iv, and that is made salient at v. It is not merely the addition of line segments that conceals the 4 in iv inasmuch as the 4 is perfectly visible in vi. The aspect of the configuration that is effective here is the factor of good continuation, one of the so-called laws of organization. (B) The "law" of proximity: at i, the lines closest to each other group to form concave shapes; at ii, the same lines group to form convex shapes. (C) The "law" of closedness: At i, closedness and proximity reinforce each other to make the concave shapes visible; at ii, the two "laws" are in conflict and the former prevails (note that good continuation prevails over closedness in Ai, ii). (E) Figure and ground: The spaces between the letters have been made figure (by the use of closedness and good continuation); the letters, and the word they spell, have then become invisible. (E) A projection of a wire cube, which looks flat because the good continuation between i and ii must be broken to see it as tridimensional. (F) A projection of a wire cube, which looks tridimensional because the good continuation between i and ii must be broken to see it as flat. To Gestalt theorists, this was important because it was taken to show that each part (e.g., any section of line or intersection) is seen in a way that depends on the whole organization. (G) St. Michaels (Hildesheim), with towers removed. Gestalt "good forms"?



9. Ames trapezoid. A flat metal sheet, viewed from above at (A), rotates  $360^\circ$  as shown by the solid arrow. It is trapezoidal, as shown in elevation at (B) and may be painted to look like a tridimensional window to heighten the following perceptual illusion: When viewed in elevation from a few yards' distance, the rotating trapezoid appears to oscillate through  $180^\circ$ , instead of making the complete rotation that it actually does execute. The best current explanation is this: Even when the small end is nearer than the large end, as shown in plan and elevation at (C) and (D), respectively, the small end is perceived as further because of the depth cues of linear perspective and relative size (see Fig. 2D), and these static depth cues are sufficiently strong to overcome the information about depth and shape that is theoretically provided in the optic array by motion parallax (see Fig. 3C) but is not effectively used by the viewer.



10. Flow patterns in small and large vistas. (A) A lateral head movement of one foot leftwards produces a gradient of motion parallax in a nearby scene (leftward arrows 1, 2, 3) that serves as motion perspective—information about the relative distances of the parts of the scene. (B) In a large scene with architectural distances, the parallax displacements produced in the optic array by the same head movements are largely undetectable. (C) With near surfaces, an approach movement of one foot produces a noticeable set of expansion patterns that viewers might use as information about the surfaces' distances and layout. (D) In a large scene and with architectural distances, the expansion patterns produced by the same approach movement must be largely undetectable.

that is in one/one correspondence with) the spatial arrangement of surfaces in space, we should not expect viewers moving around buildings and in urban spaces to experience any reversal of figure and ground in the surfaces amidst which they move. Questions of Gestalt organization would therefore be completely irrelevant to architecture except with respect to pictures, friezes and other decorations. We will see, however, that in architectural settings the motion parallax information on which this argument depends is often below threshold (see Sect. IA) and therefore unavailable, that the spatial relations are ambiguous and that organizational factors are then free to determine what the viewer will perceive.

As has been known for about a century, it is easy to demonstrate that fact in the laboratory. An example that has recently received a great deal of attention is the "Ames trapezoid" represented and described in Figure 9. This is quite a robust phenomenon, and it occurs under conditions that must be common in the viewer's physical world, except that the fallacy of his perceptions is rarely made so evident.

In rebuttal one might argue that normally the information offered by motion parallax is indeed available and above threshold, but the few data we have render such an argument dubious. All of the following factors (and others considered in sect. ID1 below) must often work to make motion parallax information unavailable to the viewer. Whereas in the laboratory (or the architect's model) the viewer's head and body movements are both large and fast compared to the sizes and distances confronted (Fig. 10A, C), they are tiny compared to the scale of architectural settings (Fig. 10B, D), so real-world motion parallax must often be below threshold, and relative nearness (i.e., figure-ground) must therefore be ambiguous. Secondly, whereas the natural texture of shrubs or pebbles, in the foreground is probably sufficient to provide a detectable "flow pattern" and texture-density gradient, the relatively smooth texture and slight slant to the line of sight characteristic of architectural facades should provide less obvious evidence for placing surfaces and buildings in depth. Finally, for reasons we shall discuss shortly, visual sensitivity to motion-produced information about relative depth rapidly falls off away from the very center of the field of view.<sup>13</sup> With large objects the center of vision will fall far away from the object's edge when the viewer is looking at some surface detail, and depth information will be unusable by the viewer. In short, we have no reason to believe that the orientations and distances of architectural surfaces are perceptually unambiguous under normal conditions of locomotion. Questions about the perceived organization of the layout, and which alternative figure-ground arrangement will be perceived, cannot be dismissed. In this respect at least, the Gestalt demonstrations do seem to be applicable to architectural theory and practice. But we will next consider some further demonstrations that radically alter the significance of Gestalt phenomena, giving warning that theorists should use them only with extreme caution.

(c) *Wholes vs. parts: The separate levels of perceptual processing.* Figure 11A (which rests on principles discovered by Penrose and Penrose in 1958)<sup>14</sup> looks three-dimensional, although if the Gestalt principles are taken seriously, it certainly should not: the object is not simpler when perceived as three-dimensional than when perceived as flat. Indeed, it is inconsistent as a tridimensional object, and yet perfectly consistent as a flat pattern. The left and right halves of the pictured object do not immediately conflict because you cannot focus your attention on both corners simultaneously—they are too far apart. When

the corners are brought closer together in 11B, their inconsistency as a three-dimensional object becomes obvious, and the object looks flat.<sup>15</sup>

It is often argued that such perceptual anomalies occur because pictures provide contradictory information about flatness and solidity, and thus are irrelevant to the real world, but observe Figure 11D. Although the cube is fixed and unambiguous at intersection 1, if you fix your gaze on intersection 2, the perspective will reverse at 2 even though intersection 1 specifies one and only one orientation of the cube. Moreover, this is true of real three-dimensional objects, viewed with motion parallax!<sup>16</sup>

As these demonstrations show, the whole organization does not determine the appearance of its parts. Such tolerance of inconsistencies throws into question the most basic of the Gestalt principles. Structural inconsistency and physical impossibility do not make pictures of spatial arrangements look like flat designs (even though the pictures are inconsistent only as three-dimensional structures, not as two-dimensional designs). Moreover, the specific inconsistencies are neither automatically nor immediately perceived: one can glance at Figure 11A, perceive that it looks solid, and go on without a further thought. With more effort, and some perceptual intention to consider the object's structure, one begins to recognize that there is something peculiar about it. And finally, if one does wish to perceive the specific relationship between the parts of the structure, one must set out to parse the structure, and only then does the nature of the peculiarity become explicit. This takes effort and time.

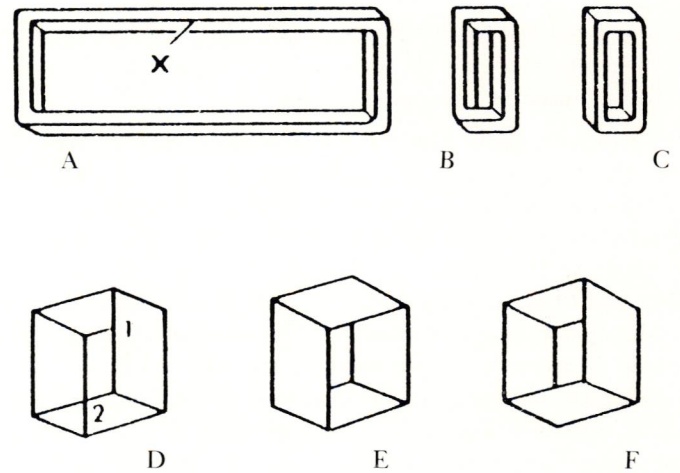
Understanding such phenomena is essential to an understanding of architectural perception, to perception theory in general, and, I believe, to any understanding of visual esthetics.

When we turn from the small expanses of laboratory patterns (and from the Albers's exercises, Escher's impossible millraces and stairways, and Piranesi's *Carceri* etchings) to the vastly larger extents of architectural spaces and volumes, in which the distances between corners and features that specify orientation can be very great indeed, the fact that it takes time to assemble one's glances—a fact that we have not yet considered—becomes unavoidable.

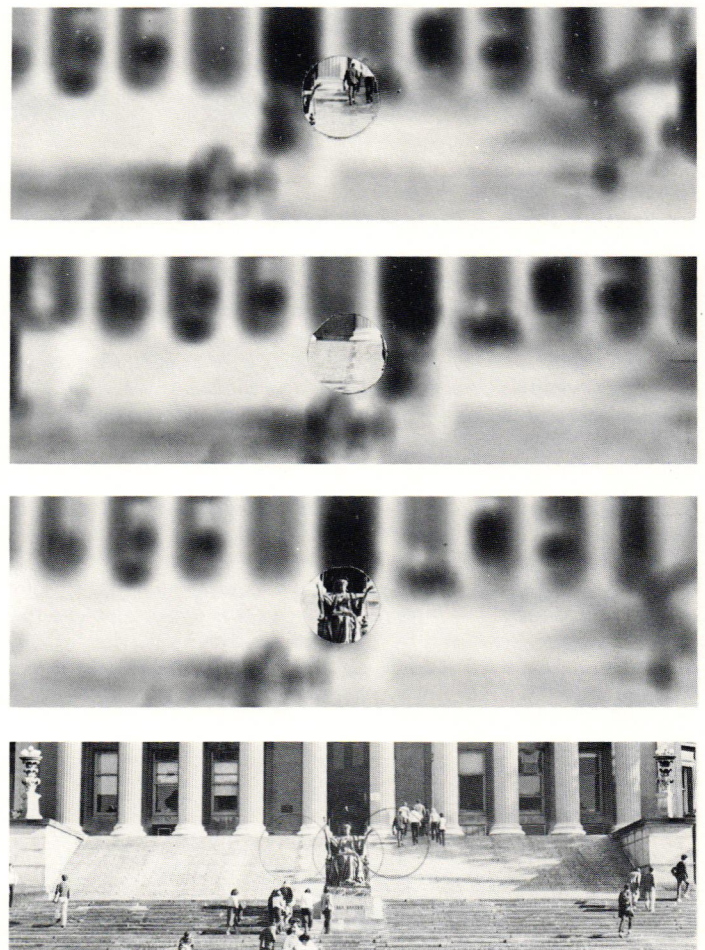
#### D. Space constructed over time

The physical world lies before us, relatively permanent and unbounded. To the exploring eye of the viewer walking through it, however, a continually changing and closely bounded field of view provides the means by which his conceptions and perceptions of that world are achieved. We must now consider the nature and consequences of those changes and limits.

(1) *The limits of the momentary glance and the integration of successive views.* If two points (or other details, such as the width of a pilaster, the height of a tread, or the extent of an ornament) are so far from the eye that their separation in terms of visual angle is less than approximately 1/60th of a degree, the two points will be indistinguishable (or the details undiscernible). This threshold for resolving detail, called visual *acuity*, is substantially affected by factors such as illumination level and contrast, which in principle may be controlled by the architect and the lighting engineer. Other factors, such as intention and visual ability, rest with the viewer, and of these the most important to us is the fact mentioned earlier that detailed vision is available only in a very small part of the retina: the fovea, a region of about 2° in extent, that is, a region that would be covered by a thumbnail



11. Pictures of inconsistent objects and inconsistent perceptions of consistent objects. (A) This "frame" looks tridimensional, even though the corners must be inconsistently oriented as a tridimensional object. (B) The same pattern looks flat when the inconsistent corners are close to each other, perhaps because they then are apprehended within a single glance. (C) The corners here are as close as they are in (B), but are not inconsistent, and the pattern now looks tridimensional again; the flatness of (B) is not, therefore, merely a matter of proportion. (D) A picture of a consistent object, oriented as at (F), but with a transparent bottom. Its orientation is fixed by the single depth cue at 1. If you attend to point 2, after a moment the apparent orientation will reverse, and alternate between those of (E) and (F).

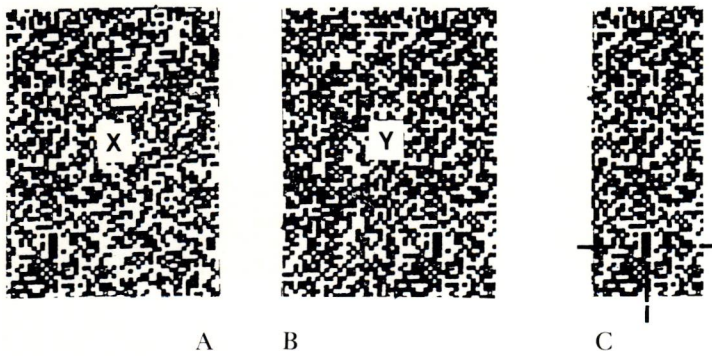


12. (A) - (C) Three successive glimpses at an architectural scene (D). The sharp region in the center of each of the first three pictures simulates what is seen in foveal vision. Peripheral vision (poorly simulated here by blurring the picture) is largely the same for each view.

at 14 inches or by a hand's width at 10 feet. Outside of that region, acuity falls very rapidly; only large separations can be detected, only large masses discerned. This has consequences that are important for the perception of architectural objects and spaces and for psychological theory.

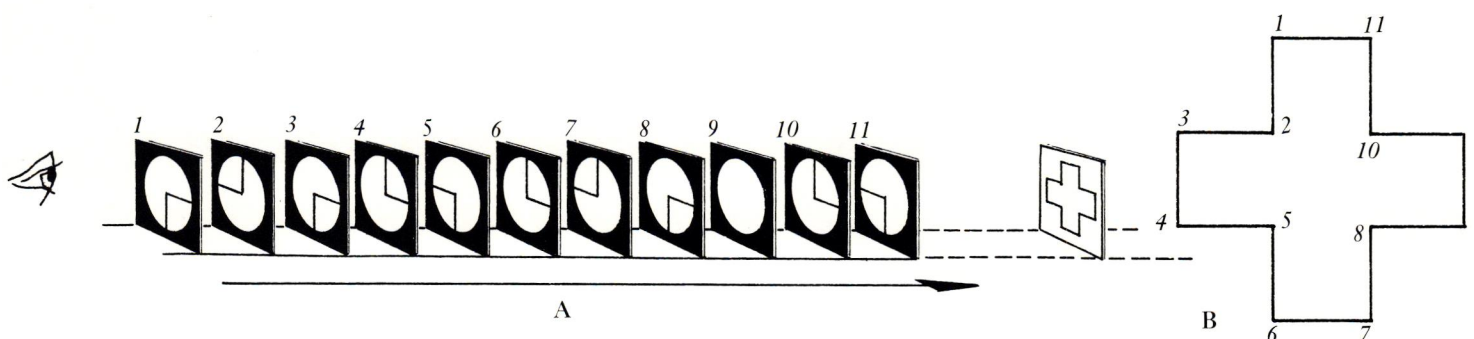
(2) *Perceptual status of large masses and small details.* Figure 12A-C simulates three successive glances at a single scene. Note that the light and dark masses, discernible in the general field of peripheral vision, are much the same in all three; only the details of shape and texture, discernible only in foveal vision, are very different. Vision is preponderantly peripheral vision.

The first glimpse is almost entirely made up of general masses. Further details are added to this first impression only if subsequent eye movements are made. If the scene contains only a clutter of fine details, undiscernible in peripheral vision—like the texture in Figure 13 or meaningful detail, as in, say, the textural bas reliefs of Angkor Wat—peripheral vision cannot provide a framework within which the successive foveal details can take their places. These facts were, I believe, important in the development of 20th century painting,<sup>17</sup> providing as they do a new dimension of esthetic tension in paintings from Impressionism onward. Where such conditions are ex-



13. If there are no landmarks by which locations can be discerned in peripheral vision, no context is offered in which to place the separate foveal glances, and then other means (see Fig. 14) and a specific effort are needed if the viewer elects to relate those glances to each other. (A) and (B) are overlapping partial views of a textured surface: on that surface, is X to the right of Y, or vice versa? The area of overlap, that is shared by the two views, is shown at C; the intersection of the two dashed lines marks a landmark that is common to (A) and (B). If you search for and find the landmark in each view, it will then become evident that X is to the right of Y on the textured surface.

14. Mental maps and schemas can replace peripheral context in integrating successive glances. (A) A sequence of right angles, projected one after another on the same place. As the hands of a clock, or the corners of a square that is jumping erratically behind a circular aperture, the sequence is too long to remember. (B) If the corners in (A) do in fact have an underlying order to their sequence because they are the successive views of a cross, as shown, and if the sequence is introduced by the "long shot" and then it zooms in on the first shot in A, the viewer can then follow the "map," and will recognize that the sequence 8 - 10 is a shortcut across the right arm.



treme, the viewer cannot integrate the information from the successive glances and, as we next discuss, does not even know where to look.

(3) *Saccadic eye movements are directed, intentional, and elective.* We glimpse the world mainly by means of *saccades*: purposive eye movements that are directed toward some point in the optic array previously seen in peripheral vision. They are *elective*, that is the viewer is not compelled to look one way rather than another, or indeed to change gaze direction at all. They are executed very rapidly (less than 1/20th of a second, as a rule), but they take a relatively long time to prepare and initiate (about 0.120-.200 sec.), so that their rate of occurrence rarely exceeds four or five per second.

In the few seconds in which a casual viewer may survey an architectural or urban scene from a given head position, he can focus on perhaps no more than between 5 and 20 separate places. This is both few and many glances.

It is few glances because it means that only a very small part of the layout will be seen in detail. With such limited opportunity, if the eye were directed by chance alone, it might sample only places with no detail, or places where the detail is not particularly informative. In fact, we know that peripheral vision does direct the eye selectively to places that are likely to offer informative detail to the fovea. If the details then take their place in some mental structure—some arrangement that the viewer can remember and flesh out—a very few glances will suffice. The viewer can reconstruct the entire arrangement at will because he knows what details any further glances would disclose: if, after seeing the first 6 letters, I have decided that a printed word is "antidisestablishmentarianistic," I do not have to look carefully at the remaining 24.

It is a large number of glimpses because the viewer could not sort out the rapid sequence, nor remember their contents and their relative locations in space, were they all independent items. We can, as is often noted, remember no more than five to nine really independent items, that is, items that do not fit together in some way. If the details obtained in the successive views take their places as part of some overall configuration that can itself be remembered, the problem disappears. If I know that the word is "antidisestablishmentarianistic," I can always retrieve the 15th or 25th letters from the mental structure that comprises my knowledge and recognition of the word.

Normal layouts present massive and coherent configurations that are discernible to peripheral vision. These inform the viewer where significant details are likely to be found; make it unnecessary to take more glances, once the objects in the scene are identified; and make it possible to "remember" or generate the individual details and where they fit.

Peripheral visibility, however, is neither sufficient nor necessary, of itself, to serve these purposes. The experiments discussed in connection with Figure 14 will show that it is not

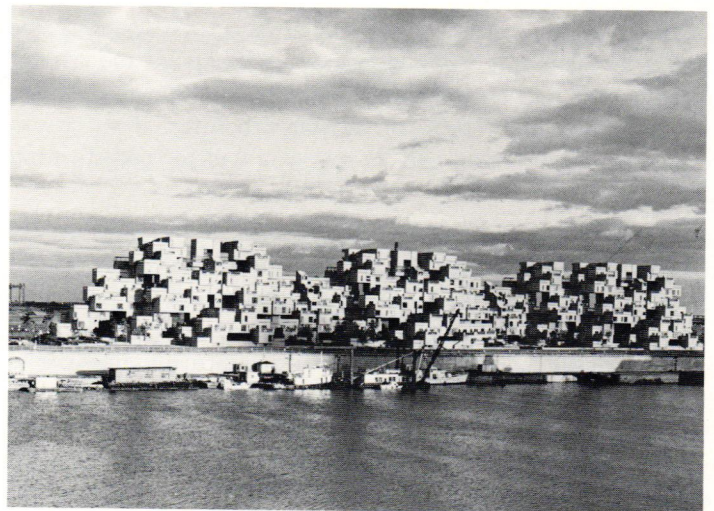
sufficient. And it is relatively easy to show that peripheral visibility is not necessary: if a sequence of individual corners (Fig. 14A) is presented successively at the same place in space, projected on a screen one after another, say, the sequence soon exceeds the viewer's ability to remember individual items. If however, the viewer is told or shown that the views are the successive corners of a cross, starting with the upper left hand corner and proceeding clockwise, the individual corners take their place in his spatial map of a cross. He then can detect whether an arm has been skipped, knows when the circumnavigation of the figure has returned to the starting place, and so on.

Peripheral vision clearly is neither necessary nor sufficient in itself to insure that a succession of details will be perceptually comprehended. What then is needed? That question brings us face to face with what I think is the most important concept and problem of psychology, the notion of *schemas*. In approaching this idea, let us consider how the movement of the viewer through space makes architectural perception especially sequential in nature.

(4) *The moving viewer: Sequential vistas from changing viewpoints.* Unlike the painter or photographer, the architect and sculptor must take into account that the optic array itself changes as the viewer moves. Objects change places in the field of view; things that are hidden come into view and vice versa. Some constraints on the pedestrian do of course exist. But the architect and sculptor share with the film maker the problem of providing a sequence of optic arrays that is comprehensible, interesting, and pleasing.

I noted earlier that Gibson and Benedikt made a beginning at describing the optics associated with this problem.<sup>18</sup> The former was concerned with the information about spatial layout that is offered to the eye by the changes and parallax within the optic array received by a moving viewer, and the latter was concerned with describing a space in terms of the fields of visibilities of the surfaces it contains. I myself have no great hopes for what was thus begun. The heart of the problem is not optical. It is perceptual, and rests on the necessarily incomplete nature of the momentary glance. As noted above, in dealing with objects of small scale, the peripheral context normally provides the framework within which successive foveal views of details can take their place over time. One must not overlook the factor of time, since even with small objects we require some form of perceptual storage or memory in order to combine successive glances. On an architectural scale, however, the matter is exaggerated because the shapes that give the individual fixations their meaning are usually so large that only a lengthy motion in space, taking appreciable time, will do to obtain the successive views that are needed. *Whether, when, and whence viewers look depends on their perceptual intentions and inquiry*, and as we will see shortly these simply cannot be reduced to matters of optics.

Film makers solve the similar problem of making comprehensible a sequence of fragmentary motion picture views of some scene by periodically presenting an establishing shot or long shot that provides to the viewer's visual memory the context for the details in the individual medium shots and close-ups. Hooper<sup>19</sup> reports that when viewers are allowed to explore large-scale (simulated) environments with the maximum freedom imaginable—namely, in interactive computer graphics displays—they periodically rise into the air to obtain an overview of the space they are exploring, an act equivalent to the film maker's insertion of establishing shots in films. Architects cannot always provide such overviews at will. They can at most offer an overall long view, and the effects of that initial



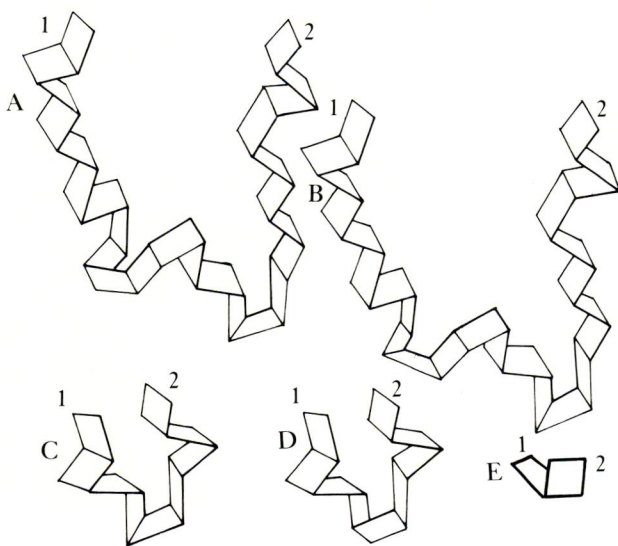
15. (A) Hampton Court Maze. (B) Habitat (Montreal)

prospect must last long enough to provide the cognitive map or image of the layout into which subsequent views may be integrated, if the viewer wishes to achieve such integration and is capable of the task.

For it is often impossible for many people to keep track of their successive views of space. Differences in spatial visualization abilities are immense in the laboratory, and remain largely unstudied in real spaces. A succession of views obtained by a freely moving viewer may contain all of the optical information but remain incomprehensible: if the establishing shot in a film (or in a viewer's encounter with an architectural structure) consisted of a brief overhead view of the Hampton Court Maze (Figure 15A), of Greenwich Village, or of Habitat (Figure 15B), would that inspection suffice to make comprehensible a subsequent sequence of street-level views? Furthermore, if the establishing shot is a view in which a great deal of the layout is occluded, the viewer must elect to complete the visually incomplete forms and must supply the mental structure needed. He is perfectly free *not* to make the effort, as shown by the failure to detect inconsistencies in Figure 11A, a fact that is obscured in the case of very simple figures.

An analysis of the optical stimulation available to the viewer in spaces and structures of a large, architectural scale may be useful, but it simply will not do as a stopping point and it is not clear how it is even a starting point. For the moving viewer, we must turn to *schemas*, or mental structures, if we are to understand perception and its role as a tool for maneuvering in space.

(5) *The mental structures of physical perception.* In principle we can measure the information about space and layout that is offered by the optic array, using physical instruments and analyses; the problems can be clearly stated and resolved,<sup>20</sup> and the difficulties are only technical. Such analyses provide a satisfying and seemingly purposeful task. But that sense of purpose may be somewhat mistaken. At best, such analyses are only a beginning. In order to continue we must introduce the model of schemas into perceptual theory, moving our interest as examiners away from the measurable visual information available in the optic array and turning our thoughts to the power of the beholder to take in, to store, to organize, and to understand the visual world. One tool of the viewer is "parsing"—giving a meaningful sequence to a series of glances in order to determine relationships between the parts of a scene.



16. Objects that demonstrate perceptual parsing.

(a) *Parsing surfaces and parts.* Imagine that Figures 16A, B, C and D are three dimensional objects, made of flat ribbons. In each case, are the surfaces marked 1 and 2 the same or opposite sides of the object? You can decide more rapidly in C and D than in A and B: in fact the time to reach a decision increases linearly with the number of panels in the object.<sup>21</sup> Full spatial information about each bend in the figure—information that mathematically specifies fully and unambiguously the relationship between surfaces 1 and 2—does not of itself insure that the relationship will be perceived, for unless the viewer specifically elects and undertakes to *parse* the individual bends, he may never know the relationship between 1 and 2. The three points made by experiments with such objects are these:

(i) Spatial relationships are not automatically and directly perceived by the viewer, even by the freely moving viewer, except in the case of simple layouts. This point is usually obscured by perception psychologists, who use spatial relationships so simple (like the single intersection in Figure 16E, for example) that the judgment is essentially immediate and involuntary. Greater complexity lays bare the process.

(ii) The parsing of the parts is an active purposive process (except, perhaps, with very simple figures). Normally the parts of any familiar object strongly *imply* each other—that is, they are associated in the world and in the viewer's mind or nervous system—so that the viewer need not actually look at each part to determine its relationship to other parts. The perceiver has in mind a schema or structure from which the relationship between the parts can be generated when needed. The relationship between Houston and Great Jones St., the distance between the first and second *n*'s in *antidisestablishmentarianistic*, the approximate proportions of a Renaissance chapel—I can evoke all of these when required to do so. But it requires action on my part: the connections are not inevitable either in my momentary gaze or in my perceptions or thoughts about them.

(iii) The objects in Figure 16A, B take time to parse because the bends are *independent* of each other: their sequences are arbitrary and do not fall into familiar patterns or schemas. Objects constructed in this way, which are at an extreme that is rarely encountered in the normal world, enable us to study how spatial schemas are learned.

We can now see why the inconsistencies in Figure 11A were not immediately evident even though the stimulus information lay in plain view. But in the case of architectural structures and spaces in the real world, stimulus information is usually even less of a factor because usually very little of the layout is visible from any one vantage point. Much of perception in the real world is a process of completion—a filling in of the parts of objects and spaces that are not represented in the optic array at all. We consider next what this implies.

(6) *In the mind's eye: The completion of objects and spaces.* In Figure 17, the closed shapes named in the caption are simply not present in the stimulus; they must be supplied by the mind of the viewer. In Figures 17 and 18A, the shapes are geometrically good and simple ones. If we restricted ourselves to these examples, we can see why it seemed plausible to many architectural theorists that the Gestaltist's "goodness of form" *inherently* offers readily grasped forms and spaces. The simple and redundant structure of St. Michaels (Fig. 8G) will clearly be correctly perceived even if only a few features are actually visible.

What Figures 18A–C show us is that completion is not the prerogative of a set of privileged Platonic solids, universally rooted in the nature of the human mind or nervous system. In Figure 18A, the shapes of the structures occluded by the wall

become quite different if you know that they are the tops of letters (see Figure 18C); and in Figure 18B, only someone familiar with Russian Orthodox churches and St. Basil's cross will perceive that an onion-shaped dome lies behind the wall, or that the foreground is a rooftop or terrace. The structures that are brought to perception depend on the viewer's culture and experience in definite and demonstrable ways. We do not presently know which kinds of schemas can become "good forms" and predominant in perception.

We now can consider the major perceptual theories, and discuss their general implications for the prediction of architectural esthetics.

## II. The major perceptual theories and their architectural relevance

There have been three major overarching perceptual theories. The first, the classical theory, relies predominantly on the notion of mental structures that the viewer acquires from experience with the world. The second and third approaches were framed largely in opposition to the first. In my opinion, the classical theory needs serious amendments, but, with such amendments made, can clearly encompass the other two.

### A. The classical theory

This general approach, which took its modern form in the mid-nineteenth century with the works of the philosopher John Stuart Mill and the physicist and physician Hermann von Helmholtz, expresses what has been a major thread in Western philosophy since a much earlier time. Simply stated, our perceptions of objects and shapes are really complex experiences, and are built up out of simpler psychological elements, or *sensations*, as the result of learning the way in which properties are associated together in the physical world. That is, the properties occur in groups that have *structure*, rather than being equally likely in every combination.

(1) *The early view.* This general viewpoint, identified with Hobbes and with Berkeley in the seventeenth and eighteenth centuries, held that all consciousness consists of very simple sensory properties such as a particular red hue, a sweet flavor, and so on, and the memories of those sensory experiences. Memories of these sensory experiences cohere by association, building up the complex experiences we have of things in the world: my visual perceptions of an apple would thus consist of the direct visual sensations of redness and greenness, falling together in a particular pattern, plus my nonvisual memories of reaching and touching. This conception, most vigorously developed by Berkeley rested on the mathematical fact that (as noted in Figures 1, 2) three dimensions cannot with certainty be specified in two. Berkeley concluded from this and other arguments that our senses cannot give us knowledge about the world that is absolutely certain. In the course of developing this position, he first presented in a systematic and collected fashion the theory that perceived depth is a complex, learned idea and not a direct and fundamental sensation.

I have found cropping up in recent architectural papers references to articles by J. J. Gibson and Noam Chomsky, on perception and linguistics, respectively, that argue those seventeenth- and eighteenth-century issues and whose arguments are in my opinion as irrelevant to the more modern versions of the classical theory as they must be to the practice or theory of architecture.

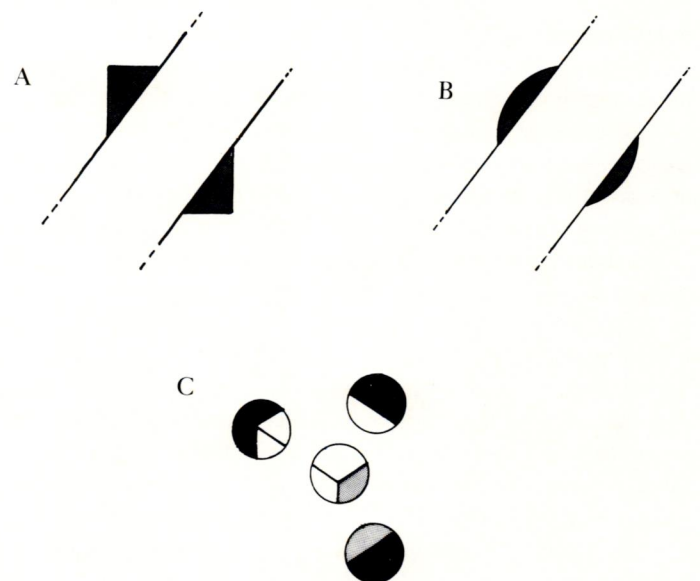
(2) *Modern versions.* The effort to account for our perceptions and ideas about the world in terms of their simplest sensory

origins reached its peak with James Mill, John Stuart Mill, and Helmholtz in the nineteenth century. Three aspects of their general theory are still important to us:

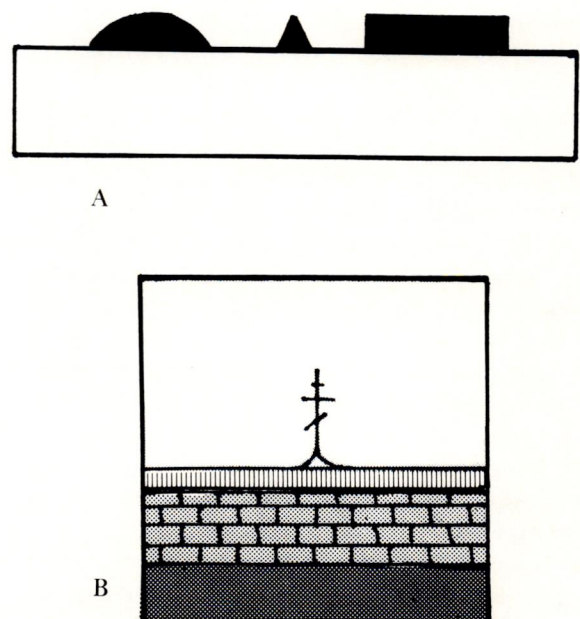
(a) The world has simultaneous structure (things are likely to occur together in characteristic patterns); therefore our sensory experiences have simultaneous structure; and we have simultaneous associations formed in our perceptual memories: for example converging lines (linear perspective) and texture-density gradients (cf. Figure 2D) occur together in the optic arrays presented by the world, and will therefore be associated with each other in our perceptions and memories.

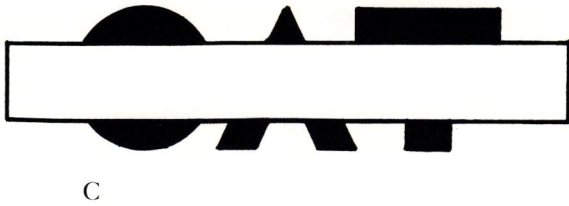
(b) Similarly, the world and our movements through it provide for successive associations: as the hypothetical viewer steps to the left, the corners that are hidden in Figure 19A will come into view, as in 19B.

(c) Frequent associations become so strong and so habitual that the individual, simple, fleeting sensations that compose



17. Partial views of a square (A), a disc (B), and a cube (C).





18. (A) Partial views of a disc, a triangle, and a square. (B) View from elevated Kremlin courtyard, with partial view of St. Basil's Cathedral. (C) A more complete view of 18A, showing that caption to be wrong.

common complex experiences can no longer be discerned. Our perception of an object consists of the whole complex of simultaneous associations and of our expectations—our successive associations—as to what sequence of experiences will most likely follow from any act of sensory exploration. Thus, our perception of the rectangles in Figure 19 consists of the expectation that a leftward step will transform the sensory pattern from that of Figure 19A to 19B.

All versions of this theory assumed that our associations will be strongest for those combinations of sensations that are encountered most frequently. The modern versions now depart from earlier versions by assuming that the underlying object is encountered not as an individual packet of sensations but as the schema or structure that would provide the transformation of views that results from our changes in viewpoint<sup>22</sup>. Given some pattern or sequence of sensory stimulation, therefore, what we perceive is just that layout of objects and events that normally would produce that pattern of stimulation most frequently. This brings us back to the constancies that we discussed earlier: that in normal situations we will generally see the physical properties of objects correctly. This process also includes a form of *visual thinking*: for example, for a given extent of retinal image,  $\theta$  in Figure 4, the viewer needs to solve the equation  $S = kD \tan \theta$  in order to perceive the size of any object that does not have some specific familiar size. Or if the object does have a familiar size (e.g., a man, a chair, etc.), and no other depth cues are present, the equation can be solved in the other direction ( $D = S/\tan \theta$ ) in order to perceive its distance.

Indeed, such reasoning explains not only the constancies, but the illusions as well. Consider Figure 7, in which the retinal extents of  $A$  and  $B$  are indeed equal. This is the famous Mueller-Lyer pattern, and various versions of the following explanation are still popular. In the optic arrays that are provided by the normal world, lines that converge to an apex like the "fins" in the pattern arise because of linear perspective, in which  $A$  would be nearer than  $B$ , as symbolized in Fig. 20. Given the premise that  $A$  and  $B$  in Fig. 7 are equal in retinal extent,  $\theta$  (which of course they are), and the premise normally provided by perspective convergence that  $D_A$  is greater than  $D_B$ , it follows from the equation that the physical size of  $A$  must be less than that of  $B$ .

Three aspects of this classical theory should be noted. First, its explanatory power is great—we will see shortly that it easily subsumes its opponents. Second, its predictive powers are much poorer (for how will one know which figures will generate illusions? We now have a long catalog of them, but they were explained after the fact, and not predicted from the formula above). Third, the perceptual problem solving that, according to this theory, lies at the heart of perception, is not

*conscious* in any sense. Critics have characterized it as "unconscious inference from non-noticed sensations." The notion that visual inference may be unconscious, however, should not be too much to swallow: whatever processes go on in *any* kind of thinking (outside of the logic classroom) are usually quite inaccessible to conscious analysis.

Contemporary students of the visual arts are probably most familiar with the Gestalt theory, which we consider next.

### B. The Gestalt theory

The major criticisms of the classical theory were these: that the notions of fundamental visual sensations, corresponding to the simplest attributes and the actions of individual photoreceptors in the retina, were too simplistic to correspond either to the nervous system or to the actual appearance of things. Furthermore, the notion of unconscious inference from non-noticed sensations was an unparsimonious and unmeasurable conception, made necessary only because the classical theory claimed elementary sensations as its starting point. If we started instead with more appropriate ways to analyze perceptual experience, it was held by Gestalt theorists, the cumbersome notion of unconscious inference would be unnecessary.

The demonstrations like those surveyed in Figure 8 were devised by Gestalt theorists (notably, Max Wertheimer, Kurt Koffka, and Wolfgang Köhler), in the period following World War I. They were intended to discover and demonstrate the principles that govern how the configurations of whole patterns determine what we perceive, and to provide the evidence on which a new theory of brain organization might be based. As far as this last point is concerned, the Gestalt psychologists offered at best very vague notions that did not even begin to explain the figure-ground phenomenon and the laws of organization, let alone the other major problems of perception, such as the constancies and the illusions.

Indeed, the demonstrations of the Gestalt laws may themselves be taken for something quite different. The counter-demonstrations in Figure 11 lead us to think in terms of local depth cues rather than global laws that operate over the entire extent of the figure. And once we do that, it is easy to think of the figure-ground phenomenon as the result of the viewer's effort to treat the lines on paper as though they were objects' edges, and to consider the laws of organization as merely good cues as to what parts of the pattern will turn out to be parts of the same object, and therefore parts that will probably move together in the field of view when the viewer moves.

This explanation, which I find persuasive in a qualitative way, is of course very much *post hoc*: only after familiar shapes are concealed by such factors as those in Figure 8 does a theorist of the classical school conclude that good continuation is more familiar, in a wider set of circumstances, than are particular letters and numbers: the Gestalt psychologists' demonstrations are thus explained by the classical theorist, but not predicted.

In summary, one of the two Gestalt criticisms of Helmholtz was true, and one was inappropriate: it is surely true that Helmholtz's units of analysis were too small. We now know that the visual nervous system contains receptive networks that respond to much larger and more abstract properties than such attributes as red, bright, sweet, and as we will see, these networks may change how much of the perception of the world we need to attribute to visual thinking and to unconscious inference. The second criticism was that the very notion of unconscious visual thinking is uneconomical. This criticism now becomes moot as far as the Gestalt alternative is concerned, for

by any account the Helmholtzian approach explains the Gestalt phenomena and more, whereas the Gestalt theory did not even attempt seriously to explain the Gestalt phenomena.

The last alternative, that of J. J. Gibson, which has only recently begun to make its way into architectural theory, we consider next.

### C. "Direct" theories of perception

In the early classical theory of the seventeenth and eighteenth centuries, our perceptions of physical properties like size, distance and form were taken to be composed of simpler experiences—sensations—of hue, lightness, extent, and so on. In the more modern versions of this general approach, it was still thought that our visual systems (meaning the photoreceptors in the retina) respond directly only to the wavelength and intensity of the light falling on the eye, not to properties of the object such as size, form, and so on. Since the matter has first been considered, however, physiologists and psychologists have speculated about sensory mechanisms that might respond to such features in the light to the eye as are normally closely correlated with the properties of objects. For example, Hering proposed in 1864 that the two eyes are linked in such a way that the differences in their views (binocular parallax) would be directly responded to, and would therefore act as the direct stimulus for perceiving the distance of any point in space. Another example: if two objects' reflectances remain constant, the *ratio* between the amounts of light that each reflects into the eye also remains invariant, regardless of how the illumination falling on the pair changes (as long as the same amount falls on both). A network of photoreceptors in the visual system that is arranged to respond to the ratio of light in adjacent regions of the retinal image (rather than to the absolute amount of light in each region) would respond as well to the objects' reflectances.

The search for such complex or "higher-order" mechanisms is very active today, and it is not an exaggeration to say that the relationship between sensory physiology and visual perception is presently in a state of revolution or disarray.

The work of J. J. Gibson was the most ambitious of the attempts in this area, in the sense that it attempted to obviate entirely the need for attributing visual thinking to the perceptual process, and indeed was intended to refute the psychological and philosophical conclusions that go back to Bishop Berkeley.<sup>23</sup> For example, Gibson proposed that we perceive a surface's slant in direct response to the texture-density gradient; that an object's distance is given directly by the place at which an object intersects that gradient in the optic array (Fig. 21); and that information specifying the object's size is given directly by the amount of texture the object subtends where it touches the ground. Size constancy, distance perception, and so on, thus would occur without any visual thinking, if this information were actually picked up and used by the visual system: regardless of the viewer's distance and viewpoint, these properties are normally invariant in the optic array when the objects and their layout do not change.

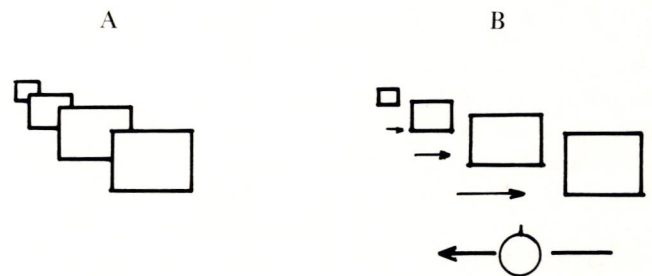
The viewer's motion and the consequent transformations of the light to the eye in the world also provide invariant properties that reflect the physical characteristics of the objects and layouts in the world (Fig. 10). Gibson proposed that we "pick up" these invariants directly. Among such properties he included *affordances*—the usefulness of objects—for example, the sit-on-ability of a chair, which is invariant despite the various transformations in form from Sheraton to Eames to beanbag.

To architects the problems and variables being discussed from this viewpoint, especially the emphasis on moving ob-

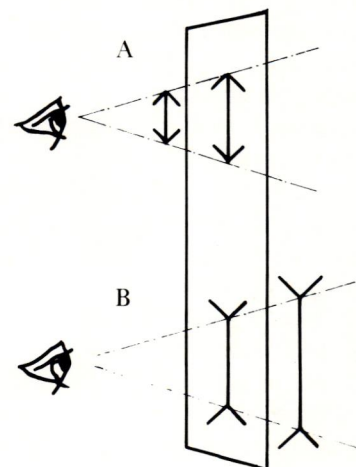
servers, changing vistas, and the occlusion and disocclusion of surfaces, promise to address the issues that are really important to them. To Gibson the preceding assertions are chiefly addressed to two points: first, that although Bishop Berkeley was right in holding that the light to the eye of a static viewer (or from a still picture) is ambiguous, the viewer is more normally in motion and the information then available is unambiguous, veridical and certain; second, Gibson argued that a moving observer's veridical perceptions of space are the direct responses to information present in the stimulus, rather than the addition by the organism of prior associations or unconscious inference.

Regarding the first point, the refutation of Berkeley is irrelevant to architectural theory and practice: the argument is a philosophical one, and in purely philosophical terms the information in the array is not and cannot be unambiguous and certain.<sup>24</sup> As far as more practical concerns go, we simply do not know how truthful perception is under normal conditions (Figs. 9, 10), so that questions of the certainty of the senses cannot rest merely on assertions about information in the light to the eye.

With respect to the second point, the claim about the *directness* of pickup of the information about vistas and layouts does not offer the architect a perceptual theory that is clearly different from the classical one inasmuch as no one has seriously argued (since 1850, at least) that we first consciously experience



19. Given the view at (A), the viewer can expect the transformation shown at B to accompany the head movement shown by the large arrow, should he elect to make that movement.



20. A common explanation of the illusion shown in Figure 7.

points of hue and lightness, and then add to these our memories of past experiences to end up with complex perceptions of objects and spaces: that is, as far as the *conscious* experience of the viewer is concerned, the classical theory, as well as its opponents, holds that the perception of the world is “direct.” Considering that we do not presently know how well the Gibsonian information is used, if indeed it is used at all, the concern with directness or indirectness is premature in any case.

Gibson’s approach does not consider the illusions (Fig. 7), the Gestalt organizational phenomena (Fig. 8), or the matter of thresholds, which, as we say, determine the usability of information of the kinds with which architects must be concerned (Figs. 9, 10). And precisely the kinds of visual thinking that the “direct theory” of Gibson was intended to deny appear in quite “normal” situations (Fig. 9), especially under the conditions that must prevail when viewing architectural objects and spaces.

For these reasons, the direct theory cannot replace the classical theory, although it does serve to emphasize some of the latter’s inadequacies. In particular, it leads us to ask whether any given perception necessarily rests on thoughtlike unconscious inferences as Helmholtz believed. I will return to this point when discussing the kinds of visual thinking that are particularly relevant in responding to architectural structures and spaces.

### *III. What makes people feel good in a place: Esthetics, habituation and visual thinking*

What will make people feel good or awestruck or cozy? Such questions, when specifically directed, are answerable at least in principle.

When seeking to predict such esthetic responses, most theoretical offerings have attempted to appeal to innate, universal formulas that do not have to take into account differences between individuals, cultures, or circumstances. Such theories are much like the direct theories of space perception in that they require measurement of only the stimulus characteristics, not the viewer’s characteristics, in order to make predictions about what will be liked and disliked.

#### *A. Theories about objective bases for preference or esthetic value*

Formulas for beauty are almost as old as recorded history. They are usually considered as being inherent and hence universal, and often are given a physiological explanation.

For example, many people believe different colors have specific emotional effects, measurable by subjects’ ratings, electrical skin responses, and so on. Now, overall illumination does have effects that depend on inherent properties of physics and physiology. For example, in dim red illumination, the periphery of the retina is essentially blind, so that the viewer receives a relatively narrow glimpse of the world with each glance. In some respects then, red light is like focal lighting instead of general ambient illumination, and might therefore be used as a tool for heightening either mystery or coziness. The gradations of human complexion are mostly shades of red, and are wiped out under red illumination, whereas they are converted to exaggerated differences of dark and light under green illumination. There is a great deal of sound knowledge about how colored objects change in appearance in different illuminations and settings, so it is surely as reasonable to speak of a science of color vision as of any other science.<sup>25</sup> But the emotional effects of color are quite another matter. Most color consultants rest their expertise on proprietary data, which of course cannot be

evaluated; and what research has actually been published does not reveal strong or stable effects for the architect to use.

Rules about good or beautiful form and composition have been even more common. With respect to form or proportions (modules), there are formulas for “unity in diversity,” or some optimal degree of complexity, and physiological mechanisms have been proposed to explain the supposed efficacy of such formulas.<sup>26</sup>

Some of the prescriptions have been detailed and objective: in sculpture, Polykritos’s Canon; in painting and design, Hogarth’s Curve of Beauty; in architecture, various modular descriptions from Alberti onward; and, in all areas of visual art, the Golden Section. Some prescriptions have fallen just short of being measurable and objective. For example, there is Le Corbusier’s prescription that architectural forms should be clearly readable, because readability makes for beauty (where readability means that the spaces that compose the object or structure are immediately or readily apprehended); and in order to be readable, the forms should be simple.<sup>27</sup> This is clearly related to Plato’s assertion that the cube, sphere, and so on, figures made with only ruler and compass, are inherently and immutably beautiful. As we have seen earlier, however, there is no solid basis today for believing that one form is inherently simpler or more readable than another.

Other prescriptions sound at first as though they can be made objective, but in fact cannot—for example, the prescription, offered by Pugin in 1841, that the appearance of an edifice should accord with its purpose.<sup>28</sup>

Let us first consider the status of rules that appear to be inherent, objective, and measurable. First, do they really work for all, or even most, viewers? Second, are they really innate and universal, “eternal and absolutely beautiful,” or are they the mutable evidence of habit and fashion?

Regarding the first question, a line of research on experimental esthetics dates back to 1876, to the physicist G. T. Fechner.<sup>29</sup> In such research, meaningless patterns or shapes are shown to subjects who are asked to make comparative judgments of their beauty, pleasingness, and so on. The shapes are chosen to test some esthetic prescriptions—the Golden Section, for example, or the notion that pleasingness increases up to a certain degree of “complexity” in design and then decreases. Much of the research has shown that subjects agree with each other, and usually agree with the theoretical predictions.<sup>30</sup>

Architectural writers have drawn upon such findings to support some prescription of design for constructions, spaces, and neighborhoods, apparently feeling more secure in such prescriptions as appear to have support in psychological research and theory. Both the theory and the research should be viewed with great caution. The judgments obtained with such uninteresting material cannot, it seems to me, be accepted at face value; instead, they can only represent more or less successful attempts by the subjects to solve the “test of good taste” (with all the connotations that suggests) set for them by the experimenter. And even if such judgments could be taken seriously, they could not establish a general case. Even though complexity of design does predict subjects’ judgments in laboratory experiments, the haiku, the simple calligraphic stroke, the perfect porcelain bowl, the minimal canvas all show us that complexity is quite unnecessary for esthetic value.

With respect to the second question: even if viewers genuinely agree in their esthetic judgments (and, for the reasons given above I don’t think that the existing data can be readily interpreted) that does not mean that the principle in question is

inherent or immutable. Polykritos's Canon may only embody in stone normative anthropometric measurements of Polykritos's countrymen;<sup>31</sup> the privileged status of the Golden Section may be due to familiarity;<sup>32</sup> the effects of complexity may merely derive from the nature of the task that confronts the subjects in such experiments.<sup>33</sup>

Indeed the very nature of complexity and simplicity as absolutes must be questioned. The Gestalt theory once appeared to give a warrant to such notions, but that theory itself is no longer seriously maintained. I like Prak's phrase on the subject: "Architecture had to go back to 'pure' forms . . . but why should a cube be more 'pure'—or even more geometrical—than a Tudor arch?"<sup>34</sup>

The background of place and time against which a particular work of art was made, including the esthetic arena in which the artist implicitly or explicitly announces it, must be considered, and the "statement" made by the client in commissioning or buying the structure, simply cannot be set aside. Such components of the artistic and social context are often not reducible at all to physical analysis, nor are they even within the domain of perceptual psychology in any reasonable sense: consider, for example, the assumptions about communication that guide participants in discourse and that must pervade the response to arts, as well, or the even more culturally dependent factors of resonances, fantasies and implied life styles that only the sensitive critic can discern and discuss. But such difficulties do not mean that the effects of context and of habit make measurement or prediction completely impossible, as we will see.

#### B. Habituation, adaptation level, and visual interest

When an infant is first shown a novel pattern or object, its gaze is held for some time. After several showings, the stimulus becomes *habituated*, and fails to attract or hold attention. Moreover, the effects will generalize, and other similar objects will require fewer presentations to reach the same degree of habituation.<sup>35</sup>

Similar effects are found in the way in which adults look at pictures: first, they glance at the least predictable (most informative) regions, then take a few confirmatory glances, and finally stop looking at all unless they have something specific to search for, or until something new appears. In motion pictures and in dance, something new appears because the artist continues to perform; in architecture, sculpture and comic books, the viewer moves on. In architectural objects and spaces, visual change occurs for the moving viewer partly because new vistas open up, and partly because of motion parallax, that is, because things move in the optic array with velocities that depend on their distances from the mover. Note that if the architect dismisses such parallax motion as a visual experience because he accepts the direct theory (that we perceive the spatial layout directly, and not the motions in the retinal image), he has unjustifiably dismissed a powerful component of the esthetic value of any set of vistas.<sup>36</sup> Change and new information sustain interest, and the monotony of the perfectly familiar and predictable provokes boredom—these are facts of art and fashion that are no less powerful because trite. Circumstances or objects to which the viewer is fully habituated set what Helson called the *adaptation level*<sup>37</sup>—the viewer's framework or set of expectations. The adaptation level is in principle a quantitative notion, but it is not clear that it can really be measured explicitly in a multidimensional situation in which the object varies in many ways, and at many levels, at once. McClelland and his colleagues<sup>38</sup> proposed that objects that are at the adaptation level will be experienced as neutral, neither pleasurable

nor unpleasurable. If the situation changes slightly from adaptation level, it becomes pleasant, passing through maxima on each side of the adaptation level. With larger differences from adaptation level, the object or situation is unpleasant. The very same object, therefore, originally unfamiliar and far from adaptation level, should change as the object becomes more familiar: first, as the object approaches adaptation level, pleasantness increases to a maximum, and then, as object and adaptation level coincide, falls to neutrality. With neutrality should come disuse in favor of some more pleasing object; a shift in the adaptation level away from the first object; and therefore a likely recurrence of part of the first cycle.

I know of only one experiment actually testing this theory.<sup>39</sup> That used water temperature as the habituating stimulus, and is open to many interpretations. And of course change along a single dimension, or a single level of meaning, would not significantly capture or maintain the interest or esthetic preference of an adult. Nevertheless, a theory of this form would account for the kinds of transition from outrage through popularity to boredom, followed by eventual revival, that characterize fashion and taste, especially in the popular arts. A theory of this kind is, moreover, compatible with the stimulus complexity theory and would indeed subsume it as a special case.<sup>40</sup> Although it sounds at least partially true to me, and makes sense of several pervasive phenomena, I don't believe that the adaptation level theory (or its near relatives) has been developed enough to be evaluated seriously, or to be applied to architectural problems in any detailed or technical sense; nor am I confident that it ever will be. I mention it here as a theory that does not place beauty or pleasure or interest inherently in the objective stimulus, but assigns esthetics entirely to the viewer's prior experiences.

There is an implication in this theory (and in others touched on above) that once the viewer grasps the rule or principle by which the work of art was constructed, and can therefore *completely* predict what will be seen in the next glance, the perceptual and esthetic interest will wane. This implicates a form of visual thinking or problem solving in the esthetic process, as does the familiar dictum that design should reflect function. In this context I will now reconsider the problem of visual thinking.

#### C. Visual thinking

The very term seems insightful: isn't this precisely what is involved in the appreciation and understanding of most of the visual arts, and precisely what is missing both from classroom discussions of thinking and from all but the very best artistic criticism?

Be warned, however, that the subject of visual thinking is not a virgin area needing only to be lightly cultivated to yield its riches. Although they have not been identified with the name, the topic consists of a well-worked set of problems, most of which have proved to be difficult to phrase in an answerable form and even more refractory to study. Moreover, these problems do not constitute a single set that can be conquered by the discovery of a single set of underlying principles. I will outline what I see as the fields of research that involve those kinds of thinking relevant to the concerns of the architect and planner. In most cases, we must question whether visual thinking occurs in the sense of using one visual perception as the premise from which other visual conclusions are drawn, as in a formal logical analysis that solves problems in propositional form, or whether instead the viewer responds "directly" to some information in the pattern of light that confronts the eye. But there

are numerous examples to be found in which the viewer simply cannot be responding directly to information in the optic array because no such information is present and the viewer *must* draw on some mental structure or representation in order to reach a perceptual inference.

(1) *Space and form.* We have already discussed the “unconscious inference” by which the viewer seems to solve the size-distance equation for size by taking into account the distance, or vice versa (Figs. 4, 20); the possible direct solutions that he might use instead of such visual thinking (Fig. 21); and examples that nevertheless clearly demonstrate that something like an inference process does occur, especially in architectural situations (Fig. 9). We have seen that perception often requires the viewer to infer what object will fit some few fragmentary features that are present in the light at the eye in a cluttered environment (Figs. 17, 18, 19), and to infer what view a particular motion in space will disclose. There is also evidence that viewers can make such perceptual inferences, that they can perform operations on a mental representation of the object or space: when a subject is required to decide whether or not two shapes are the same, and they are at some angle to each other, the time that it takes to reach a decision is (under some circumstances) directly proportional to the angle (Fig. 22). This fact may be explained in several ways. But what is important here is that if the figure is shown briefly, and then a subject who is well practiced at the task of “mental rotation” (that is, at rotating the memory of the first figure at some fixed rate) is shown the second figure at a time when its angle would be  $\phi'$  to what the imaginary orientation of the first figure should be in the course of being mentally rotated, the time the subject needs to reach a decision is now directly proportional to that imaginary angle,  $\phi'$ .<sup>41</sup> Thus if the subject has a characteristic rate of mental rotation (as estimated in other experiments) of  $\omega$  radians per second, and the second stimulus (B) were always presented after a duration,  $t$ , such that  $\omega t = \phi$ , the reaction time does not increase with increases in  $\phi$ , because then the rotated memory of the first figure, and the orientation of the second, coincide. This experiment quite clearly demonstrates the effects of a mental operation that cannot be attributed to information in the stimulus per se. It provides an operational definition for previous speculations about “mental rotation.” And it is a fine laboratory demonstration of the definition of perception that had been introduced by J. S. Mill and Hermann von Helmholtz in the nineteenth century as the modern version of the classical theory. This definition, that our perceptual idea of an object is composed of our ability to predict its appearance when viewed from any of a set of different viewpoints, is also what the architect and urban planner, concerned with how people integrate successive views and vistas from different places, *must* mean by perception.

Such visual inferences about objects and their motions have mostly been studied in the context of research on *imagery*. Presently, the major issue in connection with such research is whether the underlying cognitive process is “pictorial” (or “analog”), as opposed to being propositional as in a verbal or an algebraic description of the same object. This issue however, has no consequence for the architect or the visual artist, because *whatever* the underlying mechanism is, if the mental representation is to be useful to the viewer in dealing with real objects in the real world, it must reflect the relevant characteristics of real objects and their motions.

But this does not mean that the layouts and structures of the world are repeated within our skulls. Remember first that whatever aspects of the physical world are indeed mirrored in

mental structure, at least some significant aspects are not (Fig. 11, 16). This means, of course, that the notion of an image has no *general* explanatory value: to say that the subject could read the time off an imaginary clock, or could see the shortcut from one house to another, because a mental image or map was being experienced, is a non sequitur: what information we can count on being able to read out of mental structures remains to be discovered and systematized.

Second, there are great individual differences in the ability to solve visual problems. Indeed, the task of judging whether differently oriented shapes are the same or different as in Figure 22, or of searching out objects that are “concealed” by good continuation, as in Figure 8A, were primarily studied in the field of intelligence testing. The great differences that occur in such visual intelligence presumably also appear in the ability to find one’s way in complex structures when guided by real or remembered maps, and so on.

The ability to form a cognitive map out of the successive glances and from the vistas one receives while walking around an environment—to find one’s way and take shortcuts in a building or in a complex environment like a city neighborhood—has not been well studied. The closest well-studied area of research was that concerned with animals and mazes, in the 1950s. The issue then was very close to the issue presently paramount in the study of imagery: is performance in spatial environments governed by what might now be termed propositional learning (that all learning is a matter of specific responses to specific stimuli, organized in chains of stimulus-response connections), or does the animal learn to run the maze by acquiring a cognitive map of its environment? The battleground and indeed the combatants have changed greatly since then, but we should note first that the outcome was complex and inconclusive, and that in those cases in which animals appeared to have learned a spatial layout, what we now (since Lynch)<sup>42</sup> call *landmarks* were probably present—stimuli that were generally visible or audible throughout the environment. In terms of the present discussion, a good landmark is one that is visible from all of the neighborhood (and identifiable to peripheral vision)<sup>43</sup> and that provides directional information about each place from which it is seen. In order to get to some goal that I cannot see, over a path that I have not traversed before (e.g., to realize that I can take a short-cut from here to there), I need a cognitive map of the environment, and it is clear that people (and animals) can at least under some conditions call upon such mental maps. But note that where appropriate landmarks are provided, cognitive maps, or mental images of the environment, are not needed to get around in the environment: If I know that my goal lies near some landmark that I see from afar, all I need do is keep heading toward the landmark as directly as the terrain permits. Regardless of where I am in the environment, the landmark remains a fixed and stable signpost for the things that are near it; and of course the pattern formed by several landmarks is more informative still. Landmarks can therefore provide fairly direct solutions to many problems of how to get from here to there, providing invariants, in the Gibsonian sense, that make inference-like solutions and detailed mental maps unnecessary.

The fact that people do indeed manage to get around in their environments does not show, therefore, either that their perceptual systems automatically extract from their successive vistas the invariant structure of the three dimensional layout through which they move (as the direct theory would have it) or that they assemble a cognitive map of that layout (as the classical theory would have it). Kevin Lynch’s surveys of in-

habitant's images of their cities do not show humans to have much more sophisticated cognitive maps than did the animals in the 1950s studies, nor do the experimental studies on orientation in real environments that have been done with humans.<sup>44</sup>

But we really know very little about cognitive maps in humans. The computer has now made research on this question feasible. For example, viewers who are free to "travel" through a "town", by means of computer-generated vistas that they themselves can direct, elect to rise periodically above the town to reorient themselves by obtaining bird's-eye views, as found by Hooper and colleagues;<sup>45</sup> this finding both argues for the special status of the plan view or mental map as a means of storing information about vistas, and provides a tool for studying their use. There is only fragmentary research on this point as yet. Whether theory, economics, or both will develop to support such research is not yet clear. I do not know of any major theoretical questions in psychology that could presently be addressed by studying the limitations and characteristics of human cognitive maps, although of course the enterprise, once undertaken for exploratory or more practical reasons, might well generate issues that would then prove of great systematic importance.

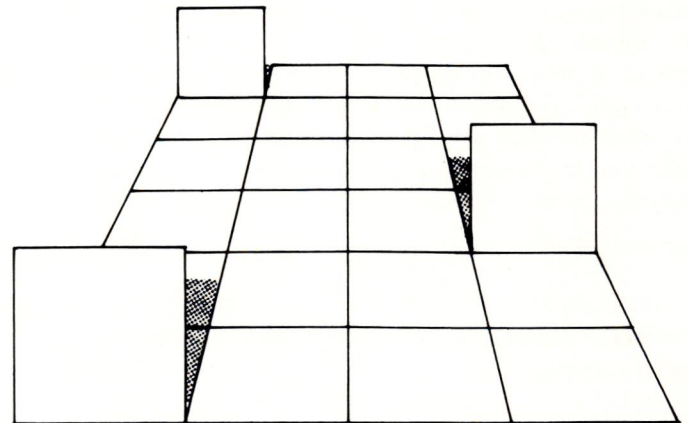
(2) *The perception of construction and function.* In Berlage's influential Amsterdam Exchange Building (1898-1903), the structural elements are not plastered over: in the interests of constructive sincerity, they are not only left visible, they are made salient; for example, the doors are clear varnished leaving the pegs visible, and the steel beams are painted blue and cream to make them stand out against the brick interior. As Prak says, "Phenomenal and actual construction coincide . . .," one of the three chief aims of the architecture of the 1920's.<sup>46</sup>

How do we perceive "construction"? This is part of the more general question of how we perceive function: to perceive the part that a beam plays in the construction of a vault, or that a peg plays in the construction of a door, is to perceive its mechanical function. It is also part of the general question of how we perceive order, inasmuch as the constraints of construction imply a spatial structure to which esthetic criteria can be applied.

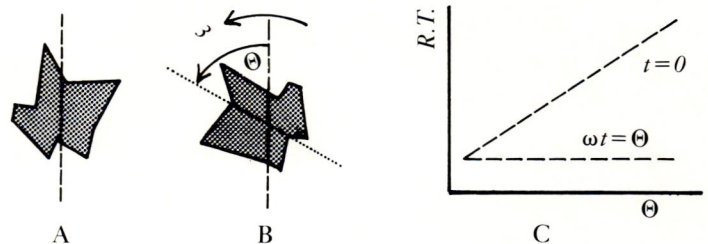
Some spatial or physical possibilities are surely not immediately perceived: the distribution of stresses in an arch or cantilever, the shortcut between two parts of town that are not mutually visible and that share no landmark, the operation of an airfoil, the consistency between figures and parts of objects that are even moderately complex (for example, Figs. 11A, 11D, 16). Other functions seem to be readily perceived—whether an upright object is in stable balance, where one object will emerge from behind another, the depth of a step, and so on. If form is to follow function; if the building or the environment is to be transparent to its uses and to guide its users; if the designer is to control how clearly and rapidly the principle that is embodied in some design is grasped and set on its path of both engaging the interest and habituating to boredom—for all of these functional and esthetic purposes, the architect and planner should know whether there are rules that govern the perception of function, and what they are if they do exist.

To the psychologist the question of perceived function is also potentially extremely important: not only does the invention of solutions to spatial and mechanical problems in the physical world depend on the inventor's perception of function; there is also a vast realm of non-spatial problems that are readily solved when cast into appropriate pictorial mode.<sup>47</sup> I say *potentially* important because I know of no systematic and

viable theory of the perception of function, despite the number of people who have been seriously concerned with formulating one. Here are some components for such a theory that may be worth mentioning: it is more difficult to achieve solutions that run counter to the Gestalt "laws" (Fig. 8), whether in the case of a human trying to solve a matchstick puzzle, using objects and tools for some unusual purpose, or trying to solve some abstract time-and-distance problem by setting up a visual analogy, or in the case of a chimpanzee that must fit two sticks together to reach the banana it desires.<sup>48</sup> If the architect hides the exit by good continuation (Fig. 8A), visitors who have not discovered it must use the window. As we have seen, however, the Gestalt laws are neither predictive nor explanatory in their present form, so this is only a half step toward a theory.<sup>49</sup> Lipps, in 1897,<sup>50</sup> proposed that we respond to architectural forms in terms of the bodily movements we would have to make in order to duplicate their main lines (and it is true that we do tend to perceive the main lines of architectural objects as being vertical, and as being straight ahead, even when they are not and when our internal bodily senses inform us otherwise; this is not quite the Lipps "empathy" proposal, but it is the closest evidence that I know of). Finally, there has long been talk about the perception of objects' functional properties, or *affordances* (Gibson, 1966)<sup>51</sup> and the potential viewer's perceptions of them; Tolman, 1932,<sup>52</sup> called them *means-end readiness*.



21. Two objects of the same size, standing on the ground, subtend the same number of texture elements at their bases, regardless of how far they are from the viewer.



22. An experiment in mental rotation.

None of the discussions have so far amounted to much that was either concrete or theoretical. Given the considerable amount of work that has been done in recent years in the fields of computer simulation and artificial intelligence, however, on redefining the Gestalt laws, and on paradigms of problem solving, it would probably be worthwhile to undertake a major integrative review in this area in the near future.

But that will not help the architect at this time, and I see no reason to be particularly optimistic about the future. The general problem is far too large and general to make it likely that anything of use to the architect is imminent. If an understanding of the relevant aspects of the perception of function are to be developed, the architect will have to raise the appropriate questions before psychologists can reasonably be expected to attempt an answer. I do not know whether the conditions for undertaking and sustaining so scientific and academic an approach to these problems exist in the architectural profession.

#### IV. Conclusions

Although they have the tools with which to answer questions that seem to be relevant to the concerns of architects and environmental planners, and although their scientific theories motivate perceptual psychologists to ask many of those questions in an introductory fashion, there is no internal reason for perceptual psychologists to undertake the kind of systematic research that could provide "handbook" information of a sort that would be useful to architect or planner. I have no idea whether the economics of the marketplace or university will serve to nourish such an enterprise, but if that information is ever to be gained, it seems to me that architect-psychologists or psychologist-architects<sup>53</sup> will have to answer questions posed by architects: I do not think that the questions will be asked or answered by perceptual psychologists in the pursuit of their own discipline.

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#### Notes

1. People can be induced to assign numbers with surprising reliability and consistency to a great variety of "abstract," "qualitative," and "subjective" dimensions. The enterprise started with G. T. Fechner, *Vorschule der Aesthetik* (Leipzig: Breitkopf & Hartel, 1876) and continues in a modest way today. See D. E. Berlyne, ed., *Studies in the New Experimental Aesthetics* (Washington, D.C.: Hemisphere, 1974). For examples of the development of subjective scales relevant to architecture and environmental planning, see T. Gärling, "Studies in Visual Perception of Architectural Spaces and Rooms: I—Judgment Scales of Open and Closed Space; II—Judgments of Open and Closed Space by Category Rating and Magnitude Estimation," *Scandinavian Journal of Psychology* 10 (1969): 250–68; S. C. Hayward and S. S. Franklin, "Perceived Openness—Enclosure of Architectural Space," *Environment and Behavior* 6 (1974): 37–51; R. W. Seaton and J. B. Collins, "Validity and Reliability of Ratings of Simulated Buildings," in W. J. Mitchell, ed., *Environmental Design: Research and Practice* (Los Angeles: University of California Press, 1972); P. Thiel, "Notes on the Description, Scaling, Notation and Scoring of Some Perceptual and Cognitive Attributes of the Physical Environment," in H. Proshansky, W. Ittelson and L. Rivlin (Eds.), *Environmental Psychology: Man and His Physical Setting* (New York: Holt, Rinehart and Winston, 1970).

2. Sources in which the reader can pursue the psychophysical and scaling methods are: N. H. Anderson, "Algebraic Models in Perception," in E. C. Carterette and M. P. Friedman, eds., *Handbook of Perception*, Vol. II. (New York: Academic Press, 1974); T. Engen, "Psychophysics: 1. Discrimination and Detection; 2. Scaling Methods," in J. Kling and L. Riggs, eds., *Woodworth and Schlosberg's Experimental Psychology* (New York: Holt, Rinehart and Winston, 1971). For a critique of the use of such methods in matters related to esthetics and taste, see J. Hochberg, "Art and Perception," in E. C. Carterette and M. P. Friedman, eds., *Handbook of Perception*, Vol. X (New York: Academic Press, 1978).

3. I expand this point at some length below, especially in connection with Figure 10. Architects and environmental planners have known for centuries, of course, that control of the sequences of vistas is an important tool of the trade; cf. N. L. Prak, *The Language of Architecture. A Contribution to Architectural Theory* (The Hague: Mouton, 1968).

4. The painter is not free, for example, to use a set of lines that converge in an upright V, with its apex at the bottom of the canvas, much as he might like to for purposes of composition or design, if these lines are also intended to portray a road running off to the horizon. Neither is the architect free to ignore the fact that the patterns provided by converging lines, interrupted shapes, and gradients of text provide powerful cues to depth even if the latter does not exist and is not what the designer intends to be perceived.

5. J. J. Gibson, *The Senses Considered as Perceptual Systems* (Boston: Houghton Mifflin, 1966).

6. M. Benedikt, "To Take Hold of Space: Isovists and Isovist Fields," *Environment and Planning B* 6 (1979): 47–65.

7. For a description of this cinematic "language of visual motion," and discussion of the implications of the fact that film makers normally feel quite free to substitute a pan for a tracking shot, or a zoom for a dolly shot, see J. Hochberg and V. Brooks, "The Perception of Motion Pictures," in E. C. Carterette and M. P. Friedman, eds., *Handbook of Perception*, Vol. X (New York: Academic Press, 1978).

8. J. J. Gibson, *The Ecological Approach to Visual Perception* (Boston: Houghton Mifflin, 1979). The reader who is not a perception psychologist should be warned, however, that although there has been a fair amount of mathematical analysis of the ways in which motion parallax might provide information about space to the eye, there has been very little actual research showing that that information is in fact used. Much of the really extraordinary enthusiasm for this approach that has been manifested in recent years (cf. C. F. Michaels and C. Carello, *Direct Perception* [Englewood Cliffs, N.J.: Prentice-Hall, 1981]) is really quite premature, and has occasioned both claims and controversy far beyond what the modest empirical base can support (cf. S. Ullman, "Against Direct Perception," *The Behavioral and Brain Sciences* 3 (1980): 373–415, for a recent critique and rebuttals).

9. Benedikt, "To Take Hold of Space"; J. Lang, "Theories of Perception and 'Formal' Design," in J. Lang, C. Burnette, W. Moleski, and D. Vachon, eds., *Designing for Human Behavior* (Stroudsburg: Dowden, Hutchinson and Ross, 1974).

10. See for example D. Levi, "The Gestalt Psychology of Expression in Architecture," in J. Lang, C. Burnette, W. Moleski, and D. Vachon, eds., *Designing For Human Behavior*; Prak, *The Language of Architecture*.

11. Prak, *The Language of Architecture*.

12. Gibson, *The Ecological Approach to Visual Perception*.

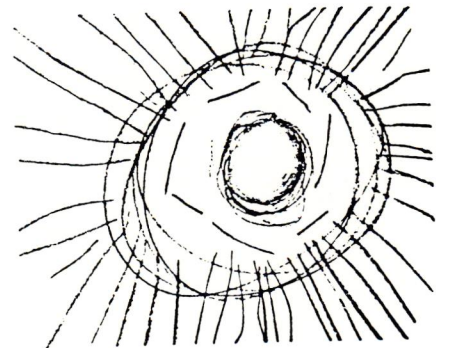
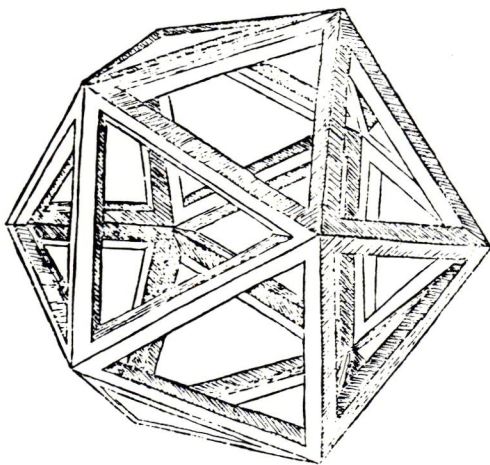
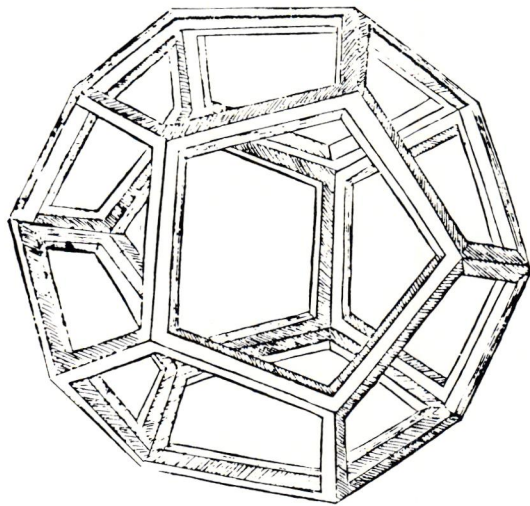
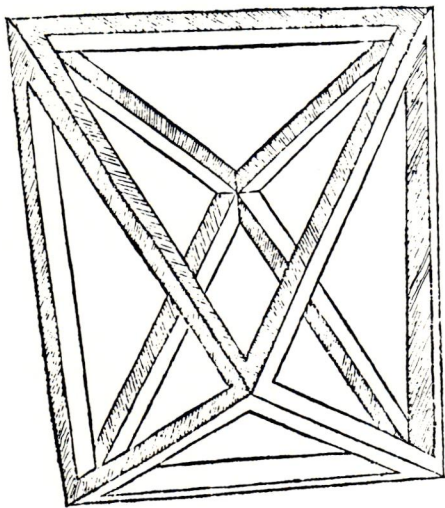
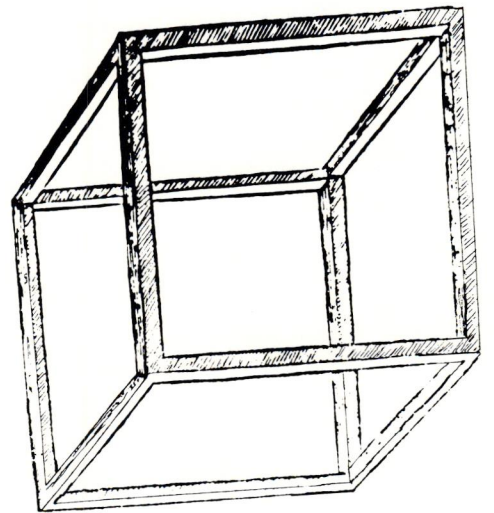
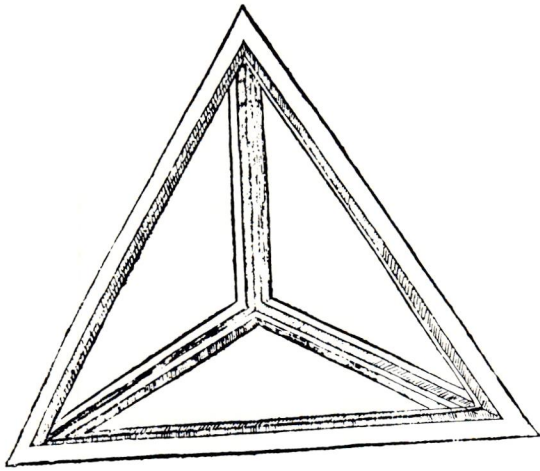
13. J. Hochberg, J. Green and S. Virostek, "Texture-occlusion as a foveal depth cue." Paper presented at the American Psychological Association Convention, 1978, and described in J. Hochberg, "Levels of Perceptual Organization," in M. Kubovy and J. R. Pomerantz, eds., *Perceptual Organization* (Hillsdale: Erlbaum, 1981).

14. L. Penrose and R. Penrose, "Impossible Objects: A Special Type of Visual Illusion," *British Journal of Psychology* 49 (1958): 31–33. The actual figures used here, designed to permit the proportions to be varied systematically, are from J. Hochberg, "In the Mind's Eye," in R. N. Haber, ed., *Contemporary Theory and Research in Visual Perception* (New York: Holt, Rinehart and Winston, 1968).

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All figures are by the author. Figures 2D, 9, 14, and 20: J. Hochberg *Perception* 2d ed. (Englewood Cliffs, N.J.: Prentice-Hall, 1978); the demonstration in Figure 9 was devised by A. Ames, and is described by W. H. Ittelson and F. Kilpatrick, "Experiments in Perception," *Scientific American* 185 (1952): 50–55.

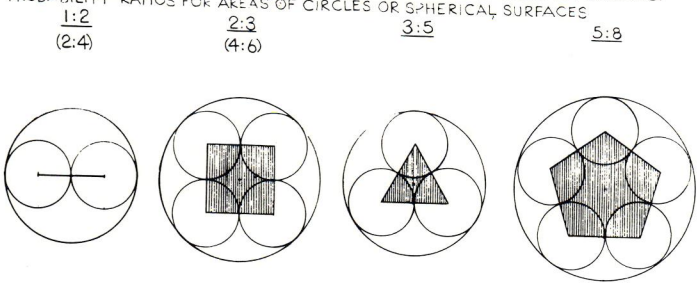
15. One might think that the difference between 11A and 11B is solely a matter of their proportions, but at 11C the possible and consistent picture has the same proportions as those in 11B, and nevertheless 11C looks normal and three dimensional.
16. M. A. Peterson and J. Hochberg, "Perspective Reversals that Refute both Gestalt and Direct Theories of Object Perception: Measures of Local Cue Strength and Attention," abstract in *Proc. Eastern Psychological Association 52nd Annual Meeting* (1981): 148.
17. J. Hochberg, "Pictorial Functions and Perceptual Structures," in M. Hagen, ed., *The Perception of Pictures, Vol. 2* (New York: Academic Press, 1980).
18. Gibson, *The Senses Considered as Perceptual Systems*; Benedikt, "To Take Hold of Space."
19. K. Hooper. The use of computer-controlled videodisks in the study of spatial learning. *Behavioral Research Methods and Instrumentation*, 1981, 13, 77-84.
20. J. Hay. Optical motions and space perception. *Psychological Review*, 73 (1966): 550-565; D. N. Lee. Visual Information During Locomotion. In R. B. MacLeod and H. L. Pick, Jr. (Eds.), *Perception: Essays in honor of J. J. Gibson*, (New York: Cornell University Press, 1974); W. C. Purdy. "The hypothesis of psychophysical correspondence in space perception." Doctoral dissertation. Cornell University, 1958.
21. D. S. Klopfer and J. Hochbert, "Seeing Is Not Perceiving: Schemas Are Needed Even When Visual Information Is Complete," abstract in *Proc. Eastern Psychological Association 52nd Annual Meeting* (1981): 148.
22. There are serious theoretical problems that are glossed over in taking the steps from perception as an association between individual sensations to the kind of abstraction expressed in this formulation. But it should be noted that the same problem remains unsolved by any of the opposing theories, surfacing most frequently in connection with the question of how we grasp what principle underlies a set of specific instances, or defines their similarity. In Gibson's approach, superficially so different from the classical theory of J. S. Mill and Helmholtz that is being considered here, the mechanism is left merely as one of "picking up" the invariant under transformation—which is precisely what the Mill-Helmholtz proposal results in (see E. Cassirer, "The Concept of Group and the Theory of Perception," *Philosophy and Phenomenological Research* 5 (1944): 1-35).
23. Gibson, *The Senses Considered As Perceptual Systems*.
24. Just as we cannot specify three dimensions in two, we cannot specify four dimensions (motion in a tridimensional world) in three dimensions (that is, in the transformations of a two-dimensional array of light at the eye), a fact that is amply demonstrated each time we set up a motion picture that contains all of the visual information that would be received by the eye of a moving viewer in a three-dimensional scene, but which is nevertheless in actuality a flat pattern of lights and shadows.
25. For two recent and excellent books, see R. Boynton, *Human Color Vision* (New York: Holt, Rinehart and Winston, 1979); and L. M. Hurvich, *Color Vision* (Sunderland, Mass.: Sinauer, 1981).
26. See, for example, N. Rashevsky, *Advances and Applications of Mathematical Biology* (Chicago: University of Chicago Press, 1940).
27. Le Corbusier (1923). *Vers une Architecture* (Paris, 1923).
28. A. W. Pugin, *The True Principles of Pointed or Christian Architecture* (London: 1853).
29. Fechner was also the founder of the psychophysical methods discussed at the beginning of this paper (See *Vorschule der Aesthetik*).
30. Berlyne, *Studies*.
31. J. Ruesch, *Greek statuary of the fifth and fourth centuries B.C.* Doctoral dissertation. Columbia University, 1977.
32. C. Lalo, *L'Esthétique expérimentale contemporaine* (Paris: Alcan, 1908).
33. Hochberg, "Art and Perception."
34. Prak, *The Language of Architecture*.
35. L. B. Cohen, "Habituation of Infant Visual Attention," in T. J. Tighe and R. N. Leaton, eds., *Habituation* (Hillsdale: Erlbaum, 1976). See also G. M. Olson, "An Information Processing Analysis of Visual Memory and Habituation in Infants," in T. J. Tighe and R. N. Leaton, *Habituation*.
36. A moment of unprejudiced observation in the following situation will make this point. Move a few steps left and right while looking through a window or balustrade, and note the dramatic motions and choreography of the different planes of depth in the field of view.
37. H. Helson, *Adaptation Level Theory* (New York: Harper and Row, 1964).
38. D. McClelland, J. Atkinson, J. Clark and E. Lowell, *The Achievement Motive* (New York: Appleton-Century-Crofts, 1953).
39. R. N. Haber, "Discrepancy From Adaptation Level as a Source of Affect," *Journal of Experimental Psychology* 56 (1958): 370-384.
40. A complex stimulus should habituate more slowly, and take longer to run its cyclical course, than a simple one, and offer the viewer new aspects with which to become familiar and to pass through pleasure to neutrality at adaptation level.
41. L. A. Cooper, "Demonstration of a Mental Analog to an External Rotation," *Perception and Psychophysics* 19 (1976): 296-302.
42. K. Lynch, *The Image of the City* (Cambridge, Mass.: M.I.T. Press, 1960).
43. J. Hochberg and L. Gellman, "The Effect of Landmark Features on Mental Rotation Times," *Memory and Cognition* 5 (1977): 23-26.
44. Recent reviews of this scanty literature are to be found in D. Canter, *The Psychology of Place* (London: Architectural Press, 1977); G. T. Moore and R. G. Colledge, eds., *Environmental Knowing: Theories, Research and Methods* (Stroudsburg, Pa.: Dowden, Hutchinson and Ross, 1976); D. Stokols, "Environmental Psychology," *Annual Review of Psychology* 29 (1978): 253-95. For research on cognitive maps of familiar places, see K. Hooper, The Identification of Mirror Images of Real World Scenes. Doctoral dissertation. Stanford University, 1973; A. Biel and G. Torell, "The Mapped Environment: Cognitive Aspects of Children's Drawings," *Göteborg Psychological Reports* 7 (1977), no. 7; R. M. Downs and D. Stea, "Cognitive Maps and Spatial Behavior: Process and Products," in R. Downs and D. Stea, eds., *Image and Environment* (Chicago: Aldine, 1973). For comparative research on sighted (and unsighted) acquisition of cognitive maps, see G. L. Allen, A. W. Siegel and R. R. Rosinski, "The Role of Perceptual Context in Structuring Spatial Knowledge," *Journal of Experimental Psychology: Human Learning and Memory* 4 (1978): 617-30; L. T. Kozlowski and K. J. Bryant, "Sense of Direction, Spatial Orientation and Cognitive Maps," *Journal of Experimental Psychology: Human Perception and Performance* 3 (1977): 590-98; E. Lindberg and T. Gärling, "Acquisition of Locational Information About Reference Points During Locomotion With and Without a Concurrent Task: Effects of Number of Reference Points," *Umeå Psychological Reports* No. 145, (1978).
45. K. Hooper, "The use of computer-controlled video disks."
46. Prak, *The Language of Architecture*.
47. M. Wertheimer, *Productive Thinking*, Enlarged ed. (London: Tavistock, 1969); K. S. Duncker, "On Problem Solving," *Psychological Monographs* 58 (1945): No. 270; G. Polya, *How to Solve It* (Princeton, N.J.: Princeton University Press, 1945); R. Arnhem, *Visual Thinking* (London: Faber and Faber, 1969).
48. W. Köhler, *The Mentality of Apes* (New York: Harcourt Brace, 1925).
49. The Gestalt theory has had successors that have attempted to provide more objective and measurable versions of the "laws" of organization in terms of "information theory" or "encoding theory." For earliest versions of this approach, and still the most general, see F. Attneave, "Some Informational Aspects of Visual Perception," *Psychological Review* 61 (1954): 183-93; J. Hochberg and E. McAlister, "A Quantitative Approach to Figural 'Goodness'," *Journal of Experimental Psychology* 46 (1953): 361-64. I mention this only because there are still psychologists who are not yet convinced, as I am by the implications of Figure 11, that the wholistic core of Gestalt theory is hopelessly wrong. The most recent publication by "encoding theorists" is H. Buffart, E. Leeuwenberg and F. Restle, "Coding Theory of Visual Pattern Completion," *Journal of Experimental Psychology: Human Perception and Performance* 7 (1981): 241-74. For a more complete discussion of why I think it is wrong, see J. Hochberg, "Levels of Perceptual Organization."
50. T. Lipps, "Aesthetische Einfühlung," *Zeitschrift für Psychologie und Physiologie der Sinnesorgane* 22 (1900): 415-50.
51. Gibson, *The Ecological Approach to Visual Perception*.
52. E. C. Tolman, *Purposive Behavior in Animals and Men* (New York: Century, 1932).
53. Such interdisciplinary efforts are certainly being made. I have referred to several of these in the body of the paper, and a largely nonoverlapping set is described in a recent review, K. Hooper, "Perceptual aspects of architecture," in E. C. Carterette and M. P. Friedman, eds., *Handbook of Perception*, Vol. X (New York: Academic Press, 1978).



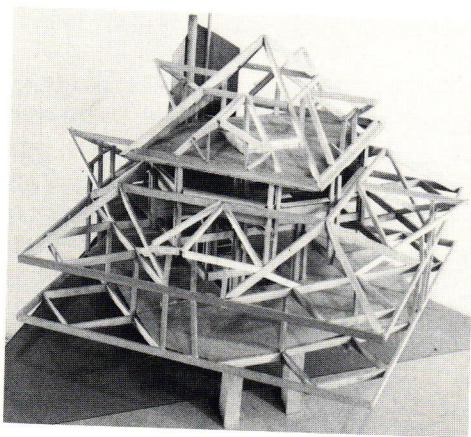
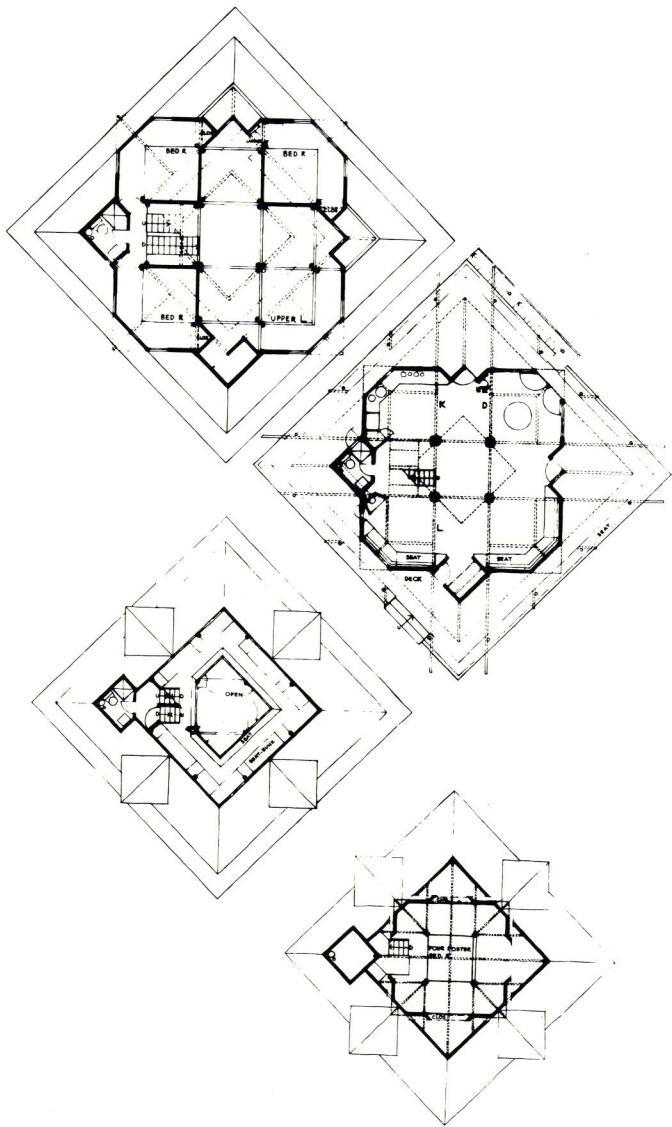
1. Leonardo da Vinci, *Five Platonic Solids*.  
*Sun with unusual center markings, drawn by a child 40 months old.*



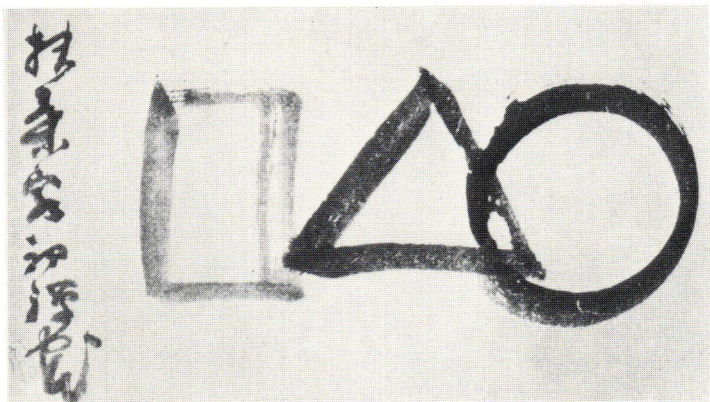
BASIC SYMMETRIES FROM CLOSE-PACKING OF CIRCLES OR SPHERES IN FIBONACCI PROBABILITY RATIOS FOR AREAS OF CIRCLES OR SPHERICAL SURFACES



8. Close-packing of circles.



9. Four Poster House.



6. Sengai's Universe.

immediately of da Vinci, Kepler and Goethe. In 1611, Kepler's towering intuition glimpsed the significance of the Fibonacci series as a natural forming principle; "It is in the likeness of this self-developing series that the faculty of propagation is, in my opinion, formed: and so in a flower the authentic flag of this faculty is flown, the pentagon."<sup>21</sup> Not only do these symmetries occur in natural forms as the improbable order within probable disorder, but I have found that they occur as the result of a Fibonacci fitting of forms within forms.

By giving form to the numbers of the Fibonacci series as a pattern of dots, it can be seen as an infinite sequence of series within series, of numbers within numbers, of forms within forms, an archetypal symbol of infinity (Fig. 7). Like the Pythagoreans, architects can give shape and meaning to number. Architecture, that gives form to number or gives number to form, can resonate with universal forming principles. In these patterns of the Fibonacci sequence (created by Buron Glaser in 1978 and Dominic Mercadante in 1980 in my class on Forming Principles at the University of Pennsylvania and by an English architect Richard Penton in 1981) one can recognize the clusters of twos, threes, and fives which are the building blocks of larger numbers. The identity of these small numbers can be intuitively perceived (without counting) as clusters that offer clues to the "scale" of the larger numbers of which they are a part. These patterns include the simplest bilateral symmetry or polarity of form. As incremental patterns of growth, they offer images of hierarchical resonance, an archetype of number connecting the individual "1" to "infinite" collectivity.

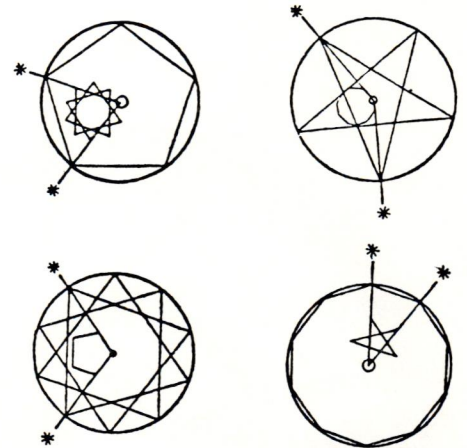
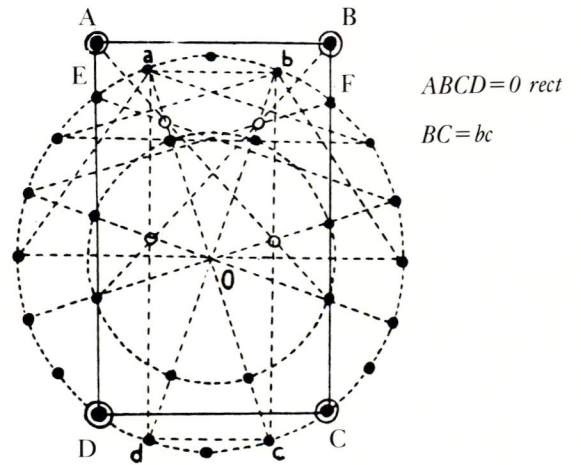
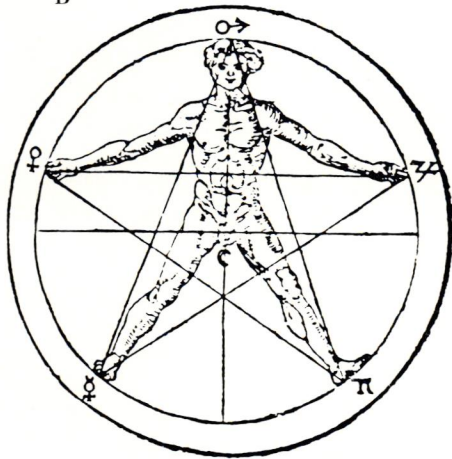
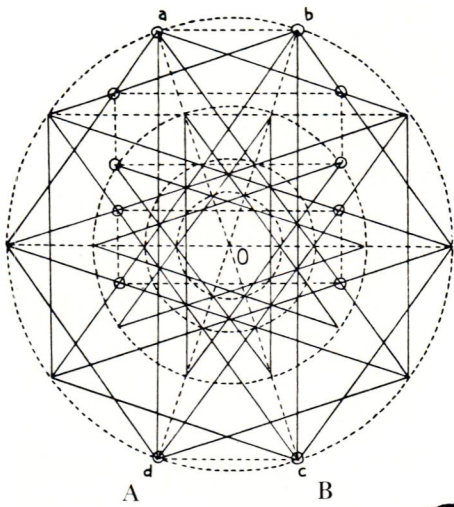
By expanding the dots used for the number patterns into circles and close-packing them in clusters of two, three, four, and five, with each cluster contained within a larger circle, a series of Fibonacci ratios can be found between the sum of the areas of circles in each cluster and the area of the containing circle (Fig. 8). This fit of Fibonacci ratios for basic symmetric clusters provides for physical and psychic resonance of forms within forms. This law of close-packing can be stated as follows:

*When equal circles or spheres are close-packed within a plane in a larger circle or sphere, the ratios of areas or spherical surfaces of contained to container in Fibonacci ratios of 1:2, 2:3, 3:5, and 5:8 produce symmetries that are bilateral, square, equilateral triangular, and pentagonal; even when the ratio is approximate, no more equal circles or spheres can be contained than those in these symmetries; of these, the square, equilateral triangle, and pentagon are the only faces of the only five regular three dimensional polyhedrons, the five platonic solids: When equal spheres are close-packed within a larger sphere, the ratios of spherical surfaces of contained to container in Fibonacci ratios of 1:1, 2:3, 13:8, and 21:13 produce the symmetries of the five platonic solids, the cube and octahedron, the tetrahedron, the icosahedron, and the dodecahedron; even when the ratio is approximate, no more equal spheres can be contained than those in these symmetries.*

The fitting of two equal circles into a larger circle results in a precise 1:2 ratio between the sum of the areas of the two smaller circles and the area of the containing circle. A precise 1:1 ratio occurs as a linear resonance between the circumference of the containing circle and the combined circumference of the smaller circles. This 1:1 and 1:2 image could resonate at many levels between physical and archetypal. It may describe the bonding of the hydrogen molecule, the simplest of all molecules made up of the simplest atoms. In color it may express both the physical measure and the emotional

section (Divine proportion) in their gradation of depth.<sup>15</sup> As well as noting these physical characteristics, Itten also ascribed archetypal meaning and shape to color. Red is a square and material force, blue is a circle and submissive faith, while yellow is a triangle and bright knowledge.<sup>16</sup> The square as matter, the circle as spirit, and the triangle as knowledge suggest the universal archetypal power of these fundamental forms.

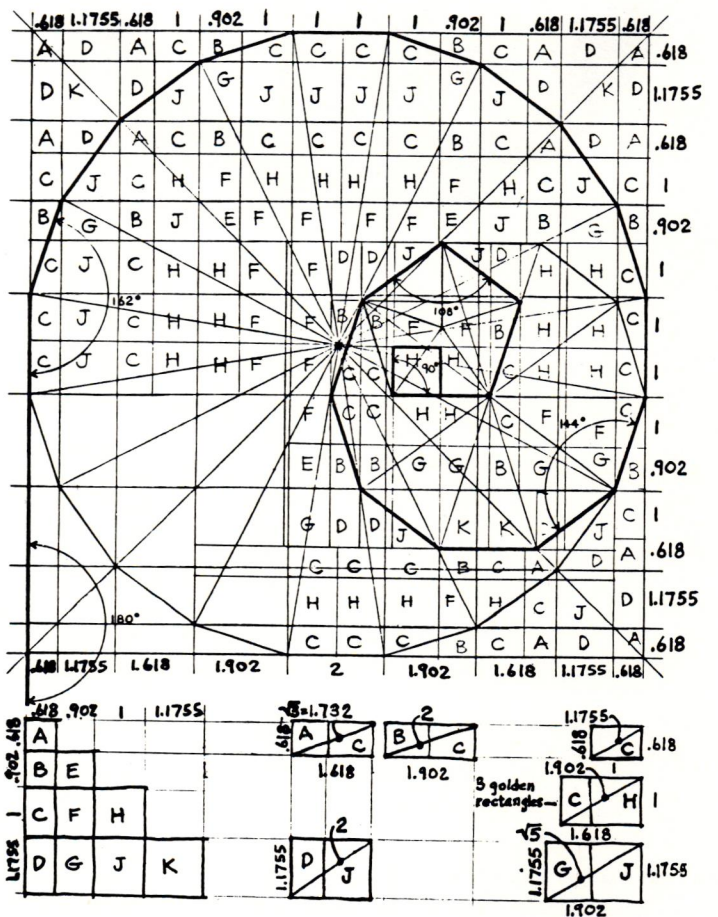
The square, triangle, and circle were the archetypes of the universe for the seventeenth century Zen artist, Sengai (Fig. 6). The square symbolized the earth, the circle the sky, and the triangle a link between earth and sky.<sup>17</sup> For the Pythagoreans almost twenty-five centuries ago, the five platonic solids were the playthings or "dice" of baby Bacchus and the archetypal patterns from which all things in the universe were made. The cube was the earth; the dodecahedron since its pentagonal faces were, of all faces in the platonic solids, closest to the circle, was the cosmos. The three solids with triangular faces, the tetrahedron, octahedron, and icosahedron, symbolized fire, air, and water, the triangulated elements linking "square" cubic earth with "circular" dodecahedron sky.<sup>18</sup> We now know these five platonic solids (in each of which all the sides are equal, as are the angles at which the sides meet) are the only regular solids possible in three-dimensional space and that they occur in



effect of the equal/opposite intensity of red and green.<sup>22</sup> In music it may encompass the simultaneous difference/sameness of the two notes of an octave, the interval produced by a physical 1:2 ratio of lengths of string. It may evoke the opposing/balancing mirror image of bilateral symmetry in a building. It may symbolize the symmetry of the human body or the binocular vision of two eyes, or the Yin/Yang polarity of dark/light, feminine/masculine contained within a circular unity.

10. Man, the microcosm (from: Cornelius Agrippa von Nettesheim, *De Occulta Philosophia*, 1531); Gothic master diagram; J. Kepler, diagram of the soul (from: *Harmonices mundi*).

For four circles fitted into a larger circle, the ratio between the sum of the areas of smaller circles and the area of the larger circle is approximately 2:3. An approximate ratio of 3:5 between the circumference of the larger circle and the combined circumferences of the smaller circles reverses the dominance of large over small and offers proportional resonance of 2:3 and 3:5 between the ratios for area and linearity. The cluster forms a square, the universally prevalent orthogonal order—left/right, front/back in the human body and north/south, east/west in human orientation. The rich symbolism of this four-fold cluster recalls “the squaring of the circle” from ancient Egypt and medieval alchemy. This figure in its accurate form resonates with multiple 1:1 ratios, with side of square 1 to area of square 1; perimeter of square 4 to perimeter (circumference) of circle 4, diameter of circle 1.2732 to area of circle 1.2732. In addition, since  $1.272 = \sqrt{1.618}$ , there is a very close approximate ratio of  $1:\sqrt{1.618}$  between side/area of square and diameter/area of circle. With the center of one side of the square tangent to the circle, the corners of the opposite side are mathematically 0.0186 within the circumference of the circle, close to visually tangent. From either of these near tangent corners to the center of the circle is 0.618, and is thus in a Divine proportion ratio of 0.618:1 to the side of the square. This isosceles triangle between side of square and center of the circle is part of a pentagon! Numinous meanings for this image of “squaring the circle”—completion and wholeness, end/



11. Twentieth century matrix, speed spiral and twenty-sided grid.



beginning and death/rebirth, synthesis and totality—have been documented elsewhere.<sup>23</sup> The archetypal order of the square underlies my design for the Four Poster house for Mount Desert Island, Maine (Fig. 9). The master bed, an eight-foot square centered at the top of the house, is surrounded by four corner posts, that are the tops of tapered tree-trunk poles. As each pole goes down through the house, it incrementally adds three more poles to become one of a four-pole cluster. These four clusters of four poles each are the main support of the house, which is cantilevered on beams threaded through them. The entire house is built up from these four clusters of four poles supporting squares within squares, all generated by the dimensions of the master bed.

Three circles fitted into a larger circle similarly produce an approximate ratio of 3:5 and the cluster forms an equilateral triangle, the physically strongest compression-resisting form in two dimensions. The triangle also is richly symbolic of roof and mountain, spire and aspiration. It is the archetype for transcendence of opposites, a pointing toward cosmic infinity. The Four Poster house, with its dominant steeply hipped roof and its triangulated tetrahedral dormer windows, is linked also to this archetypal order of triangle.

Five circles clustered in a larger circle in the same way produce a ratio of approximately 5:8, and give us the pentagon with its five-fold “rotational” symmetry around a center. The interlocking pentagram, the sacred symbol for the Pythagoreans, contains a sequence of Divine proportioned linear segments that suggest an infinite proportional linkage. This pentagonal order underlies archetypal images of man, temple, cosmos, and the soul: the human figure as microcosm was given the archetypal form of a pentagram in a circle; the pentagon was the basis of the Gothic master diagram for plans of gothic cathedrals; as macrocosm, the dodecahedron with its pentagonal faces was the Pythagorean symbol of the Cosmos, and pentagonal symmetry was used by Kepler for symbolic images of the human soul (Fig. 10). As a symbol of the star, the pentagon is still a numinous archetypal image today.

The clustered symmetries produced by this Fibonacci close-packing law—the simplest bilateral symmetry, the square, equilateral triangle and pentagon—occur at critical thresholds of fitting that correspond to the Fibonacci series. These thresholds of symmetric fit, represented by the ratios of 1:2, 2:3, 3:5, 5:8 . . . (or 1:2, 1:1.5, 1:1.66, 1:1.60 . . .) are all contained within the limiting ratios of 1:1 and 1:2.

Historically, a strong distinction has been made between the “man-made” orthogonal order of 90-degree square symmetry, which occurs in inorganic crystals, and the “organic” order of five- and tenfold symmetries as well as the spiral, which occurs in plant and animal forms. These symmetries have seldom, if ever, been combined in a building. For the resonance of these symmetries, previously perceived as incompatible, I have evolved a Twentieth century matrix inspired by the Gothic master diagram (Fig. 11). Although the five- and tenfold symmetries of the gothic diagram were not combined with two- and fourfold symmetries in cathedral plans, ratios and proportions were derived from five- and tenfold symmetries of the diagram for two- and fourfold orthogonal symmetries in plans. In order to offer possibilities for the combination of basic symmetries, the Twentieth century matrix is based on the 20-sided icosahedron, whose twentyfold symmetry includes twofold, fourfold, fivefold, and tenfold symmetries in a single matrix. By intersecting the corners of this figure, a graduated orthogonal order can be generated with only four relative dimensions, 0.618, 1, 0.902, and 1.1755, that offer multiple Di-

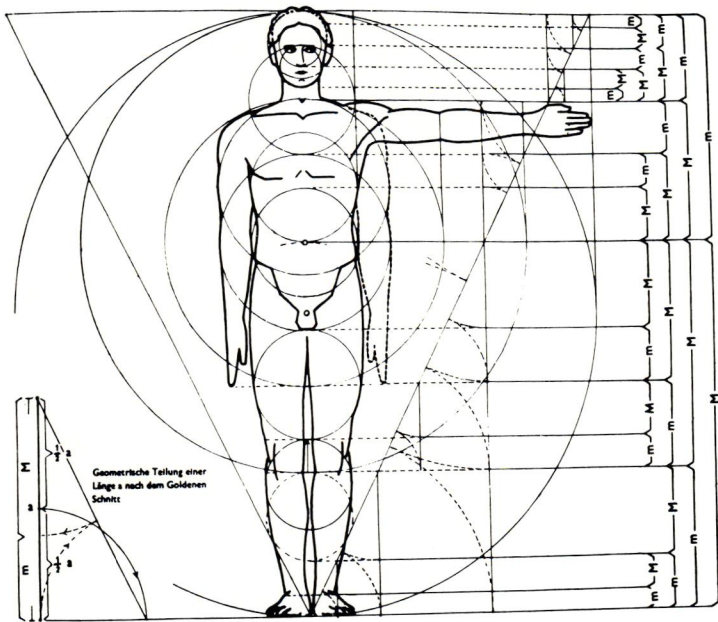
vine proportion resonance:  $0.618:1 = 1.1755:1.902 = 1:1.618$ . The resultant figure resonates incompatible symmetries and connects them within a growth spiral. In addition to the symbolic resonance of its geometry, this Twentieth century matrix may be used to integrate spiralling expressway interchanges with a scaled gridiron street pattern, or, in buildings, as a source for variations and hierarchies of symmetry from bilateral to rotational to helical to spiral.

The Fibonacci resonance of incompatible symmetries that I have found in two dimensions in close-packed circles also occurs in three dimensions. When close-packed spheres define the corners of the five platonic solids, Fibonacci ratios occur between the surfaces of contained clusters of spheres and the surface of the containing sphere, for spheres within spheres. If two spheres are contained by a larger one, the diameter of each of the smaller spheres is half the diameter of the containing sphere, so the ratio between the surface areas of contained and container is exactly 1:2. This precise ratio between surfaces of close-packed volumes resonates with the 1:2 ratio between the areas of two close-packed circles and the area of their containing circle.

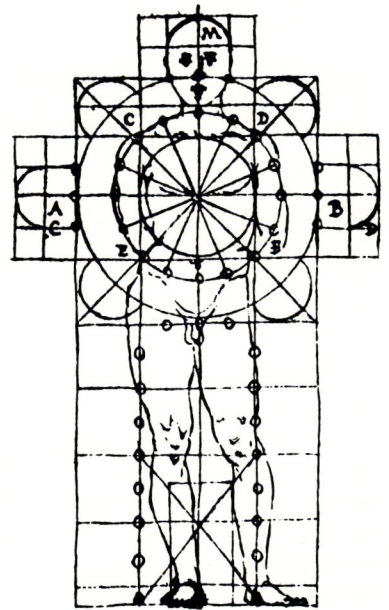
The ratio of the spherical surface of the triangulated three smaller spheres to the surface of the enclosing sphere is approximately 3:5. A three-dimensional cluster of four spheres within a larger sphere produces a tetrahedron, the simplest platonic solid, with a ratio of precisely 2:3 between the surfaces of contained and containing spheres. This has an interesting correspondence with the approximate 2:3 ratio for two-dimensional packing of four circles. The tetrahedral packing of four spheres was the underlying archetypal order for William Blake’s symbolic image of “The Four Eternal Senses of Man” (Fig. 12). This symbol has profound resonance with an evolutionary order of matter in the fourfold bonding of the carbon atom, a major molecular building bond of living form and of the brain.

If the four circles of our square cluster become spheres and are contained by a sphere, two more spheres may be added (one at top and one at bottom center) without changing the size of the containing sphere. In this case, the ratio of spherical surfaces becomes approximately 1:1, with a slight dominance of contained over containing surface (1.031:1). The enclosed spheres form an octahedron, another of the platonic solids.

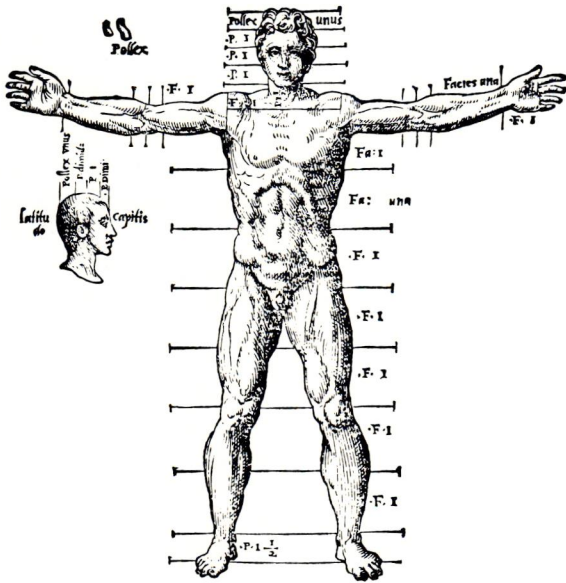
Similarly, eight spheres in the form of a cube (another platonic solid) contained within a larger sphere, produce an approximate 1:1 ratio between spherical surfaces of contained and container, with the containing surface dominating slightly (1:1.181). This slight dominance of the containing surface balances the slight dominance of the contained surfaces in the octahedral spheres. The elegantly simple 1:1 ratio between the surface areas of contained and containing spheres indicates that the close-packed orthogonal orders of both the cube and octahedron can be contained within similar larger orthogonal orders with balanced surface tension ratios between small and larger order in a 1:1 ratio resonance for infinite hierarchical levels of close-packed orthogonal order. No wonder that architecture and the north/south, east/west, earth/sky archetypes of human orientation are dominated by the x, y, z axes of orthogonal order. As an archetype of the human body, this orthogonal order adds the up/down orientation to the left/right, front/back axes of human consciousness of space. The 1:1 resonance between levels in this hierarchy offers an archetype for psychic rebirth, a powerful symbol of psychic structures contained in equilibrium within new, “higher” levels of consciousness. In an eighteenth-century Russian manuscript, just such



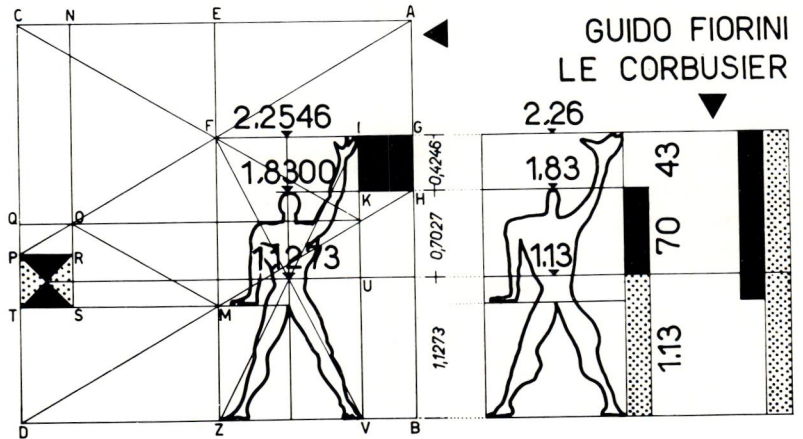
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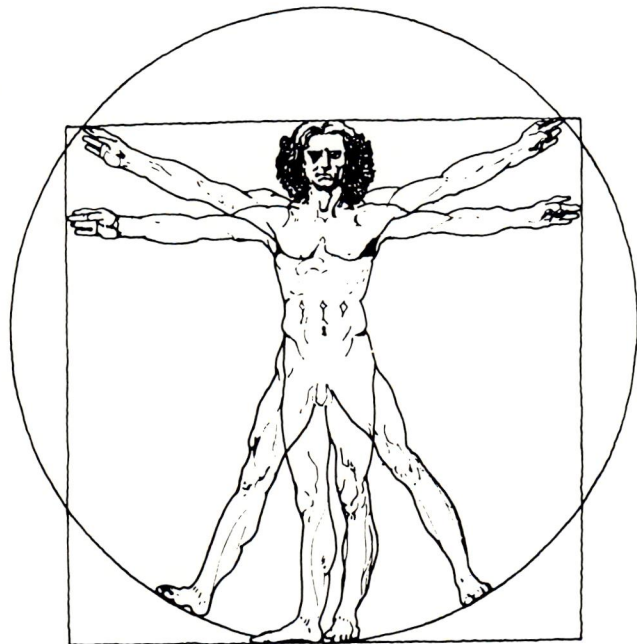
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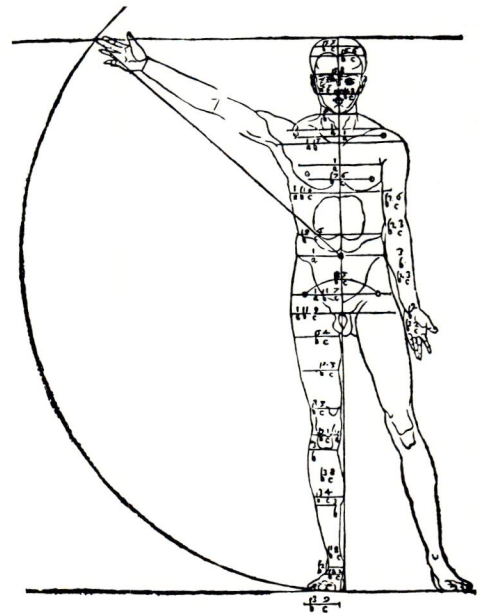
B



E



C



F

15. Human figure based on Zeising's work. (from: Neufert, *Baentwurfslere*); human figure (from: Vitruvius, *Ten Books of Architecture*); Leonardo da Vinci, *man in circle and square* (*Accademia Venice*); Francesco di Giorgio, *human figure in plan of church* (*Cod. Magliab. Bibl. Naz. Florence*); Le Corbusier, *modular figure*; Alberto Durero, *proportional figure*. (from: *Della Simmetria dei corpi*, 1591).

an archetypal symbol depicts "the Anthropos with the four elements" as a hierarchy of spheres within spheres (Fig. 13).

The dodecahedron clustering of 12 corner spheres with radii of 1 and one central sphere with maximum possible radius of 0.902 has a ratio of approximately 13:8 (13:8.4) between the surface area of contained and containing spheres. This reverses the Fibonacci ratio with a decisive shift from dominance by the containing surface to dominance by the contained surfaces. The icosahedron cluster of 20 corner spheres with radii of 1 with a central sphere with a maximum possible radius of 1.8 has a spherical surface ratio of approximately 21:13 (21:13.06), again with the internal surfaces dominating.

The fitting of the five platonic solids into spheres within spheres was the archetypal image of the cosmos for Kepler (Fig. 14). It was his proposal for the planetary orbits of the five planets that were then known. Since he later realized that this concept was not accurate, how pleased he might have been to know that Fibonacci ratios exist between the spherical surfaces of contained close-packed spheres defining the five platonic solids and the spherical surfaces of their containing spheres. He would be able to say, "And so," in the Fibonacci fitting of forms within forms, "the flag of this faculty is flown."<sup>24</sup>

Fibonacci ratios link thresholds of fitting forms within forms in numbers as well as in the clustering of two- and three-dimensional forms in the basic symmetries of improbable order. Connective proportional resonance occurs in the overlap of Fibonacci ratios, not only within each realm of quantity, of linearity, of areas and volumes, but connective overlapping resonance occurs between the realms of quantity and linearity, between linearity and area (or symmetry of shape), between area and volume, between volume and hierarchy, and a re-connective overlap between hierarchy and quantity at another level of connective possibilities. These ratios offer a controlled ratio range between 1:1 and 1:2 for hierarchical resonance of improbable order for filtering of information bits in visual, conceptual, and archetypal clustering. Built into this improbable order of cumulative choices in the grouping of information bits is always the 1 or 1 equal choice at every level for a dynamic on/off reordering of information, a simultaneity of order and randomness.<sup>25</sup>

The intuitive capacity to perceive simple spatial ratios without conscious calculation was observed by Weber, the co-discoverer of the Weber-Fechner law: "The perception of ratios of whole amounts, without measuring the magnitudes on a small scale and without knowledge of their absolute difference, is a most interesting phenomenon. In music we perceive the ratios of tones without knowing the numbers of vibrations, in architecture the ratios of spaces without being able to determine their measurements in inches. . . ."<sup>26</sup>

The intuitive capacity to perceive ratios of spaces is revealed in the earliest records of human dimensioning systems. Early systems of measure from Babylonian, Egyptian, Hebrew, Greek, and Roman sources correspond approximately to the Fibonacci series and are based on the human body as archetype. These early units of measure were standardized to the body of a chieftain or headman, who was the symbol of this archetype. A digit, or finger or thumb, roughly approximates 1 inch, the knuckle (2 digits) approximates 2 inches. The Greek palm was exactly 3 inches and 2 Hebrew palms just over 5 inches. The Hebrew handbreadth or span (the distance between outstretched thumb and little finger) was roughly 8 inches. The Greek, Babylonian, and Royal Egyptian foot averaged a bit more than 13 inches and the ell or cubit (the distance from elbow to mid-finger) is close to 21 inches. Both the Hebrew

pace and the yard (a spike or pole, archaic for penis—a numinous exaggeration of the phallus as archetypal image) are close to 34 inches, and the Roman pace approximates the 55 inch increment in the Fibonacci series. In these early attempts of the human species to dimension space, the appearance of numerical increments in the Fibonacci series as linear measure offers confirmation of this summation-logarithmic series as a universal natural intuitive principle. As light becomes brighter, as sound becomes louder, and as distances become greater, the capacity to distinguish minute differences has little practical value.

Throughout history the human body has been linked to these intuitive increments as the archetype of space and as the source of relative dimensions (Fig. 15). Vitruvius wrote, "for if a man be placed flat on his back, with his hands and feet extended, and a pair of compasses centered at his navel, the fingers and toes of his two hands and feet will touch the circumference of a circle described therefrom. And just as the human body yields a circular outline, so too a square may be found from it."<sup>27</sup> Leonardo da Vinci's familiar drawing expresses this archetypal link between the human body and the geometry of space. Although Barbaro's Vitruvius shows the human body with thumb and face as static repetitive modules, Zeising's meticulous drawing of the 1880s subdivides the body into a linked hierarchy of extreme and mean Divine proportion ratios. In the 1920s Hambidge made a strong distinction between static modules and the "dynamic symmetry" of growth in the human body. He analyzed the human skeleton in detail, finding Divine proportion ratios in it, and he stated that "the human skeleton is the source, *par excellence*, for the artist." Hambidge's finding of similar ratios in the Parthenon and other Greek art convinced him that the secret of their beauty was the use of these "dynamic" ratios suggestive of life and movement.<sup>28</sup>

Di Giorgio's drawing of the human figure as archetype for a cathedral recalls the Pythagorean concept of the temple as link between man and the cosmos. The concept of the human body as an archetype for the articulation of space reappears to inflate Le Corbusier's "Modulor," brought to flawed fruition in 1945. From the proportions of a six-foot man, he developed a double series of dimensions based on the Fibonacci series. He called it an invention and saw it as a worldwide dimensioning system for building materials. He wrote, "What we should do is form a Society of Friends of the Modulor, a world association of those who will *believe* in it . . ." (his emphasis). He saw it applied "from kitchen equipment to the future cathedrals of a world searching for its unity."<sup>29</sup> The practical limitations for application of the Modulor result from Le Corbusier's preoccupation with a specific series of linear dimensions based on the arbitrary choice of a six-foot man (the London policeman was his source for this dimension). While a suit of clothes is required to fit exactly the dimensions of the human figure, architectural space accommodates various human dimensions. Thus, a universal dimensioning system in architecture would be better derived from the vertical dimension of a door and the horizontal dimension of a bed, which offer such accommodating units of measure. But the Fibonacci-Divine proportion matrix goes far beyond the practical limits of such a system. It is a universal generative principle of three-dimensional space and is applicable to quantity, to a series based on any unit of dimension, to symmetries, to surfaces of volumes, and to hierarchies of space.

In *The Hidden Dimension*, E. T. Hall has established increments of space for territoriality in the human species that roughly correspond with the Fibonacci series, although he has



16. Salvador Dali, "The Sacrament of the Last Supper"

assured me verbally that he was not aware of any connection at the time. Hall's "intimate close" of 0 feet and his "intimate not close" of 1 foot begin the series. His "personal close" of 1.5 to 2.5 feet averages 2, and his "personal not close" of 2.5 to 4.0 feet approximates 3. His "social-consultive close" of 4.0 to 6.5 feet approximates 5, and his "social-consultive not close" of 6.5 to 10.0 feet approximates 8. His "public close" of 10 to 22 feet must be extended and subdivided, with 10 to 16 averaging 13 and 16 to 26 averaging 21. Hall's "public not close" begins at 30 to 40 feet approximating 34 feet. Hall also notes that the sense of touch drops off after "personal close" (2 average), the sense of smell after "personal not close" (3 average), conversational distance stops after "social-consultive close" (5 average), with mandatory recognition distance stopping after "social-consultive not close" (8 average).<sup>30</sup> This correlation of human territoriality and human perceptual thresholds offers another confirmation that the principle of proportional overlap underlies the identity of natural thresholds in our perception of the environment.

At the threshold for clustering people around a table, the physical limits are rooted in human dimensions and perception. An effective Round Table for the gathering of King Arthur's twelve stalwarts in which none would have precedence would require a diameter of five or six feet, close to the average five feet of Hall's conversational "social-consultive close" range. Thus, such a circular gathering represents a threshold for democratic interpersonal communication in human territoriality. In three-dimensional space, twelve is the maximum number of spheres that can surround a center sphere and be equidistant from each other and from the central sphere. (These 12 spheres would define the corners of an icosahedron or the faces of a dodecahedron.) Twelve is the number of a jury, the number of Christ's disciples, a functioning size for seminars and for corporate committees—an archetype of collective justice, democracy, spirituality, learning, and power. In Salvador Dalí's painting "The Sacrament of the Last Supper," Christ and his twelve disciples are encompassed by the 12-sided dodecahedron as a spatial archetype (Fig. 16).

In all cultures, one finds a fairly consistent "domestic" scale in the clustering of rooms around a central open or covered clerestory space. The number and size of surrounding rooms is proportioned to the central space. The *megaron* of Troy and Mycenae, the Norwegian *stuga*, Saxon *hof*, Prussian *laubenhaus*, and the courtyard house of Persia and China all demonstrate physical limits of clustering spaces in "domestic" scale. An expansion of scale and clustering occurs in the English manor house and to a much greater degree in palace courtyards. The relation between the extent of open space and the height of buildings around it is reduced from these palatial proportions in the more modest university quadrangles and monastery cloisters. In English villages documented by Sharp,<sup>31</sup> again there is a consistent range of scale in the size of village greens and in the number of houses joined together to contain them. Although there is ample space in the countryside for houses to be individually placed, this connectivity of parts within a whole creates a sense of identity beyond the identity of the individual house and establishes a sense of place. The aura of identity of a city square and its physical resonance as a container of light and green growth generate and focus collective human energy. The numinous power of centered enclosed space connects to the archetypal image of the *temenos* or sacred space, a place within a place, a city within a city.

Along with the Renaissance discoveries of form and perspective came the use of a rule-of-thumb ratio of 1:3 for the

proportion of the horizontal open space of a city square to the height of buildings around it. This very closely approximates the 18-degree angle of "fusion" that defines a focused architectural field of vision. The 27-degree angle of "perceiving" defines a more generalized architectural field of vision. These fusion and perceiving fields of vision for architecture are cited by such authors as Zucker, Blumenfeld, Maertens, and Schubert.<sup>32</sup>

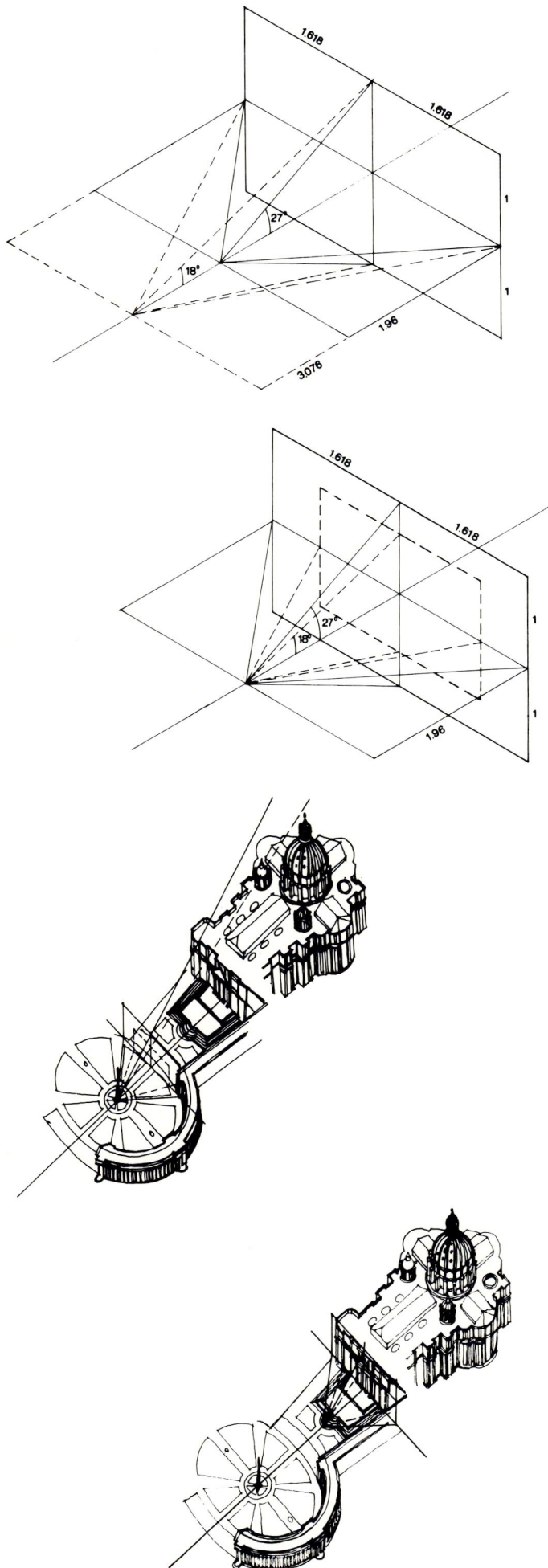
When one looks at a building from a single viewpoint, the field of fusion covers approximately two-thirds of the field of perceiving. The 2:3 ratio (1:1.569) between these fields does not exceed the Fibonacci-Divine proportion range of ratios for critical thresholds of fitting forms within forms. As in music, as in thresholds for perception of light and color, as in thresholds for relating known to unknown information, so the perception of space in architecture is ordered by Fibonacci-Divine proportion ratios at the threshold between the visual fields of perceiving and fusion (Fig. 17).

We can apply these fusion and perceiving fields of vision to St. Peter's in Rome (Fig. 18).<sup>33</sup> If we stand at the obelisk in the center of the great oval piazza, the width of the circular feature that marks the turning of the arcade on either side between the oval and the inner piazza defines the horizontal difference between the edges of these two fields. At this critical architectural feature, our focus resonates between them. From the same viewpoint, the top of the dome of St. Peter's is just within the vertical limit of the more focused fusion field. If we move into the inner piazza, naturally pausing at the bottom of the steps to look up and ahead, the edges of the wider field of perceiving outline the sides and top of the portico, while the edges of the narrower field of fusion pick up the line of the lower cornice and the inner corners of the arcade where it meets the portico. Again the critical edges of the two fields are linked, this time by the important architectural features of the portico. Again there is a resonance of visual fields.

Although one's main experience of buildings is from the point of view of an approaching pedestrian, much of our present architecture appears to be designed as a Lilliputian model to be perceived from the sky by giant Gullivers. One must crane one's neck in order to see the main exterior features of spectacular cantilevers and vertical glazed courts. On the interior, even to visually encompass the lobbies of buildings one needs the skill of a contortionist. Spatial articulation has a minimal relation to human scale. The possibilities for architectural resonance within the critical thresholds of vision are seldom realized. There are no architectural features to define hierarchical levels of focus in human vision. Such levels of visual focus from the scale of reading words to the largest scale of vertical and horizontal architectural forms can establish a sense of human scale and identity.

The American suburb, to which people fled the collectivity of the city to find individuality in a freestanding house with garage and lawn, has become a kind of collective *non*-identity through sheer numbers and the extent of its horizontal spread. Toward the other extreme, apartment towers, in their vertical egg-crates and anonymous glazed containers, express vertical collectivity and *non*-identity.

To connect architecture to the scale of the human being, forms based on the principle of hierarchical resonance can be used as a scaling device—a physical reference for individual identity within collectivity. Forms created by the human species have tended toward taller and taller buildings, longer and longer buildings, and overwhelming degrees of collectivity of repetitive forms. In these forms there is no expression of clustering, no intermediate grouping between the scale of one win-



dow and what appear to be infinite numbers of windows. The repetition of a single modular dimension or window seems obsessive, totally unrelieved by any overlapping relation or by any grouping of forms within forms. The human scale of the original module is lost in a sea of collectivity. The individual or uniquely human is given up and submerged in the collective on a conscious, objective level. At the same time, the subjective numinosity of the images of the collective unconscious is not brought to expression. These buildings connect neither to the uniquely human nor to collective symbol. This collectivity can be reconnected to human scale by articulating within it levels of identity. By overlapping progressively ordered increments and by establishing identifiable relationships of parts within wholes, complexity can be included within simplicity. This brings the collective totality within the limits of intuitive perception and offers a perceptual resonance between the architecture and an archetypal order that is profoundly familiar.

Intuitively perceivable ratios seldom exceed 1:2 or 2:3 and never involve the very small next to the very large. We see forms built by the human species from the constant scale of the human being. We see the ratio of hand to brick and of foot to step, as well as the ratio of the upper half of the human body to window and of total human height to door. We extend these ratios by relating door and window to floor height and floor height to the height of the building. The three story building is intuitively perceived by relating the floor heights in a ratio of 1:2 or 3:5, or subdivided as 1:2:2. The perception of these simple ratios of ones, twos, and threes occur below the level of consciousness. As we walk through a town, we easily respond to these natural relationships as familiar rhythms, steps, or increments of perception. In older cities we find many examples of buildings with as many as 10 stories subdivided in these natural Fibonacci increments. These methods of "scaling" the collectivity provide a sense of familiarity, a resonance or ease of perception. They operate on an intuitive level without conscious effort.

To identify a space, or to identify with a space, is to have a sense of place and to be able to find one's way. Identity of place and identity of position within a place can occur in both the vertical and horizontal dimensions. To find a room on long, continuous corridors one must first know the number of the room and then find its location by figuring out the system of numbering, which may be confused by extensions of branching corridors. By giving a corridor incremental shape, say a series of squares, circles, or rectangles, and by placing five doors on either side of the corridor for each of these shapes, one produces identifiable groups of doors. Each space has a middle door and to the right and left of each middle door, each has two end doors and two in-between doors. Each door has its own identity by its position or place. On a long corridor, on the other hand, the quantity of repetitive doors make it a linear no-man's land.

In 1961, while in the office of Louis I. Kahn, I proposed a clustered corridor scheme for Erdman Hall dormitory at Bryn Mawr College (Fig. 19). Planned as squares combined with octagons, the corridor offered an identifying position for each door, also allowing small groups to gather together—for instance, in two octagons adjacent to a square snack bar. This scheme also proposed a hierarchy of spaces beginning with cylindrical hollow columns scaled to the width of the door, with openings cut away for windows and doors on alternate sides of the cylinder at each floor. From the human scale for doors and windows, the hierarchy expands to eight-foot-square storage/entry or sleeping/study alcoves, to larger octagonal sleeping/

17. *Fields of Perceiving and Fusion*, drawn by S. Martin.

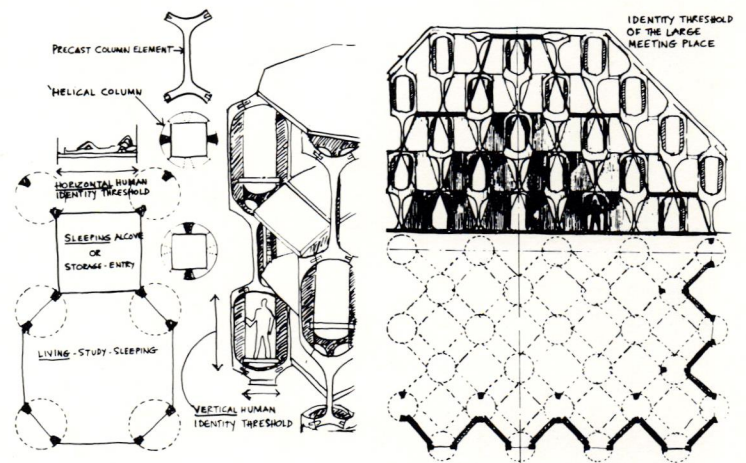
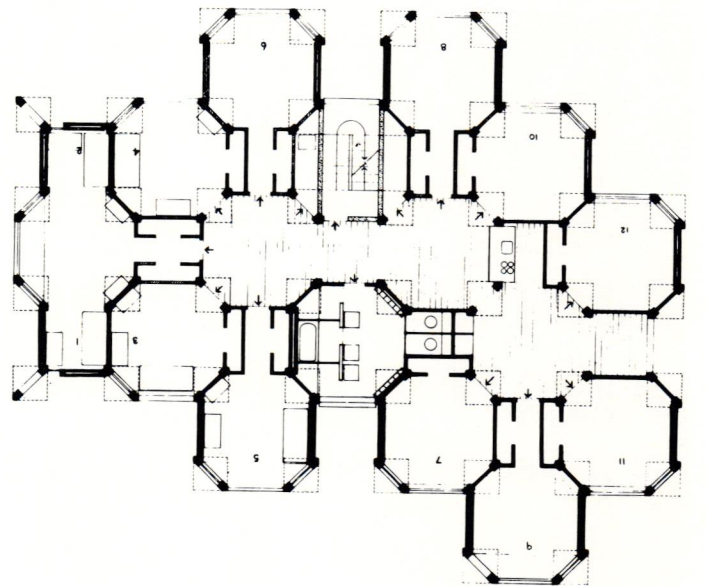
18. *Fields of Perceiving in the design of St. Peter's Cathedral*.

living spaces, to the largest dining/living spaces. These largest spaces are spanned by a corbelled square/octagon system reinforced with a three-dimensional flying buttress composed of the stepped cylinders. All of these spaces are built up from the accommodating human dimensions for door and bed, the vertical and horizontal thresholds of human scale in cities. Rather than being derived from the proportions of a six-foot man, these accommodating thresholds embody the principle of natural form as a precise approximation for the variable dimensions of very tall basketball players and very pregnant women.

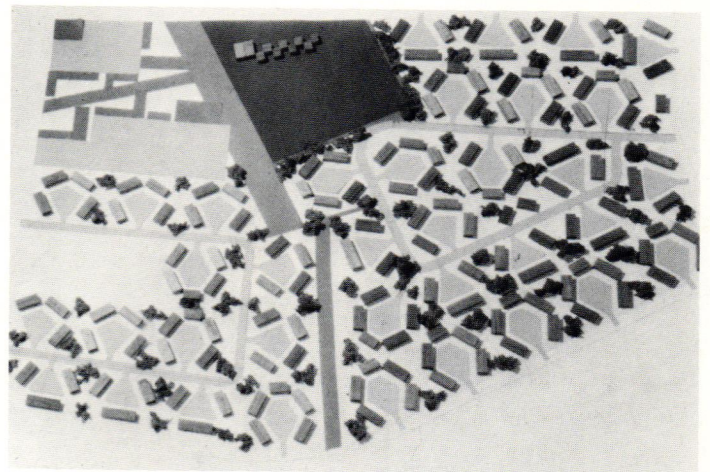
As a larger scale corridor of the city, the street, with its endless repetition of similar houses, has an oppressive objectivity and collectivity. Even with familiarity, one must check house numbers to find the right house. This situation is cartooned as a man, sometimes absentminded or drunk, coming home to the wrong house. Variations in the pairing and grouping of differently detailed roofs, windows, or doors can relieve the situation, but the most convincing sense of arrival occurs in the cul-de-sac and the square. Even when houses are similar, each one has its own identity by its position or place. Each position within the clustered grouping of houses offers more possibilities for variation, while also offering a limit to collectivity within the unity of a larger single form. My 1952 design for a cul-de-sac of rowhouses was based on hexagonal clustering (Fig. 20).<sup>34</sup> This was modified to a pentagon or triangle where site conditions were limited. These modifications to the symmetry of the cluster did not disrupt the geometry of the longer angled views between houses or the basic circulation system for cars and people.

The three-story house is almost an organic dimension of human habitation in the city. As a vertical threshold of pedestrian territoriality in climbing stairs, the three-story unit can be used as an increment to limit vertical collectivity. In Washington Square in Philadelphia, next to Cottman's three-story Athenaeum of the 1840s, a 1913 Penn Mutual Insurance Co. building has a cornice at the top of the third floor in line with the height of the Athenaeum, with two more groups of three stories, each marked by a cornice, to total nine stories. In the horizontal direction, three-story columns group the windows in pairs. With these groupings of twos and threes, the scale is intuitively perceived at a glance. In a taller building, such nine-story groupings (of three-story clusters) may be strongly articulated and differentiated from each other in combinations of twos and threes to form 18 or 27 story clusters, and so on. As long as each grouping of forms is limited to intuitively perceivable numbers, with hierarchies of forms within forms, the collectivity of very high buildings can be connected to human scale and human vision. The proportional interrelation of intuitively perceivable quantities offers a sense of resonance.

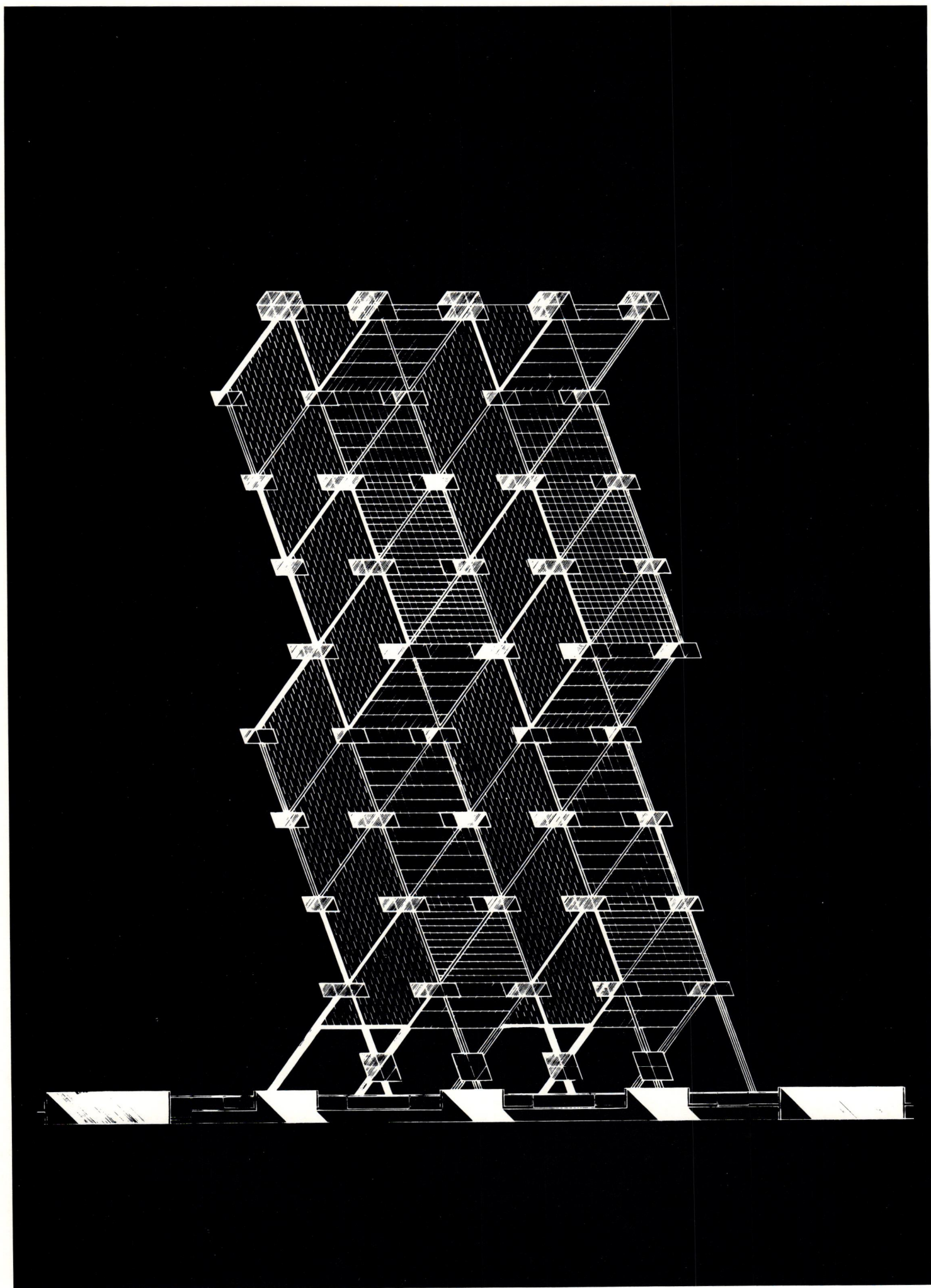
In the intuitive perception of grouped Fibonacci ratios, the concept of ratio is extended to the intuitive perception of proportion. Proportion may be defined as the resonance of ratios, the overlapping bond of two similar ratios. Plato in his *Timaeus* says, "two things alone cannot be satisfactorily united without a third: for there must be some bond between them drawing them together. And of all the bonds, the best is that which makes itself and the terms it connects a unity in the fullest sense, and it is the nature of a continued geometric proportion to effect this most perfect unity (my emphasis)."<sup>35</sup> For example, 0.618:1 is equivalent to and resonates with 1:1.618, or 0.618:1:1.618 offers infinite Divine proportion linkage, the only proportion which is both a summation series and a geometric or logarithmic series. Thus ratio resonates within proportion and proportion resonates within hierarchy.



19. Plan of Erdman Hall, Bryn Mawr College, L. I. Kahn and A. G. Tyng, showing hierarchical proportion in door, bed, living study and large living room.



20. Row House cul-de-sac, site plan, A. G. Tyng in association with L. I. Kahn; McAllister, Day and Tyng, associated consulting architects.



This rigorous mathematical connection between ratio, proportion, and hierarchy offers a depth of resonance for forms as architectural metaphors. Quantity, symmetry, and hierarchical levels of identity become tangible images in architecture. A familiar shape or image used to build an expanded image becomes a proportional bond offering metaphorical resonance. The shape of a triangle as a roof linking earth and sky occurs throughout history, in house and temple. It occurs as three-dimensional cone in cathedral spire and as spiral in the ziggurat. The architectural detail of a small "roof" over a doorway or window is an aedicular metaphor, a miniature house.

In the Four Poster house, the triangulated dormerwindow roofs are small on the top level. There are larger dormerwindows on the second level, and the largest triangular expression is the steep hipped roof itself, which "contains" the entire house and all the levels of aedicular dormers within its slopes. The expression of little roof, larger roof, and largest roof dominates the total form. The extension of aedicular expression to larger and smaller scales reinforces the image of roof and house. This connects the more collective scale of roof-house to the scale of roof-room, extending the identity of house within house as a proportional metaphor. The miniature house within the familiar image of house offers incremental resonance with the deeply ingrained archetype of house as triangular connector between square earth and circular sky.

A unique opportunity to express hierarchical shape as well as hierarchical quantity that can resonate with human scale and vision is presented by the multi-storied tower. Although one may try to count the number of floors in a high building such as the World Trade Center in order to know objectively how many stories there are, the subjective sense of scale or of levels of identity through the clustering of twos and threes is not there. The plan is repeated unchanged in the vertical dimension as an extruded two-dimensional pattern. There are no clues for the intuitive perception of its scale. In the proposed City Hall Tower for Philadelphia on which I was associated with architect Louis I. Kahn from 1952 to 1957, clues for scale were intuitively rather than consciously integrated into its design (Fig. 21). The three-fold hexagonal plan of the structure rotates in vertical increments every 66 feet. These undulating shifts of level result from the natural completion of the triangulated space-frame in its upward helical movement. Hierarchical expression occurs in variations in floor level between the main 66-foot structural levels, in the hollow triangulated "capitals," high enough for a person to stand in, and in the three-foot-deep hollow ceilings of octahedron-tetrahedron geometry. In this project, hierarchical expression of structure is integrated with hierarchy of quantity and of shapes in triangle or hexagon.

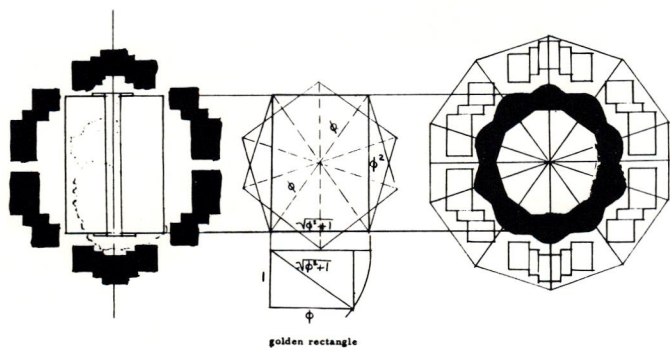
Such hierarchical expressions of structure can further enhance the natural rhythms of perception. To articulate levels of human territoriality from hand-built wood, brick, and masonry on the one hand to the scale of the tallest high-powered derrick-built structure on the other, we can distinguish between the structural identity of rowhouse technology and high-rise technology. The three-story vertical height for pedestrian territoriality for climbing stairs is a threshold which correlates with the building techniques of "low technology" and the scale of the wall-bearing house. In high-rise buildings, the entire structure is usually accomplished with "high technology" steel and reinforced concrete. Now that the distinctions between

high and low technology have been more clearly evolved, it is possible to recombine them within a unified structure instead of the either/or solution of high-rise apartments immediately adjacent to rowhouses. The correlation of the structural thresholds of low and high technology with thresholds of human territoriality can profoundly reinforce the rhythmic increments of human perception.

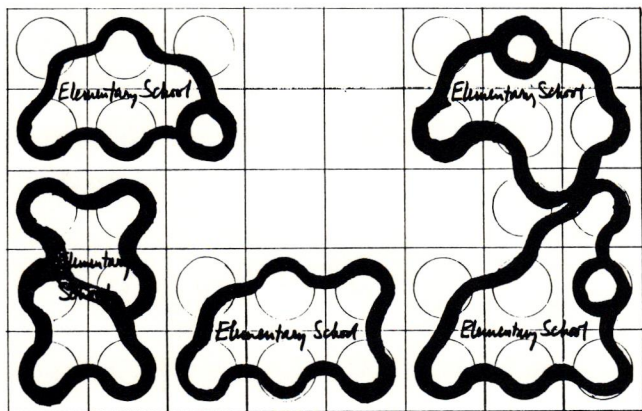
For instance, in high-density areas of the city, the three-story wall-bearing low technology house, which need only support itself and which may be built in traditional forms with pitched or domed roofs or with indigenous materials, can be the three-story increment of a multi-story structure, with each house supported on a high technology platform of reinforced concrete. In this way the identity of regional or national architectural traditions may be expressed and contained within the high technology support and utility systems rather than be obliterated, as it now is, by high-rise apartments built exclusively in an "international high technology" esthetic. These high technology platforms could be built as terraced manmade contours, opening up or stepping back to allow sun and light into each house. As building lots, ramped for vehicular access to the ground, these terraced platforms also establish a scale reference to ground level. Exterior steps connecting these platforms, as in Rome's Spanish Steps, can create a hierarchy of public open spaces to reinforce thresholds of human territoriality. On the platforms, each house would have its own public/private interface, a front door with access for police car, ambulance, moving van, or fire-truck. In the horizontal dimension, individual houses may be connected and grouped around a pedestrian court, as a larger "house" or place. This, in turn, may be grouped with other courts around a vehicular cul-de-sac or place for stopping—an even larger "house." Parking of cars can be incrementally distributed, accessible to houses, and scaled down to quantities that are intuitively acceptable, rather than stored in the oppressive collectivity of massive underground caverns. As the terraced building platforms accumulate vertically, they create the character of a "hill village," which can have the unity of a larger place. Hill villages can be combined to enclose an even larger place, containing within it shopping facilities and supplying other commercial and institutional needs.

The proposal for a high density Urban Hierarchy that I developed in 1970 explores such a concept of interlocking high and low technologies (Fig. 22). In addition to expressing a structural hierarchy, the forms articulate changes in symmetry correlated with increases in scale to mark thresholds of human identity. This gives further reinforcement to perceptual thresholds in the interlocking architecture of place and movement. These layered shifts of basic symmetries, from *bilateral* or *rectilinear* house and pedestrian court cluster, to larger scale *rotational* vehicular access of ramped cul-de-sac, to *helical* symmetry of "hill village" and elementary school neighborhood and to *spiral* connector between institutional center and expressway commercial core, are all included in a *larger scale symmetry of bilateral* expressway interchange. This marks a level of bilateral synthesis, the hierarchical inclusion of parts within a whole.

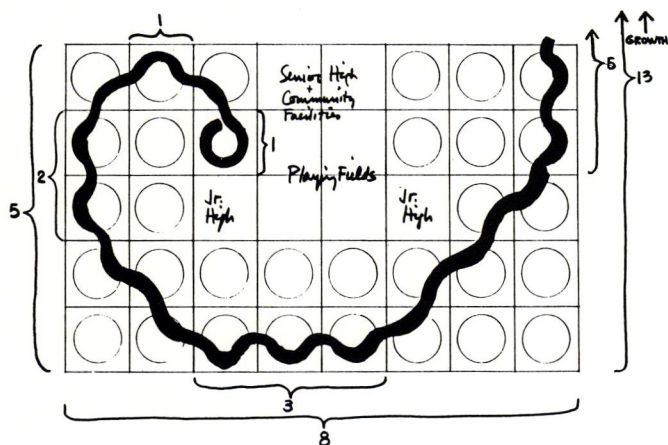
In 1976, in a further exploration of high density forms for the Biscayne West Florida competition, I reduced, and modified by terracing, the verticality of the Urban Hierarchy proposal of 1970, and at the same time was able to meet the unusually high density requirement of 135 dwelling units per acre (Fig. 23). In this proposal, I explored the house as part of a larger house in an incrementally scaled mountain form. Access to the 11 stories of houses was from eight car levels threaded



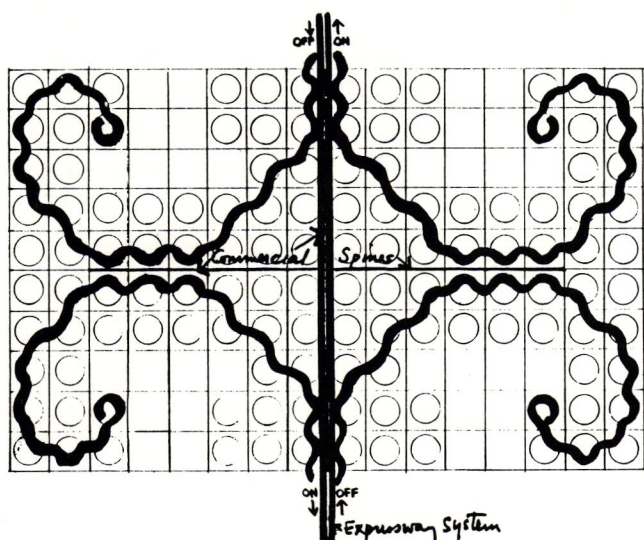
Bilateral



Helical



Spiral

Bilateral Hierarchy  
22. Urban Hierarchy.

through the "open windowed" mountain form of this larger "house." Large flying buttresses integrated with the stair structure below were intended to strengthen the triangular expression of the pyramidal form as a simpler container of the clustered houses.

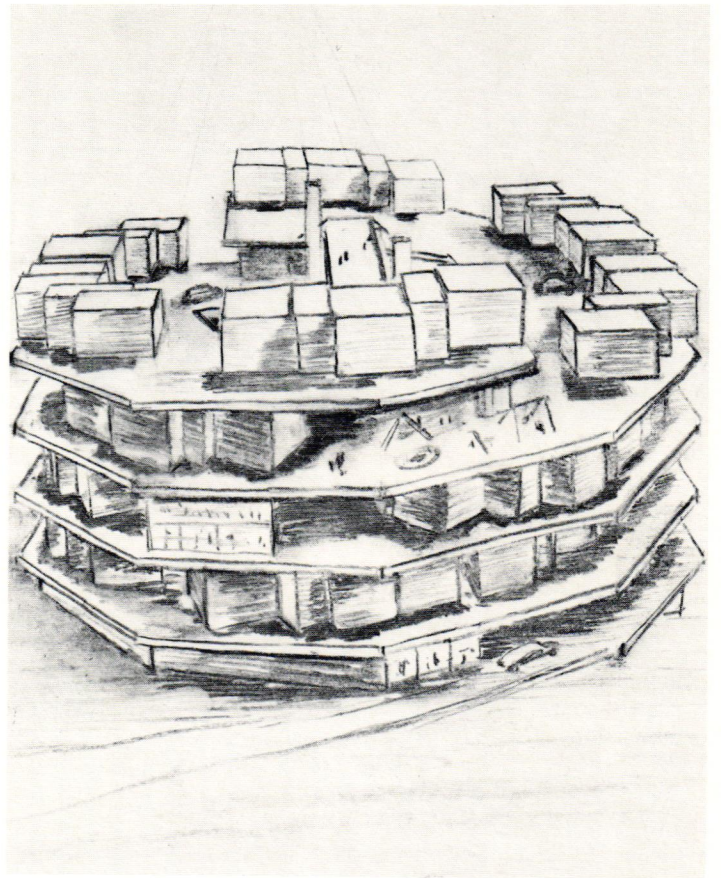
A more recent exploration of the incremental expression of human identity in high density forms is my 1979 proposal for Manhattan Landing, a site over the East River (Fig. 24). In this terraced scheme, the self-supporting rowhouses on high technology platforms combine to create a larger "house" around a cul-de-sac, with pedestrian courts at the corners opening out to the river. Each one, two or three-story house takes the form of a recognizable single "block" and is distinct from its neighbor in 7 foot horizontal and vertical shifts. These 7 foot shifts step in around a cul-de-sac to form a larger "house" with open "skylights" and corner "windows" off the pedestrian courts. The variation of story heights for houses is vertically grouped in Fibonacci increments from the bottom up, as two layers of two-story houses, a layer of one-story houses, three layers of two-story houses and another layer of one-story houses topped by a layer of three-story houses. At larger scale, the terracing of the cul-de-sac "house" overlaps vertically the cul-de-sac "houses" above and below. There are seven living stories between the cul-de-sac car levels, with four stories overlapping at the bottom and three stories overlapping at the top. Houses are reached by car from the riverside expressway by a ramp system to terraced car platforms which lead to the cul-de-sacs. Cars are parked under the upper houses and on the lower level of the truss supporting the car platforms. These trusses correspond with a layer of one-story houses, but the vibration of the car platforms is horizontally separated from the structure of the platforms supporting the houses. Within the cul-de-sac, access to each house is within a maximum of two stories up or down, with a balcony from the next higher level cul-de-sac providing access to the top layers of houses in the cul-de-sac below. The large cul-de-sac "houses" combine to form the fabric containing a much larger "house." This fabric takes the form of an arched roof over the East River with shops, restaurants and community facilities corbelled under it. This corbelled underside of the arch overlooks a marina and frames a view of the river from an existing city park.

The reinforcing of these thresholds between house and bigger "house," between place and bigger place, is planned to be in scale with the visual effect at different speeds of movement. Pedestrian movement encourages the perception of individual houses, details and pedestrian courts. Vehicular stopping and slower car movement is linked to the perception of the bigger cul-de-sac "house." Faster movement allows one to visually encompass a cluster of bigger "houses" and the pattern of a residential fabric. With even faster expressway movement one perceives in quick glances the articulation of high technology ramps and platforms. An architecture of movement defining hierarchies of speed correlated with a contoured, multi-levelled architecture of place, offers a fresh approach for high density forms in the city. This approach recombines the tactile and traditional crafts of building with machine-formed high technology and reaffirms individual identity within levels of more collective identity.

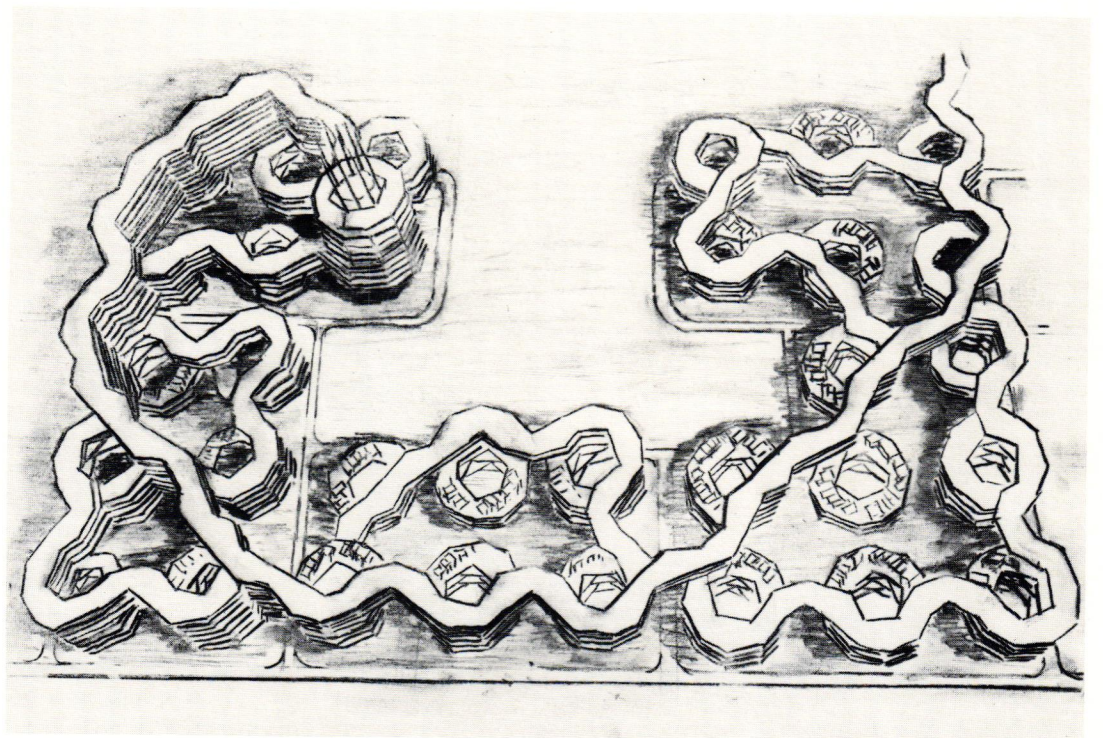
An architecture that links the laws of human vision to archetypes of human consciousness, that combines principles of ratio, proportion, and hierarchy, finds the source of its resonance beyond the artifacts of history in the beginnings of evolution and in extensions of the human spirit. In these deeper archetypal sources, principles of architecture can be found for

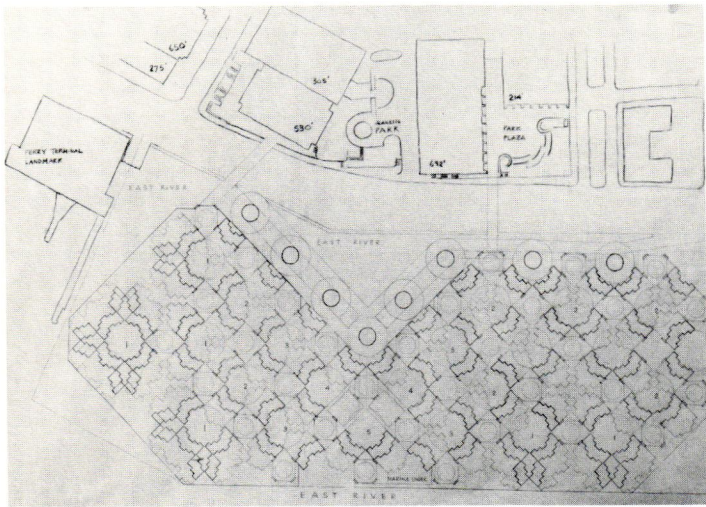
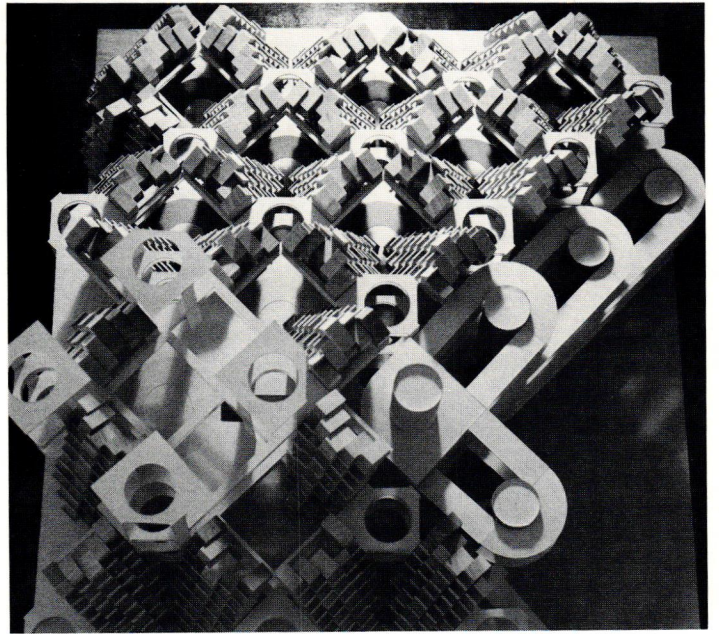
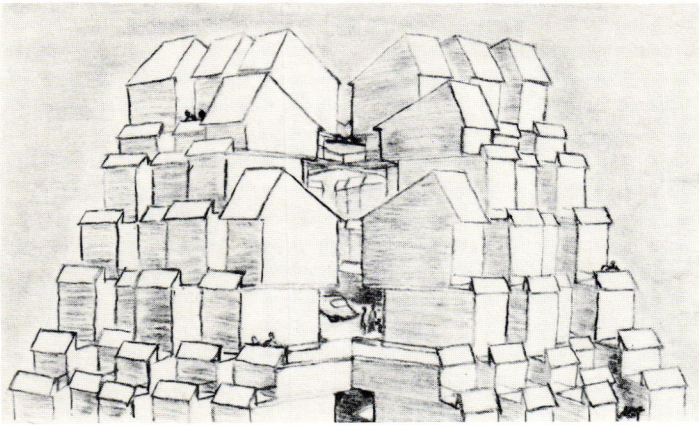
resolving the environmental stresses of dissociated time and place, the dichotomy of objective and subjective expression, and the split between tradition and technology, between individual and collective. Rhythmically reinforcing the limits of intuitive vision by articulating forms within forms and symmetry within symmetry establishes a sense of human scale. This sense of scale results when forms synchronize with intuitive rhythms of perception that vibrate in frequency with the archetypal order of how we are made and with the laws of three-dimensional space. This esthetic-scientific reinforcement offers new distinctions and simultaneities of rhythms of perception, of scales and symmetries, recombinations of technologies with traditions, and increments of place with thresholds of speed and movement. Rhythmic thresholds of vision and hierarchies of form provide a sympathetic resonance from individual house to the largest scale of the city when they are linked by an underlying archetypal order. The laws of form and of intuitive perception offer a continuing chain of resonance from the archetypal image of the human body as a source of symmetry, measure, and orthogonal orientation of consciousness to the image of Temple, from the archetypal image of City to the image of the Cosmos, and from the archetypal image of infinity (as in number) to images of the soul or "inner body," and back to the physical laws of form.

A great work of architecture forges an unbroken bond of resonance between matter and meaning. From material principles architecture contains and reflects, intensifying physical energy into numinous symbol. Solar energy as light from the sun enters space through openings, highlights edges, washes surfaces, dances, reflecting energy from surface to surface. Ratios between surfaces offer infinite proportional links, bonding, containing, and shaping light energy. From the archetypal eye of the sun, the light energy of shaped resonance enters the human eye, connecting to infinitely bonded thresholds of perception. Principles of resonance touch the truths of form. Forms closest to these truths offer resonance between eye and archetype.

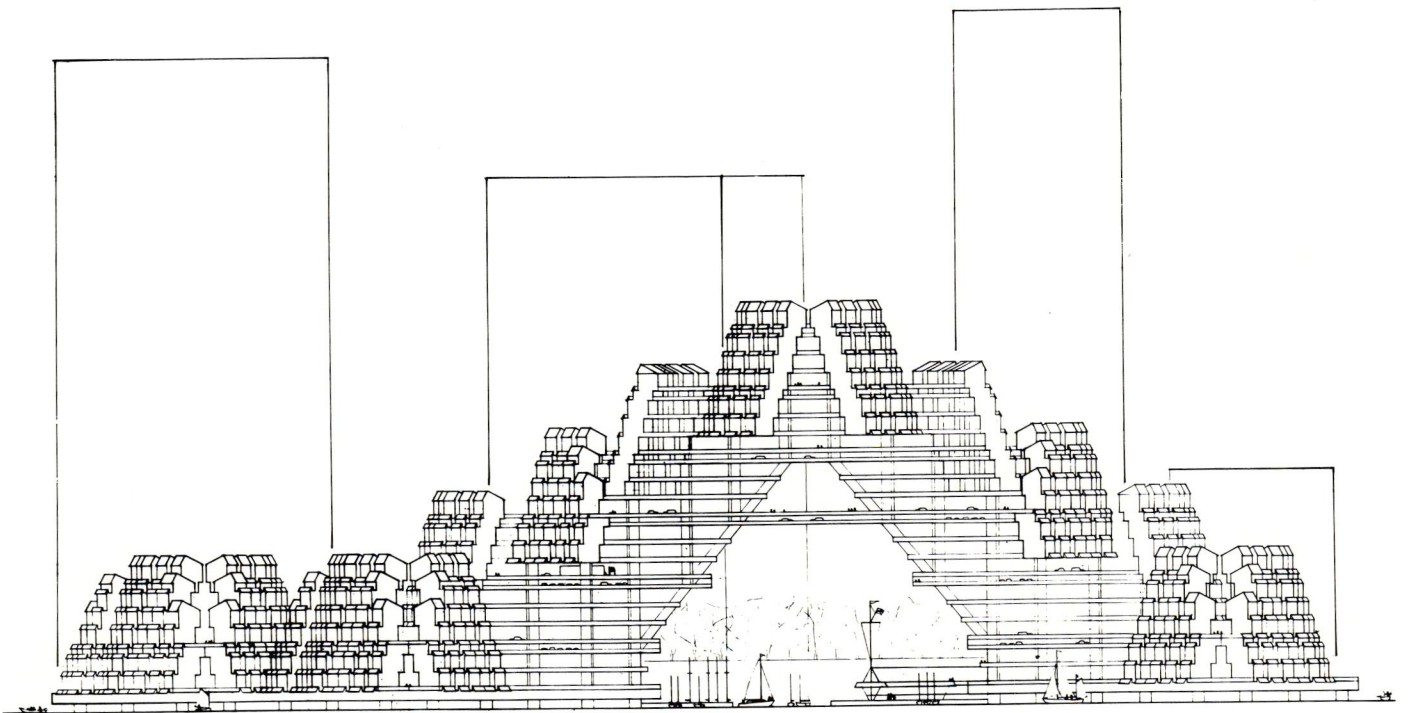


23. Project for Biscayne West.





24. Project for Manhattan Landing.

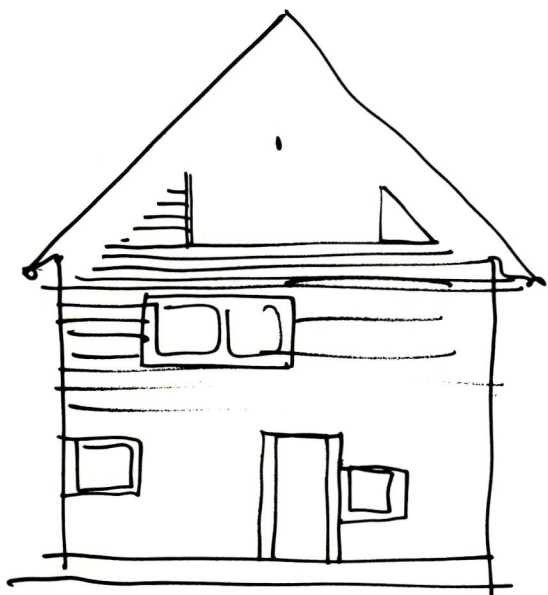


Anne Griswold Tyng, an adjunct associate professor of architecture at the University of Pennsylvania, was for many years in the office of Louis I. Kahn, associating with him as a principal architect on several seminal architectural and planning projects. A Fellow of the AIA, she recently received a Graham Foundation Grant for studies of human scale and is currently finishing a study of London public squares.

Special thanks to Joseph Burton for help far beyond the duties of editor, for his enthusiasm and patience in the difficult early stages of this article and for his encouragement to include examples of my own architectural efforts.

## Notes

1. C. G. Jung, *The Archetypes and the Collective Unconscious* (New York: Pantheon, 1959), pp. 79–80, vol. 9:1 of *The Collected Works*, Bollingen Series XX. Jung defined the archetype as consisting of both form potential and psychic energy. "Its form might be compared to an axial system of a crystal, which, as it were, preforms the crystalline structure in the mother liquid, although it has no material existence of its own. . . . It may vary endlessly by reason of the different size of its planes or by the growing together of two crystals . . . the only thing that remains constant is the axial system or rather the invariable geometric proportions underlying it. The same is true of the archetypes. In principle it can be named and has an invariable nucleus of meaning—but always in principle, never as regards its concrete manifestations."
2. A. G. Tyng, "Geometric Extensions of Consciousness," *Zodiac* 19 (1969): pp. 131–152.
3. *Ibid.*, pp. 152–162.
4. Sir Thomas Heath, *A History of Greek Mathematics*, vol. 1: *Thales to Euclid* (New York: Oxford University Press, 1960), p. 76.
5. E. F. Edinger, *Ego and Archetype* (New York: Putnam's, 1972), pp. 20, 87–89.
6. Published in Philadelphia Chapter *AIA Yearbook*, spring 1952.
7. A. G. Tyng, "Simultaneous Randomness and Order: The Fibonacci-Divine Proportion as a Universal Forming Principle," (Ph.D. diss., University of Pennsylvania, 1975), pp. 24–25, 30–34. Available from University Microfilms International.
8. A. Moles, *Information Theory and Aesthetic Perception* (Chicago: University of Illinois Press, 1966), p. 23.
9. A. G. Tyng, "Simultaneous Randomness and Order," pp. 40–41.
10. R. Granit, *Receptors and Sensory Perception* (New Haven: Yale, 1955, [5th printing 1967]), p. 10.
11. A. G. Tyng, "Simultaneous Randomness and Order," pp. 40–41.
12. S. Deutsch, *Models of the Nervous System* (New York: Wiley, 1967), pp. 86–87.
13. R. W. Pickford, *Psychology and Visual Aesthetics* (Hutchinson: 1972), pp. 81–85.
14. C. M. Hutchins, "The Physics of Violins," *The Physics of Music*, Readings from *Scientific American*, 1948 to 1978 (San Francisco: Freeman, 1962), p. 63.
15. J. Itten, *The Elements of Color*, trans. E. Hagen (New York: Van Nostrand Reinhold, 1970), p. 77.
16. *Ibid.*, p. 75 (shape), p. 89 (meaning).
17. O. Marc, *Psychology of the House*, trans. J. Wood, (London: Thames and Hudson, 1977), pp. 41–42.
18. Plato, *Timaeus*, trans. F. M. Cornford, (Indianapolis: Bobbs-Merrill, 1959), pp. 59–61.
19. R. Kellogg, *Analyzing Children's Art* (Palo Alto: Mayfield, 1969, 1970), pp. 9–10.
20. Sir Herbert Read, *Education Through Art* (London: Faber, 1958), p. 189.
21. J. Kepler, *The Six-Cornered Snow Flake*, trans. C. Hardie (Oxford: Oxford University Press, 1966), p. 21.
22. J. Itten, *The Elements of Color*, p. 59.
23. C. G. Jung, *The Archetypes and the Collective Unconscious*; Jung et al., *Man and His Symbols* (New York: Doubleday, 1964); M. L. von Franz, *Number and Time* (Chicago: Northwestern, 1974); E. F. Edinger, *Ego and Archetype*.
24. See note 21.
25. A. G. Tyng, "Simultaneous Randomness and Order".
26. G. Fechner, *Elements of Psychophysics*, trans. H. E. Adler (New York: Holt, Rinehart and Winston, 1966), Weber quoted p. 30.
27. Vitruvius, *The Ten Books on Architecture*, trans. M. H. Morgan (New York: Dover, 1960), p. 73.
28. J. Hambidge, *The Elements of Dynamic Symmetry* (New York: Dover, 1967), pp. xv–xvi.
29. Le Corbusier, *The Modulor*, trans. P. de Francia and A. Bostock (Cambridge, Mass.: MIT, 1967), p. 239.
30. E. T. Hall, *The Hidden Dimension* (Garden City, N.Y.: Doubleday, 1966), pp. 118–119.
31. T. Sharp, *Anatomy of the Village* (London: Penguin, 1946).
32. H. Blumenfeld, *The Modern Metropolis* (Cambridge, Mass.: MIT, 1967), pp. 216–269, quotes H. Maertens, *Der Optische Masstab in den bildenden Kuensten*, 2nd edit. (Berlin: Wasmuth, 1877); O. Schubert, *Optik in architektur und stadtebau* (Berlin: G. Mann, 1965); P. Zucker, *Town and Square* (New York: Columbia University Press, 1959), p. 7.
33. Analysis and drawings of St. Peter's by S. J. Martin, teaching assistant for my course Human Scale in Cities, University of Pennsylvania in 1981.
34. One of several cul-de-sac studies for the Philadelphia City Planning Commission Louis I Kahn Consultant Architect, McAllister, Braik, and Tyng Associated Consultant Architects.
35. Plato, *Timaeus*, p. 21.



Robert Venturi '77

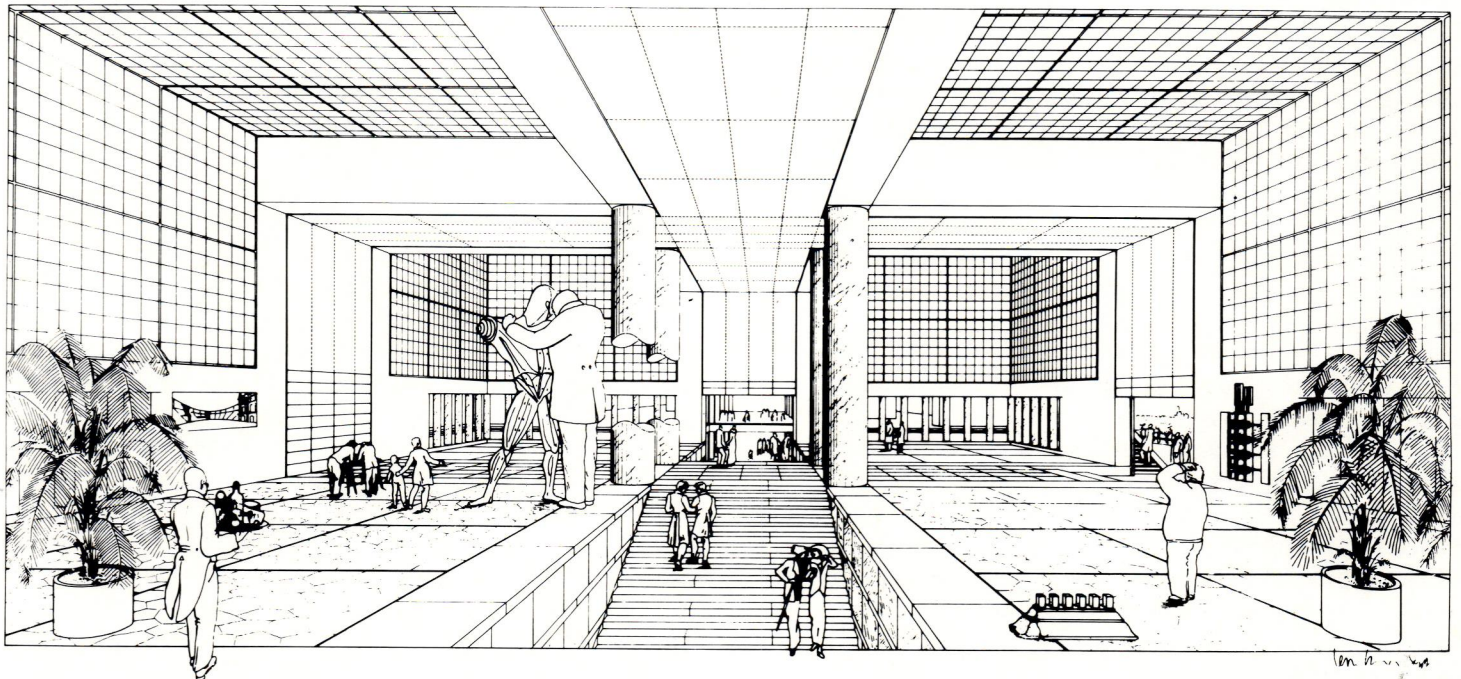
## "THE ODOUR OF A ROSE"

Gilbert Cass

*I suppose, indeed, that nobody will be inclined to deny that the end promised by a work of art is always to please the person whose senses are to be made conscious of it. It was done for someone who was to be made happier by it; his idle or restful mood was to be amused by it, so that the vacancy which is the besetting evil of that mood might give place to pleased contemplation, dreaming, or what you will; and by this means he would not so soon be driven into his workful or energetic mood; he would have more enjoyment, and better.<sup>1</sup>*

*Therefore the Aim of Art is to increase the happiness of men, by giving them beauty and interest of incident to amuse their leisure, and prevent them wearying even of rest, and by giving them hope and bodily pleasure in their work; or, shortly, to make man's work happy and his rest fruitful. Consequently, genuine art is an unmixed blessing of the race of man.<sup>2</sup>*

ARCHITECTURE seems to be reaching a mind-ful stage where one longs for an architecture of pleasure such as that described by William Morris, free from theoretical contamination. At the heart of the present architectural confusion is the age-old issue of how to reconcile or balance the often conflicting impulses of the intellect and the senses, the rational and the emotional. It is this internal rift that the seventeenth-century philosophers debated and T. S. Eliot termed "the dissociation of sensibility," a fissure between the mind and poetry. Eliot contrasts it with the union of heart and mind he saw in early French Renaissance poetry and suggests that poets then were able "to feel their thoughts as immediately as the odour of a rose."



At the moment we are experiencing the dissolution of one such period of reconciliation, for we are breaking away from the coherent intellectual, social, and esthetic ideal that modern imagery has been able to establish. This dissolution is caused not so much by a weakness of theory as by the failure of modernist imagery to reflect the complexity of contemporary society. Attempts to answer that need have catapulted the sensual and expressive back into the pages of architectural journals. However we label this phenomenon, it is essentially a rejection of a somewhat forced, reason-bounded cycle and reflects an overwhelming desire for the pleasure of an architecture that inspires sensual feeling and a visually active response.

Present architectural ideology has traveled a frenzied path dependent to a large degree on theories borrowed and transposed from other fields. Such liberal use of transposed theory has broadened speculation, but, we must ask, how has this affected visual imagery and the enrichment of space? The most obvious effect is that we have come to assume that for an image to be sincere or theoretically justified, it must be grounded within the expectations of reason and that a form must fit a predetermined set of parameters, whether these be functional, ideological, or esthetic. As this philosophy has become a method of design, architects' interests have moved further and further from the realm of visual and emotional sensation. Increasingly, object making has become externally motivated and unconcerned with sensual experience, to the degree that intellectual motivation has snuffed out "the odour of a rose." This dilemma has left the architect with little instinctual confidence in his own perceptual sense, and to a large extent visual collage and re-emergent historicism are symptoms of this loss. Throughout this dissatisfied search, architects are asking to "see" buildings again through their visual aspects and to respond first to "the way a thing presents itself to mind or eye." Perhaps we may view the present as a seesaw period in design, swinging between the admitted need for visual pleasure and the burden of an architecture infected with intellectual pretentiousness and functional practicality. This ideological vacillation suggests more than a reawakened interest in visual pleasure: it indicates the need for the kind of theoretical investigation that can heighten visual consciousness and sharpen visual acuity, encouraging a literate eye and a responsive visual instinct.

The visual artist probably has always known that the made object, by its nature, has a dual life of both feeling and meaning and that meaning has the tendency to reduce sensual effect. The artist knows instinctively that our first response to an object is emotive and that it is a "feeling" about the thing that inspires curiosity. This "object duality" in visual perception is characterized by the psychologist J. J. Gibson as both "literal" and "schematic." Literal perception is our direct sensory response to the pattern in the stimulus image or visual field, which is made up of phenomena such as color, texture, motion, depth, and so on. These phenomena we primarily perceive unconsciously and immediately through emotive reaction, mainly from feeling or instinct. Schematic perception, in contrast, depends on previous knowledge and describes the meaning or representative content of the pattern (tree, house, and so on), relying upon experience for perceptual understanding.

*Or, conversely, a style is not so much a "way of seeing the world" as it is a technique for representing what is already seen. The primitive arts, especially, suggest that the feeling for form is always limited, controlled, defined, by technical experience. Since nature offers the artist only the materials for a style, the formal patterns of art (as in*

*the distinct fields of decoration in primitive designs) are modified by craft and medium. Then, in turn, whenever the representation is conventionalized into formal patterns by craft and medium, these patterns themselves acquire symbolic meanings and emotional values. Technique influences form, and form, by a kind of reflexive activity, influences the techniques, therefore, the styles of the various arts are separable and distinguishable, for each art has its own techniques to exploit its special medium, subject, or substance.<sup>3</sup>*

Perception never conveniently separates the schematic and the literal, but for the sake of illustration it is helpful to consider each in turn, since we posit that each enhances or inhibits the other and thus affects the visual experience. I shall use drawings to illustrate this effect when discussing architecture, since it is difficult, when looking at architecture, to read the visual field and the visual character of the object literally. It is only by learning to see the visual field that we may describe our pleasure by abstracting our literal response from the more "real" schematic experience.

Schematic perception, because of its dependence on previous experience, has a tendency to discourage perceptual abstraction and to reduce the sense of immediate feeling. Our inability to walk easily with both perceptual forms is a relatively recent phenomenon. Familiarity with literal reading is simply no longer part of our perceptual training. During the Renaissance, architects were trained to "see" in this manner and demanded primarily an articulation of the literal. Directing the eye of the observer by manipulating literal phenomena was considered to be the most effective way to inspire insight. Drawing as a means of shaping patterns, highlights the literal aspects of the perceptual response. The two-dimensional picture offers multiple readings within a limited context where abstraction is relatively easy, and encourages the interplay between schematic and literal readings. Architectural drawings especially require us to accept this dual nature. The representative image of the intended real object and the literal pattern of the picture often simultaneously reveal the intended perceptual experience. The contemporary eye unfortunately has developed the habit of reinforcing the schematic representation while ignoring the more emotive reaction suggested in the literal interpretation. I suggest that it is the literal content of the drawing, revealed in the placement and pattern of marks, that primarily carries, either consciously or unconsciously, the perceptual and emotive content of the built object. A literal reading encourages us to see and feel our place in the made space. The ability to abstract becomes essential and can inspire a conscious use of visual phenomena in the drawing to highlight the visual experience of the built work.

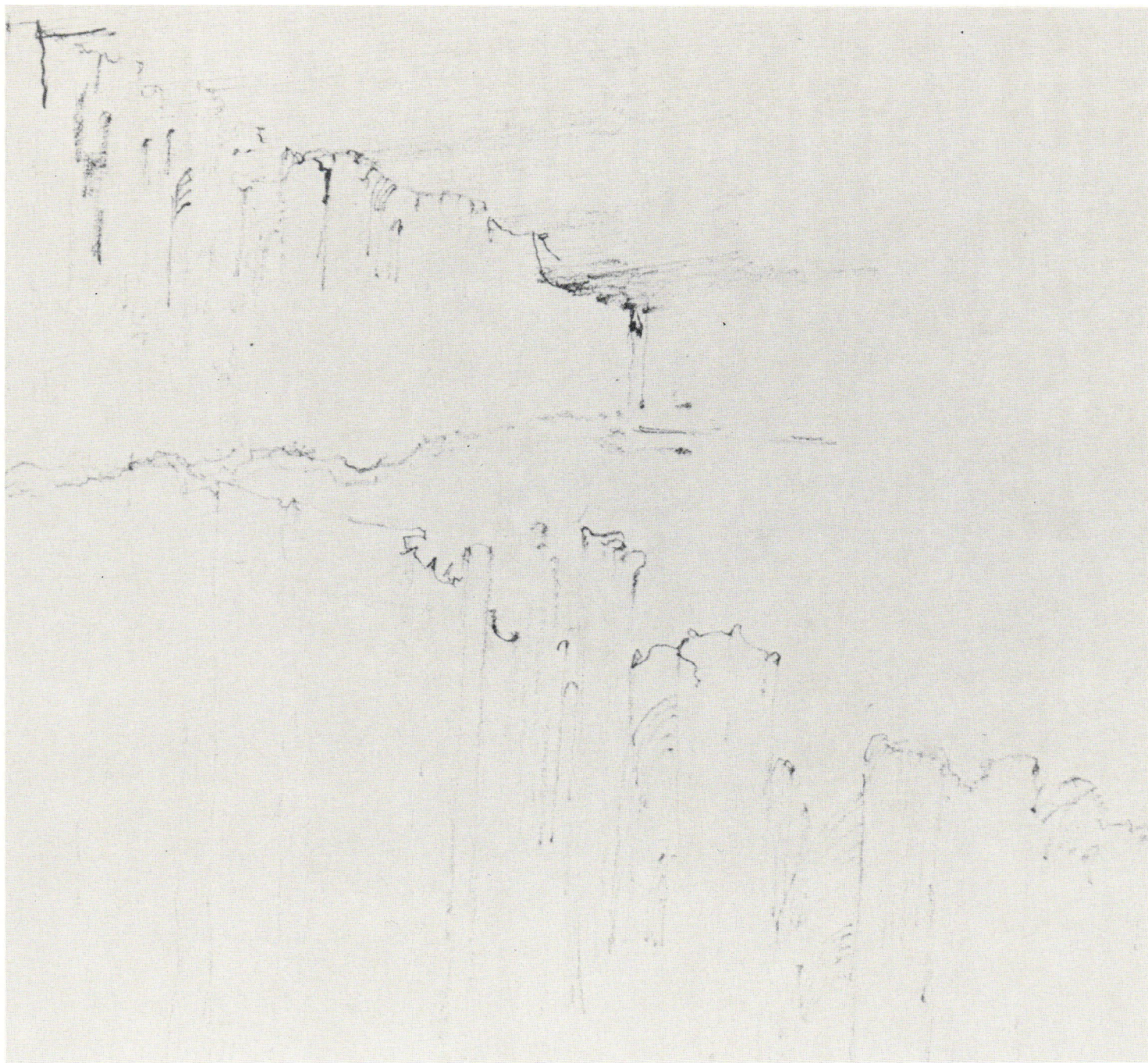
There is much to learn from those involved in perceptual research, and I touch here on two of the major tenets of William Morris's ideal of visual pleasure. First, we must have a conscious understanding of the effects of visual phenomena and second, confidence in sensual instinct, which I believe to be fundamental to the idea of pleasure.

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3. Folk painting presents a fresh and real image of the painter's idea of house and village. The distortion of perspective and proportion conveys the spirit of the image. It is not intended to represent reality but rather the feeling and memory of the place.

American School, *Twenty-two Houses and a Church*, c. 1850.





*Ritual is mechanical, so any ritualizing aesthetic must have the power to mechanize the artist's meanings. Poe's mechanisms are his "effects," whose compulsively precise workings are regulated by the theory of the picturesque. As defined by Joseph Addison, Uvedale Price, John Ruskin, and their restless crowd of colleagues, the picturesque is first of all a mode of perception. Its theorists presuppose a Lockean mind which draws its structures from the world by way of the senses. To keep this mechanically conceived organ alive requires a constant play of stimuli. As Addison points out, we "find our thoughts a little agitated and relieved at the sight of such objects as are ever in motion and sliding away from beneath the eye of the beholder."*

*Thought, guided by feeling, learns to join these perceptions in associative chains. Peculiar to each individual, these linkages to the poems, paintings, and best of all, landscapes where, to quote Uvedale Price, "the varied effects of light and shadow are promoted by the variety and intricacy of the objects" to be seen there. Picturesque effects don't work unless they lead quickly from one to the next. It is the pattern of effects which sustains meaning, so the mind's first concern is to keep its patternmaking mechanisms, its powers of association in good running order.<sup>4</sup>*

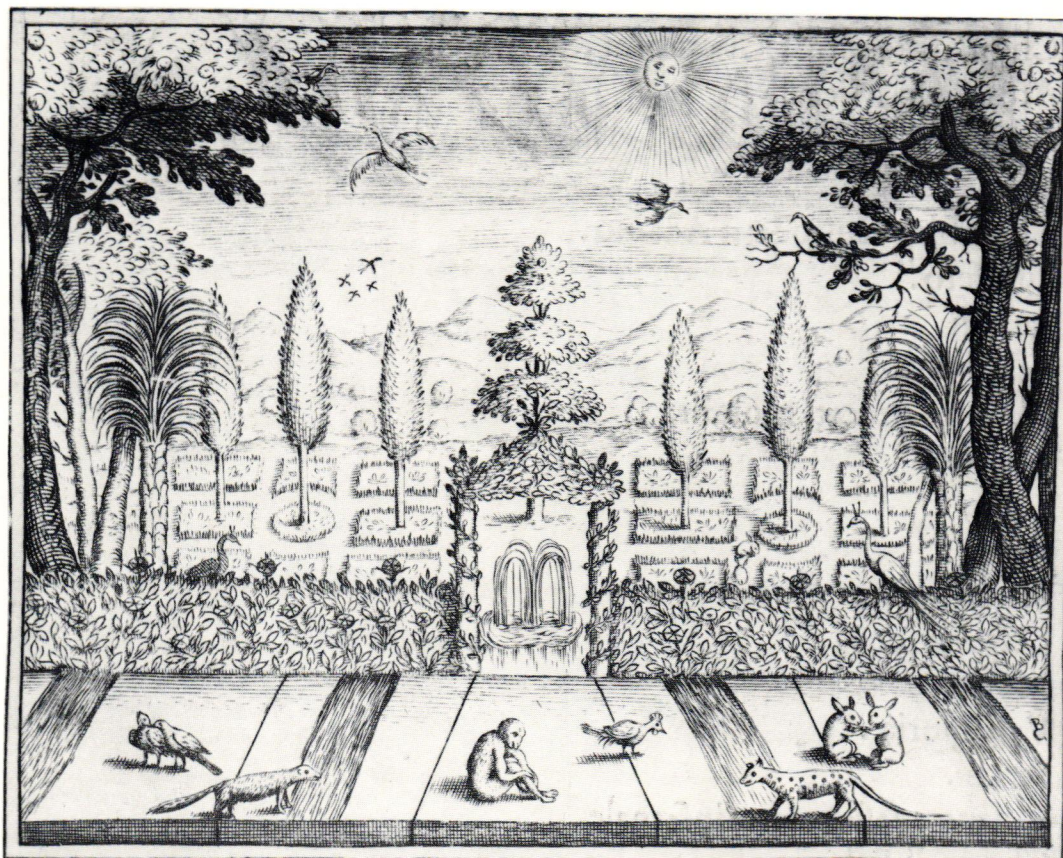
In the study of perception, theoretical investigation has attempted to present the process of visual understanding by describing the characteristics of the stimuli that provoke a sensory response. The early Gestalt psychologists described a method for exploring the mind's response to sensation by

focusing on the parts as a means of understanding the whole. They assumed that the physical, biological, and psychological responses to the stimulus are integrated in such a way that parts of the structure cannot be isolated without affecting the configuration of the whole. Phenomena that fitted Gestalt methods provided a rational basis for a search for the common roots of a visual language. This work formed a theoretical framework for describing a radically new way of experiencing the visual world and manmade objects. The original motivation for the early modernist experiments was the desire to strip the object of individual differences of technique and make its expressive impact more accessible to the viewer.<sup>5</sup>

*I realized, after an hour, that I had made a well-composed and very interesting sketch without having added the slightest invention of my own.<sup>6</sup>*

Although much of this work is now viewed as constrained and reason-bound, the early studies on abstraction by Mondrian, Van Doesberg, and others are extremely helpful records of the effort to connect the visual experience with descriptive phenomena and to suggest that sensory response and visual perception have common, universal features. An understanding of visual phenomena is essential if we are to make sensory response an integral and conscious part of design.

Visual phenomena are in one sense the reflection of the creative instinct. They indicate the uniqueness of signature that makes any work of art a reflection of the artist's special vision.



4. Alvar Aalto's sketches show the spatial gesture first intended and finally achieved in his architecture.

5. *The Garden of Eden is an idealized dream. The device of shifting from perspective space outside to narrative frontal space inside supports the ideal image of the garden within.*

*Garden of Eden, as illustrated in L'Adamo of Andreini, Milan, 1617.*

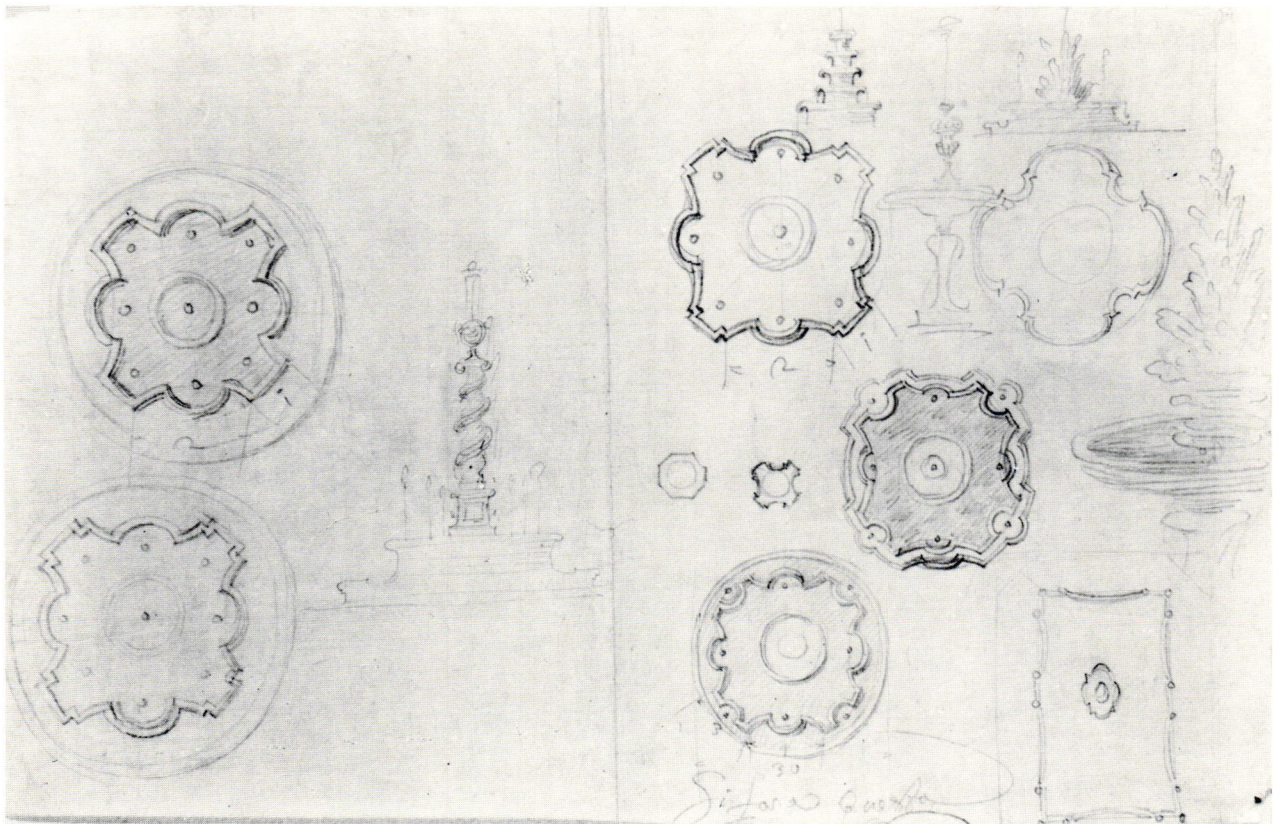
In any work of Art the primary medium is cast into a formal pattern, and there are analogies between patterns in unlike media, for spatial configurations can appear in literature as well as in painting or architecture. Tennyson, for instance, gains "distance" by presenting minute details in his descriptive foreground and leaving his backgrounds dim, vast, glimmering. So also, rhythm is one of the techniques of a style in either music, architecture, painting, poetry or sculpture; a pattern or recurrence that is, by analogy, similar in a minuet, a rococo panel, a painting by Falconet. The tempo of this style is kindred; and tempo is one device to make sculptural accent. By contrast, the rhythm is very different in the style to which belong the polychoral music by Giovanni Gabrieli, Saint Peter's in Rome, Ruben's painting, "Paradise Lost", and Bernini's statue of Saint Teresa. Even in literary "form" there are changing laws of composition governing the sequence, development and mode of statement or representation. A poem by Pope is not composed on the same formal principles as a poem by Swinburne.

The relation of an artist's subject with his style is "elastic." His style is his language and if this language does not allow him to say everything, it allows him to say what he chooses to say. To this degree style is both "vision and design." Technique is not merely a technical feat: if it is a way of representing what is seen or experienced, then it involves the whole cultural and social world that influences the artist to try to represent reality as he does. If style is a mode of representation, yet the artist is bound to represent the kind of world in which he lives, to which he belongs. Therefore not all

kinds of style are available at any given time, since a style is modified by the artist's own vision, and his vision, in turn, by the world he inhabits. Vision has its own history. There are "period" styles, period techniques, period angles of approach, periods of history.<sup>7</sup>

The notion of "visual history" is different from that of "period history" and may be considered separately from it. One can make a distinction between literal and stylistic principles in terms of Gibson's descriptions of the dual nature of visual perception. Visual literacy as the result of consciously "seeing" the literal character of an image and understanding the phenomena is of paramount importance to the notion of visual consciousness. For the artist, visual phenomena and technique are quite different means of expressing the literal nature of an object. The artist's technique may be defined as the way he organizes his material to create the intended visual effect, and visual phenomena may be considered the "facts" or "events" in the organization of material that illuminate the sensual effect of the image. Phenomena then must be considered separately from issues of subject and period style and must be linked to what Sypher calls "visual history" rather than to "period history".

The complex interplay between phenomena is the source of meaning and sparks the emotive effect of the image. If a successful work of art or architecture is one that gives "pleasure" and if we are curious about why and how it pleases, then we



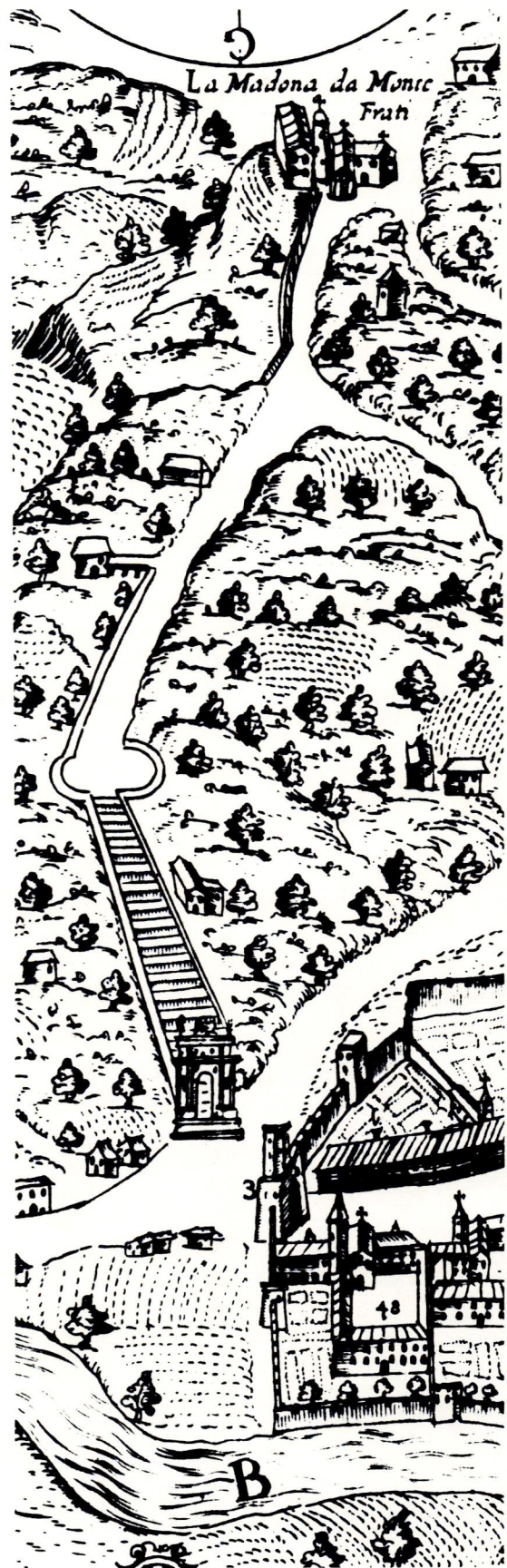
6. Borromini drew to find and reveal the intended spatial experience. Line is a search for what the eye will see in the real space. His interest is distorted perspective and extended vista and are read in the literal pattern of the drawing.

Francesco Borromini, drawings for a fountain for the Oratorio di S. Filippo Neri, Rome, c. 1640.

should become familiar with how visual phenomena affect sensory response to the image. A most effective means of study in the arts is drawing, the timeless tool of all concerned with the visual world. Drawing as a means to architectural design lost its primary position in the schools and in the profession during the mid-twentieth century and became dissociated from the visual pleasure of the built object. Although it has enjoyed a resurgence recently in architecture, there seems to be little evidence that the link has been reaffirmed as essential and that drawing has brought the architect closer again to visual history. Most modern architectural drawing suggests a dependence upon historic period style and a borrowing of images. Like recent theory the drawing, rather than bringing one closer to the pleasure intended, to the spirit or feeling of the visual experience, has tended to further remove the object from the possibility of reconciliation of "sensibilities".

If we agree with Sypher that for the artist style serves as the syntax of consciousness, then for the architect a drawing becomes more than a signifier of representative or symbolic information and should reveal the personal sensual and emotive insight of the artist. This indeed may suggest that there are two types of drawing, but more importantly it suggests two ways of reading. The one we are familiar with conveys real information about the built object, schematic information as opposed to literal. Scaled plan, elevation, and section drawings offer a familiar representative content yet are seldom read or seen as an expressive pattern that indicates attitudes toward spatial depth, motion, rhythm, and so on. The early intuitive sketches are more often thought to reveal feelings about these things. These notations carry the seed of sensual insight, revealing the phenomena that may orchestrate the visual experience of the building. Alvar Aalto's line sketches echo the feeling for movement and shape that uniquely characterizes his work. These early sketches are found in the final work. There is a conscious building and joining of line and element, for in each drawing, including the measured works, plans and elevations, is a link between the sensual idea and the placement of the physical parts to make an inclusive whole. Similarly, Borromini's drawings reveal the intentional distortion of perspective and unique selection of station point found in his built works.

Much of the drawing presently published by architects misses this critical point. We are seeing an abundance of architect's drawings published as objects, as complete, final, static images, pumped up collages of borrowed references devoid of personality and revealing an often empty visual instinct. Rather we must look to drawing in architecture as the means of illuminating a feeling about the thing, as a way of making sensations conscious and of discovering the essential phenomena that will build the perceptual theme. We are frequently blind to our own drawings, failing to see the visual clues in the pattern. Recognizing and reading the dual nature of drawings is as much a part of learning to draw as rendering the work. Seldom is the drawn work interpreted or, for that matter, conceived as an abstraction indicating the building's phenomenal intent. This failure is invariably the building's loss, as the drawing is the first means of illuminating the perceptual experience intended for the finished work. The failure to make explicit the sensual intent is a failure of the architect's capacity to abstract and until very recently, contemporary drawing acutely illustrated this lack. A reawakened interest in the drawing is a promising start to "seeing" architecture again as Morris's purveyor of pleasure.



7. The drawing is not intended to suggest a deep spatial vista but a sequence of events making a perspective drawing useless. The author's spatial invention illustrates the charm and variation of the journey.

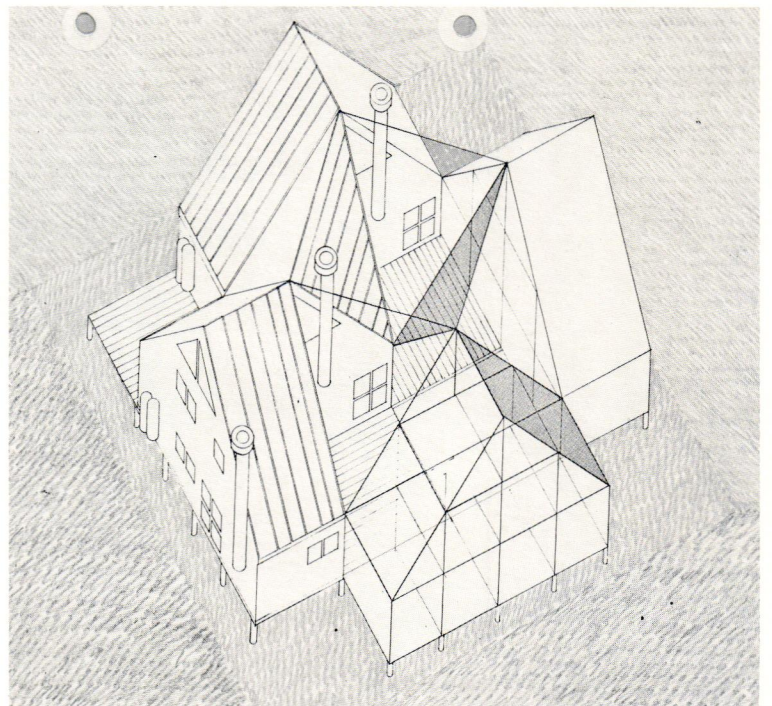
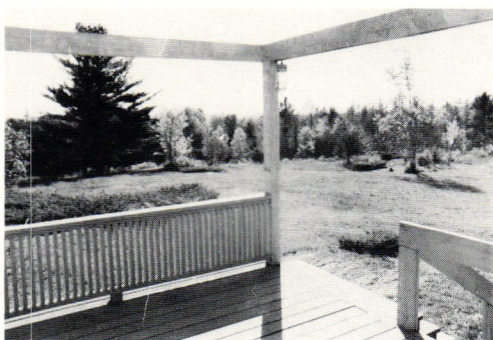
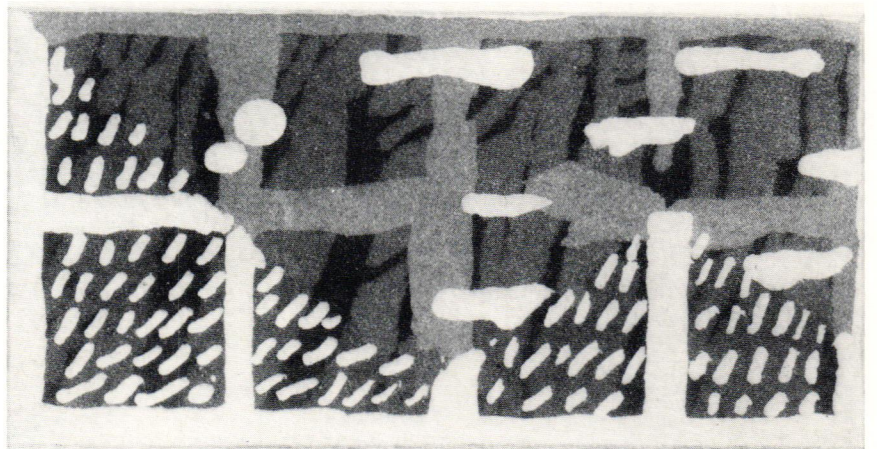
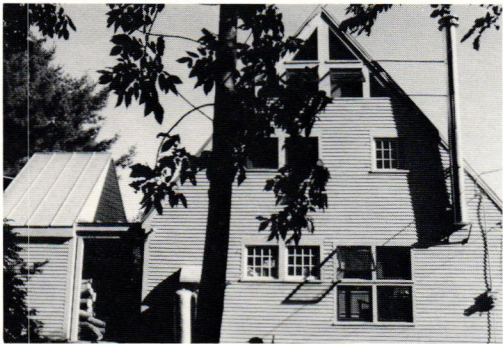
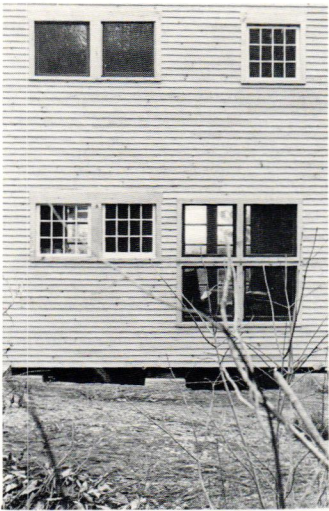
G. Monticalo, plan of Vicenza, detail showing the Church of Monte Berico, the Arch leading to the steps, L'Arco delle Scalette, and the Rotunda.

## Notes

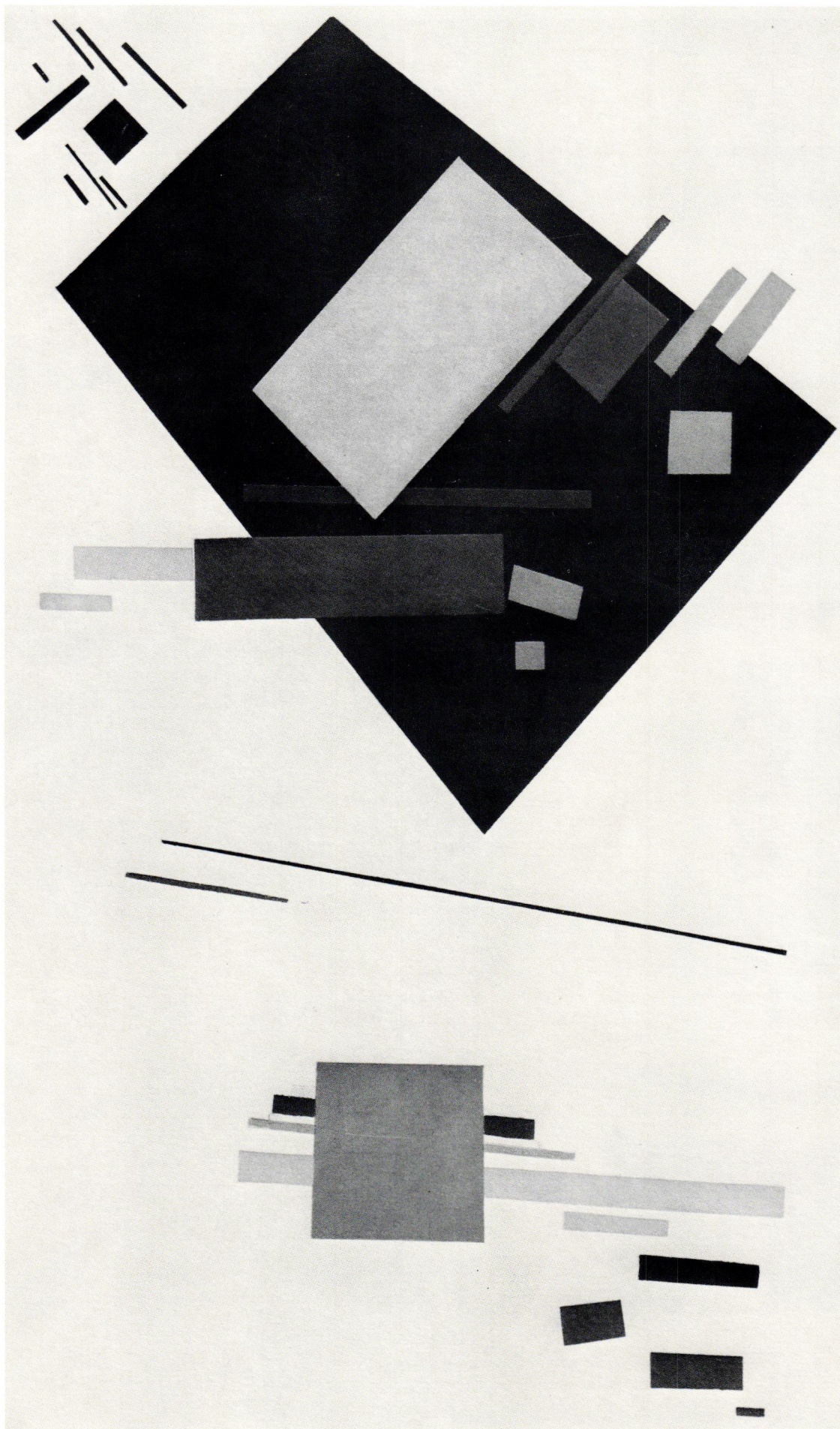
1. William Morris, *The Aims of Art* (London: Office of the Commonweal, 1877), p. 6.
2. *Ibid.*, p. 10.
3. Wylie Sypher, *Four Stages of Renaissance Style, Transformations in Art and Literature 1400–1700* (New York: Doubleday, 1955), p. 8.
4. Carter Ratcliff, *Joseph Cornell, Mechanic of the Ineffable* (New York: MOMA Publications, 1980), p. 10.
5. In this discussion, I use the word “phenomenon” as defined in Webster’s: “A fact or event in the changing perceptible forms as distinguished from the permanent ‘essences’ of things, as contrasted with their true or ideal being—an object of sense perception as distinguished from ultimate reality.” I make the distinction in order not to confuse my interpretation of visual phenomena with the more complex one found in Husserlian philosophy, which attempts to describe the formal structure of phenomena in terms of material essences revealed in pure acts of intuition.
6. Sypher, p. 10.
7. *Ibid.*, p. 13.

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Site drawings by the author are a way of finding the motion and rhythms of the place for a small house. They show the importance of window and shape as they evolved through studies of the surroundings. The window as the means for directing the eye to the multiple ways of seeing the setting and of experiencing the variable light evolved from these studies that imagined the experience intended.



1. Kasimir S. Malevich, *Suprematist Painting*, 1915.

# ASPECTS OF SPATIAL FORM AND PERCEPTUAL PSYCHOLOGY IN THE DOCTRINE OF THE RATIONALIST MOVEMENT IN SOVIET ARCHITECTURE IN THE 1920s

Anatole Senkevitch, Jr.  
Cornell University

OVER THE YEARS DIFFERENT THEORIES OF PERCEPTION have inspired various conceptions of architectural form and space. The psychological theory of "empathy" (*Einfühlung*), which proved influential in the last part of the nineteenth century, maintained that the observer "feels into" a perceived form the pressure of the weight, or force of gravity, that the form must resist. Thus, the visual effects of that pressure, which were believed to correspond to the observer's own physical state and bodily movements, were often insinuated in the design of forceful architectural forms.<sup>1</sup> The ensuing concept of a free and dynamic space that evolved in modern architecture in the early twentieth century was stimulated by psychological investigations into the phenomenon of space perception, involving the perception not of space *per se* but of objects in their spatial relationships to each other and to the observer.<sup>2</sup> The Froebel kindergarten "gifts," adapting psychological principles to help the child become aware of and perceive the visible world of objects, helped train Frank Lloyd Wright to think in three-dimensional terms about forms in space.<sup>3</sup> Concepts of basic design formulated by the Bauhaus masters also drew appreciably from theories of psychology, particularly Gestalt theories of perception. Walter Gropius maintained in 1947 that he had long been concerned with the psychological problems connected with the perception of architectural form and space. "I consider these psychological problems as basic and primary," he remarked, "whereas the technical components of design are our intellectual auxiliaries to realize the intangible through the tangible."<sup>4</sup>

Substantially the same viewpoint had been advanced in the 1920s by the Rationalist movement in Soviet avant-garde architecture. The achievements of this movement have long been eclipsed in the West by the intense interest in Constructivism, the other major trend in Soviet avant-garde architecture of the period, which frequently has been misconstrued as encompassing the whole of modern Soviet architecture.<sup>5</sup> The Soviet Rationalists promulgated a distinctive theory of dynamic spatial form in modern architecture, one whose salient tenets were extracted from contemporary modern art and rationalized by principles of perceptual psychology. The purpose of this essay is to illuminate this little known theory and to elucidate the relationships and influences of major historical and theoretical factors in its development.

The Rationalist movement obtained its primary theoretical impetus and name from the innate theory of a "rational" architecture postulated by Nikolai A. Ladovsky (1881-1941), in collaboration with Vladimir F. Krinsky (1890-1971) and Nikolai V.

Dokuchaev (1891-1944). In his only explicit published definition of a rational architecture, Ladovsky wrote:

*Architectural rationalism is predicted on economic principles just as is technical rationalism. The difference between them stems from the fact that technical rationalism represents the economy of labor and material in the creation of an expedient structure, while architectural rationalism represents the economy of psychic energy in the perception of the spatial and functional aspects of a building. The synthesis of these two rationalisms in a single structure, then, constitutes a rational architecture.<sup>6</sup>*

A rational architecture, for Ladovsky and the Rationalists, was one capable both of creating a homogeneous image of a visually ordered spatial experience and of communicating the prominent aspects of that experience to the observer through an expressive vocabulary of architectural elements systematized by principles of perceptual psychology. Ladovsky maintained that prerevolutionary architects, in concocting their designs out of the vocabulary of past styles, had conceived of buildings not as spatial environments but as mere trappings of archaic forms and details. Modern architecture, he believed, had to reassert the preeminence of the spatial environment by creating a suitable new language of architecture capable of articulating the emerging Rationalist conception of dynamic spatial form. The Rationalist doctrine constitutes the elaboration of just such a language.

In creating such a language, Ladovsky and the Rationalists focused on the problem of visualizing in vivid terms the salient aspects of their architectural thought. Their conception of spatial form was translated through the process of composition into meaningful images that were made up of discrete elements encompassing the rational new visual language devised expressly for the purpose. Space and mass were conceived as the basic elements of this new language. A new morphology and syntax were developed to facilitate the rational organization of these elements into an ordered architectural form. A new mode of composition was formulated to express the Rationalist conception of spatial form and experience, and to communicate these fully to the observer. Such an approach to composition was intended to help the observer perceive, in moving through and around a complex of spaces and masses, not only that each design element is integrally related to the one that precedes and follows it, but that every one of these elements contributes in a coordinated manner to a concept of the whole. The principal aim of the new language devised by the Rationalists was to articulate the expressive qualities of both the form itself and its encompassing spatial environment in a way that is visually lucid and perceptually clear. To verify the essential aspects of their new language, the Rationalists sought to investigate the human reaction to spatial forms and relationships that distinguishes harmony from cacophony, makes the observer prefer

certain aspects of form to others, and facilitates the observer's orientation to form and its spatial environment. Clarification of this psychological response to form and space was obtained by consulting the latest experimental findings in perceptual psychology.

The Rationalists followed a complex but fascinating route in arriving at their particular conception of spatial form, penetrating to the core of innovative developments in contemporary Soviet and Western avant-garde art. That route commenced with Ladovsky's and Krinsky's work in 1919-20 within the so-called Commission for Painterly-Sculptural-Architectural Synthesis (ZHIVSKULPTARKH), a small group of artists and architects dedicated to formulating an architectonic synthesis of the spatial arts. The focus of these initial explorations of modern art for means of articulating spatial form was sharpened in 1921 at the Institute of Artistic Culture (INKHUK), where Ladovsky, Krinsky, and Dokuchaev amplified their basic notions of design fundamentals. At the same time, reference to contemporary experimental findings in perceptual psychology at the Harvard Psychological Laboratory enabled the Rationalists to develop an objective framework of formal principles for organizing the elements of their new design vocabulary into a dynamic architectural whole. The facts of perceptual psychology were employed not as determinants of a style, but as a principle for organizing the design process and cultivating in the designer a dynamic three-dimensional manner of conceiving architectural form and space. The results of all these efforts culminated in the basic design course that Ladovsky developed at the Higher Artistic-Technical Studios (VKHUTEMAS) beginning in 1920. Here, the basic Rationalist concepts of dynamic spatial form were applied, tested, and refined within the exacting framework of a comprehensive program for teaching the new principles and methods of architectural design. All these varied activities proved vital excursions in which the Rationalists constantly developed new ideas on their route to the conquest of a dynamic new conception of spatial form. It is only in the larger cumulative context of the concepts that Ladovsky and his colleagues advanced and from which they borrowed along the way that the essential content and historical significance of the Rationalist doctrine can be properly understood.

### *The Commission of Painterly-Sculptural-Architectural Synthesis (ZHIVSKULPTARKH): Conceptual Beginnings*

Established in May 1919, ZHIVSKULPTARKH proved the cradle of the Rationalist movement in Soviet architecture. The commission, a small group of seven architects, two painters, and a sculptor, aimed at exploring the latest developments in avant-garde art in search of means to achieve a synthetic spatial art form. Through these efforts, Ladovsky and Krinsky, both members of the group, first discovered new dynamic elements of form and space, the relationships between them and their perceptual effects. It was here also that Ladovsky first voiced his fundamental belief that architecture was the art of space. "Space, not stone, is the material of architecture," he proclaimed in 1920. "It is in space that the soaring wonders of modernity will be built by art plus the intellect."

Ladovsky's early emphasis on intellect was characteristic both of the man and of the theory of architecture that gave rise to the Rationalist movement. In his few theoretical writings and scant publications of the period, Ladovsky appears as a disciplined thinker who assimilated leading currents of esthetic

and intellectual thought without undue excursions into utopian flights of fancy. Krinsky recalled that, from the outset, Ladovsky had "conducted himself in a very calm and civil manner" and possessed a "highly rational turn of mind that put a specific stamp on his work," which "proceeded to a far greater degree from intellect than from emotion."<sup>8</sup>

The idea of synthesis held by the members of ZHIVSKULPTARKH involved something more than merely combining architecture and monumental works of painting and sculpture. As Krinsky put it, they conceived of

*... a certain new form of art arising, as we thought, out of the traditional arts of painting, sculpture, and architecture and absorbing within itself all the latest achievements and formal qualities of construction, plastic movement, and color. This, simply speaking, was the new architecture for us architects, breaking with stylization, becoming rooted in a new building technology, and possessing new plastic and chromatic qualities. But such an architecture did not yet exist, and therefore had to be sought out through a difficult process of exploration.<sup>9</sup>*

That process focused on the latest achievements in avant-garde art in search of fundamentally new principles of abstract spatial form. At this stage, however, it was still essentially a painterly approach to form, insofar as these principles were extracted primarily from notions of constructing spatial form that had been advanced in modern painting. To be sure, their attention was focused on those aspects with clear implications for architecture. "Our attitude to such painting," Krinsky explained, was that "we did not see, nor wished to see, anything in it other than the material embodiment of composition, which we sometimes called 'construction,' i.e., the definite construction of form and chromatic mass concentrating within themselves in a condensed and clearly expressed form the material qualities of the objective world."<sup>10</sup>

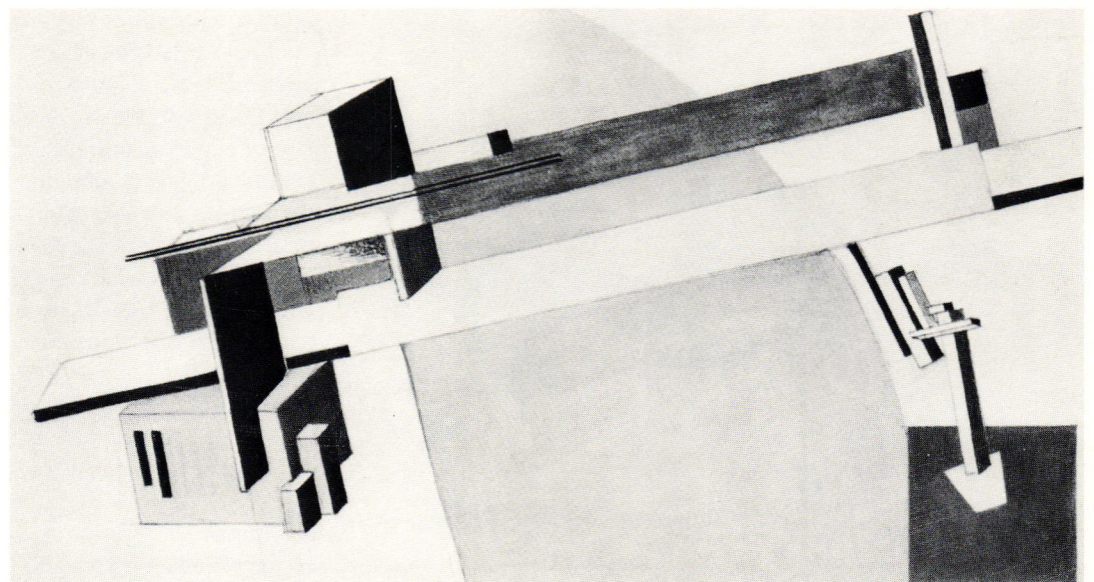
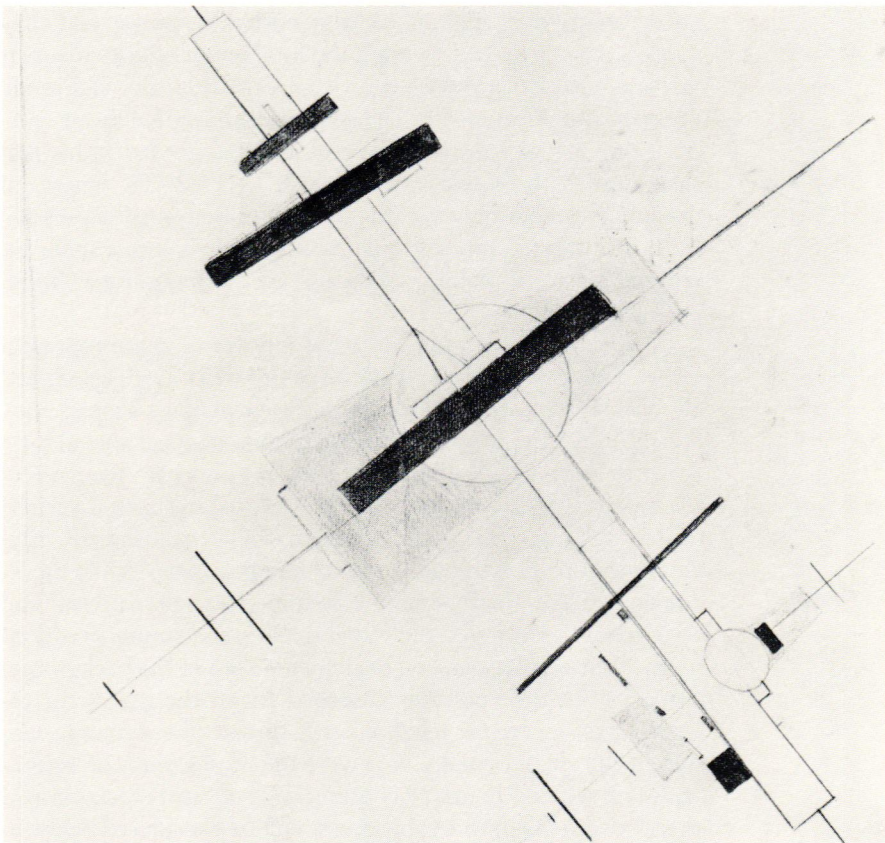
The initial frame of reference for these explorations was supplied by the analytical phase of Cubism, which had originated around 1909 with the work of Pablo Picasso and Georges Braque. Cubism appealed to the Rationalists at this juncture "because of its dynamics and simplicity of geometrical forms, their spontaneous juxtapositions and contrasts."<sup>11</sup> The Rationalists first discovered the use of the interpenetrating plane as a device for creating a dynamic multidimensional space in the Cubist rendering of simplified shapes as an aggregate of overlapping planes. From the Cubist technique of depicting objects as though seen simultaneously from several points of view and thus superseding conventional perspective, they also gleaned the artistic implications of the concept of space-time. Cubism thus played a vital role, as Krinsky put it, in "cleansing and cultivating our sense of vision." However, it was the subsequent experiments of contemporary Soviet avant-garde artists, moving from the Cubist fragmented representation of objects into the realm of totally nonobjective art, that provided the grist for Ladovsky's and Krinsky's experiments at ZHIVSKULPTARKH. Kasimir Malevich's Suprematism and El Lissitzky's Prouns, which amplified the Cubist measures for portraying a dynamic multidimensional space, suggested separate avenues for manipulating and heightening the spatial effects of abstract form, as did Alexander Rodchenko's spatial compositions with line and plane.

In his Suprematist art, Malevich, like the Cubists who inspired him, sought to return to the pure means of expression afforded by pristine elements of form, shapes such as squares, rectangles, circles, and triangles (Fig. 1). Unlike the Cubists, however, he reduced the number of elements, increased their size, and eliminated all traces of representation, creating purely

nonobjective compositions. In addition, he aimed for a visual equilibrium between the solids and voids created with these elements, thereby achieving a deeper and more powerful sense of pictorial space. In his "planite" drawings, the intersecting and overlapping rectilinear elements heightened the sense of space while virtually eliminating any evident links to painting as such (Fig. 2).<sup>12</sup>

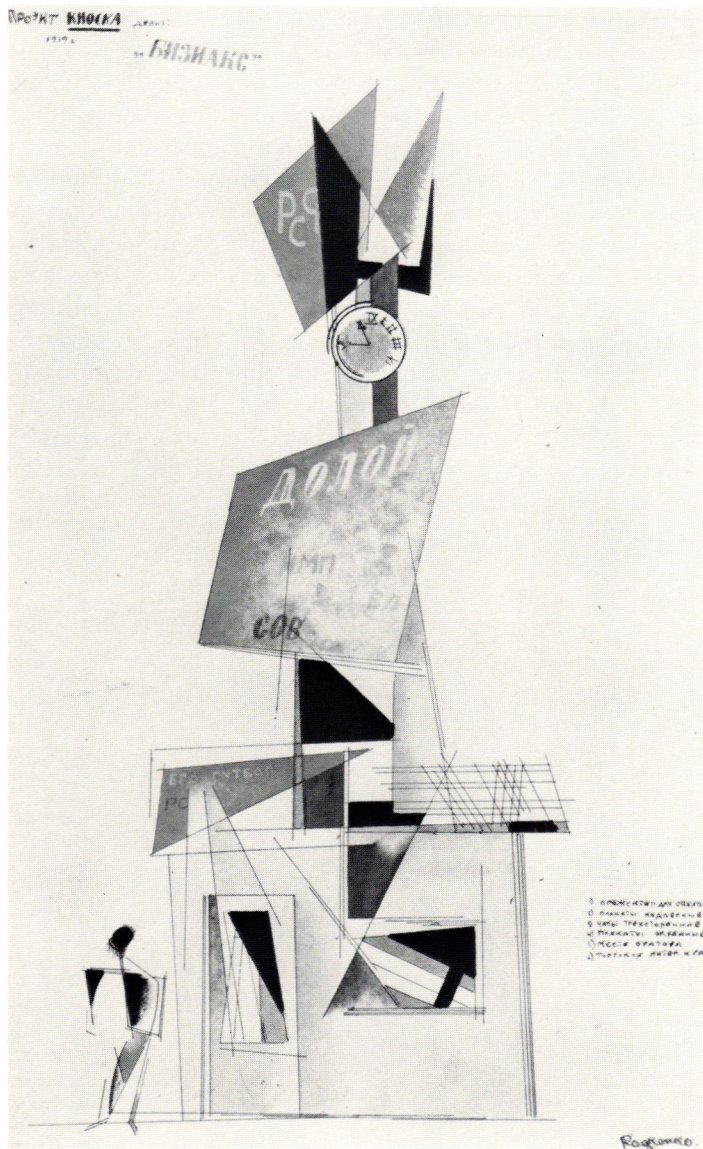
Malevich's art helped the Rationalists appreciate the perceptual power of simple unembellished forms. It must have indicated as well the virtually inexhaustible possibilities for combining these forms in expressive, dynamic compositions that evoke a concomitant sense of space. Its immediate implications for architecture, however, were developed not so much by Malevich's subsequent "architectons" as by the Prouns of El Lissitzky, which emerged as a logical consequence of his work with Malevich at Vitebsk in 1919-1921.<sup>13</sup>

Trained as an architect, Lissitzky had conceived of his Prouns as a distinctive formal realm, a "station on the way to building a new form," proceeding from painting to architecture.<sup>14</sup> His Prouns were three-dimensional elements in an essentially Suprematist system of spatial composition (Fig. 3). Unlike Malevich, however, Lissitzky conveyed explicit spatial depth by rendering his forms as actual three-dimensional entities, imbuing them with architectonic clarity. In addition, the various elements in Lissitzky's compositions not only move backward and forward in relation to the viewer, as do those in Malevich's Suprematist paintings, but imply movement in all possible directions, along a conglomerate of related axial systems as well. Thus, Lissitzky was not seeking to represent bodies at rest, but rather to convey a dynamic interplay of movements in different directions, suggesting a dynamic concept of kinetic form and space.<sup>15</sup>

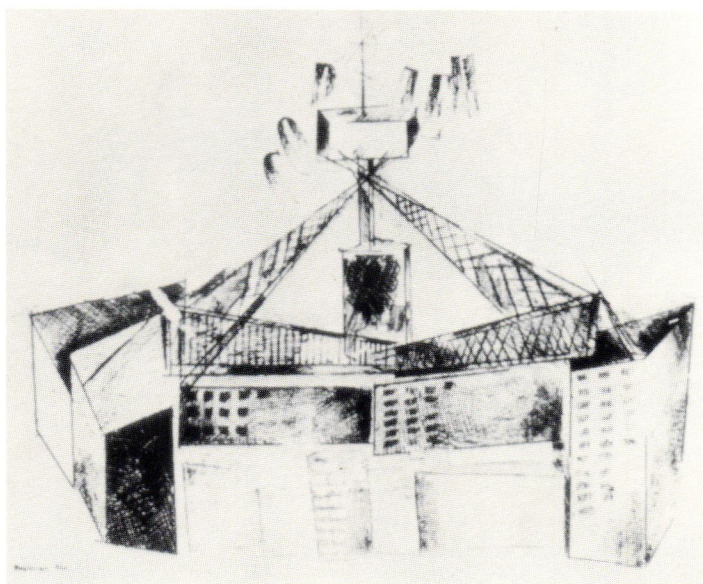


2. Kasimir S. Malevich, *Suprematist Architectural Drawing*, 1917.

3. El (Lazar M.) Lissitzky, *Proun IA, Bridge*, 1919.



4. Alexander M. Rodchenko, *News Kiosk*, 1919.

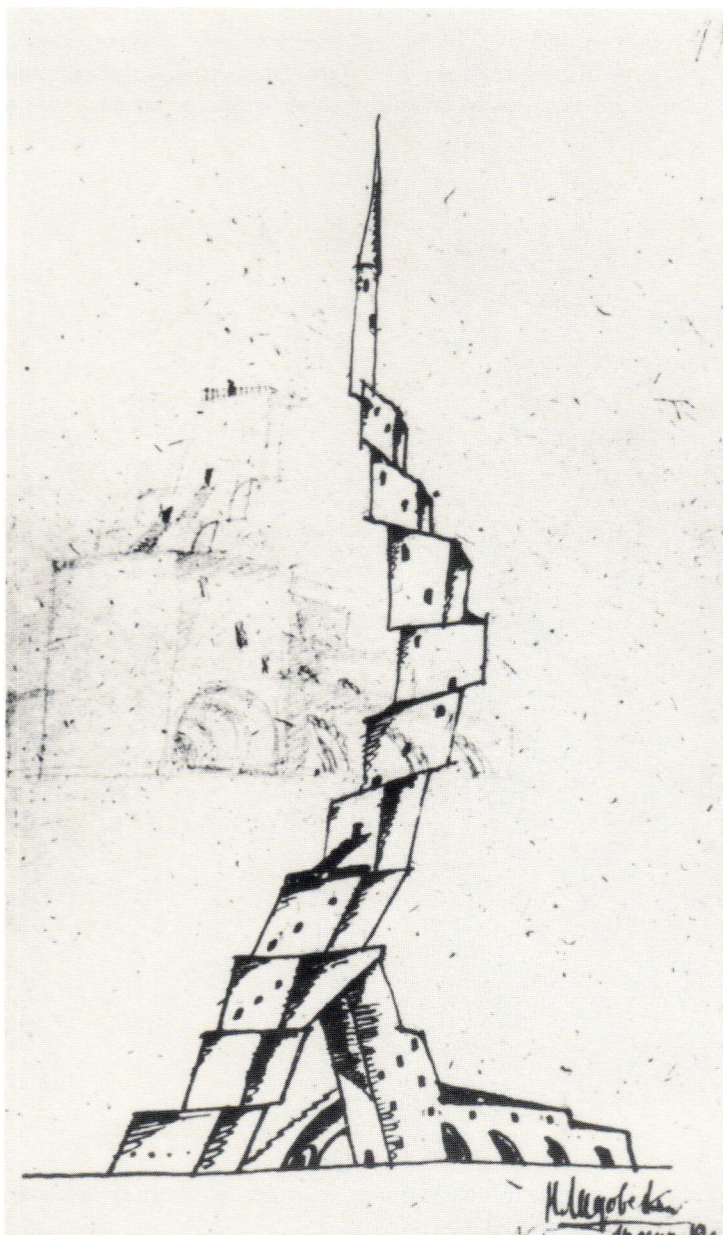
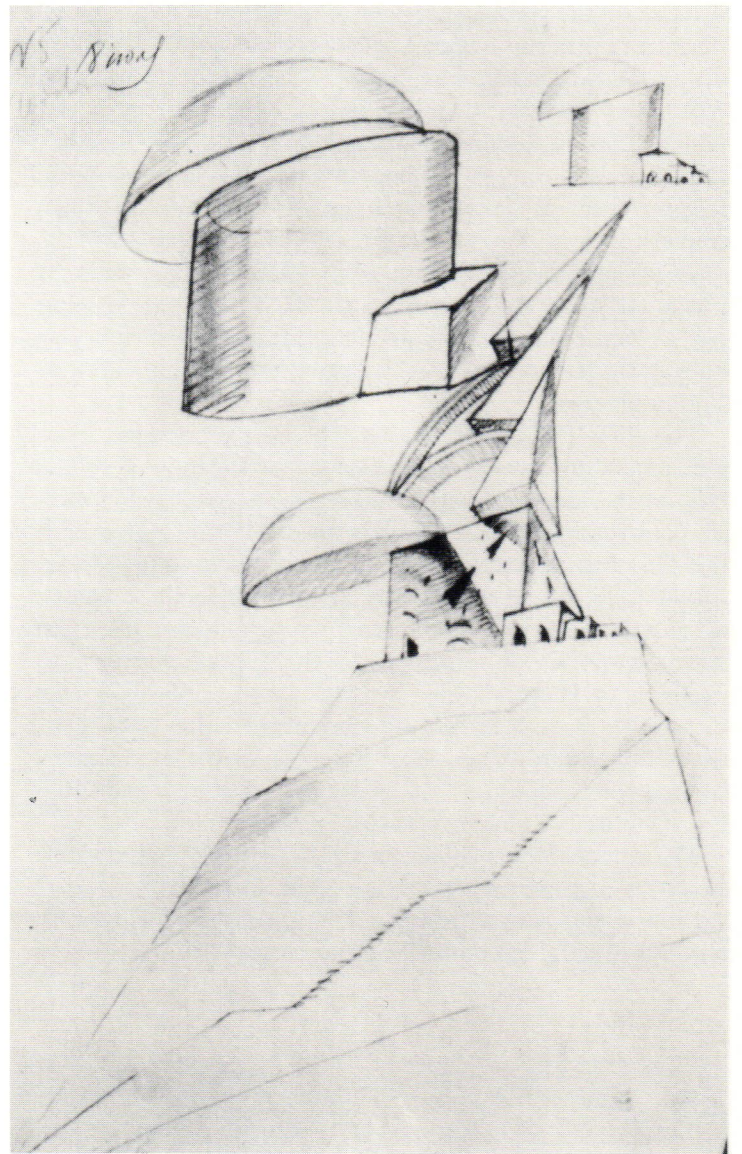


5. Nikolai A. Ladovsky, *Experimental project for the "Temple for The Congregation of Peoples,"* 1919.

Equally significant were the abstract compositions executed by Alexander Rodchenko between 1918 and his association with ZHIVSKULPTARKH. Rodchenko's work, though inspired by that of Malevich and others, had evolved along an independent and innovative course.<sup>16</sup> In the work produced just prior to his ZHIVSKULPTARKH period, Rodchenko succeeded in creating a system of pictorial construction in which the process of manipulating elements, rather than the shapes themselves, became the focus of perceptual activity (Fig. 4). While Rodchenko, like Malevich, used such primary shapes as the triangle, square, circle, and line, his compositions created a more definite impression of being constructed rather than composed. Correspondingly, he achieved a more vivid suggestion of pictorial space through the lively manipulation of line and plane, an effect that also differs from the one Lissitzky obtained in his *Prouns*. Each line, in itself, neither carried any particular esthetic impact nor implied any pictorial space. And yet spatial effects of considerable power and elaboration were achieved through the interaction of lines to create transparent planes possessing visual density, scale, and tangible spatial definition. Rodchenko's enthusiasm for linear composition, spatial construction, and architecture led to his participation in the work of ZHIVSKULPTARKH, where his designs created a new variety of three-dimensional expression by projecting his line and plane compositions into a more literal architectonic realm, as indicated by his design for a "building" (Fig. 5).

A significant common thread of innovative space representation runs through these tendencies in Soviet avant-garde art. By reducing plastic form to the most elementary shapes, they reestablished the primary constructive elements of spatial form that the Rationalists adapted to their purpose. By their use of the diagonal axis, contravening the accepted horizontal-vertical ordering of pictorial and literal space, they revealed a powerful device for creating dynamic spatial compositions. While the elemental shapes facilitated the juxtaposition of patterns and thus openly manifested the visual stresses and strains produced by the dynamic suspension of elements both in the background space and in the void that absorbed them, the use of the diagonal axis served to heighten still further the dynamic tension of the spatial whole. Nor were the implications of Tatlin's "counter-reliefs," or actual constructions of "real objects in real space" overlooked; these, however, will be considered below in the context of the Rationalists' move toward the design and construction of overtly three-dimensional spatial forms.

The initial thrust of Ladovsky's experiments at ZHIVSKULPTARKH was aimed at exploring the combination of space and volume as the content of the new architecture. A series of experimental designs for the "Temple for the Congregation of Peoples," modeled on the French and Belgian "Maison du Peuple" idea, explored the space-volume relationships of pristine geometrical volumes such as parallelepipeds, spheres, cylinders, cones, and pyramids in forms shaped by isolation, combination, coordination, or subordination. Evident in these exercises was a conscious effort to create not only a definite form of space, but at the same time a definite form in space. One of his designs featured an undulating, gradually tapering stack of truncated volumes, corbelled out one on top of the other and crowned by a conical spire, rising from a broad base (Fig. 6). Another design involved more complex multitiered groupings of pristine geometrical volumes, appearing to be at once autonomous and subsidiary elements of the whole, thrusting dramatically into the sky (Fig. 7). These exercises, focused on exploring the elementary aspects of volumetric



6-7. Nikolai A. Ladovsky, *Experimental project for the "Temple for the Congregation of Peoples,"* 1919.

form, recall the visionary designs of the German Expressionist Hermann Finsterlin, which likewise had arranged basic shapes into various utopian building types with a fantastic imagery all their own.<sup>17</sup> Despite their distortions of building form and seeming lack of architectural tangibility, Ladovsky's studies, like Finsterlin's, suggest a thoughtful and consistent attempt to explore means of imbuing architecture with a dynamic new richness of form. Parenthetically, Ladovsky's approach in this series of experimental designs is reminiscent of the notion of integrated space and volume as the basis of all architecture that, as Paul Zucker has pointed out, had been pursued in Germany at the turn of the century, inspired by Hildebrand's conception of space.<sup>18</sup>

The ZHIVSKULPTARKH experimental designs, however, tended to concentrate less on the articulation of volume than on the manipulations of planes as the principal element for constructing space, recalling Rodchenko's approach. It doubtless was here that Ladovsky first crystallized his conception of architectural form not as a closed, monolithic volume but as a dynamic series of layered, interpenetrating planes, as shown in another of his designs for the "Temple for the Congregation of Peoples" (Fig. 8). This project still shows unmistakable traces of Cubist influence in rendering what is still essentially a two-dimensional composition of an apparent three-dimensional form.<sup>19</sup> Rodchenko's project for a "building" (Fig. 5), reveals a more overt sense of "built" form.

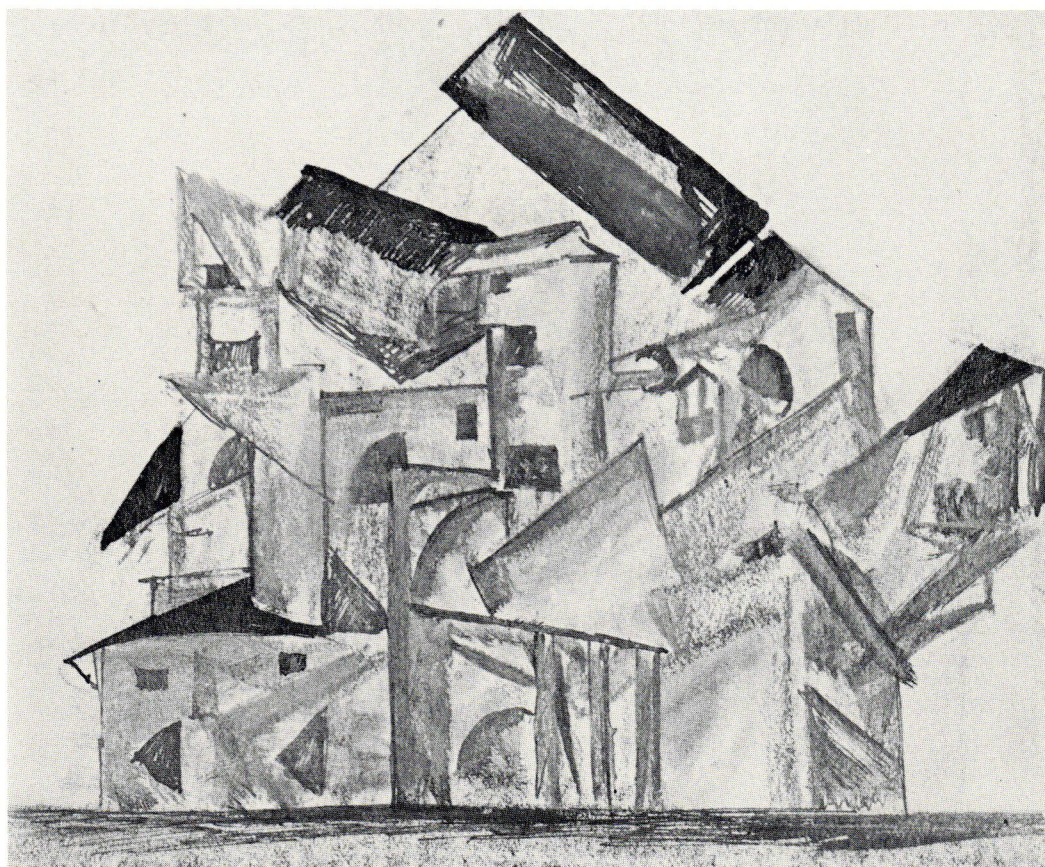
The works of the members of ZHIVSKULPTARKH were shown as a group at the "Nineteenth State Exhibition" in Moscow in the summer of 1920. They constituted, as Krinsky later remarked, "preliminary sketches and studies of new

building types" that were "not so much actual projects as quests for new means of expression in architecture." In that sense, they proved to be the initial crystallization of a distinctly Rationalist esthetic sensibility:

*Trying to free ourselves from traditional architectural paradigms and striving to overcome them completely, we sought a penetrating, dynamic expression of modernity, one permeated with the spirit of struggle. We did not delve into the details of actually realizing these projects, as our task lay elsewhere: to counter the surviving outlived forms with a search for the new, even if it were to assume the form of a graphically delineated declaration.<sup>20</sup>*

Ladovsky's project of 1920 for a communal house suggests a more explicit manipulation of the architectural envelope to enclose habitable space, proposing a multi-story building with rooms arranged around a central hall (Figs. 9-10). The complex, dynamic aspects of this design flow out of the juxtaposition of a skewed rectilinear plan and the external composition of irregular parallelepipeds, crowned by soaring cantilevered projections which recall the conical spires surmounting Ladovsky's earlier volumetric compositions. Ladovsky's approach appears liberated from literal references to Cubist painterly technique and recalls Rodchenko's manipulation of planes to establish the apparent boundaries of spatial form.

However schematic the designs, the ZHIVSKULPTARKH phase of Ladovsky's and Krinsky's work confirms that, from their studies of the articulation of spatial form in modern art they succeeded in deriving vital elements for a dynamic new language of architecture. The Rationalists would sharpen and refine the basis aspects of this new language in their work at INKHUK.



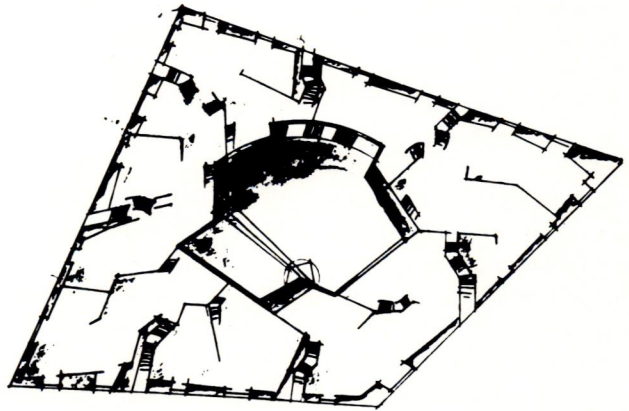
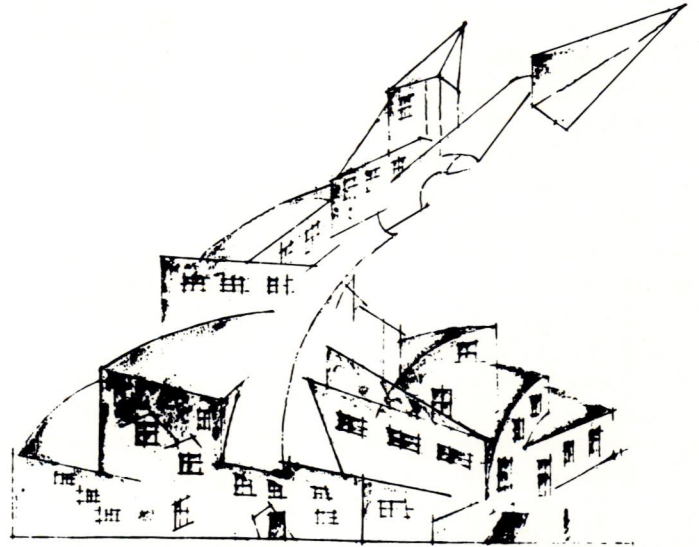
8. Nikolai A. Ladovsky, *Experimental project for the "Temple for the Congregation of Peoples,"* 1919.

### *The Institute of Artistic Culture (INKHUK): Theoretical Consolidation*

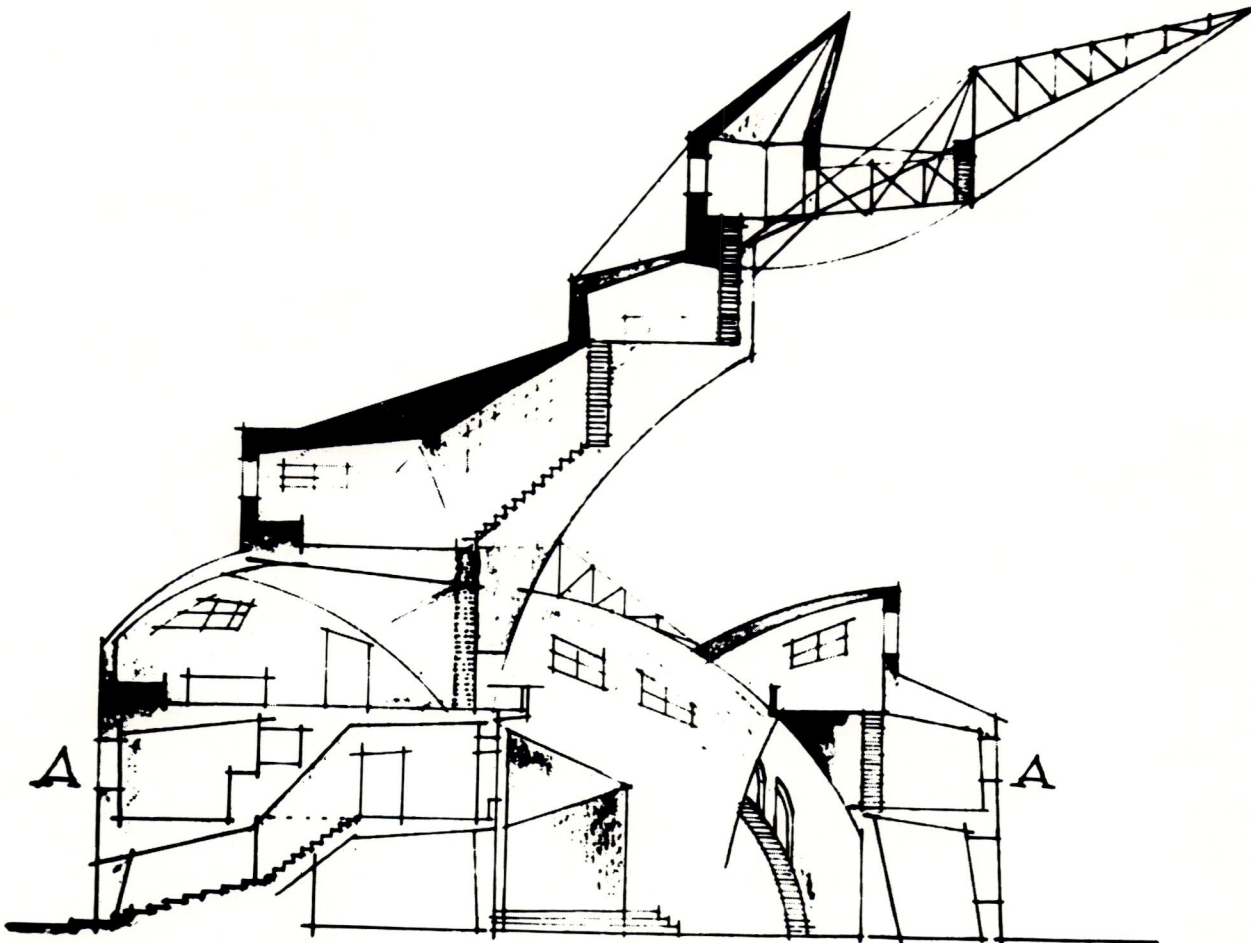
Organized in May 1920 under the aegis of the Fine Arts Department in the Commissariat of Enlightenment, INKHUK emerged as a key center where the theoretical underpinnings of the leading currents in Soviet avant-garde art were developed. During this relatively brief but fertile period, the work of INKHUK vacillated between the fractious extremes of "pure" and "applied" esthetic and ideological tendencies. One extreme was marked by the initial phase of activity under Vasily Kandinsky, who conceived of INKHUK as a research institution for analyzing various aspects of the fundamentals of artistic creation and relating them to the human psychic experience. At the other extreme stood the proponents of a "productive" art, whose rejection of "easel art" and advocacy of the creation of socially useful objects led to the rise of Constructivism in the fall of 1921. Nestled in between these two extremes was a discrete phase of development, which was not Constructivist in either content or orientation, that emerged in opposition to Kandinsky's metaphysical approach. This phase, with its promulgation of the so-called "objective method" for analyzing art, supplied the basic framework within which the Rationalist nucleus at INKHUK conducted its work.

#### *The Kandinsky Period*

As the institute's first president, Kandinsky developed a comprehensive program for its proposed activity. His preamble to the program announced: "The purpose of the work of the Institute of Artistic Culture is the science of researching analytically and synthetically the fundamental elements both of the individual arts and of art as a whole."<sup>21</sup> The program proposed conducting theoretical research into the means peculiar to painting, sculpture, architecture, music, dance, and poetry.



9-10. Nikolai A. Ladovsky, *Experimental project for a Communal House*, 1920.



This analysis was to be conducted "in terms of ascertaining the reflection of the means of art in the emotional experience of the person perceiving it, i.e., in his psyche." The scope of this analysis was to encompass investigations into not only formal elements per se, but also the psychological factors operating in man's perception of these elements in the given forms of art. Emphasis was to be placed on analyzing those aspects that affect man's emotional state in perceiving art, that bring him to a state of ecstasy, for example. Kandinsky's program also professed the need to clarify the role of the subconscious in the creative process, and to develop a theory of the interrelationship of the plastic arts (painting, sculpture, architecture) that would lead to the creation of a synthetic, architectonic, monumental art.

Notions of such a synthetic art, recalling those advanced in ZHIVSKULPTARKH, were, in truth, never more than ancillary concerns of either Kandinsky's program or his art. The work undertaken during the eight months of Kandinsky's tenure at INKHUK was dominated by his desire to explore the rhythmic and psychic associations between painting and the "time arts" of music, dance, and poetry as a way of rationalizing his personal conception of the ultimate synthetic monumental art. Though Kandinsky later incorporated these highly original ideas into his teaching methods at the Bauhaus, they proved too tangential to prevailing theoretical impulses and interests to constitute the singular direction of theoretical inquiry at INKHUK.

Disturbed by Kandinsky's virtual elimination of sculpture and architecture from consideration and distressed by the subjective cast of his psychological method, a number of INKHUK members rallied around Rodchenko in opposition to Kandinsky's approach. In the fall of 1920 they advanced an "objective method" for analyzing art and established an autonomous Working Group of Objective Analysis to counter Kandinsky's group. In January of the following year, nine new members were voted into the institute, including Nikolai Ladovsky and Vladimir Krinsky. A proposal calling for adoption of the "objective method" was put forward. Kandinsky's faction, now a minority, was outvoted and left the institute.<sup>22</sup>

Although Kandinsky's call for scientifically based research into the formal means of art and into the psychological aspects of human perception were consonant with general Rationalist intentions, its reworking in the next phase of INKHUK's activity provided a more congenial paradigm for the Rationalist doctrine.

#### *The "Objective" Reaction.*

In the wake of Kandinsky's departure, the Working Group of Objective Analysis became the conceptual nucleus of INKHUK, headed by the sculptor Aleksei V. Babichev (1887-1963). Greatly streamlining Kandinsky's tendentious proposal and discarding its metaphysical baggage, Babichev drafted a new program which sought to transform its nominal scientific underpinnings into an objective framework for the research and analysis of art. In adopting the scientific method, it made clear that its aim would be objective analysis rather than subjective speculation: "Emotional factors (and ethics), as subjective causes of one artistic phenomenon or another, can be incorporated in an object of research . . . but cannot be incorporated in methods of research."<sup>23</sup> Babichev's program established two basic directions for the institute's work. The first stressed theoretical work, which encompassed the analysis of art and postulations of artistic concepts and theories. The sec-

ond, that of "laboratory work," involved the testing of these concepts in actual graphic experimental studies.

One of Babichev's apparent concerns was to divest abstract form from its overlays of subjective associations and to assert its credibility as a logical consequence of *a priori* esthetic intentions. "There are in essence no abstract forms in art," he explained. "There are objective and nonobjective, but always *concrete* forms." Apart from arguing against the use of the term "abstract" as a synonym for "nonobjective," Babichev maintained that an inclination toward abstraction in art was nothing more than a manifestation of the artist's power of abstract thought, expressing itself in the formulation of his artistic concepts. Thus, he concluded, "what in art is called 'abstract form' . . . is actually concretized conception."<sup>24</sup>

Of the various topics considered at INKHUK, none provoked greater controversy than the one on "composition and construction." The long debate that unfolded in the spring of 1921 precipitated a schism that was to lead to the rise of Constructivist art, and that very likely proved a source of much subsequent contention between the Rationalist and the Constructivist movements in Soviet architecture. The thrust of the initial stages of the debate focused on concepts of construction and composition in art as a whole. In time, the focus shifted from painting, where construction with real materials was not possible, to the idea of a synthetic constructive art that involved the actual construction of objects. The initial result was that the nature of the object as such, rather than the manner of its construction, emerged as the question of primary concern, leading to the idea of "objectism" (*veshchism*). According to this view, an art object, while it could serve a useful purpose, had to be conceived as something more than merely a utilitarian implement. Its design had to evolve as a conscious product of esthetic intentions over and above functional and technical considerations. The gist of the "object" idea was expressed by Lissitzky, one of its staunch exponents, in an editorial for the trilingual journal, *Veshch/Gegenstand/Objet*, that he and Ilya Ehrenberg had founded in Berlin in 1922. For us, he wrote,

*. . . art is the creation of new objects. This determines our dedication to realism, to weight, to volume, and to the earth. But it should in no way be thought that, by objects, we mean articles for everyday use. Of course, in utilitarian objects manufactured in factories—the airplane or the automobile—we see genuine art. But we do not wish to have the production of artists limited to utilitarian objects. Any organized production—whether it be a house, a poem, or a painting—is a useful object that does not isolate people from life but helps them organize it. Thus, we are far removed from the poets who in their verse propose to quit writing poetry, or from the artists who, with the help of paintings, propagandize their rejection of painting. Primitive utilitarianism is alien to us.*<sup>25</sup>

Both the "object" idea and the esthetic sensibilities underlying it, paralleling those that later gave rise to Nikolaus Pevsner's now-famous dictum that "A bicycle shed is a building; Lincoln Cathedral is a piece of architecture," had already been rejected by a new majority within INKHUK by the time Lissitzky's editorial appeared. Indeed, it is possible to see the remarks about painters as a pointed reference to the "5 + 5 = 25" exhibition, held in Moscow in the preceding autumn, in which five artists had proclaimed their rejection of easel art and professed the belief epitomized by Varvara Stepanova's declaration that "technology and industry have confronted art with the problem of *construction* not as a contemplative representation, but as an active function."<sup>26</sup> These artists and others at INKHUK, who organized the "Productivist" group that

emerged as the conceptual nucleus of Constructivist art, had also proclaimed themselves to be "against the object." They opposed the "object" idea as an impractical and damaging ideology whose categorical rejection of utilitarian utensils as legitimate objects of art would thwart the critical transition from a "laboratory art" to a viable program for an industrially based productional design.

Ladovsky and Krinsky were sympathetic to the "object" idea and especially to the method of "objective analysis" advanced by Babichev. While they may well have derived some inspiration from Kandinsky's statement, the Rationalists adapted Babichev's program, with its objective approach to art, as the basis of their work within the Working Group of Architects at INKHUK.

*The Working Group of Architects.* Established in March 1921, the Working Group of Architects was one of several groups, each one devoted to a separate art form, created within INKHUK as adjuncts of the Working Group of Objective Analysis. The architects' group was headed by Nikolai Ladovsky and included Vladimir Krinsky and Nikolai Dokuchaev, as well as A. Efimov, I. Petrov, and G. Mapu, all of whom were members of the Rationalist movement. Thus, this small body proved simultaneously the first organized grouping of modern Soviet architects and the organizational nucleus of the Rationalist movement. In 1923 this nucleus expanded to form the Association of New Architects, or ASNOVA, that likewise was organized by Ladovsky, together with Krinsky and Dokuchaev.

The period during which the Rationalists were active in their working group at INKHUK, though rather short-lived, appears to have been a fertile one. It was here, in the initial spirited give-and-take of theoretical speculation that permeated INKHUK before the lines were hardened by the strident, Constructivist-induced schism, that Ladovsky and his Rationalist colleagues worked to amplify salient theoretical concepts.

Emphasizing the need for "the most expeditious development of our program," which was adopted in April 1921, Ladovsky outlined three basic phases of work that he and Dokuchaev had projected for the group. The first involved the compilation of all existing theories of architecture. The second concerned the accumulation of collateral material applicable to architecture that had been developed in other realms of art, including the research undertaken at ZHIVSKULPTARKH and currently under way at INKHUK. The third phase, the crux of the effort, was to concentrate on "the elucidation of our own theoretical views on architecture." These three phases were intended, as Ladovsky put it, to "encompass the past, or 'what was done;' the present, or 'what is being done;' and the future, or 'what should be accomplished' in respect to our theoretical substantiation of architecture."<sup>27</sup>

Adapting the conceptual thrust of Babichev's statement, the Rationalist program called for systematic research, based on the scientific method, into what were deemed the essential elements of architecture:

*The group considers the predominant and fundamental elements of architecture to be: space, form, and construction. Acknowledged as the secondary elements of architecture and acting as its means of expression are: mass, weight, color, proportion, movement, and rhythm. Since the essence of architectural solutions leads to the controlled modulation of spatial magnitudes, the problem of space, which architecture employs as its material, constitutes its most critical problem.*<sup>28</sup>

The program also stressed the significance of the "psychology of the perception through which, in the final analysis, the means of architectural expression register their appeal."

Among the art theories explored in some depth in this period was the one advanced by the German sculptor Adolf von Hildebrand, who aimed at a spatial fusion of sculpture and architecture. The concept of perceptual form and space promulgated in his important treatise *Das Problem der Form* (1893) bears a marked affinity to the conceptions which the Rationalists put forth at INKHUK.<sup>29</sup> Dokuchaev referred to Hildebrand's ideas in his own writings, and included the Russian translation of Hildebrand's treatise in the basic readings for his course on architectural composition; it is conceivable that Hildebrand's work may have acted as a catalyst in helping the Rationalists realize the extent of the interrelationships between perception and spatial form, thus prompting them into a more probing inquiry into the principles of perceptual psychology.

Hildebrand's theory of perceptual form and space, which emphasized the need for movement in experiencing plastic form, suggested that the observer could comprehend the significance of such a three-dimensional composition *in its entirety* only through a sequence of movements around it. The whole of its esthetic impact could be experienced in no other way, he explained, as an appreciable part of the form is always out of sight when observed from any single vantage point. In addition to establishing the importance of the observer's role in perceiving the essential elements of form, Hildebrand also maintained that the most significant aspects of form proceeded from its spatial characteristics.

Esthetic perception was regarded by Hildebrand, much as it was later to be viewed by the Rationalists, as the perception of the constituent elements of plastic form interacting to reveal its three-dimensional properties and spatial relationships. Similarly, his notion of the "total space" in which art objects exist conceived of space as a coordinated three-dimensional matrix within which all forms are organized and perceived. Hildebrand thus argued that the artist, to facilitate the observer's perception of these basic three-dimensional aspects of both form and space, should build up his forms in parallel layers. The resulting transposition and interpenetration of the successive planes comprising the visible surface of the form would thus serve to heighten the observer's awareness not only of its evident depth, but also of its orientation to the encompassing spatial matrix.

Although Hildebrand's theory was aimed chiefly at promoting a simplification of contemporary sculptural form, its implications for architecture as one of the more vivid repositories of perceptual form and space were also addressed:

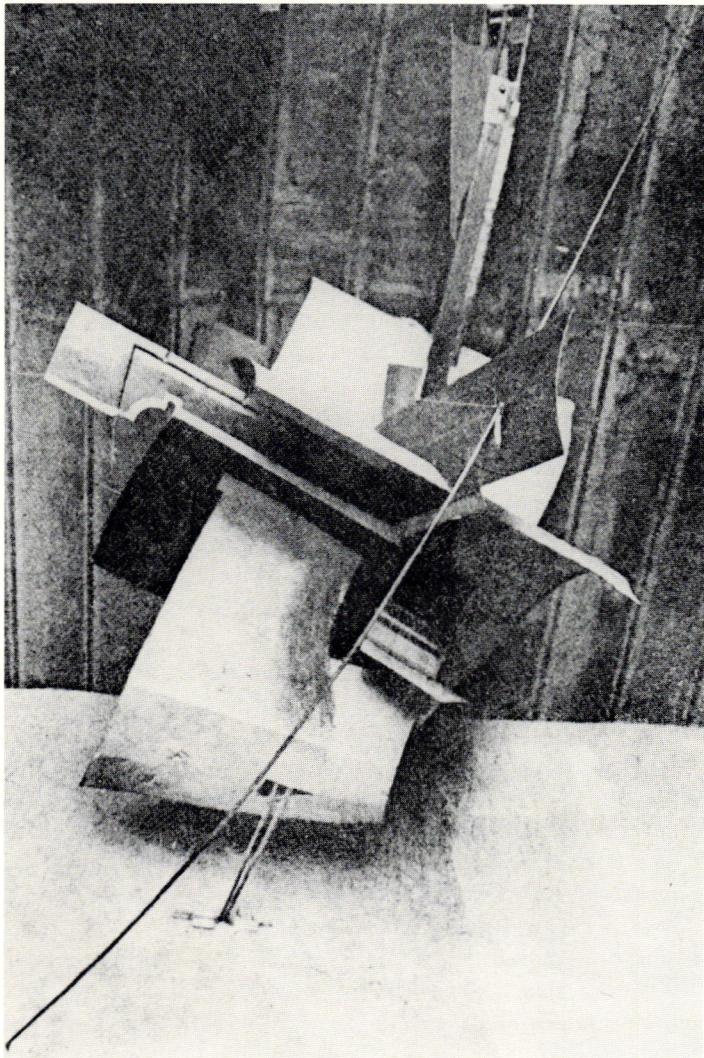
*Our relation to space finds in architecture its direct expression. Architecture arouses in us not merely the idea of a possibility of movement, but a definite feeling of space; instead of having to orient ourselves, as we often do when confronted with Nature, we are saved in that effort by having before us a space that has already been definitely articulated. Furthermore, just as in sculpture, where ideas of movement are stimulated and attain unity of effect through visual impression, so, in architecture, space itself, in the sense of actual form, is converted into a visual impression.*<sup>30</sup>

In addition to reducing spatial experience to visual image, Hildebrand also made clear his belief that ideas of function were not independent considerations in architecture, but were instead subordinated to the demands of the ultimate spatial form. Indeed, he concluded, "it is only within a certain total effect of space that the functional representation can develop,

and can take shape in specific architectural forms." These sentiments were to be echoed by the Rationalists as well, albeit more convincingly, in the tenets of their design method.

The most descriptive early exposition of the crystallizing notion of perception and space as the *leitmotif* of the Rationalist doctrine is found in the talk that Vladimir Krinsky delivered at INKHUK in May 1921. In it, he evidently felt the need to put some distance between his conceptions and Kandinsky's initial program and activities at INKHUK. "The point of departure for our exposition is not metaphysics," Krinsky began, "but modern science."<sup>31</sup> Later, in an apparent reference to Kandinsky's work at INKHUK, he declared: "Fundamental to architecture, as well as to its creation and perception, is the architectural idea, which is in no way music or poetry or literature, as it cannot be expressed in any language other than architecture."<sup>32</sup> On the other hand, Krinsky obviously was not inclined, as Babichev evidently had been in his program, to qualify his commitment to abstract form as the essence of modern art and architecture.

In his talk, Krinsky advanced the notion that the "discipline of abstract form" epitomized the aim and content of modern architecture. "Creation in real space is impossible without an abstract study of form," he asserted, "for form provides the only way to comprehend space."<sup>33</sup> Central to Kandinsky's argument was the premise that "any work of art as such incorporates idea both as generalized formula and as solution." Its content is thus idea and solution, and "it is only as idea and solution that a work of art is properly perceived."<sup>34</sup>



11. Vladimir E. Tatlin, *Corner Relief*, 1915.

Both real and abstract forms, he continued, have the single objective of exerting an influence on man through idea and solution. The realization that real forms manifest idea and solution may be impeded by the fact that they tend to look familiar, or assume an appearance associated with a given object. Abstract forms, on the other hand, having no such recourse to conventional or preconceived associations, can exert a perceivable impact only through the abstract manifestation of idea and solution. The domain of abstract form functions not as a reflection of tangible reality, which is inherently impossible, but as a vehicle for intellectual content and sensory perception. Such geometrically abstract elements of form as "the cube, the cylinder, and the cone are not tangible forms in and of themselves, but rather conceptions that may help us arrive at a given form." Thus, if the content of modern architecture is idea, the manifestation of that idea is abstract form.

The solution of abstract form, in turn, was properly to be channeled toward "the problem of apprehending form, which in architecture, sculpture, and painting comes down to the problem of apprehending space."<sup>35</sup> Moreover, while "it is through form that man orients himself to the 'external' world," the means for that orientation obtain from "the ordering of perception that we establish for ourselves." Thus, Krinsky believed that the new expression made possible by the use of abstract form enabled the individual to orient himself to his spatial environment, not only in purely visual and perceptual terms, but also in ways that would help him adapt to the growing complexities of modern life by bringing the inner and outer worlds together in a coherent system of sensible impressions. The "scientific discipline of abstract form," Krinsky concluded, "constitutes our way of thinking in real space. Any solution of abstract form represents our formulation of spatial experience."<sup>36</sup>

This more literal conception of lucid form and phenomenal space, contrasting with the more nebulous, painterly phenomenon evident in the ZHIVSKULPTARKH projects, suggests the heightened conceptual impact of Tatlin's constructions, whose influence Krinsky later readily acknowledged. Tatlin's remarkable "counter-reliefs" sought both to extend pictorial space beyond the picture frame out into the domain of real space and to use objects of the real world as the basic elements of an unprecedented mode of construction with "real objects in real space." The artistic means of Tatlin's "counter-reliefs," which claimed to be nothing more than constructions of different materials, thus derived from the newly acquired esthetic potentialities of actual materials compositionally and spatially combined. In an attempt to make the spatial content of his constructions even more emphatic, Tatlin produced his famous "corner reliefs," in which the space within the construction and the space beyond, were integrated into a spatial whole (Fig. 11).<sup>37</sup> Though not yet full-fledged constructions, these relief sculptures revealed what Krinsky discerned as a vital connection to the plane as compositional element, "which assumed a vertical aspect, acquired a rectilinear profile, and provided the means both for fastening the construction of the different materials and for serving as its background." Though not objects of any utilitarian purpose, "they were fully materialized."

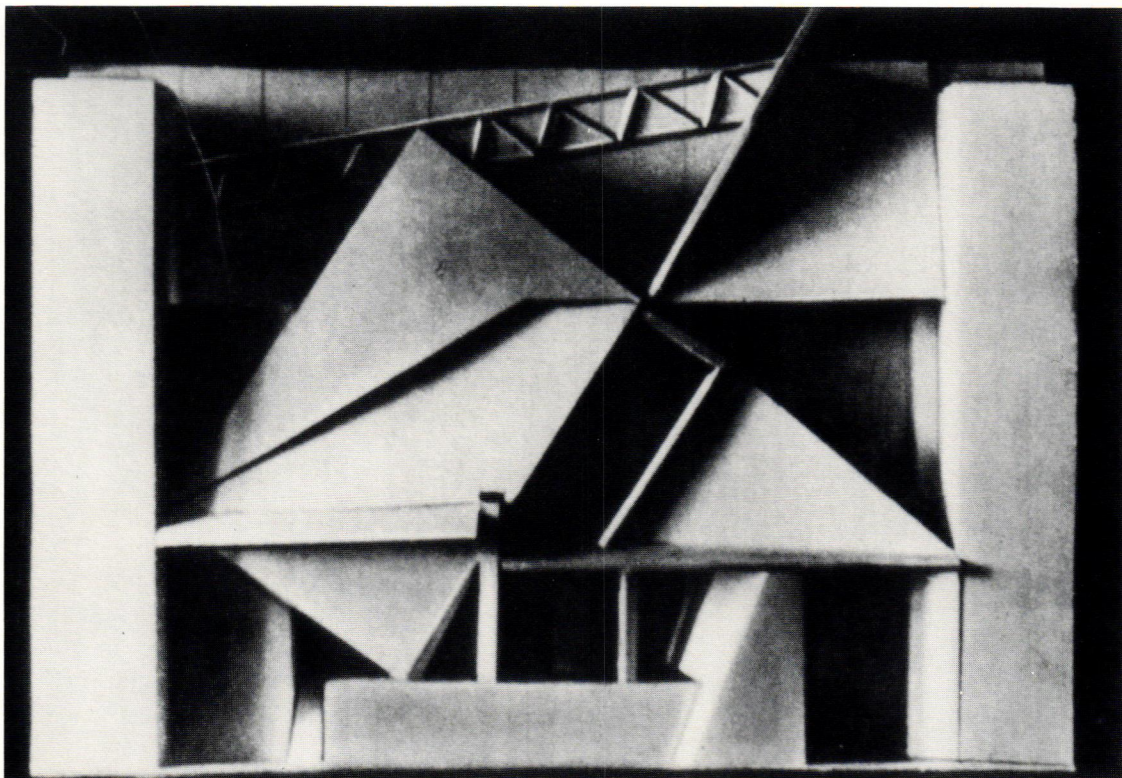
Krinsky's tribune project of 1921 reflects a remarkable transformation of the principles underlying Tatlin's reliefs into an innate architectonic realm, exploiting the potentialities they had suggested through their use of "concrete and virtual building materials (wood, metal, plaster, glass)."<sup>38</sup> Not least, Krinsky's design reveals the adaptation of the plane, essentially as defined by Tatlin's relief sculptures, as the organizing ele-

ment of the spatial form (Fig. 12). The complex form is broken down into a series of large intersecting and interpenetrating planes that pierce the mass. There is the same slipping of the rectilinear planes as in Tatlin's reliefs, and the spatial relationship of the planes to each other is similarly complex. This complexity extends to the spatial character of the form itself: the envelope, or outer boundary of the form, is no longer composed of a single flat plane. Rather, it is broken up into an intricate layering of planes that allow the interflow of exterior and interior, thus making it difficult to establish the precise boundaries of enclosed and non-enclosed spaces. In this way, plane and volume have become virtually indistinguishable as they had in Tatlin's corner reliefs, and their interrelationship determines the specific character of the spatial form. The superposition of the system of rectilinear shapes on an emphatic diagonal axis, adapting the compositional device developed by Malevich and accentuated by Lissitzky, endows Krinsky's design with heightened visual tension that intensifies the dynamic quality of his spatial form.

In certain respects, Krinsky's tribune project appears as a more apparent outgrowth of the "counter-reliefs" than does Tatlin's own "Monument to the Third International" (Fig. 13). As the culmination of his aspiration to project construction into a decidedly architectonic realm, however, Tatlin's tower had a measurable impact on the emerging Rationalist esthetic sensibilities. Intended, at 1,300 feet high, to be considerably taller than the Eiffel Tower, Tatlin's monument consisted of four geometrical volumes of steel and glass suspended in a dynamic open structure of two intertwining spiral lattices buttressed by a diagonal spine of paired girders. These transparent volumes, each rotating at progressively faster speeds, were intended to serve a useful purpose by housing a variety of functions not unlike those called for in the program for the Palace of Labor competition in 1922. However, the tower was

conceived primarily as a multifaceted symbolic statement: on the one hand, the spiraling structure was a monument to the dynamic soaring progress of a society liberated by Bolshevism; on the other, it was intended to symbolize the dynamic constructive potentialities of such new building materials as steel and glass. The structure was envisioned and actually designed primarily as an intuitive visualization of constructive potentials, or as a metaphorical image of construction, rather than as a paradigm for the empirical application of engineering or building expertise as such.<sup>39</sup>

In various deliberations at INKHUK the Rationalists showed a comparable inclination to construct dynamic structure as spatial form by evoking aspects of "artistic" rather than "technical" construction. In the spring of 1921 Ladovsky offered a definition of "technical construction" that conceived of it more in phenomenal than literal terms, describing it as the "joining of designed material elements according to a definite schematic plan for achieving an effect of force."<sup>40</sup> Though he also spoke of collateral aspects of tension, movement, and resistance, it is evident that he did so primarily in terms of their apparent manifestations rather than their actual transmission through the structure of a form. In an earlier statement made at ZHIVSKULPTARKH, Ladovsky had illuminated the context in which he regarded the relevance of construction to architecture. "Construction enters into architecture," he maintained, "insofar as it determines the comprehension of space."<sup>41</sup> While he surely considered the structural implications of new methods and materials, he never regarded them as ipso facto determinants of form. His statements suggest instead the conceptual inclination, amplified in his work at the VKHUTEMAS, to strive for a compositional energizing of form by endowing it with "physical" and "mechanical" aspects that would make it appear as though the force of gravity were acting on the visible envelope of that form.



12. Vladimir F. Krinsky, *Project for a Tribune*, 1921.



13. Vladimir E. Tatlin, *Monument to the Third International*, 1919–1920. Finished model in Tatlin's studio at the Free Studios (SVOMAS) in Petrograd.

Krinsky conveyed much the same understanding of construction in his remarks at INKHUK. In the same debate on construction and composition, he observed that any construction in general "assumes movement, force, or direction, the schematic manifestations of which are lines" and "systems of planes or spatial forms."<sup>42</sup> Accordingly, he continued, architectural construction had likewise to be regarded as being "constructed on the basis of the physical laws of gravity and equilibrium, which determine the interaction of the elements of construction in a building."<sup>43</sup> Yet these remarks, like Ladovsky's, envisioned something other than literal or technical aspects of construction. The point was amplified in a remark Krinsky made on another occasion to the effect that all architectural forms were affected by principles of mechanics. Krinsky illustrated his point by citing as an example the typical churches of Pskov, with their large bulbous domes on a drum looming over the structure. The effect he had in mind, however, was not the one involving the structural resolution of load-bearing forces, but rather "the apparent lightness we sense" when perceiving those domes.<sup>44</sup> Clearly, then, what both Krinsky and Ladovsky had in mind was the manner in which the *apparent* rather than the *structural* effects of mass and weight were suggested in the composition of a form and presented as clues for the perception of its expressive character.

Such notions recall the psychological theory of empathy (*Einfühlung*), first applied to esthetics in 1873 by Robert Vischer and later amplified by Theodor Lipps, mentioned in the introduction to this essay. Lipps had described empathy as the act of projecting oneself into the object of perception. According to this principle, the observer "feels into" represented objects the movement or pressure of the weight which they must resist or exert. Thus, a wispy and ribbon-like cloud suggests the force of the wind blowing it rapidly, and a big stone resting on another suggests the pressure of the lower stone in holding it up and gives the impression of an interaction of upward and downward forces. Lipps maintained that the appreciation of art was likewise dependent upon a similar projection into the object. This, he averred, was because the feeling in question is also influenced by definite induced body responses. For example, when viewing a column that appears too light to support the weight it bears, the observer feels strain, thus making the experience unpleasant.<sup>45</sup>

The empathy theory was updated around the turn of the century as a result of findings obtained from investigations into kinesthesia by a number of perceptual psychologists. Among them was the German-American psychologist Hugo Münsterberg, whose work the Rationalists assimilated and applied to their architectural theory.

### *Aspects of Perceptual Psychology: Conceptual Framework*

The Rationalist doctrine, like Babichev's INKHUK program, epitomizes a variation of the tendency in Soviet art scholarship of the twenties toward a precise, scientific approach to knowledge. To establish a psychological rationalization for their theory, the Rationalists appropriated that scientific method which Ladovsky deemed to be the most relevant for developing an understanding of the peculiarities and effects of perception and its role in conceiving and creating a work of architecture. The architect, Ladovsky insisted, "must be acquainted, in however elementary a manner, with the laws of perception and with the means of achieving visual impact in order to utilize everything that modern science has to offer."<sup>46</sup>

This move was analogous to the Constructivist movement's appropriation of the method of scientific management to rationalize the functional doctrine promulgated by Moisei Ia. Ginzburg in the mid-twenties.<sup>47</sup> Both movements were equally dedicated to the incorporation of scientific methods into the architectural design process. Understandably, each one selected those methods deemed consistent with what it perceived to be the essential task at hand in revamping and objectifying the design process. It is the divergences in this perception, in fact, that most accounts for the differences between the two movements: The Rationalists consulted the young science of perceptual psychology to rationalize their conception of objective spatial form and to generalize it to man's experiential sensibilities; the Constructivists appropriated the principles of scientific management (or the "scientific organization of labor," as the term is usually rendered in Russian, usually abbreviated as NOT) for the purpose of rationalizing the objective content of architecture in terms of its social, functional, and technical requirements.

Of the theories of perceptual psychology appropriated by the Rationalists, Ladovsky wrote in 1926: "The work developed by me and subsequently by my colleagues at the VKHUTEMAS since 1920 in the field of architecture [was] verified by methods of psychotechnics . . . [developed by] the famous psychologist Münsterberg, [who] works year in and year out in his Harvard laboratory in the field of aesthetics."<sup>48</sup> Hugo Münsterberg had first established a psychological laboratory at the University of Freiburg. His work proved controversial in Germany, but won the praise of U.S. psychologist William James, who invited him in 1892 to be visiting professor at Harvard University and to establish a psychological laboratory there. After he returned permanently in 1897 to direct the Harvard laboratory, Münsterberg became increasingly concerned with the applications of psychological research to a number of different areas, including that of esthetic perception.<sup>49</sup>

It may seem strange, at first glance, that it was the perceptual theories of Hugo Münsterberg, who has not been associated with the field of perceptual psychology, rather than those of the Gestalt psychologists that were appropriated by Ladovsky and the Rationalists. For the pioneering work of the Gestalt psychologists Wolfgang Köhler, Max Wertheim, and Kurt Koffka has come to be regarded as being virtually synonymous with the mainstream of modern perceptual psychology.<sup>50</sup> However, the psychological investigations by Münsterberg and especially by his associates into the visual perception of art objects anticipated by almost a decade many of the concepts advanced by the Gestalt psychologists in the 1920s. In the decade prior to World War I, Münsterberg's psychological laboratory at Harvard was the only one in the world to conduct sustained research on the subject.<sup>51</sup> Under the circumstances, then, it is not surprising that Ladovsky should have turned to Münsterberg's work on perceptual psychology, given that there was little comparable material available in the early post-revolutionary years, and surely none that would have proved as immediately relevant or applicable to architecture.

Münsterberg's theoretical contributions in perceptual psychology derived from and supported his belief that psychology is a natural science wholly objective in character because it, too, approaches the phenomena it studies as objects, analyzing them into simple elements bound together by regular and predictable patterns. Münsterberg maintained that the science of psychology was possible only because of psychological parallelism, by which he meant that every mental event was accompanied by a psychological corollary that could be measured,

analyzed, and explained. The psychologist, by superimposing the mental phenomena upon the psychological, could thus derive patterns and regularities in the flow of ideas by examining their effects on the physiological organism. At the same time, Münsterberg also elaborated a philosophy that posited science and idealism as complementary orders. According to this conceptual framework, scientific or *causal* psychology deals with phenomena that are essentially mental constructs. In contrast, *purposeful* psychology, encompassing philosophical and historical studies, treats the real world of ideas and values. Man's inner self is a subject with will and purpose linked by a hierarchy of values to overarching metaphysical principles. While this subject is inaccessible to the scientist, who pursues truth limited to causal explanations, science and idealism are compatible nevertheless because the labors of objective psychology are required to fulfill the subjective purposes of real life.<sup>52</sup> This innate conception of science in the service of idealism provided the background for Münsterberg's pioneering work in the various realms of applied psychology, perceptual psychology not least among them.

Münsterberg's conceptions of perceptual psychology were rooted in his personal adaptation of the motor theories that had begun evolving in the late nineteenth century, which sought correlations between elements of the perceptual experience and physiological processes of the sense-organs and the brain. Boring has noted that Münsterberg was among the first to make kinesthesia basic to space and time perception.<sup>53</sup> Münsterberg argued that the sensations of strain and impulse induced by the observer's perception of a form are caused by motor impulses flowing inward to the central nervous system from the muscular structure of the body. These impulses are not external sensations vaguely transposed into the body, as had been suggested by Lipps's concept of empathy. Rather, they represent discrete visual impressions produced by eye muscle movements induced by body tensions that correspond to the observer's actual body movements. These visual impressions build up ideas of geometric forms that are endowed with aspects of force and energy echoing the same body tensions. They also contribute to the sense of space perceived by the observer.<sup>54</sup>

The experiments conducted at Münsterberg's laboratory at Harvard focused on investigating the "psychological factors . . . involved in the perception of spaces and outlines" of forms, asking "how it happens that mere lines awake in our consciousness the ideas and feelings of energies, and that a certain combination of these lines satisfies us while other combinations displease us."<sup>55</sup> Münsterberg and his associates found that the forms perceived to be the most pleasing were those tending toward vertical bilateral symmetry in their distribution of elements, corresponding to the balance between the right and left sides of the muscular structure of the human body. Yet, at the same time, nonsymmetrical arrangements of elements were also found extremely pleasing under certain circumstances. Münsterberg suggested that this was due to the fact that no corresponding symmetry exists between the lower part of the human body, which "has to give us stability," and the upper half that "has the free mobility of action."<sup>56</sup> Ethel Puffer, who conducted the experiment, concluded that the appeal of non-symmetrical arrangements was most evident when "the apparently non-symmetrical arrangement contains a hidden symmetry, and . . . all the elements of that arrangement contribute to bring about that bilateral type of motor impulses which is characteristic of geometrical symmetry."<sup>57</sup> Thus, it was possible to infer from the most pleasing nonsymmetri-

cal arrangements a background of decisive symmetry against which the asymmetrical elements stand out in emphatic balance. According to these findings, then, the older interpretation of balance obtained through rigid geometrical symmetry proved the most evident kind of balance, but had to be supplemented by another conception of a dynamic balance obtained from the arrangement of unlike elements. While such elements might at first glance seem to disturb symmetry, a longer contemplation of them suggested that they also serve to emphasize it.

These findings also stressed the significant roles played by the related phenomena of repetition and balance in the perception of dynamic but visually pleasing form. The use of different combinations of elements showed that the principle of repetition, with its attendant corollaries of variation and rhythm, were a significant source of the pleasure elicited by asymmetrical compositions. According to Münsterberg, it was found that no real pleasure results from mere repetition, such as the recurrence of the same shape and proportions in architecture. However, the monotony of mere repetition appeared to be dispelled and the pleasure heightened by varying the rhythm and introducing variations in the grouping of recurring elements. The pleasure appeared the greatest when two groups of elements alternate, one being perceived as the primary and the other as the secondary group. In the primary group, "far-reaching variations may occur without interfering with the pleasure, but if the secondary group is not exactly repeated, the enjoyment quickly decreases. The magnitude of the units is more important than their quality."<sup>58</sup> Although the primary experiments were conducted by stretching white threads over a black field in various groups of combinations, "it was at the same time possible to demonstrate the actual realization of these principles in works of architecture, where windows and columns, statues and arches alternate."

The concept of balance emerged as another important principle in the perception of esthetic form. While the sense of balance is self-evident in a symmetrical form, where the contrasting elements are identical, they discovered that the essential condition distinguishing a pleasing form was that alternating elements, however much they may be unlike one another, obtain a "pleasing feeling of equilibrium." These elements had to offset one another by achieving what Münsterberg termed a "mechanical balance" between the elements in a composition that are at rest and those that are in movement about the field. Puffer found that this mechanical balance was a function of the visual state of equilibrium perceived to obtain between those elements moving toward or away from the center and those acting in concert with or resisting the forces of weight and gravity that appear to act on the form.<sup>59</sup> Puffer saw in these findings definite implications for the perception and composition of spatial form:

*We may thus think of a space to be composed as a kind of target, in which certain spots or territories count more or less, both according to their distance from the center and according to what fills them. Every element of a [composition], in whatever way it gains power to excite motor impulses, is felt as expressing that power. . . . The skillful artist will fill his [spatial] target in the way to give the maximum of motor impulses with the perfection of balance between them. It is thus in a kind of substitutional symmetry, or balance, that we have the objective condition or counterpart of esthetic repose, or unity.<sup>60</sup>*

According to Münsterberg, the basic laws of statics and dynamics underlying the concept of "mechanical balance"

were vital corollaries to the principles of perception that enabled man to apprehend the external world of physical form. Through them came an understanding of physical form as a complex "world of atoms which move according to mechanical laws," thereby revealing "the forms of connection which make the thinking of a connected world of objects possible at all." In this way, mechanical laws were to be regarded as "laws of thought applied to the conception of space and time."<sup>61</sup>

The aggregate implications of these findings led Münsterberg to propose that the most interesting forms among those achieving mechanical balance were those whose combinations of elements were most rich and complex, corresponding to the complexity of the kinesthetic energies involved in perception:

*The bilateral balance of rigid geometrical symmetry is . . . less interesting than the balance of unequal combinations of lines where, for instances, the length of the lines on one side is balanced by the strangeness of the curves, or by the outward bending of the line, or by the heaviness of the line combination on the other. The richer and more manifold the motor impulses, the higher is the esthetic value of the form.*<sup>62</sup>

Münsterberg's and Puffer's principles of dynamic spatial form bring to mind two striking coincidences. The first is the extent to which they resemble the findings obtained by Ladovsky and his colleagues at ZHIVSKULPTARKH and INKHUK, which perhaps further illuminates the basis of Münsterberg's appeal for the Rationalists. Equally striking, on the other hand, is the extent to which his conception of energized form may be seen to correspond, at least superficially, to theories of empathy, which likewise had correlated dynamic qualities of expression to induced body stresses and strains.<sup>63</sup> To be sure, the theoretical foundations for each set of correlations had shifted from virtually intuitive association to empirical psycho-physiology. Still, the esthetic implications and tangible architectural manifestations, or formal metaphors, of both theories proved similar in the means for composing and energizing form. Only the treatment of the architectural envelope had changed, proceeding from a vocabulary of past architectural styles toward one of modern abstract form.

Questions have, and doubtless can, be raised about the nature and applicability of the research that Münsterberg and his associates conducted on the perception of esthetic objects at the Harvard Psychological Laboratory. Some of their findings have been superseded by later research, while others continue to be applicable today. The issue here, however, is not the validity or completeness of Münsterberg's prescriptions in the realm of perceptual psychology, but rather their historical significance, measured by the conceptual and programmatic value that they had in their day. In the case of the Rationalists, who actually made use of them, these prescriptions served as an objective framework for substantiating and systematizing the principles of composition extrapolated from modern art and applied to architecture. Contrary to some criticisms of Münsterberg's esthetic prescriptions, the Rationalists' appropriation of his findings in perceptual psychology did not stifle the creative process by supplanting artistic inspiration.<sup>64</sup> Rather, they expanded its horizons by cultivating in the designer the conscious ability to systematize the various interactive formal levels of cause and effect inherent in the design process. To that extent, therefore, they provided for the concretization and primacy of means, not ends.

When Ladovsky indicated, as noted earlier, that he had verified his work at the VKHUTEMAS by reference to "psychotechnical methods," he was referring to Münsterberg's concept of psychotechnics, described as a "technical science related to

causal psychology as engineering is related to physics." Its aim, he proclaimed, was the "realization of certain concrete ends" in those practical endeavors "in which important purposes of man are to be fulfilled . . . and human tasks exist in the performance of which the mind plays a role."<sup>65</sup> Among the endeavors to which Münsterberg proposed applying his method of psychotechnics was that of art and architecture. "We have touched on a variety of esthetic experiments in the field of visual impressions," he noted, referring to the work undertaken at his Harvard psychological laboratory. "Their psychotechnical importance refers equally to painting, sculpture, architecture, and industrial arts."<sup>66</sup> The technique of the artist in each field could be enhanced by applying knowledge gained from psychotechnical data concerning the perception of space and time, the degree of apparent movement suggested by the angles and intensities of line, and the sense of weight and resistance suggested by the various parts in an artistic form.

At the same time, he cautioned, certain inherent limitations had to be taken into account in applying the psychotechnical method to art. Though the psychologist could supply the empirical data obtained from his experiments, only the artist could translate the experimental results into practical standards. Too, the detailed psychological investigations had to be adjusted to the particular needs of the specific form of art. Finally, the psychotechnical prescription could not be regarded as a substitute for true artistic inspiration. Just as the "mere knowledge of counterpoint is not sufficient for composing," so the "psychotechnical prescription too can never replace the imagination and originality of the artist." While "an acquired knowledge of the psychotechnical rules" could be of immense aid to the artist, the place of such knowledge in the larger scheme of the creative process should be "as subordinated to his creative energies as the mere technique of color mixing is to the intentions of the painter."<sup>67</sup>

It thus was Münsterberg's programmatic concept of psychotechnics and not Freud's concept of psychoanalysis, with its pansexual and infantile associations, that formed the basis for the so-called "psychoanalytical method" of design that Ladovsky introduced at the VKHUTEMAS in the fall of 1920. The term was applied literally to convey Ladovsky's incorporation of the psychological method of analyzing the means and effects of spatial form conveyed in Münsterberg's psychotechnical prescriptions.

Characterizing the psychoanalytical method as being analogous to the "method of the exact sciences," Nikolai Dokuchaev underscored the essentially Cartesian nature of its approach to architectural instruction: "Practically speaking, this method provides that the student begin his study of architecture by acquiring incremental knowledge of the elements of form, of the principles and laws of composition, and of [the means of] architectural construction."<sup>68</sup> Dokuchaev stressed that the principles embodied in the method were not to be presented to the student "as absolute laws, as certain prescriptive norms that he must apply to his work." Rather, they were intended as an objective basis that would enable him

*. . . to approach the subject under study deliberately, critically, and sensibly, and to draw viable conclusions. . . . With the [psycho]analytical method, the creative act of the student as an artist acquires a reliable and auspicious methodology."<sup>69</sup>*

Elsewhere, Dokuchaev made clear that the psychoanalytical method was equally valid as a design method for the practicing architect, "steering him in the proper direction for understanding architecture as a three-dimensional plastic and spatial art."<sup>70</sup>

That method, however, was elaborated as the cornerstone of the teaching program that Ladovsky and his Rationalist colleagues developed in their design courses at the VKHUTEMAS.

### *The VKHUTEMAS: Crystallization of Architectural Theory as Pedagogical Method*

It was within the pedagogical opportunities and constraints operating in the VKHUTEMAS, or the Higher Artistic-Technical Studios, in Moscow that Ladovsky and the Rationalists gave final definition to the theoretical and methodological content of their doctrine. Although, as has been shown, vital groundwork had been laid in the important artistic experiments at ZHIVSKULPTARKH and the theoretical formulations at INKHUK, the framework of an active teaching program, demanding rigorous application and continual adjustment, supplied the ultimate arena for testing and refining both individual tenets and the doctrine as a whole. "As experience accumulated," Krinsky later recalled, "our theoretical positions were defined more precisely."<sup>71</sup>

The leading Soviet art school in the single decade of its existence, the VKHUTEMAS began in 1920, in a burst of cultural idealism and progressive educational reform, to educate a generation of Soviet architects and designers to anticipate the emerging needs of the new revolutionary order. Its contingent of faculties (departments) in painting, sculpture, architecture, graphics, textiles, woodworking, and metalworking rivaled the Bauhaus in formulating and embodying the ideals of modern design in the twenties. The Architecture Faculty quickly emerged as the center for the promulgation of the leading tendencies in Soviet avant-garde architecture: the Rationalist movement was represented by Ladovsky, Dokuchaev, and Krinsky; the Constructivist movement, by Alexander Vesnin and Moisei Ginzburg.<sup>72</sup>

The Rationalist triumvirate joined the Architecture Faculty in the autumn of 1920, at the inception of the VKHUTEMAS. From the outset, they consolidated their individual design sections to form the United Studios (OBMAS), where they functioned as an integral team. Here, in the autumn of 1920, Ladovsky introduced the "psychoanalytical method" for teaching basic design, which was developed in collaboration with Krinsky and Dokuchaev. That method not only encompassed the Rationalists' comprehensive program for teaching design, but elucidated the core of their architectural theory as well. Unlike the Constructivists, who directed their theoretical pronouncements primarily to the Soviet community at large, Ladovsky and his colleagues promulgated their theory almost exclusively through the medium of their teaching and research programs at the VKHUTEMAS. To that extent, the Rationalist movement was by far the more pedagogically oriented tendency in Soviet avant-garde architecture.

The centerpiece of Ladovsky's method was the formulation of a systematic approach to the design of an expressive spatial form, which he defined as possessing the following properties:

- 1) it is clearly and easily perceived by the observer by means of its basic elements, which constitute a visual unity; 2) it possesses an appropriate level of visual tension through which its organization can exert an impact on the observer; and 3) it organizes the movement of the observer in space, forming a visually dynamic system.<sup>73</sup>

To develop the student's ability to discern and express these properties in his designs, Ladovsky advanced the concept of "manifesting the expressive qualities of form" by applying discrete principles of composition. These principles adapted

Münsterberg's experimental findings concerning the psychology of perceptual organization to structure the basic means for articulating spatial form that Ladovsky and Krinsky had devised at ZHIVSKULPTARKH and INKHUK; these means became clarified and refined in the course of the actual work in the design studios.

Ladovsky's psychoanalytical method proceeded from the basic assumption that there were expressive perceptual qualities inherent in architectural form that, if consciously exploited by the designer, would facilitate the observer's comprehension of and orientation to the built environment in spatial terms. Hence, the rational solution of an architectural problem was to be predicated on articulating these perceptual qualities through the rational manipulation of "architectural motifs." These visual symbols, or metaphors, would both enable the designer to determine the shape and impact of the architectural form and allow the observer to apprehend and measure the effects of that impact and thus orient himself to his physical surroundings.

*The architect constructs form by introducing elements that are neither technical nor utilitarian in the usual sense of the terms, and which can be viewed as "architectural motifs." In architectural terms, these motifs must be rational and must serve man's higher technical need to orient himself in space.<sup>74</sup>*

These "architectural motifs" were conceived by Ladovsky as elements that would establish a direct correlation between the compositional structure of a form and those basic qualities that determine its innate visual character and expressiveness. He advanced four categories of expressive quality that operate simultaneously and interactively within any given form. The first was *geometrical* quality, which made possible the perception of the geometrical properties of form by indicating the relationships of sides, edges, angles, and surfaces. The second, or *physical* quality, involved the visual effect of an appearance of weight and mass, or the force of gravity, acting on a form. The third quality, encompassing the *mechanical* properties of form, concerned the perception of dynamic states of equilibrium between elements appearing at rest and those appearing in motion within a form. The fourth quality, which Ladovsky termed the *logical*, focused on perceiving the significance of surface, or plane, both as a formal element in its own right and as a device marking the boundaries of a volume.

Ladovsky's four categories of expressive qualities, conceived as articulate metaphors of gesture and movement, were intended to embody an architecture capable of enrichment on a formal level by both intellectual and emotional content. Though each category was isolated out for purposes of analysis, their effect on architectural form was both interactive and cumulative, obtained through a sequence of carefully orchestrated impressions of one "motif" and then another, each superimposed on the last.

One of the chief reasons for articulating the geometrical properties of form, according to Ladovsky and Dokuchaev, was to compensate for the extreme distortion of form resulting from perceiving it at close range. This foreshortening too often yielded the perception of only the immediate fragments and not their proportional relationship to the form as a whole. To compensate for the effects of such optical distortion, as well as to establish a primary visual framework for incorporating the entire complex of "architectural motifs," Ladovsky advanced the principle of the "geometrical expressiveness of form." It called for revealing the basic geometrical properties of form by

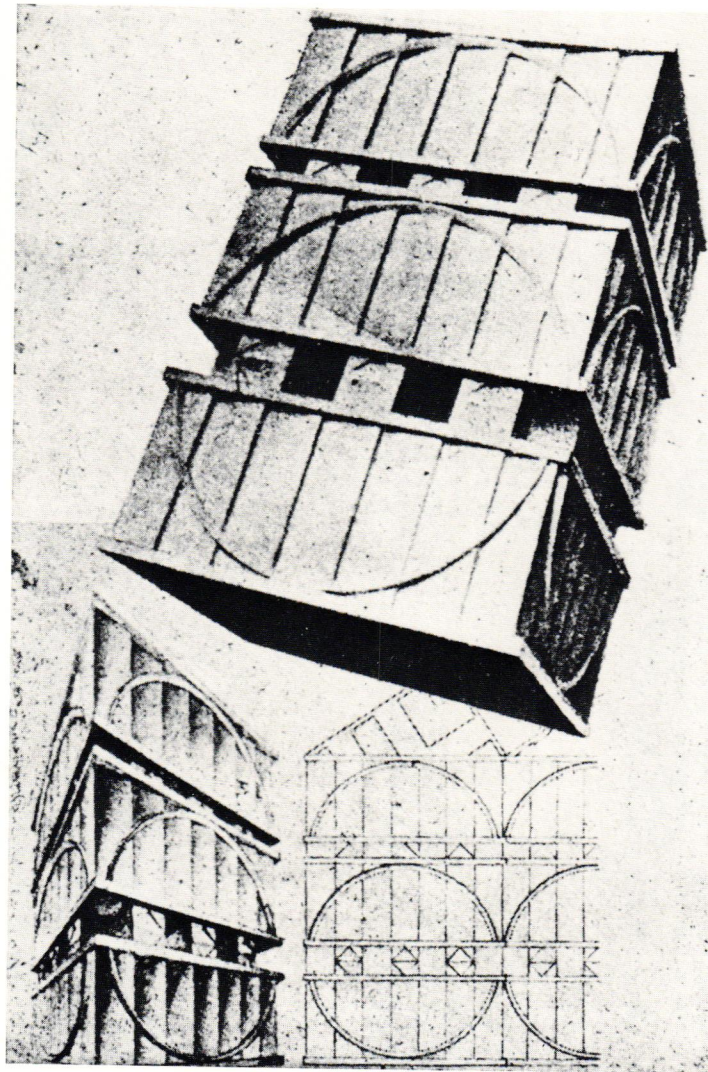
breaking the latter down into a complex of discrete, easily perceivable geometrical elements (rectangle, triangle, square, circle, and their three-dimensional equivalents). Reduced to a measured complex of geometrically articulated elements, architectural form could thus be made to communicate its proportional interrelationship of parts directly to the observer by visually rendering its elementary properties of size, shape, depth, and position in space (Fig. 14). Although Ladovsky had cautioned that the application of this technique should not be developed beyond "the degree that is necessary in a given case,"<sup>75</sup> its fundamental importance in implementing the psychoanalytical method later prompted Dokuchaev to assert that the architect "must essentially be a geometrician" if he is to succeed in articulating the basic geometrical aspects of form and the proportional correspondence among them in a way that is "visually precise and perceptually clear."<sup>76</sup>

Fundamental to the articulation of the geometrical properties of form, and to the mastery of composition in general, was the concept of rhythm, which Dokuchaev called "the compositional beginning." Dokuchaev made clear, however, that the Rationalists had in mind not the "mechanical rhythm" of simple alternating elements, but a more subtle and complex form of "artistic rhythm," involving more intricate alternations of rhythmic impacts and intervals. This concept of rhythm was linked by Dokuchaev to notions of space and time in art:

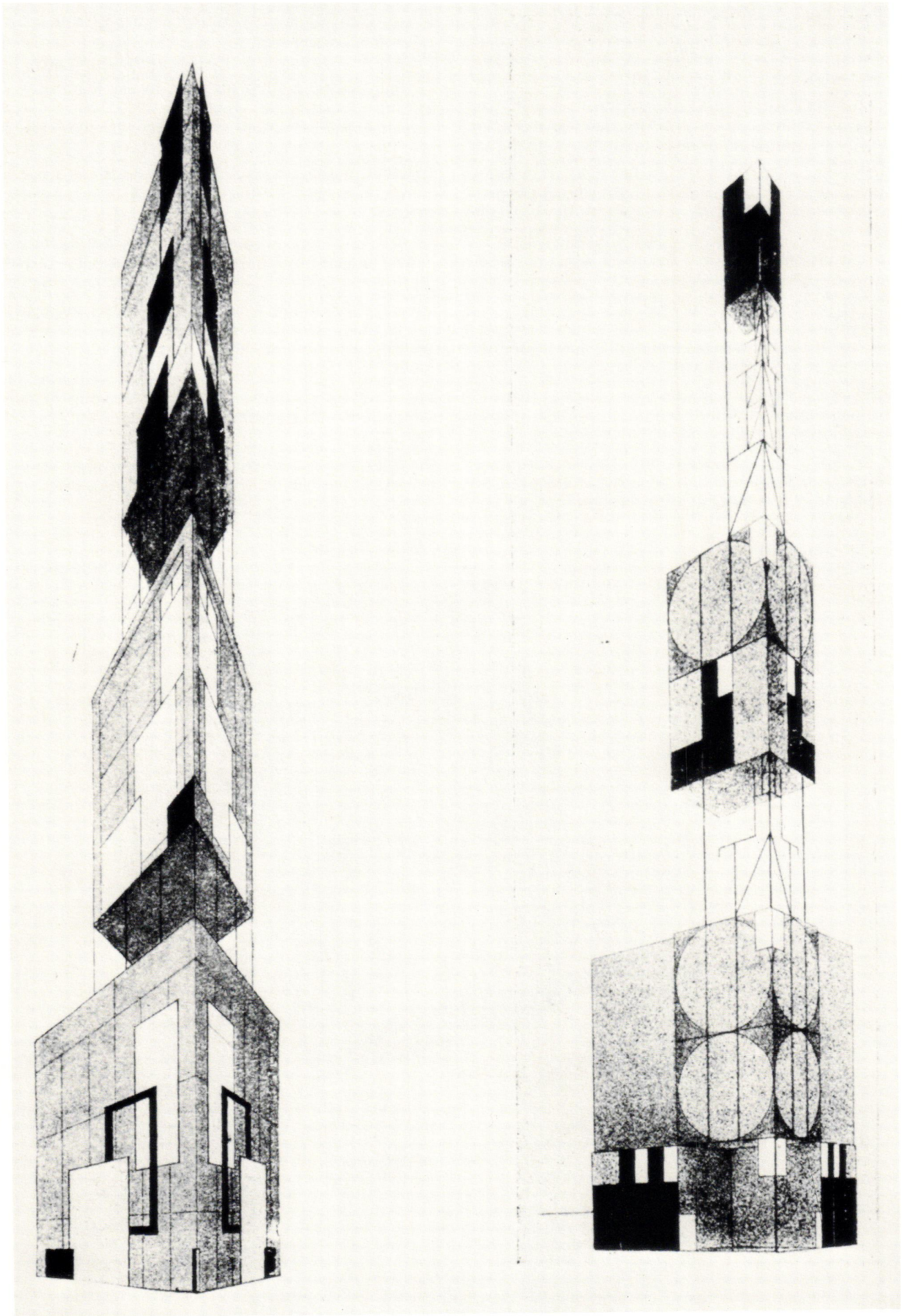
*Rhythm is a form of movement . . . consisting of time and space, for there can be no movement only through space (without time) or only over time (without space). Only time provides us with an opportunity to substantiate our understanding of rhythm in art.*<sup>77</sup>

The artistic rhythm advanced by the Rationalists took into

account the implications of space-time movement by establishing simple, complicated, and supplementary categories of rhythm. *Simple rhythm* consisted of visual impacts (forms) and intervals (voids and spaces) alternating with regular frequency. The simple and explicit proportional correspondences apparent in such a sequence contribute greatly to a compositional scheme of explicit clarity and coherence. In a *complicated rhythm*, the sequence of impacts was rendered not by one but by a complex of forms of varying sizes separated by intervals of varying frequency and period. Here, visual relationships become more subtle and complicated; less apparent at first glance, they require a greater amount of contemplation and deciphering by the observer in order to ascertain the full measure of the proportional correlations existing within the form. *Supplementary rhythm* involved a modulation of simple rhythms through the introduction of supplementary uncomplicated forms, which imbued rhythm with a richer expression than is obtained in the simple variant.



14. V. A. Petrov, *First-year Exercise in Manifesting the Geometrical properties of Form*, 1920. VKHUTEMAS, Ladovsky studio.

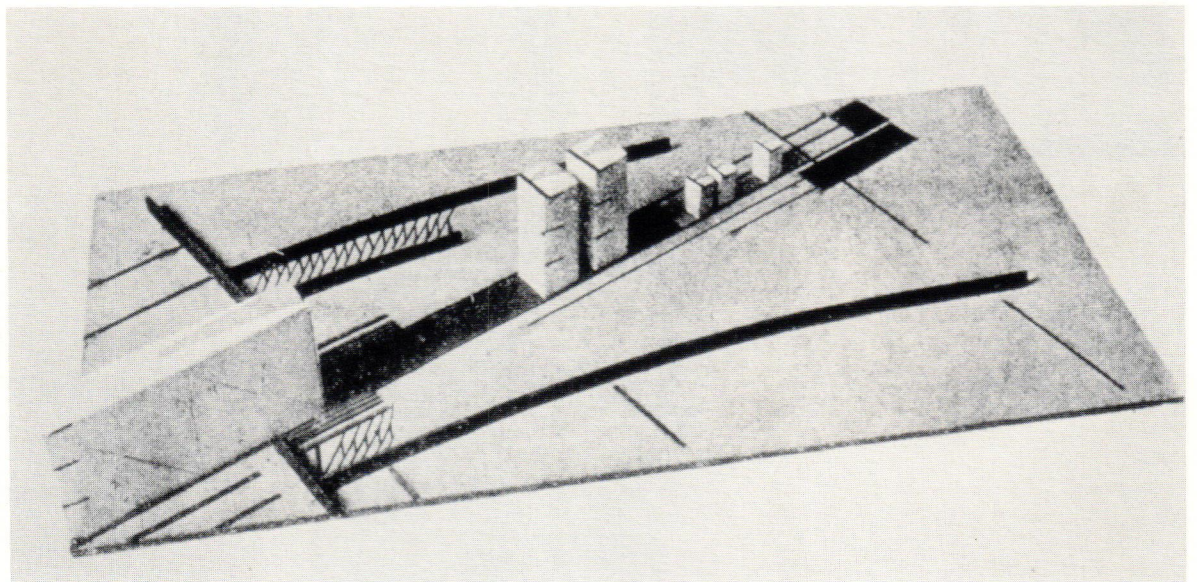
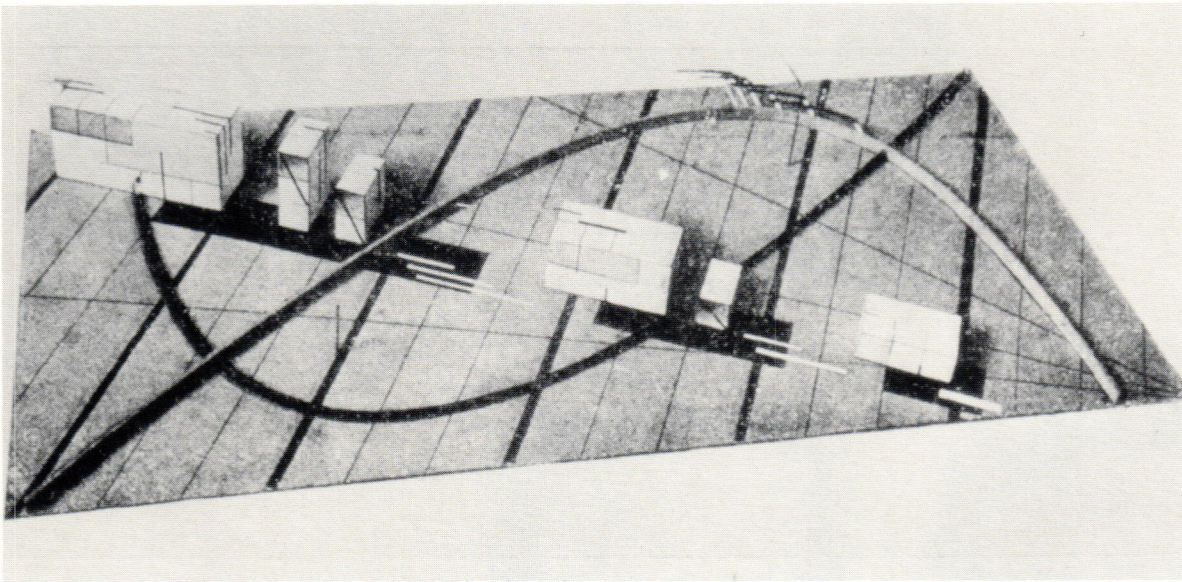


15. A. A. Silchenko and G. I. Glushchenko, *First-year Exercise in manifesting Dynamics, Rhythm, Ratio and Proportion (along the vertical)*, 1924. VKHUTEMAS, Ladozsky studio.

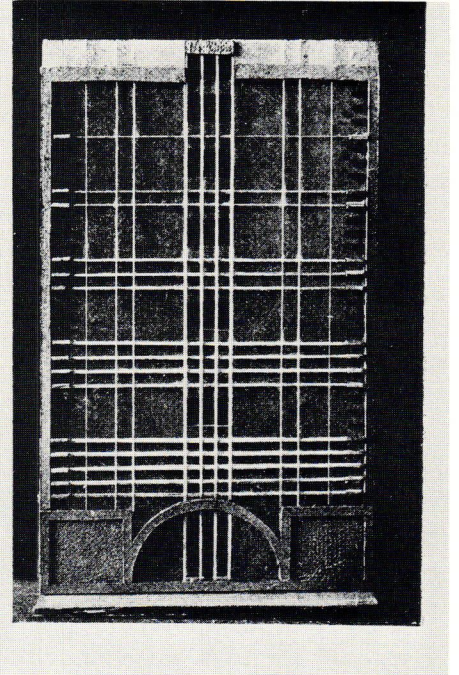
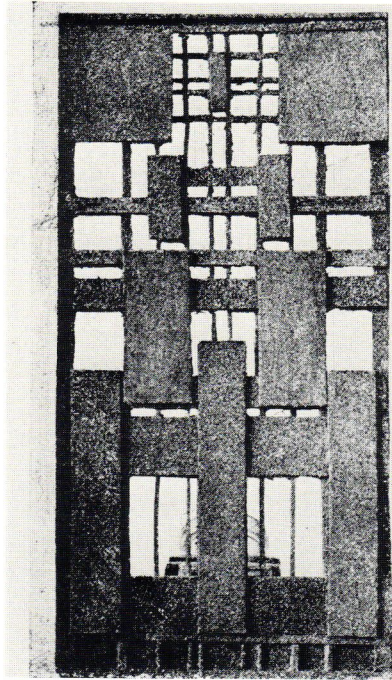
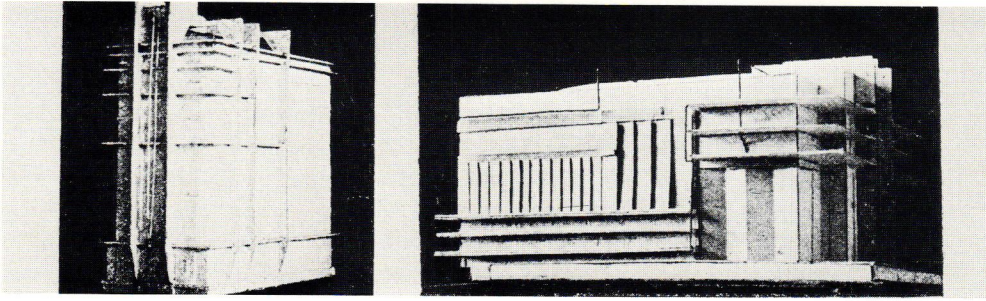
These modulations of rhythm were conceived as the primary means for articulating a dynamic sense of movement in formal composition. A series of basic design exercises on manifesting the dynamics of rhythm in the geometrical articulation of form that Ladovsky assigned at the VKHUTEMAS reveals the range of possibilities for varying the sequence of forms and intervals along both vertical and horizontal axes, and thus enlivening the complex form as a whole (Figs. 15 & 16). A corresponding system of rhythmic modulation is at work in the geometrical articulation of each of the subsidiary forms, thereby extending proportional correlation throughout the form. The integration of these variations into a single complex structure of rhythmic articulation introduces a more subtle type of balance between what may be regarded as "open" and "closed" forms. In both sets of exercises, each group of forms can be read in turn as an element in a rhythmic sequence of filled ("closed" form) and empty ("open" form) spaces. Such an approach was intended by the Rationalists to increase the range

of possibilities for the rhythmic arrangement of elements in space.

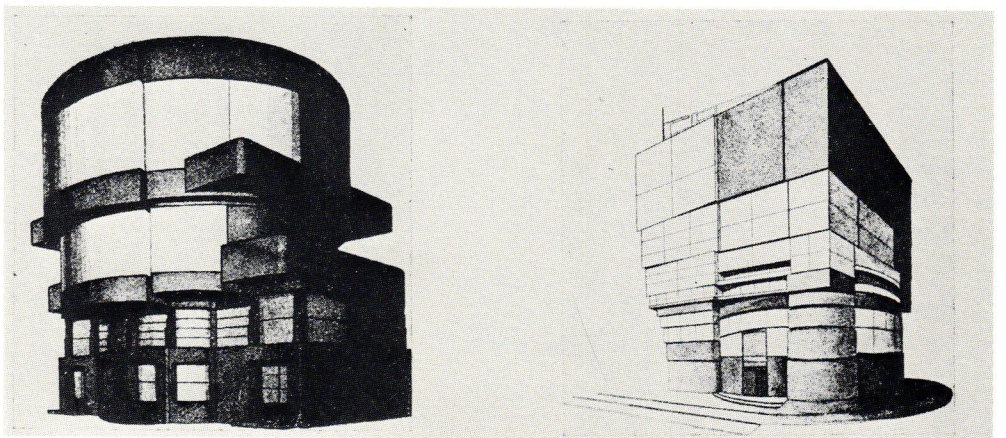
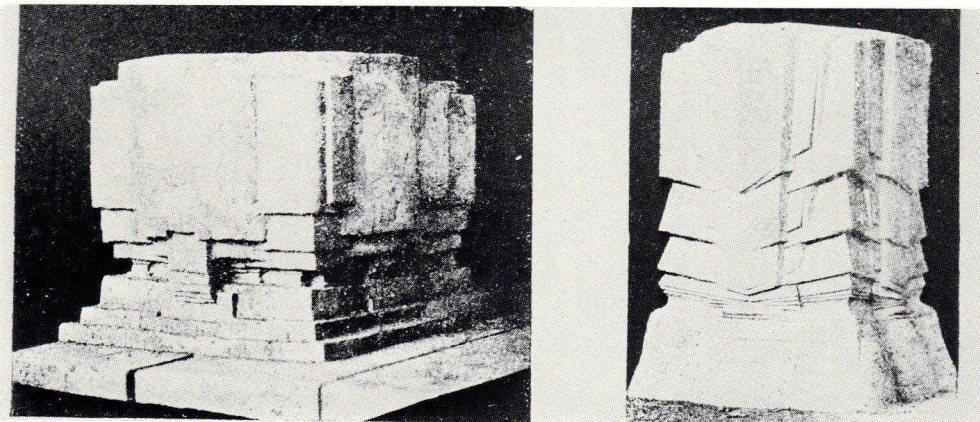
The second and third of Ladovsky's categories of expressive qualities, encompassing the physical and the mechanical properties of form, were conceived as means for heightening the visual and emotional impact of the perceptual experience. This was to be accomplished by articulating the composition of form in a way that would visually simulate the apparent impact on the whole of the force of gravity acting on the form, as well as of those elements appearing to augment or resist it. The link between these formal manipulations and human body movements, established by Münsterberg's kinesthetic theory of perception, provided the basis for supposing that the observer would be able to grasp the underlying impulses of a given formal gesture and its expressive relationship to the form as a whole. At the same time, these two categories of formal expressiveness also served to enhance the esthetic and intellectual dimensions of the perceptual experience. In considering the



16. M. A. Turkus and I. V. Lamtsov, *First-year Exercise in manifesting Dynamics, Rhythm, Ratio and Proportion (along a surface)*, 1923. VKHUTEMAS, Ladovsky studio.



17. First-year Primary Department, Exercise in Manifesting Form (above) and surface (below), 1926-27. VKHUTEMAS, Teaching associates in the Space Cocenter.



18. Second-year Exercise in Manifesting Mass and Weight: USSR Silicate Pavilion, VKHUTEMAS, Krinsky studio.

apparent effect of physical and mechanical action as esthetic factors, the observer had to take into account such related intellectual concepts as stillness and movement, stability and deformation, substantiality and insubstantiality, as discernible attributes that endow a form with an innate character and personality. Thus, by testing the outer limits of the formal gestures involved, the designer would master those qualities that would enrich and personalize the expressive content of architectural form.

Elaborating on the conceptual basis of Ladovsky's second category of expressive quality, that of the physical properties of mass and weight, Dokuchaev explained that "we determine weight in architecture to mean the force causing the mass of a form to [appear to] fall downward under the force of gravity."<sup>78</sup> The formal manipulations employed to simulate such action in a form, he explained, will be far better understood by the observer and thus be of greater interest to him if they are rendered in a way that conveys vividly "the degree of its [the form's] visually discernible stability and compactness."<sup>79</sup> The degree to which these two aspects were capable of being perceived by the observer was determined by whether the form projected a low center of gravity and substantial density of mass, leading to the perception of its stability, or a high center of gravity and insubstantial mass verging on instability. Consequently, it was imperative that the designer facilitate the perception process by articulating his composition with utmost clarity and infusing his formal manipulations with adequate clues about the projected physical character of the form.

Dokuchaev suggested three types of formal manipulation to provide perceptual clues about the apparent mass and weight of a form: surface treatment, surface details, and formal allusion. In the first type, the surface treatment consisted of the use of smooth textures to convey a feeling of relative lightness and roughly textured surfaces to make a form appear more massive. The second type involved the use of surface details, ranging from the fluting on a column to the joints in a rusticated wall and the layering and interpenetration of planes in the surfaces of an abstract form (see Fig. 17). The substantial depth of penetration possible in such details tends to accentuate the mass of a form by accentuating the massiveness of its surface. The third type of manipulation, formal allusion, unlike surface treatment and surface detail, was directed toward affecting the appearance of the form as a whole. Such manipulation ranged from the use of a single form, such as an inverted cone, to suggest the movement downward of a single force, to the conscious deformation of a simple or compound form. The latter technique involved simulating the visual impression of gravitational pull suggested by an inverted cone through more complex and dramatic formal manipulations.

A series of exercises on the expression of mass and weight completed in Krinsky's basic design studio at the VKHUTEMAS (Fig. 18) indicates that solutions of this problem still relied on compositions made up of discrete geometrical elements interlocked in an evident proportional system. By reverting to the deformation of form, however, a rather more complicated balancing of the apparent effects of weight on the form and its constituent parts enters into the perceptual assessment. In the upper two exercises, the deformation is rendered by means of a wedge-like displacement of shapes concentrated in the apparent downward path of intensified gravitational force.<sup>80</sup> In the lower two exercises, displacement is conveyed more subtly by the uniform modulation of the entire proportional grid of the form along its vertical axis. The resulting incremental reduction in the size of the elements as they approach the bottom of

the form conveys a vivid visual impression that the upper masses are uniformly bearing down on and compressing those below.

Ladovsky's third category of expressive quality, that of the mechanical properties of form (motion, rest, equilibrium), were aimed at amplifying the range of formal means for articulating form by energizing its *apparent* structure—what Dokuchaev referred to as *architectural*, as distinguished from *technical*, construction. Such energizing was projected not in a purely mechanical way, but by summing the observer's intuitive feeling, bolstered by his psychophysiological basis for perception, for how gravitational forces in architectural form can be carried, either undisturbed or in contention with disruptive forces, down to the foundation. In this sense, the mechanical properties of form envisaged by the Rationalists may be seen as visual metaphors aimed at clarifying the observer's impressions of how gravitational forces are intended by the designer to flow through architectural form. Just as the physical properties of form were aimed at raising the observer's sensitivity to the appearance of weight and to the way architectural form carries such weight, so too the mechanical properties were directed at heightening his awareness of the point of equilibrium in a form. It was assumed that the observer could recognize intuitively the appearance of balance, and that this awareness could in turn be sharpened by the "mechanical metaphors" to discern the play of forces upon a form's apparent structure and thus to detect how they have been brought into equilibrium. Various states of equilibrium were conceived and explored. Some achieved a calm and static balance in which gravity appeared the only operating force. Others conveyed a more dynamic balance of thrust and counterthrust of contending forces, at times verging on the precarious.

The Rationalists proposed a number of ways to apply the laws of mechanics to the composition of architectural form. An asymmetrical composition, for example, could draw form out of a static equilibrium and into a dynamic one by implying a dynamic sense of movement in the final configuration. Modulating the proportions of component parts could be made to accelerate or retard the sense of movement in a form. It could also be manipulated to transform inherently static shapes (square, circles, equilateral triangles, etc.) into more dynamic configurations (attenuated rectangles, ovals, and triangles, etc.).

Thus, the distortion of form, first mentioned as a means of expressing physical properties, also proved the ultimate vehicle for achieving mechanical expressiveness. This was due in part to the fact that the mechanical properties (dynamics) of form operated as the chief agents of visual distortion, or mannered deformation. Yet, clearly, it is also attributable to the Rationalists' fervent belief that the articulation and distortion of form, within finely judged limits, provided one of the most dynamic ways to obtain the meaningful enrichment of form in modern architecture.

Dokuchaev noted that "the compression of form and the stretching, bending, twisting, and shearing of it," constituted the most evident effects of formal distortion obtained by manipulating mechanical moments.<sup>81</sup> These effects, moreover, were frequently interactive in the sense that, by revealing "the action of both individual forces and of entire systems of forces," architecture is involved ultimately in "manifesting the composition and decomposition of their effects."<sup>82</sup>

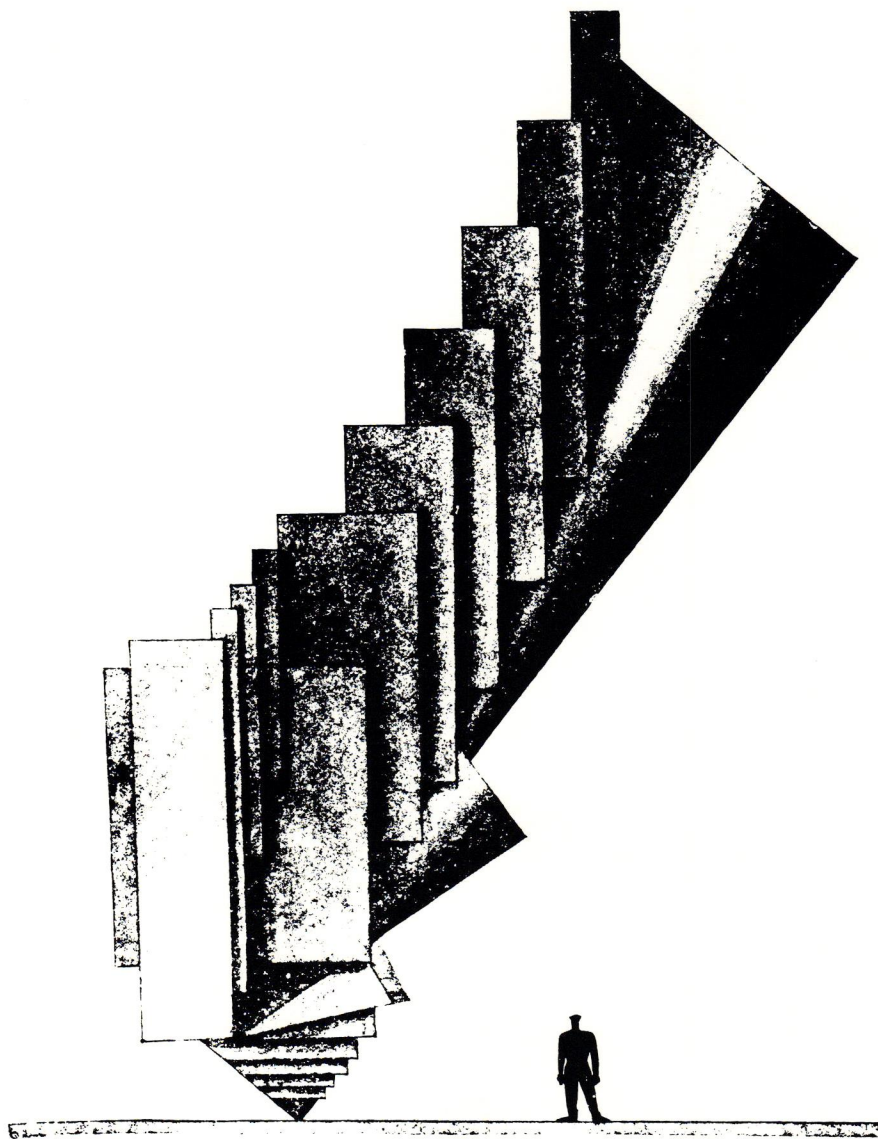
Several solutions to the problem of expressing mass and equilibrium assigned at the VKHUTEMAS by the Rationalists suggest the range of possibilities explored. The first, done by A. Arkin in Ladovsky's studio, developed a highly dra-

matic approach to the problem (Fig. 19). Arkin achieved equilibrium through a bilateral balance of dissimilar parts about a vertical axis, recalling Puffer's earlier references to "symmetrical asymmetries" in her experimental findings, discussed above. The parts are treated as a carefully articulated series of overlapping rectilinear shapes contained within an inverted cone-like configuration that recalls Dokuchaev's mention of the inverted cone as an example of formal allusion. The rhythmic relation of the relative size, proportion, and overlapping of these shapes, locked into a complex geometrical matrix, appears carefully calculated to suggest a complete geometrical balance between the collections of shapes on either side of the vertical axis that terminates in the fulcrum resting on the datum plane.

The precarious balance achieved in this composition results from the evident distortion of the usual shape of a cone as a result of its eccentric loading, the corresponding deviation from the customary rectilinear matrix for rendering and perceiving form, and particularly the form's seemingly unsteady perch atop so insubstantial a resting point as its apex. These three aspects combine to call into question, at least at first glance, the apparent stability of the form. And yet they doubtless were conceived to catch the mind's eye and to create a

memorable impression. The placement of the small human figure beneath the most precarious part of the form seems to confirm the designer's intention to create just such a sense of dynamic visual tension. It is one that the Rationalists sought consciously, albeit more subtly, to cultivate in their work.

A similar sense of tension was created in the exercise by S. Lopatin, also done in Ladovsky's section, which aimed at visualizing the apparent moments of construction (Fig. 20). In this architectonic composition, the pronounced cantilever conveys something of the quality of an outflung arm arrested in motion, creating obvious visual tension by attempting to balance the ponderous masses placed at the end of the cantilevered platform with a tensile but visually insubstantial cable network.

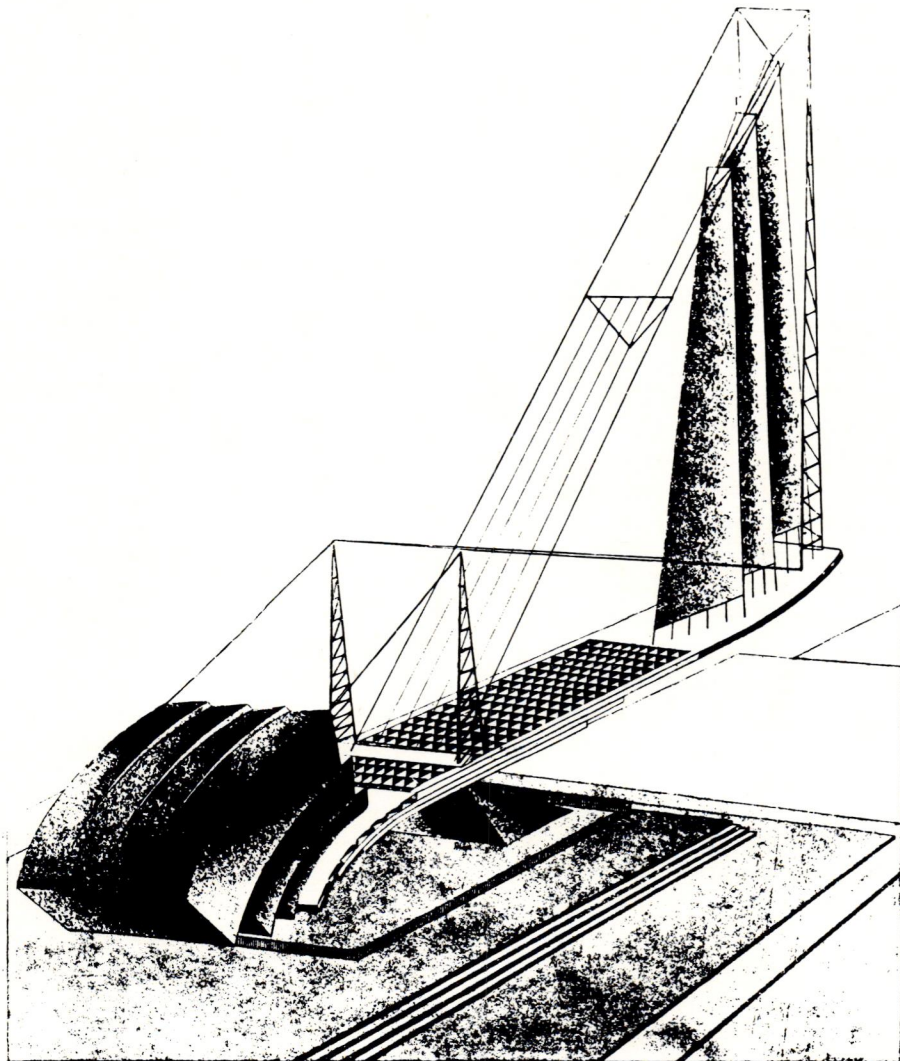


19. A. Arkin, *First-year Exercise in Manifesting the Physical-Mechanical properties of Form (mass and equilibrium)*, 1922. VKHUTEMAS, Ladovsky studio.

A comparable approach to the visualization of structure was cultivated in the more advanced versions of the mass-and-equilibrium problem assigned in the second-year design studio. Building upon the approach developed in the first-year problems, this assignment focused (as all did in the second year) on the solution of an explicitly architectural problem. In this case, the problem called for designing a pier and restaurant beneath a cliff jutting out over the sea. The chief objective of this exercise—as of Tatlin's Monument to the Third International—was to demonstrate that a building can create a powerful esthetic image through the visually emphatic expression of its *apparent* structure (Dokuchaev's *architectural* construction) and movement. Such an approach presupposed endowing the structure with an expressive metaphorical image of the apparent physical and mechanical forces at play. It is this image, rather than any overt demonstration of engineering expertise *per se*, that both provides the ultimate rationale for the structure and imbues the building with its innate character and dynamic visual aspect.

Two designs, both done in Ladovsky's studio, illustrate distinctive approaches to the problem. The one by Vladimir Simbirtsev (Fig. 21), created a rhythmic progression of four groups

of prismatic volumes, each one resting on a platform. Clinging to the inclined underside of the projecting cliff, this network of built-up platforms connects the pier on the shore below to the uppermost platform boldly cantilevered out beyond the edge of the cliff. A funicular provides access to all the levels, while its cable network serves as a kinetic visual axis connecting the articulated parts into an expressive architectural whole. The result is a dramatic composition whose visual power derives from its very setting and from its corresponding distortion of all conventional notions of structural support. In the second design (Fig. 22), both the platform's connection to the underside of the cliff and the articulation of its individual parts are expressed more convincingly. Where Simbirtsev's stages were



20. S. A. Lobatin, *First-year Exercise in Manifesting Construction (cantilever)*, 1921. VKHUTEMAS, Ladovsky studio.

modulated by a simple rhythm of similar forms, the more complicated rhythm employed here, akin to the one noted by Dokuchaev, enlivens the design and achieves greater visual interest. Too, the extent of the glazed surfaces rendered explicitly in this design suggests a degree of transparency that somehow makes the massive cliff behind rather than the transparent structure itself, appear to provide sufficient support, thereby mitigating the structure's apparent instability. The visual tension between apparent substantiality and insubstantiality at play in this design was one of several formal devices employed by the Rationalists to energize architectural form.

Ladovsky's fourth and final category of expressive qualities, which he termed the logical, might in truth have been called the *spatial*. The ultimate significance of the plane, which Ladovsky conceived as the primary formal element in this category, was believed to derive from its capacity, as a vital component in the envelope of architectural form, to facilitate the dynamic enclosure and interpretation of space. The Rationalists regarded this notion of space, moreover, as the central idea of modern architecture and the cornerstone of their doctrine. Thus, it represents a kind of conceptual staging area for integrating the means espoused in all four categories of formal manipulation into an integral method for designing a spatially dynamic architectural form that would be visually precise and perceptually clear.

Ladovsky and the Rationalists professed a new image of the architect as the creator of dynamic spatial environments capable of eliciting esthetic responses. The observer's awareness of space, regarded as a key factor in the esthetic appreciation of architecture, was seen as a response not merely to the physical area or volume of an enclosure, but to the kind of feeling it evokes about the quality of the space flowing through and beyond it as well. Accordingly, the designer had to provide for the possibility of capturing the observer's imagination through his awareness of space by creating sufficient perceptual clues for measuring and detecting key spatial relationships. The formal manipulations that Ladovsky advanced in his last category of expressive qualities were aimed at providing just such clues.

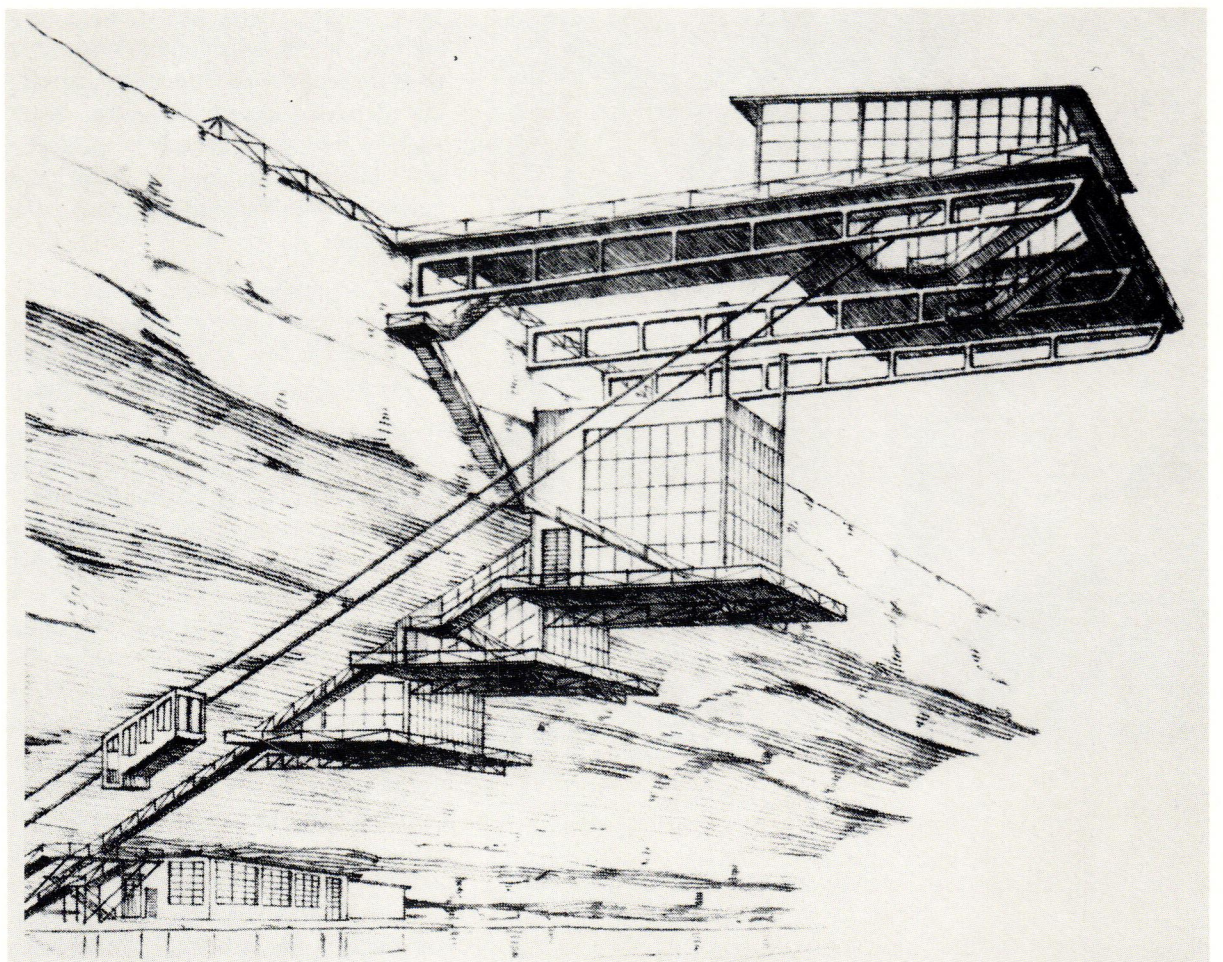
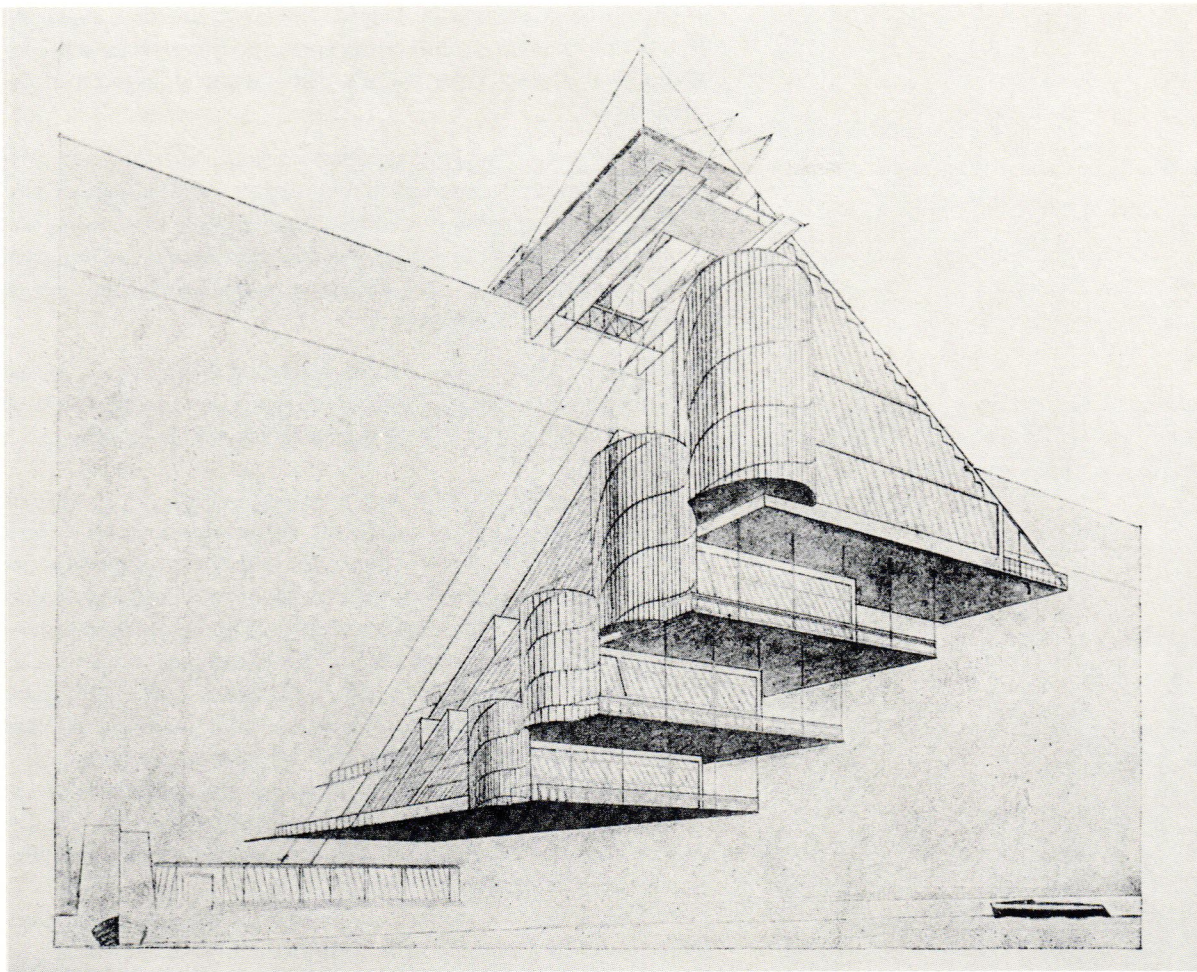
The space that loomed as the object of the Rationalists' concerns was not the *real* space found in nature, which Dokuchaev called "undesigned" space, but real space modulated and transformed into *architectural* space. Architectural space, Dokuchaev explained, "is understood to be an integral and continuous expanse in width, height, and depth, organized and given shape by forms, their inherent character, and their relationship to one another."<sup>83</sup> Such a space existed not as something enclosed from without, but as enlivened from within. It was, as he put it, "a kind of hollow plastic phenomenon, filled with volumetric object-forms of varying degrees of permeability, that occupies the expanse between these object-forms." Dokuchaev and the Rationalists thus had in mind a kind of spatial coordinate system, similar to the one Hildebrand had proposed, which operated in the three dimensions over time as a common perceptual framework for designer and observer alike. Such a conception of architectural space suggested a universal scale of modulation for measuring the spatial magnitudes of architectural forms, as well as for orienting them to one another and to the observer. It also presupposed an interpenetration between the space within the envelope of the form itself and the space beyond.

The Rationalists regarded the essence of spatial form to proceed not from its aspect as a volume, but from its unique capacity to enclose space. Spatial form was neither a solid nor a monolithic entity, but a composite of layered planes making up

its envelope and giving form its ultimate material aspect. It was conceived as a virtual synthesis of "the two-dimensional aspects of the plane, the three-dimensional aspects of the enclosed volume, and the aspect of time that reveals the spatial roots of architectural form."<sup>84</sup> Ladovsky's and Krinsky's explorations of modern art for means of expressing the innate spatial character of architectural form had revealed the expressive power of the plane, which had long been overlooked in architecture. Accordingly, the plane held a vital place in the Rationalist lexicon as the primary agent for imbuing the envelope of architectural form—and thus, architecture itself—with the desired dynamic spatial aspect.

The technique proposed for constructing the envelope as an aggregate of planes was one that Ladovsky called "articulation in relief."<sup>85</sup> His belief that the envelope of an architectural form, like the wall of a building, possessed actual depth was fundamental to this principle and bears a certain correspondence both to Hildebrand's idea of building up form in parallel vertical layers and to the dynamic planar constructions of Tatlin's "counter-reliefs." This sense of depth, traditionally submerged beneath an essentially flat treatment of the wall, had to be made visually apparent through articulation in relief in order to assure that it would be properly perceived. This entailed building up the envelope out of a network of layered planes, overlapping and intersecting at various coordinated angles. The envelope would thus acquire not only an essential three-dimensional aspect, but also a plastic quality, obtained from the interaction of receding and advancing planes and the rhythmic flow of their lines. None of the planes was capable of standing alone. All derived their ultimate impact and significance from being carefully combined and arranged in perfect but dynamic equilibrium to create an integral architectural whole. The exercises assigned by the Rationalists on articulating surface and form as envelope (Fig. 17) reveal how crucial the geometrical articulation of form was to the attainment of a lucid equilibrium: the shapes, sizes, and proportions of the constituent planes and intervals all had to be balanced and correlated with absolute precision. These exercises also make clear the extent to which the elements advanced in Ladovsky's four categories of formal manipulation were conceived as an integral set of interactive principles of composition.

An article surely authored by Ladovsky applied the concept of relief articulation to the design of skyscrapers.<sup>86</sup> The first part of the presentation seems remarkably in tune with Louis Sullivan's brilliant 1896 article, "The Tall Building Artistically Considered." Like Sullivan, Ladovsky regarded the expression of height as the basic problem in skyscraper design. At the same time, he also declared that "architecture should not mask the construction" of a skyscraper. Yet, while asserting that "it must be 'truthful,'" he cautioned that "it would be naive to think that it is sufficiently 'honest' simply to reveal [technical] construction in order to fulfill architectural goals." Rather, the object was to imbue the architecture of the skyscraper with consummate artistic expressiveness by capturing its essence as an architectural form. Foremost among these was its height, which had to be expressed not by masking its facades with Gothic motifs, as had been done in recent American skyscrapers, but "simply as a bold movement upward, as the overcoming of weight."<sup>87</sup> This declaration recalls Sullivan's assertion that, in heeding "the imperative voice of emotion," the tall office building "must be tall . . . must be every inch a proud and soaring thing, rising in sheer exultation so that from the bottom to the top it is a unit without a single descending line."<sup>88</sup>



21. V. Simbirtsev, *Second-year Exercise in Manifesting the Physical-Mechanical Properties of Form (mass and equilibrium): Pier and restaurant under a cliff over the sea, 1922.* VKHUTEMAS, Ladovsky studio.

22. Anon., *Second-year Exercise in Manifesting Physical-Mechanical Properties of Form (mass and equilibrium): Pier and restaurant under a cliff over the sea, 1922.* VKHUTEMAS, Ladovsky studio.

Apart from expressing height, however, the skyscraper, no less than any other architectural form, had to articulate the architectural rather than merely the technical aspects of its construction:

*The elementary requirement which we must, after all, impose on the architectural treatment of any surface consisting of columns, beams, and windows is the proposition that the constructive elements constituting the facade of a skyscraper must be subordinated to a spatial logic . . . to expressing spatial correlations with an appropriate degree of precision.<sup>89</sup>*

Applying “spatial logic” to the design of a skyscraper meant articulating the skeletal frame in sharp relief against the wall surface, thereby manifesting the architectural construction as a “deep form.”

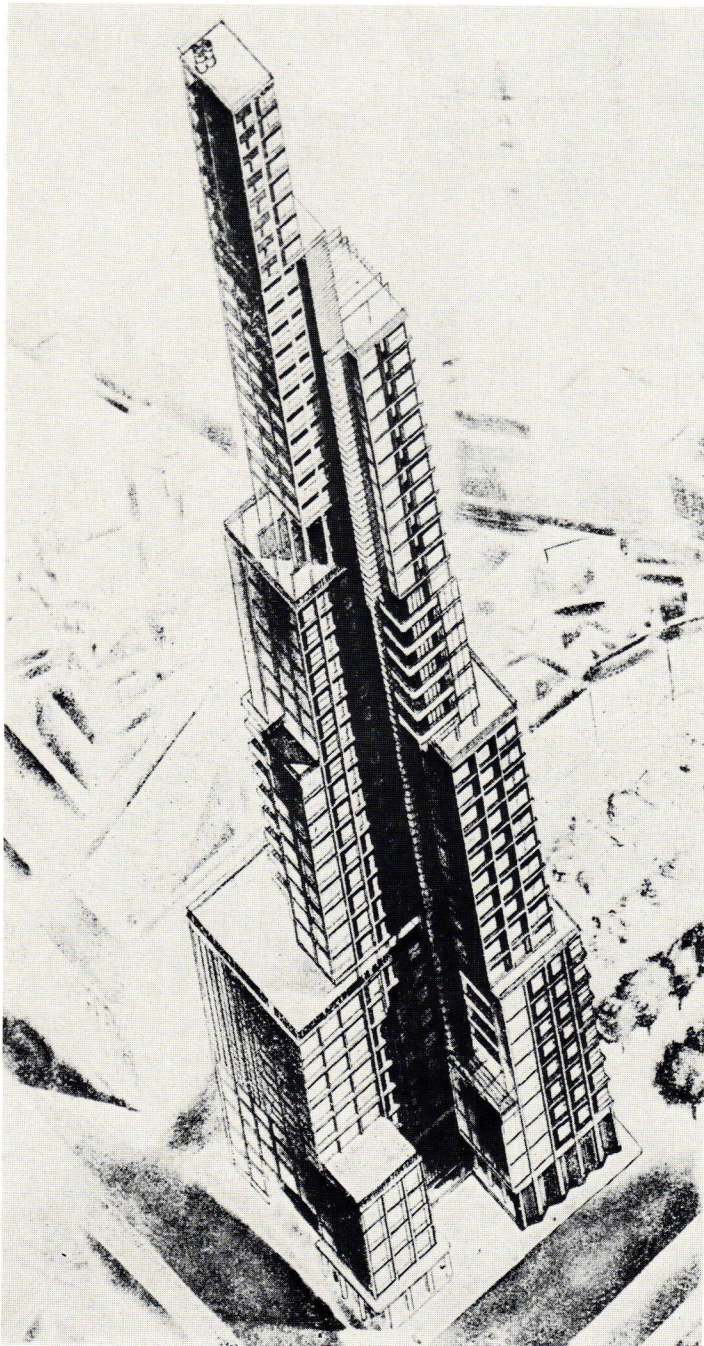
The skyscraper design by S. Lopatin (Fig. 23), a student project in Ladovsky’s second-year studio at the VKHUTEMAS, features a building whose silhouette unquestionably expresses height, although not in the form of a single extruded shaft. Instead, a hierarchical clustering of shafts that rise incrementally around the visual core of the skyscraper, somewhat in the manner of a rectilinear spiral, produces a more complex and dynamic configuration.<sup>90</sup> The use of a concrete skeletal frame is clearly evident, as is the articulation in sharp relief against recessed window walls. The rectilinear pattern of articulation is undistorted but rhythmically varied to set off the various zones and stages of the skyscraper. A dynamic but persuasive equilibrium is achieved.

Infinitely more complex and visually agitating is the skyscraper design that Krinsky produced in 1922–1923 (Figs. 24–25). The building does a good deal more than merely express height. Although it, too, employs a concrete skeletal frame to achieve a dynamic form, it is marked by a precarious distortion of the rectilinear structural grid conventionally associated with skyscraper design. Years later, Krinsky recalled that he had approached the project with lines from a poem by Vladimir Mayakovsky etched indelibly in his mind, and confessed that they had provided the seminal inspiration for his design:

*We are peddlers of a new faith,  
Giving beauty an iron tone,  
To keep the puny stuffs of nature from defiling squares  
We set off ferro-concrete into the skies.<sup>91</sup>*

It is possible to see Krinsky’s startling design, seething with restless energy, as the virtual embodiment of the effects of “setting off ferro-concrete into the skies.” The radical skewing of the lower portion of the building by juxtaposing diagonal elements within a rectilinear framework creates the impression that a substantial discharge of some kind has just shaken the building to the core, almost dislodging it from its foundation. No less venturesome is the extent of space hollowed out from the central core of the building. The geometrical composition is marked by rhythmically complex contrapuntal variations on a rectilinear theme. Provocative and even compelling, although unquestionably an experimental visionary design, Krinsky’s project demonstrates the limits to which Ladovsky’s evocative syntax was stretched in exploring for means to create a dynamic architecture of spatial form.

The exercises on expressing space which the Rationalists assigned at the VKHUTEMAS yielded more subdued but equally inventive solutions to the fundamental problem of articulating the permeable envelope as a prime determinant of spatial form. The concept of permeability, or the degree of a



23. S. A. Lopatin, *Second-year Exercise in Manifesting Dynamics, Rhythm, Ratio and Proportion: Skyscraper for the offices of VSNKh, 1923.* VKHUTEMAS, Ladovsky studio.

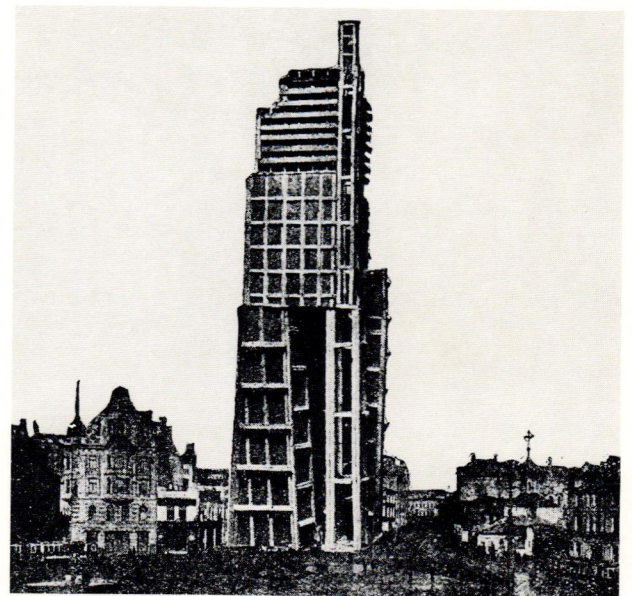
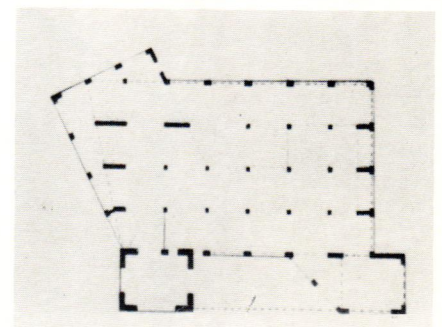
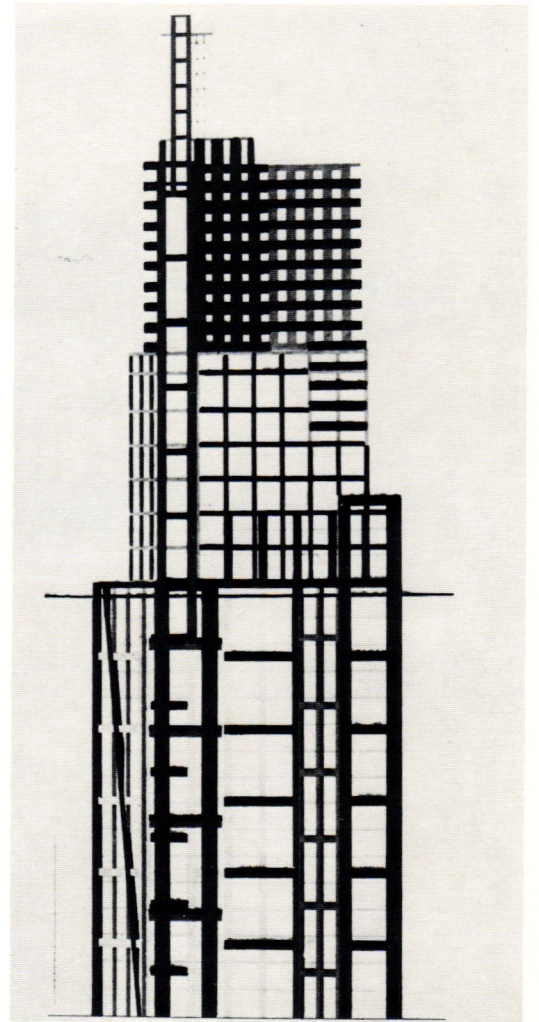
form's openness to passage and penetration, to which Dokuchaev had referred in his definition of architectural space, was a corollary of the Rationalists' view of the envelope as a composite layering of planes, and so a three-dimensional entity rather than a two-dimensional expanse. The Rationalists saw a dynamic level of permeability and the interpenetration of space that it suggests as a vital means for emphasizing the esthetic and perceptual power of space. Exploring this aspect of the problem was one of the prime objectives of the VKHUTEMAS design exercises on expressing and manipulating space.

Probably the best known of these is I. I. Volodko's design for a covered market, done in Krinsky's section (Fig. 26). His design underscores the premium placed on exploiting the fundamental relationship between the architectural envelope and the interpenetration of exterior and interior space. It reveals an awareness that a space sequence can be made to issue firm directives that the observer can detect and measure according to its rhythms and the nature of its boundaries. The device of criss-crossing planes, used effectively to articulate the surface of the roof, is echoed in the corresponding but more subdued undulations of the side walls. The result is a dynamic spatial enclosure that conveys a perceptually measurable flow through its sequence of articulated modules of space. Not least, the elements of form, envelope, and space are here inextricably fused into an integral and lucid spatial form, the transparency of its large glazed surfaces accentuating the expansive sense of interpenetrating space.

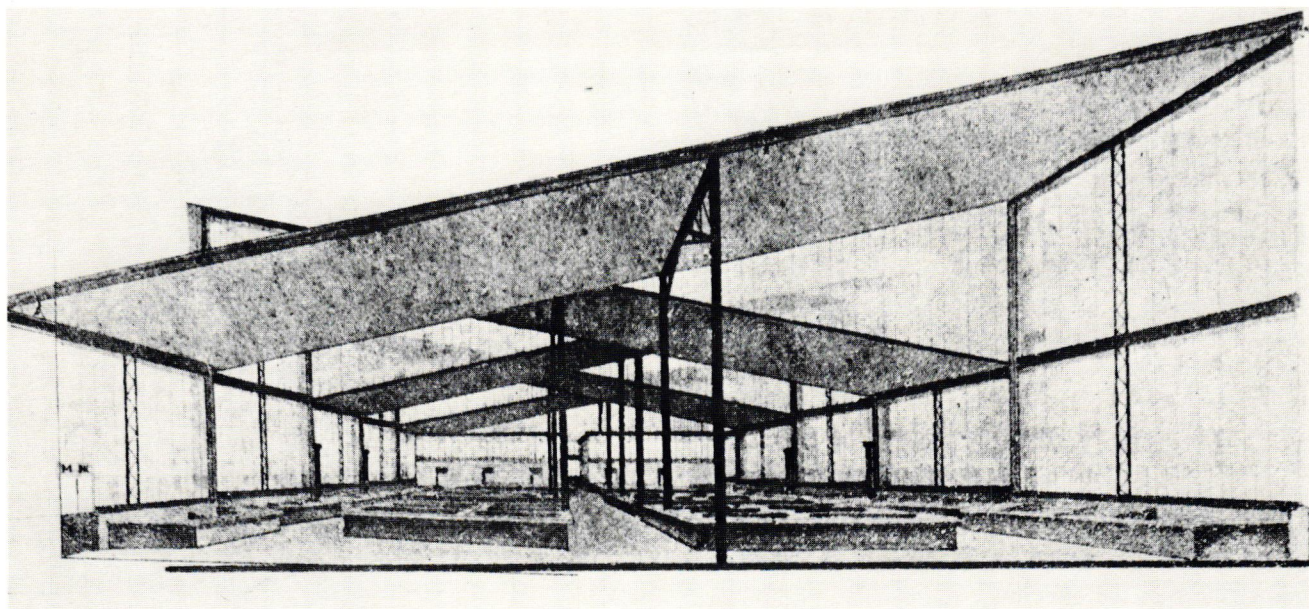
It has already been observed that the Rationalist movement was the more pedagogically oriented of the two leading avant-garde tendencies in Soviet architecture. The Rationalists believed that a new approach to modern architecture could be most rigorously and objectively developed in the controlled environment of the school of architecture. It was also in the school that the results would be effectively transmitted immediately to those who would constitute the coming generation of architects, thereby providing reasonable assurance that they would be trained to implement the new design methodology in a way calculated to bring fundamental improvement to the architectural enterprise and to the built environment at large. Thus, if some of the Rationalist pronouncements seem to verge on the tendentious, it is probably because they often tended instinctively to assume the trappings not of a propagandistic panegyric, as those of the Constructivists were wont to do, but of a didactic course syllabus or lecture.

Ladovsky, Krinsky, and Dokuchaev were quite satisfied to be pedagogues rather than practicing architects. By all accounts, they devoted themselves to the task with great vigor and relish, although Ladovsky participated in a number of competitions, developed projects for several significant housing projects, and developed numerous important town-planning schemes.<sup>92</sup> Moreover, other members of the movement, chiefly students and recent graduates of the VKHUTEMAS, likewise submitted projects jointly as brigades of the Rationalist organization, the Association of New Architects (ASNOVA).<sup>93</sup> The vast majority of these projects either emanated from or were otherwise connected to upper-level design problems assigned by the Rationalist instructors at the VKHUTEMAS. Dokuchaev himself underscored "the close ties between the 'Rationalist' architects and our higher school [the VKHUTEMAS]" as the basis of the movement's professional activity.<sup>94</sup> Still, the Rationalist design method obtained significant and measurable results in practice.

The idiosyncratic and compelling work of Konstantin Melnikov illustrates, as perhaps no other, the progressive aspects

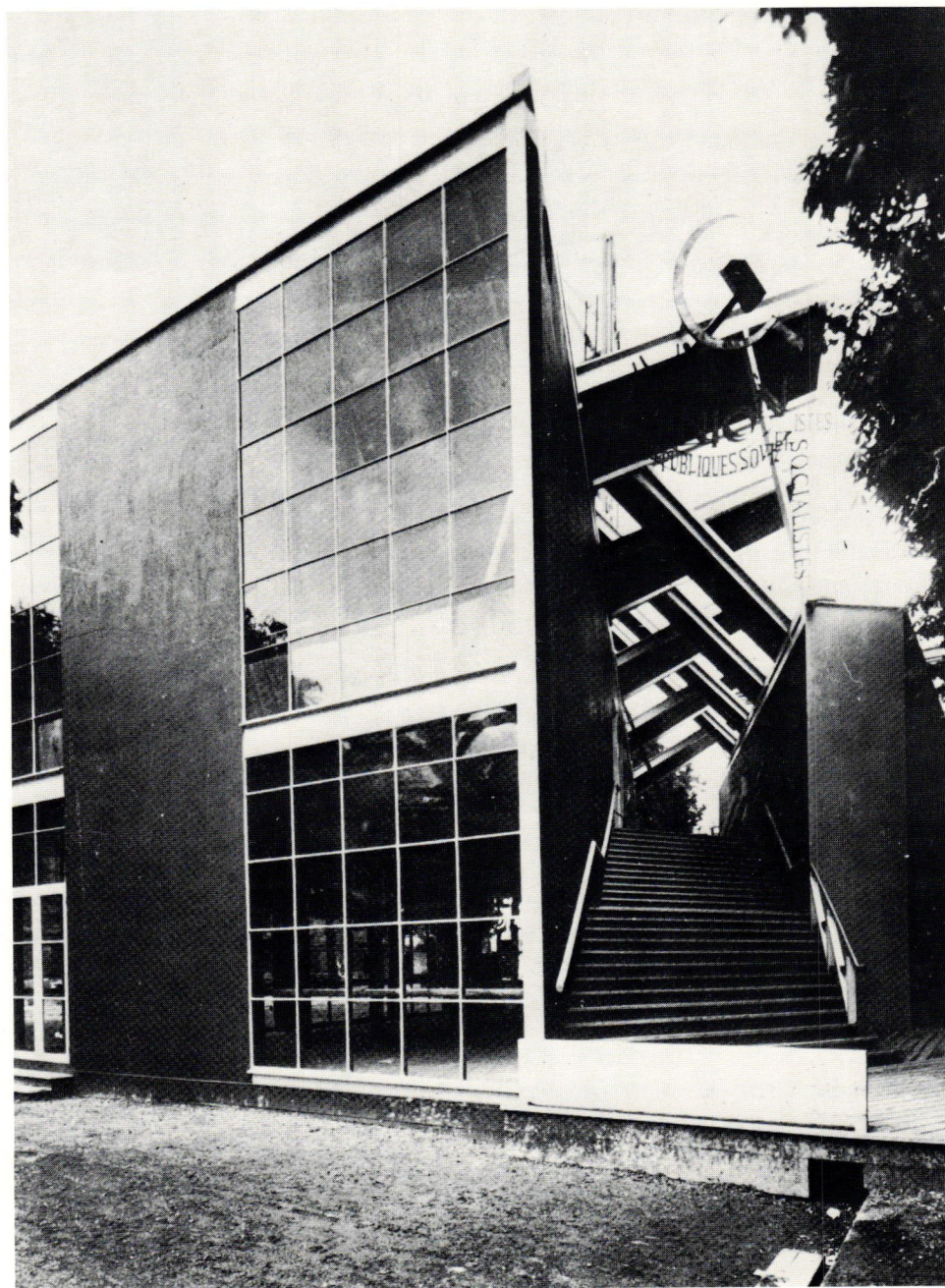


24-25. Vladimir F. Krinsky, *Project for a Skyscraper for the VSNKh, 1923. Elevation and plan.*



26. I. I. Volodko. *Second-year Exercise in Manifesting Space: Covered Market*, 1923. VKHUTEMAS, Krinsky studio.

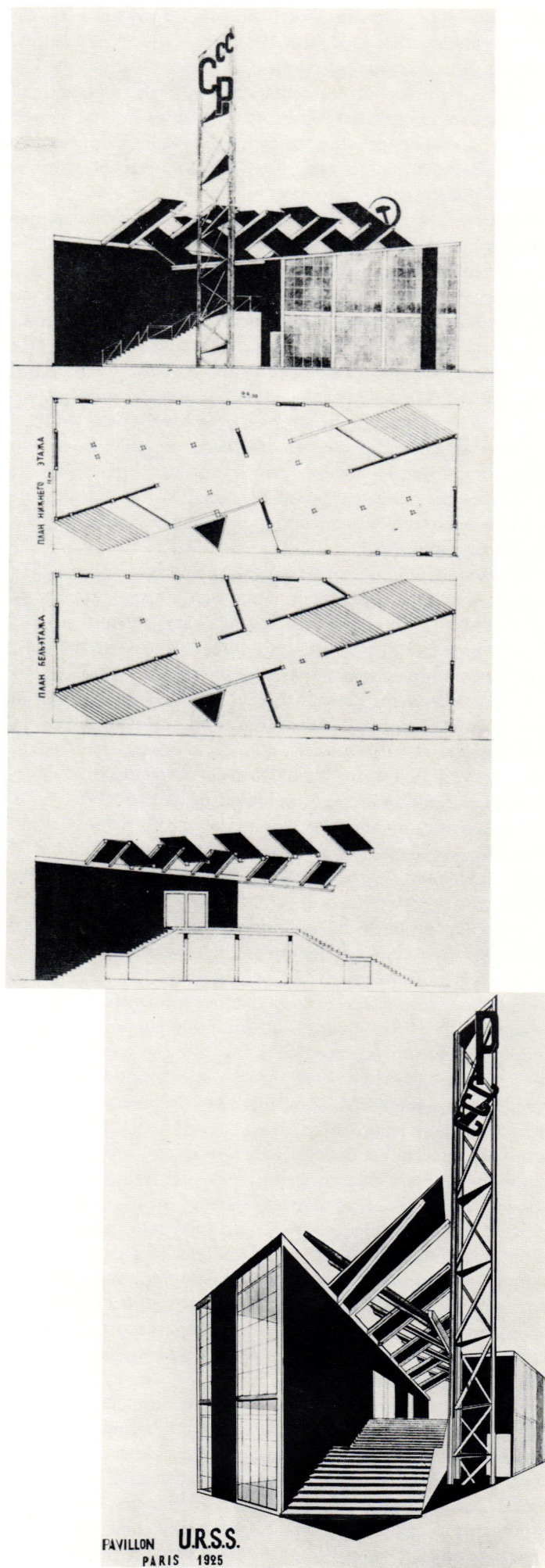
27. Konstantin S. Melnikov, *Soviet Pavilion, International Exposition of Decorative Arts, Paris, 1925.*



and potentialities of the design principles and ideas advanced by Ladovsky and the Rationalists. While there is some question about whether or not Melnikov was ever formally a member of ASNOVA, there is little doubt that he was close to Ladovsky and Krinsky and had much in common with them.<sup>95</sup> Melnikov's recent biographer, S. Frederick Starr, has pointed to the architect's inclination to extract from the vocabulary of abstract form a symbolic system with which to fashion a modern *architecture parlante* capable of communicating evocatively to the public.<sup>96</sup> As should by now be apparent, such inclinations were at the heart of the Rationalist doctrine and design method. The primary objective of that method, Dokuchaev remarked, was "to solve the [architectural] problem with the kind of expressiveness and disciplined organization of form and space that would be capable of raising and awakening man's energy and enriching his emotions." Doing so, he concluded, "opens up significant prospects for modern architecture to accomplish the kind of progress and perfection that is far removed from the tedious, the monotonous, and the mundane."<sup>97</sup> That Melnikov fulfilled these expectations with consummate panache and skill may be seen by examining two of his buildings.

The first is his Soviet Pavilion for *L'Exposition internationale des arts décoratifs*, held in Paris in the summer of 1925. The building, constructed of lap-jointed timber struts and planks with glass pane walls, fabricated in Moscow and assembled on the site, projects a bold, crisp silhouette (Figs. 27–29). The articulation of the facade with machine-like precision appears to bespeak a simple rectangular mass. However, the bold juxtaposition of outwardly simple form and inwardly complex geometrical matrix obtained startlingly unconventional results. An examination of the pavilion's plan and side view reveals a diagonal staircase that rises and falls through the rectangular mass, dividing it into two identical triangular forms. This dramatic interlocking of triangular and rectangular modes of spatial composition, emphasized by Melnikov's own perspective focusing on this particular junction of the pavilion, operates convincingly to deny the illusory simplicity suggested by the facade. The criss-crossing planes of the awning stretched out on the open frame over the staircase—recalling the roof treatment of Volodko's covered market—accentuates the dynamic flow of space that sweeps diagonally through the pavilion. Thus, the rich complexity of Melnikov's spatial composition, which compares favorably to that of Le Corbusier's Pavillon de l'Esprit Nouveau at the same exposition, belies the apparent simplicity of the pavilion's outward form. This dichotomy, epitomizing that level of spatial inflection which the Rationalists advocated for heightening the perceptual impact and experience of a building, is one that Melnikov exploited repeatedly in his buildings to excellent advantage.

The second Melnikov building is the dynamic Rusakov Workers Club in Moscow, built in 1927–28 (Figs. 30–32). The plastic articulation of mass, proclaimed by the searing angles of the cantilevered forms on the street facade, attained perhaps its ultimate realization here. The audacious structure is not only a powerful form, but a convincing one as well. The aggressive diagonal projections of the upper portions of the auditorium, appearing at first glance to be symbolic of cogs in a gear and so of the proletariat for whom they were designed, were carefully determined on the basis of optimal seating and sight lines, as indicated in the section, thereby reflecting a virtual synthesis of formal and functional elements. Still, these very projections, like the diagonal staircase in the Paris pavilion, provide the key to energizing what otherwise would have been a drab



28–29. Konstantin S. Melnikov, Soviet Pavilion, International Exposition of Decorative Arts, Paris, 1925. Elevations and plan.

rectilinear form. The Rusakov Club, more than the Paris pavilion, evinces the evocative "physical" and "mechanical" qualities of expressiveness espoused by Ladovsky and the Rationalists. Melnikov himself remarked that the manipulation of such forms was intended "to create the impression of a tensed muscle," an aspect echoing the psychophysiological metaphor that the Rationalists had assimilated from Münsterberg's principles of perceptual psychology.<sup>98</sup>

Melnikov's work, the product of a visionary but vigorous spatial logic, demonstrates the evocative perceptual power of geometrically articulated mass and space enriched by a degree of expressive quality appropriate to a given solution. The diversity of forms apparent in Melnikov's work (his evident concern with cylindrical forms notwithstanding), together with the explicit accommodation of function, is strikingly in accord with the Rationalists' insistence that their design method provided for a consistency of approach, and not of the finished product. Finally, the contrast between simple means and richly complex ends, manipulated so exquisitely by Melnikov, epitomizes the sense of visual tension that the Rationalists promulgated as a legitimate and dynamic measure for enlivening architectural form.

Of the few buildings that Ladovsky completed still standing in substantially unaltered state, none shows better his concern for symbolizing in visually expressive spatial form the activity accommodated by a given structure than his "Red Gates" (now Lermontov) entrance to the Moscow Metro, built in 1935 (Fig. 33). Begun in the mid-thirties, the Moscow Metro, or subway, was dug deeply into the ground. Escalators, passing through semi-circular tunnels, connect the street level to the track platform below, which is also rendered in essentially barrel-vaulted configurations of one kind or another. Wishing to portray visually for the Metro users the perceptual experience of moving underground along these semi-circular tunnels of space, Ladovsky devised a cogent "architectural motif" that would prove emblematic of such an experience. Using the semi-circular profile as his starting point, Ladovsky developed a conical rather than cylindrical vault, rendered as though in one-point perspective with a vanishing point thus perceived as lying below ground level. This ingenious funnel-like form may be read either as rising out of the ground in culmination of the underground tunnels or as penetrating into the ground as their effective point of origin. Furthermore, the conical vault is rendered not as a single slab, or plane, but as a concentric system of layered slabs whose articulation "in relief" underscores the depth of the architectural envelope. Above all, such a layering of the slabs serves effectively to affirm the Rationalist axiom that a space sequence, even one as shallow as this, can be made to issue emphatic suggestions of directed movement by the adroit manipulation of the rhythms and articulations of its boundaries. Ladovsky's metro entrance thus epitomizes the advantages envisioned, and in this case achieved, by his psychoanalytical method of design, which emphasized the need to manipulate expressive spatial forms in a way that was visually lucid and perceptually clear.

Although the Rationalists' concern for developing and applying an expressive language of architecture emphasized the formal aspects of the problem, there was an accompanying deep concern for the social value of architecture as well. That concern was rooted in the conviction that this new language of architecture had provided the basis for establishing a new standard of vision and spatial cognition by which the Soviet citizen could orient himself to his immediate environment. The design of lucid and congenial "outward forms and visible space,"

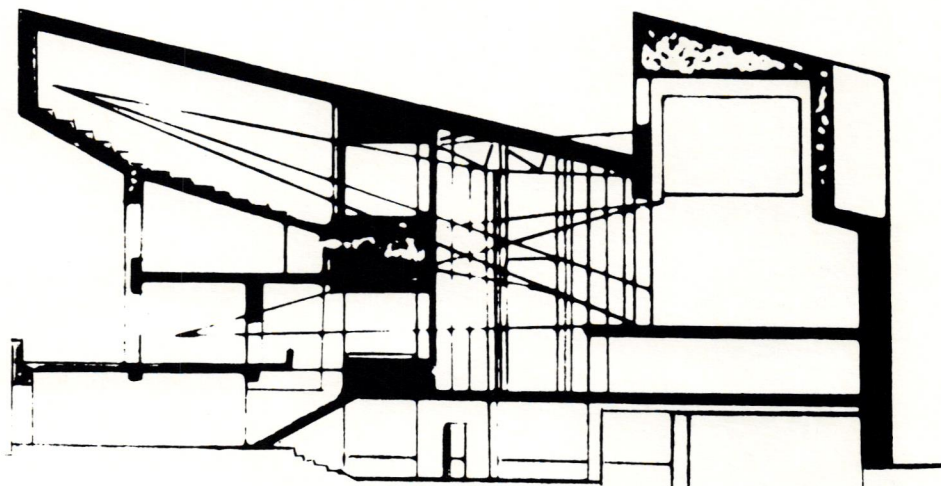
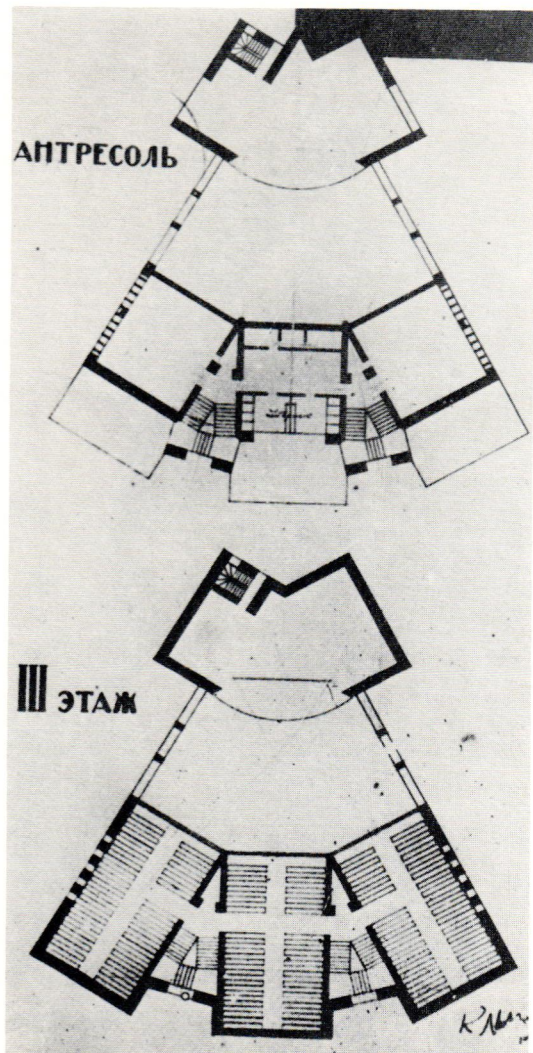
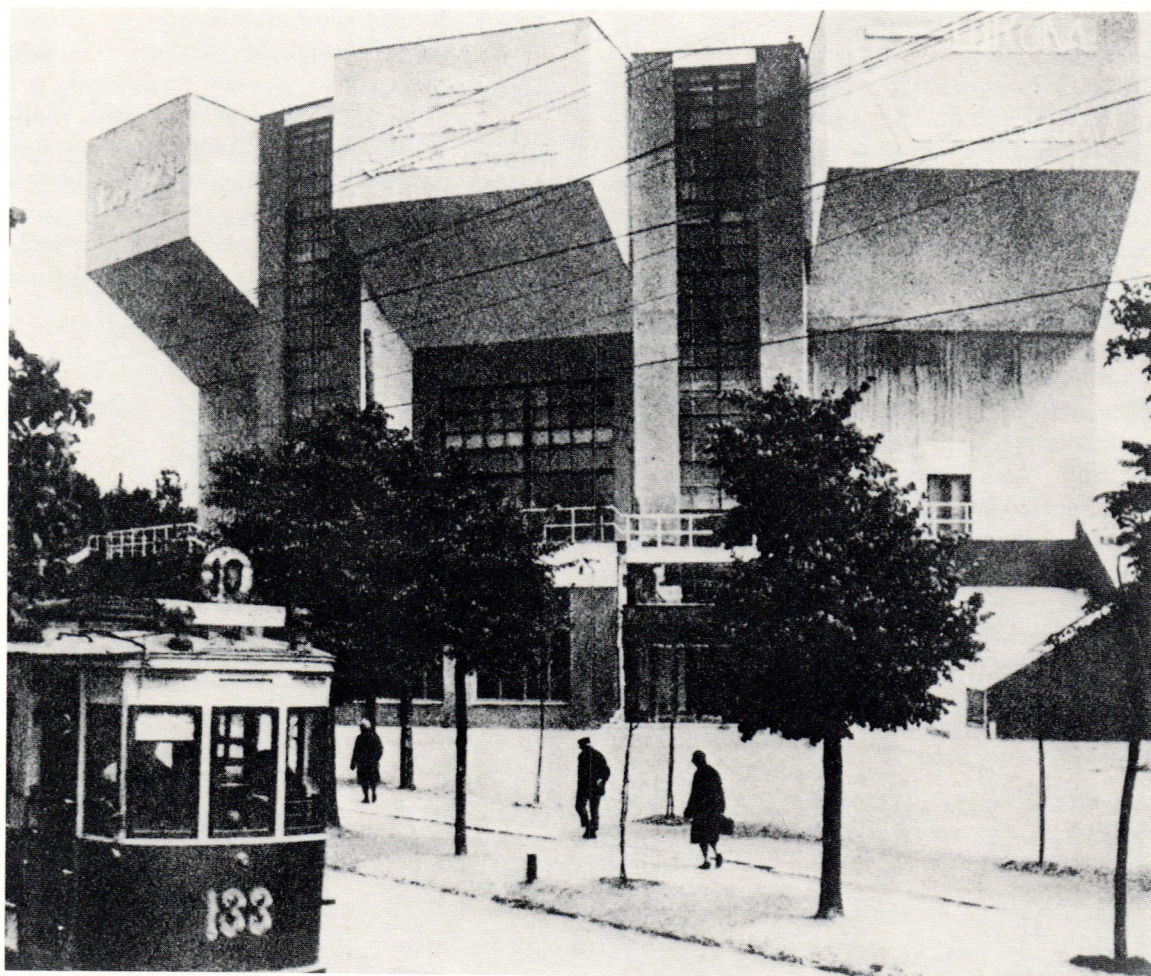
as Dokuchaev put it, would help nourish and sustain the Soviet citizen's need to feel, to comprehend, and to perfect himself. At the same time, it could also help mold and enhance the collective consciousness of the Soviet citizenry at large by granting a vision of harmony, where all was in balance, just as in the new order toward which Soviet society was evolving.

*It is necessary that our housing, where half the lives of our workers and clerks are spent; that our plants, factories, and institutions where the remaining half of their lives are spent; and, finally, that our cities, open spaces, and buildings for rest, education, and recreation . . . provide the consumer not only with comfort and shelter from the elements, but also with both visual and intellectual stimulation and impact through their sense of organization and order. For this will serve to enhance our lives and our work. By acting accordingly, we [architects] will conserve the psychological and physical energy of our citizens. Our buildings, far from being oppressive and monotonous, will, by their rhythms and the harmony of their organization, enhance our basic vitality. And this is a profound social fact.<sup>99</sup>*

Comparison of the Rationalist and Constructivist approaches is both inevitable and instructive. Although the Constructivists aimed for a social and technical rationalization of architectural form and building type, and made dramatic progress in that respect, it would be foolhardy to suppose that they were not fundamentally concerned with aspects of formal expression. While their formal ideas were seldom postulated explicitly in Constructivist pronouncements, their inference is unmistakable in Ginzburg's formulations of the "functional method" and in his and the Vesnin brothers' projects and completed buildings alike. Despite a certain diversity apparent in their work, the forms employed displayed a remarkable consistency bordering on formalization: an avowed preference for predominantly rectilinear forms of evident simplicity and regularity, with simple rhythmic asymmetrical variations obtaining chiefly in the fenestration and void patterns and in the differentiation of masses through the marked separation of functions in plan. Ginzburg first advanced this preference in *Style and Epoch*, where he rationalized it by reference to the psychophysiological prescriptions of Münsterberg's teacher, the German psychologist Wilhelm Wundt:

*Wilhelm Wundt has determined that we experience the sensation of pleasure from perceiving a line that is more comfortable for the eye to follow—such as, for example, a vertical or horizontal line—when the muscles moving the eye have to expend a minimum of energy. Correspondingly, an irregular and sharply broken line creates an uncomfortable sensation, since the eye must constantly change direction by angular movements; as a result, the nerves stimulating the muscles, as well as the muscles themselves, must experience painful sensations. If crooked lines are bent with a certain regularity, thereby providing an opportunity to anticipate the effect, they usually generate the most profound feeling of satisfaction. It is precisely in the same manner that regular forms are perceived more readily by the eye than are irregular ones. In the realm of regular forms, a developed optical sensation usually prefers forms that are subdivided according to the simplest principles, such as symmetry or the golden mean.<sup>100</sup>*

Ginzburg's remark not only indicates an early propensity for more regular and simple forms, but also reveals that he, too, consulted findings in perceptual psychology.



30-32. Konstantin S. Melnikov, Rusakov Workers Club, Moscow, 1927-28. Plan.

Thus, while the Constructivists employed a fairly consistent and restrained vocabulary of formal elements that tended increasingly to echo their approach to standardized design, the Rationalists sought a richer diversity of formal expression through a dynamic and evocative manipulation of abstract form. It is arguable that the Rationalist manipulation of form, far more than that of the Constructivists, bears a striking affinity to tendencies that have operated throughout the history of Russian architecture, from the animated juxtapositions of bulbous domes and richly patterned silhouettes up to the eighteenth century, to the more subtle but no less enriched manipulations of classical form in the next two centuries. The more lively approach to the classical syntax developed in Moscow managed to retain the native propensity for enriched form, while a more pedantic classical idiom was devised in St. Petersburg, the center of the classical tradition imported from the West. What appears striking about the Rationalist achievement, however, is the degree to which it manifested this basic impulse toward an expressive formalism in Russian architecture in a fresh and thoroughly modern manner through the literate manipulation of abstract form and space.

Above all, the Rationalist doctrine was a keen and remarkable intellectual achievement. Far from constituting "a sort of

universalism of the Larousse type . . . in which everything became subjective and conventional,"<sup>101</sup> it made possible a new spatial vision and conception of dynamic architectural form that was distinguished by an impressive vitality and depth of creative possibilities. It demonstrated persuasively that complexity and richness, handled with discipline and control, are not antithetical to the conceptual ideals of modern architecture. Significantly, this discipline and control were enhanced considerably by informed reference to principles of perceptual psychology.



33. Nikolai A. Ladovsky, "Red Gates" (now Lermontov) Metro Entrance, Moscow, 1935.

\*This essay builds on my earlier treatment of the subject in a paper on the VKHUTEMAS, presented at the New Orleans meeting of the Society of Architectural Historians in April 1974, and in my Ph.D. dissertation, "Trends in Soviet Architectural Thought, 1917-1932: The Growth and Decline of the Constructivist and Rationalist Movements" (Cornell University, 1974). It incorporates as well new insights and materials gained through additional research conducted in the Soviet Union in 1977, thanks to fellowships from the International Research and Exchanges Board (IREX) and the Fulbright-Hays Faculty Research Abroad Program.

I would like to acknowledge the generous assistance of Prof. Oleg A. Shvidkovsky, Head of the Department of Modern Architectural History at the Moscow Architectural Institute, who graciously facilitated my research and stay in Moscow in 1977. I am also greatly indebted to several Soviet colleagues who were so generous with their time and friendship, and with insights derived from their own work. The spirited involvement and response of members of the seminar on modern Soviet architecture that I gave at the University of Pennsylvania in the spring of 1979 helped sharpen the focus of my presentation. Thanks are also due to the University of Maryland at College Park for the sabbatical leave in the fall semester of 1979, which enabled me to begin work on this essay, and to the Committee on Soviet Studies at Cornell University, whose financial assistance helped with preparing the essay for publication.

## Notes

1. The theory of empathy was elaborated by the German psychologist Theodor Lipps, as discussed below; cf. n. 45 and accompanying text. Significantly, Lipps' theory of empathy forms the cornerstone of the "Humanist Values" promulgated in Geoffrey Scott's *Architecture of Humanism* (2nd ed.; New York: Charles Scribner's Sons, 1969), in which this principle is described as both "transcribing ourselves into terms of architecture" and "transcribing architecture into terms of ourselves" (p. 159). The first application of this general concept in American architectural theory occurs in Leopold Eidlitz's *Nature and Function of Art* (New York: A. C. Armstrong & Son, 1881), in which the architect maintains that the idea in art "is a perceived relation of matter" and that "some demonstration of the idea in material action should be fixed upon and defined in order to elicit the nature of the emotions which are ultimately depicted" (p. 125). It is significant that Eidlitz wrote and practiced during the High Victorian Gothic period in American architecture, which manifested tendencies to create forceful architectural forms. No architect better embodied such tendencies in his work than the Philadelphian Frank Furness, whose avid predisposition toward a mannered distortion of design elements through compression and other apparent effects of gravity has been noted, albeit without connection to the principle of "empathy," in James O'Gorman, *Architecture of Frank Furness* (Philadelphia: Philadelphia Museum of Art, 1973); see n. 80 below for further references to Furness in this connection. Vincent Scully detected similar, but more subdued, tendencies in the work of Louis Sullivan, and has recognized the "empathy" idea as the source in his "Louis Sullivan's Architectural Ornament," *Perspecta* 5 (1959): 74.

2. The study of space perception developed rapidly in the second half of the nineteenth century and still more rapidly during the twentieth as a distinct branch of psychology. The fields of investigation most relevant to architecture have been those concentrating on the factors that contribute to the perceptual articulation or organization of objects in space, such as depth perception, movement, form, color, and their interactions, as well as on such questions as how one perceives that there are six sides on a cube, even though only three of them can be directly visible at once. See, inter alia, Edwin G. Boring, *Sensation and Perception in the History of Experimental Psychology* (New York: Appleton-Century-Crofts, 1942), James J. Gibson, *The Senses Considered as Perceptual Systems* (Boston: Houghton Mifflin, 1966), and Julian E. Hochberg, *Perception* (Englewood Cliffs, N.J.: Prentice-Hall, 1964) for discussion of experimental findings and theories of special interest in space perception. For a treatment attuned more directly to questions of experimental esthetics, see R. W. Pickford, *Psychology and Visual Aesthetics* (London: Hutchinson Educational, 1972). Significantly, the rise of the study of space perception was accompanied by related innovative developments in art theory and criticism. These included the perceptual theories and analysis of Adolf von Hildebrand, Konrad Fiedler, and Alois Riegl, which revolutionized the approach to the figural arts at the close of the nineteenth century, followed by the corresponding analysis of spatial composition advanced by Riegl and August Schmarsow and amplified by Heinrich Wölfflin and Paul Frankl, which proved the hallmark of turn-of-the-century architectural criticism. These theorists analyzed the formal aspects of a spatial form that emerge only as the observer approaches and then moves around and through a building. In the process, they brought to light the kinetic experience of the observer, who arrives at a single image of an art object as the product of many partial images obtained while moving over successive time intervals through space. These innovations in art theory and criticism, together with the Cubist representation of objects from several points of view simultaneously, in turn paralleled the radical innovations in science based on the dynamic conception of space-time in modern physics, which described the universe as a continuum with four coordinates, dimensions, three of space and one of time, in which any event can be located.

The new conceptions of space in modern architecture began essentially with Wright's interpenetration of space, mentioned below (see n. 3). They encompassed such well-known innovations as Theo van Doesburg's and Gerrit Rietveld's rectilinear organization of planes conceived as layered and articulated elements in space, Miës van der Rohe's horizontally centrifugal spatial arrangements subdivided and articulated by free-standing planes and columns, and Le Corbusier's Purist layering of frontalized planes in space and play with literal and phenomenal transparency. As will be seen, the principles of dynamic spatial form advanced by the Soviet Rationalists represented yet another significant contribution to this constellation of conceptions.

3. The system developed by Friedrich Froebel may be seen as having constituted, in part, an adaptation of embryonic principles of perceptual psychology; for a general introduction to the question, see Denton J. Snider, *The Psychology of Froebel's Play Gifts* (St. Louis: Sigma Publishing Co., 1900), and Elsie R. Murray, *Froebel as a Pioneer in Modern Psychology* (Baltimore: Warwick and York, 1914). Like other basic perception theories, Froebel's kindergarten system sought to explain how an individual—in this case, a child—perceives the visible world of objects around him. The geometrical playthings devised by Froebel constituted a lucid means of facilitating that perception through the reduction of discrete objects into an interlocking complex of primary geometrical shapes, drawing parallels between the geometry of crystallography and the structure of all matter; see Maria K. Boelte and John Kraus, *The Kindergarten Guide: An Illustrated Handbook Designed for the Self-Instruction of Kindergarteners, Mothers, and Nurses* (New York: E. Steiger, 1877). There was little in the nature of the Froebel "gifts" to dictate any particular style, although the rigidly geometrical matrix did dispose Wright toward highly geometrical patterns. Beyond that, however, Wright was not impeded in absorbing and manifesting an impressive array of now well-known formal and stylistic sources, which he did with consummate skill, arriving at an innate personal synthesis. Thus, the significance of Wright's assimilation of the Froebel "gifts" does not lie in its having somehow yielded any discernible "style," as Grant Manson seems to imply in his treatment of the subject in "Wright in the Nursery," *Architectural Review*, vol. 113 (June 1953): 349-51, and in his *Frank Lloyd Wright to 1910* (New York: Van Nostrand, 1958), pp. 6 ff. That these "gifts" exposed Wright to a set of universal principles of form that inculcated in him a disciplined, three-dimensional way of thinking about form and space as interactive phenomena has recently been recognized by Richard C. McCormac in "The Anatomy of Wright's Aesthetic," *Architectural Review*, vol. 143 (February 1968): 143-46, and his "Froebel's Kindergarten Gifts and the Early Work of Frank Lloyd Wright," *Environment and Planning, B*, vol. 1 (1974): 29-50. Even in McCormac's illuminating treatment, however, undue emphasis on the tartan grid issue and thus on literal formal and "stylistic" aspects of the issue serves to obscure the conceptual and intellectual dimensions of Froebel's gifts and Wright's appropriation of them. That the Froebel episode in Wright's work was a process of assimilating principles of perceptual psychology into architectural thought was not discerned by either Manson or McCormac, or by Stuart Wilson in his "The Gifts of Friedrich Froebel," *Journal of the Society of Architectural Historians*, vol. 26 (December 1967), 238-41.

4. Walter Gropius, "Is there a Science of Design?" chap. 3 in his *Scope of Total Architecture* (New York: Collier Books, 1962), p. 30. The chapter appeared initially as an article in the December 1947 issue of the *Magazine of Art*. Among the more vivid examples of the connection between theories of perceptual psychology and concepts of basic design espoused by Bauhaus masters is the dynamic notion of space in art outlined in Lazlo Moholy-Nagy, *The New Vision and Abstract of an Artist* (rev. ed.; New York: Wittenborn, 1947). As will be seen below in a discussion of Kandinsky's work at the Institute of Artistic Culture in Moscow prior to his coming to the Bauhaus, the perceptual theories consulted by Bauhaus masters were not limited to those propounded by the Gestalt psychologists.

5. That the Soviet Rationalist movement has, until recent times, been virtually neglected in Western architectural criticism is surprising, but perhaps not difficult to explain. Its work, together with that of the Constructivist movement, was recognized and discussed as early as 1929 in Alfred Barr, Jr., "Notes on Russian Architecture," *The Arts*, vol. 15 (February 1929): 103-6; the article was published upon Barr's return from a tour of the Soviet Union to survey the contemporary Soviet art scene. Several years later, however, a decided cloud was cast on the Rationalist movement by Berthold Lubetkin, a Soviet architect of overtly Constructivist sympathies who had emigrated to England and founded the firm of Tecton in 1932. In his "Architectural Thought Since the Revolution," *Architectural Review*, vol. 71 (May 1932): 202, Lubetkin dismissed the Rationalist tendency (which he also referred to as "formalism") as "purely abstract, idealistic, and emotional," its "geometric symbolism . . . imprisoned within its own straightjacket that was inhuman and incomprehensible for the non-initiated: a sort of universalism of the Larousse type, but a universalism in which everything became subjective and conventional." Lubetkin's deep Constructivist bias and resulting antipathy toward the Rationalist movement lessens the authority of his denunciation. That bias, coupled with the superficial characterization of the Rationalist doctrine, was still reflected two decades later in Lubetkin's impressionistic piece "Soviet Architecture: Notes on Developments from 1917 to 1932," *Architectural Association Journal*, vol. 71 (May 1956): 261. In it, Lubetkin criticized the Rationalist design method's "arbitrariness of choice, which, notwithstanding its claims to be governed by universal and immutable laws of optical perception, was in fact a purely individualistic, empirical selection divorced from social and technical reality." Lubetkin's essentially polemical and quite misleading interpretation of

the Rationalist movement has been echoed in recent years by Kenneth Frampton; see his *Modern Architecture: A Critical History* (New York: Oxford University Press, 1980), pp. 171 ff. Anatole Kopp likewise has paid scant and largely disparaging attention to the Rationalists in his *Ville et Révolution* (Paris: Editions Anthropos, 1967; Eng. trans.: *Town and Revolution*, trans. Thomas E. Burton, New York: Braziller, 1970), and other writings. A more balanced though rather vague account is found in Milka Bliznakov, "The Rationalist Movement in Soviet Architecture of the 1920s," *20th-Century Studies*, nos. 7-8 (December 1972): 147-61. Vieri Quilici included a modest commentary accompanying the reproduction of a few Rationalist pronouncements in his *L'architettura del costruttivismo* (Bari: Editori Laterza, 1969), pp. 329-51; it was republished as "Formalismo e Productivismo," *VH 101* (Spring-Summer 1972): 176-89. Hence, the Soviet Rationalist movement has thus far been either overlooked or inadequately explained in Western architectural criticism and scholarship. To date, the only substantial and scholarly treatments of the movement, its theory, and its chief proponents are those produced by the Soviet scholars Vigdariia E. Khazanova and, especially, Selim O. Khan-Magomedov; for citations of their various publications on the subject, see Anatole Senkevitch, Jr., *Soviet Architecture, 1917-1962: A Bibliographical Guide to Source Material* (Charlottesville: University Press of Virginia, 1974). An English translation of a recent article on Ladovsky by Khan-Magomedov, is his "Nikolaj Ladovskij: An Ideology of Rationalism," *Lotus International* 20 (September 1978): 105 ff.

6. Nikolai A. Ladovsky, "Osnovy postroeniia teorii arkhitektury (pod znakom ratsionalisticheskoi estetiki)" [The Foundations for Constructing a Theory of Architecture (Under the Banner of a Rationalist Aesthetic)], *Izvestiia ASNOVA*, no. 1 (1926): [3]. This and other Russian-language texts cited in this essay have been translated into English by the author.

7. Ladovsky, "O roli prostranstva v arkhitekture i o karaktere sinteza arkhitektury, skulptury i zhivopisi" [Concerning the Role of Space in Architecture and the Character of the Synthesis of Architecture, Sculpture, and Painting], in *Mastera sovetsoi arkhitektury ob arkhitekture*, comp. M. G. Barkhin and Iu. S. Yaralov, vol. 1 (2 vols.; Moscow: Izd-vo Iskusstvo, 1975), p. 344. Hereafter, only the title and volume number of this documentary source will be indicated. Membership of ZHIVSKULPTARKII consisted initially of the sculptor Boris D. Korolev, its president, and seven architects: Ladovsky and Krinsky, together with S. Dombrovsky, N. Istelenov, Ia. Raikh, A. Rukhliadev, and V. Fridman; at that time, it was known as the Commission for the Elaboration of Questions of Sculptural-Architectural Synthesis (SINSKULPTARKII). The painters Alexander M. Rodchenko and Alexander V. Shevchenko and the architect G. Mapu joined by the end of the year, at which time the name was changed to ZHIVSKULPTARKII. See Selim O. Khan-Magomedov, "Pervaia novatorskaia tvorcheskaia organizatsiia sovetsoi arkhitektury (Sinskul'ptarkh-Zhivskul'ptarkh, 1919-1920 gg.)" [The First Innovative Creative Organization in Soviet Architecture (Sinskul'ptarkh-Zhivskul'ptarkh, 1919-1920)], *Problemy istorii sovetsoi arkhitektury*, no. 2 (Moscow, 1976): 5-9.

8. Vladimir F. Krinsky, "Vozniknovenie i zhizn' Assotsiatsii novykh arkhitektorov—ASNOVA" [The Emergence and Life of the Association of New Architects—ASNOVA], *Sovetskaia arkhitektura*, no. 18 (Moscow, 1969), 20. Hereafter referred to as "Vozniknovenie i zhizn' ASNOVA."

9. Krinsky, "Nachalo stanovleniia sotsialisticheskoi arkhitektury" [The Origins of the Evolution of Socialist Architecture], *Mastera sovetsoi arkhitektury ob arkhitekture*, p. 123.

10. *Ibid.*, p. 122.

11. *Ibid.*, p. 123. At the same time, Krinsky indicated that he had been above all infatuated with Cezanne, whose work he felt had marked the beginning of the tendency toward creating the "illusion of breaking down the object into fragments" that was subsequently picked up by the Cubists. Too, "by means of painting, he [Cezanne] expressed the sense of the material, the mass, and the weight of objects. And he conveyed their volumetric aspect by means of simple geometric surfaces and bodies (planes, cylinders, cubes, spheres)" (p. 121).

12. Kasimir S. Malevich, *Die gegenstandlose Welt*. Bauhausbücher no. 11 (Munich: Langen, 1927; Eng. trans.: *The Non-Objective World*, trans. Howard Dearstyne [Chicago: Theobald, 1959]). See also his *Essays on Art, 1915-1928*, ed. Troels Andersen, trans. Xenia Glowacki-Prus and Arnold McMillin. (2 vols.; London: Rapp & Whiting, 1969), and Troels Andersen, *Malevich* (Amsterdam: Stedelijk Museum, 1970).

13. In a letter to the editors of the Constructivist architectural journal *Contemporary Architecture (S.A.)*, Malevich claimed that his "volumetric Suprematism," or architectons, had, after 1923, "evolved in all of its cultural aspects into modern art, which is architecture;" *S.A.*, no. 5 (1928): 156. Despite his claim, that facet of his work does not appear, on the whole, to have exerted a notable influence on the Rationalists, least of all in the ZHIVSKULPTARKII experience, which predated it. Lissitzky had studied architecture at the Technische Hochschule in Darmstadt. He returned to Russia in 1918, and taught at the Vitebsk Art School, developing close contact with Malevich. According to Krinsky, Lissitzky and Ladovsky first met when the former appeared at INKHUK to give a lecture on his Prouns, probably on 23 September 1921, striking up a lasting friendship from then on; Krinsky, "Vozniknovenie i zhizn' ASNOVA," p. 27.

14. The term "Proun" coined by Lissitzky was an acronym standing for "Projects affirming the new" (*PROekty Uvrerzhdeniia Novogo*). "Proun," he wrote, "begins as a level surface [and] turns into a model of three-dimensional space. . . ." in his Lissitzky, "Proun: Not World Visions, but World Reality, *De Stijl*, nos. 5-6 (June 1922), reprod. in Sophie Lissitzky-Küppers, *El Lissitzky*

(Greenwich, Conn.: New York Graphic Society, 1968), p. 344. For the Russian translation by Lissitzky's son from the original German typescript for the article, which is slightly different from the published text, see his "Iz 'Teziso v k prounu (ot zhivopisi k arkhitekture)" [From the "Theses for Proun (from Painting to Architecture)"], in *Mastera sovetsoi arkhitektury ob arkhitekture*, vol. 2, pp. 133-35.

15. In an article published in 1925, Lissitzky made clear the extent to which the concept of space-time had informed his conception of a dynamic space, with its attendant correspondence to the Rationalists' notions about spatial form and perception. In his article, Lissitzky advanced "Irrational" and "Imaginary" spaces as two dynamic spatial magnitudes that had been made possible by new optical discoveries. Irrational space, he wrote, had first been developed in Suprematism and his own Prouns. It combined both projection and penetration simultaneously as coequal but opposing magnitudes of visual distance between objects on a picture plane. The fact that these distances could not be measured by any finite measure made the resultant space "irrational," in the same mathematical sense that the square root of the number two is irrational. Objects arranged in such a space thus possess an infinite capacity to be perceived as extending simultaneously into background and foreground. "Imaginary" space, on the other hand, was conceived as one in which the perceptual sense of movement is utilized to create from isolated elements the illusion of visual form and space. These elements can be so arranged that, taken as a whole, they create a sense of movement that in turn produces the visual impression of a cohesive surface or volume made up of these elements. Thus, the notion of simultaneous projection and penetration in "irrational" space and the concept of expressing form and space through the rhythmic grouping of elements in "imaginary" space is analogous to the deep, three-dimensional space that the Rationalists were to formulate as a conceptual matrix for their spatial form. For Lissitzky's article, see his "[A]rt and Pangeometry," reprod. in Lissitzky-Küppers, *Lissitzky*, pp. 348-354.

16. Two excellent recent treatments of Rodchenko are German Karginov, *Rodchenko*. Trans. Elisabeth Hoch (London: Thames & Hudson, 1979), and John Milner, "Material Values: Alexander Rodchenko and the End of Abstract Art," *Rodchenko and the Arts of Revolutionary Russia*, ed. David Elliott (New York: Pantheon Books, 1979), pp. 50-54.

17. See, inter alia, Dennis Sharp, *Modern Architecture and Expressionism* (New York: Braziller, 1966), Chap. 8 (on Finsterlin).

18. Paul Zucker, "The Paradox of Architectural Theories at the Beginning of the 'Modern Movement,'" *Journal of the Society of Architectural Historians*, vol. 10 (October 1951): 12-13.

19. An illustration of a Krinsky experimental project for the "Temple for the Congregation of Peoples" is published in *Mastera sovetsoi arkhitektury ob arkhitekture*, Plate 31 (at end of book).

20. Krinsky, "Nachalo stanovleniia sotsialisticheskoi arkhitektury," p. 123.

21. Vassily V. Kandinsky, "Skhematicheskaiia programma rabot Instituta khudozhestvennoi kul'tury po planu V. V. Kandinskogo" [Schematic Program for the Work of the Institute of Artistic Culture According to the Plan Devised by V. V. Kandinsky], in *Sovetskoe iskusstvo za 15 let. Materialy i dokumentatsiia*, ed. Ivan L. Matsa (Moscow-Leningrad: Ogiz-Izogiz, 1933), p. 126. An unacceptable English translation is W. Kandinsky, "Schematic Plan of Studies and Work of the Institute of Art Culture," in *In Memory of Wassily Kandinsky*, ed. Hilla Rebay (New York: Guggenheim Foundation, 1945), p. 45.

In the summer of 1921, Kandinsky presented an abbreviated version of his INKHUK program to the Russian Academy of Artistic Sciences, published untitled in *Iskusstvo*, no. 1 (Summer 1923), pp. 415-16; Eng. trans. in *Russian Art of the Avant-Garde*, ed. John E. Bowlt (New York: Viking Press, 1976), pp. 196-98. Prior to developing his INKHUK program, Kandinsky had explored the psychological effects of color and form as well as drawn analogies between painting and music (his central preoccupation) in his important *Über das Geistige in der Kunst* (Munich, 1912; Eng. trans.: *Concerning the Spiritual in Art*, New York: Wittenborn, 1947). After leaving Russia in 1923 to join the Bauhaus faculty, Kandinsky wrote his *Punkt und Linie zu Fläche* (Munich, 1926; Eng. trans.: *Point and Line to Plane*. New York: Wittenborn, 1947), expanding his earlier analysis.

22. Cf. "Institut khudozhestvennoi kul'tury" [The Institute of Artistic Culture], in *Sovetskoe iskusstvo za 15 let*, pp. 139-143. The article was originally published in *Russkoe iskusstvo*, no. 1 (1923). See also Selim O. Khan-Magomedov, "Vozniknovenie i formirovanie INKHUKA" [The Emergence and Formation of INKHUK], *Problemy istorii sovetsoi arkhitektury*, no. 2 (Moscow, 1976): 24-27, and his "Seksiiia monumentalnogo iskusstva INKHUKA" [The Section of Monumental Art at INKHUK], *Problemy istorii sovetsoi arkhitektury*, no. 3 (Moscow, 1977): 18-23, for a discussion of Kandinsky's work and emphases at INKHUK, as well as the reaction to it.

23. Aleksei V. Babichev, "Zapiska k programme" [Notes on the Program], reprod. in Dmitrii V. Sarabianov, *Aleksei Vasil'evich Babichev: khudozhnik, teoretik, pedagog* [Aleksei Vasil'evich Babichev: Artist, Theoretician, Pedagogue] (Moscow: Sovetskii khudozhnik, 1974), p. 104.

24. *Ibid.*

25. El Lissitzky and Ilya Ehrenburg, "Blokada Rossii konchaetsia" [The Blockade of Russia is Ending], in *Mastera sovetsoi arkhitektury ob arkhitekture*, comp. M. G. Barkhin and Iu. S. Yaralov, vol. 2 (Moscow: Izd-vo Iskusstvo, 1975), p. 138; Eng. trans. available in Lissitzky-Küppers, *Lissitzky*, pp. 340-341.

26. Statement appended to Varst's (Stepanova's) contribution to the catalogue of the exhibition,  $5 \times 5 = 25$ . *Katalog vystavki* [ $5 \times 5 = 25$ . Catalogue of the Exhibition] (Moscow, 1921), n.p. The five artists represented in the exhi-

bition were Alexander Rodchenko, Varvara Stepanova, Alexander Vesnin, Liubov Popova, and Alexandra Exter.

27. Nikolai A. Ladovsky, "Iz protokolov rabochei gruppy arkhitektorov INKHUKa (1921)" [From the Minutes of the Working Group of Architects (1921)], in *Mastera sovetskoi arkhitektury ob arkhitekture*, vol. 1, p. 345.

28. Quoted in Selim O. Khan-Magomedov, *Teoreticheskie kontseptsii tvorcheskikh techenii sovetskoi arkhitektury* (Moscow: Gosgrazhdanstroi, 1974), p. 21.

29. Adolf von Hildebrand, *Das Problem der Form in der bildenden Kunst* (1893); Eng. trans. by Max F. Meyer and Robert M. Ogden: *The Problem of Form in Painting and Sculpture* (New York: G. E. Stechert, 1932). Cf. also Hildebrand's "Remarks on the Problem of Form," *College Art Journal*, vol. 11 (Summer 1952): 251-58, for a succinct reiteration of Hildebrand's essential argument. Hildebrand's treatise was translated in Russian as *Problemy formy v izobrazitel'nom iskusstve* [Problems of Form in the Fine Arts] Trans. from German by N. B. Rosenfel'd and V. A. Favorsky (Moscow: Izd-vo Musaget, 1914).

30. Hildebrand, *Problem of Form*, p. 119.

31. Krinsky, "Iz doklada v INKHUKe 'Put' arkhitektury' (Mai 1921)" [From a Speech to INKHUK "The Trend in Architecture" (May 1921)], in *Mastera Sovetskoi arkhitektury ob arkhitekture*, vol. 2, p. 114.

32. Ibid, p. 115.

33. Ibid, p. 113.

34. Ibid, p. 114.

35. Ibid, p. 116.

36. Ibid, pp. 116-117. Krinsky had noted that "Line, plane, and geometrical surface (sphere, cylinder, cone) are eternal. These are the laws of our thinking and perception."

37. Cf. Vladimir E. Tatlin, *Vladimir Evgrafovich Tatlin* (Petrograd, 1915), Nikolai N. Punin, *Tatlin (protiv kubizma)* [Tatlin (Against Cubism)] (Petrograd, 1921), Alexander Rodchenko, "Vladimir Tatlin," *Opus International*, no. 4 (December 1967): 15-18, and Troels Andersen, comp., *Vladimir Tatlin* (Stockholm: Moderna Museet, 1968).

38. Krinsky, "Nachalo stanovleniia sotsialisticheskoi arkhitektury," p. 122.

39. Vladimir Tatlin, Tevel Shapiro, Iosif Meerzon, and P. Vinogradov, "Nasha predstoiashchaia rabota" [The Work Ahead of Us], *Ezbednevnyi biulleten' VIII-go s'ezda sovetov*, no. 13 (January 1, 1921), p. 11; Eng. trans: "The Work Ahead of Us," in *Russian Art of the Avant-Garde*, ed. John E. Bowlt (New York: Viking Press, 1976), p. 206; the cosignatories with Tatlin assisted him with work on the model of his Monument to the Third International, which was transferred from Petrograd, where it had been built originally, and re-erected in Moscow on the occasion of the Eighth Congress of Soviets, in December 1920. Tatlin's intuitive approach, implicit in this commentary, is suggested in Nikolai N. Punin, *Pamiatnik III Internatsionala. Proekt V. Tatlina* [Monument to the Third International. The Project by V. Tatlin] (Petrograd: Izd. 120 Narkompros, 1920). See also various relevant statements reproduced in Andersen, *Vladimir Tatlin*. In his book *Stil' i epokha* [Style and Epoch] (Moscow: Gosizdat, 1924), Moisei Ia. Ginzburg, who emerged as the chief theoretician of the Constructivist movement, rejected the relevance of Tatlin's tower for Constructivist architecture because of its intuitive rather than empirical approach to structural design. Because of the need to balance concept with feasibility, he wrote, "an architect never builds 'castles in the air'" (p. 22). Industrial buildings offered a more suitable paradigm because their "prosaic restraint and everyday life can root experimentation firmly in the present circumstances by confining transcendental dreams to the confines of what is possible, attainable, and truly necessary" (p. 133). The early work of Alexander Vesnin, the founder of Constructivist architecture, bridged the gap between Tatlin's visionary design and Ginzburg's utopian sense of pragmatism; until 1923, Vesnin worked almost exclusively as a painter and stage designer.

40. Ladovsky, "Opredelenie tekhnicheskoi konstruktssii (1921)" [Determination of Technical Construction], in *Mastera sovetskoi arkhitektury ob arkhitekture*, vol. 1, p. 345. According to Babichev's widow, N. Babicheva, Ladovsky's definition was adopted by the Working Group of Objective Analysis at INKHUK. Her remarks to that effect are contained in annotations to Aleksei V. Babichev, "O konstruktssii i kompozitsii" [On Construction and Form], *Dekorativnoe iskusstvo SSSR*, no. 3 (March 1967): 17.

41. Ladovsky, "Iz protokolov zasedanii komissii zhivopisno-skul'pturno-arkhitekturnogo sinteza (1919)" [From the Minutes of the Meetings of the Commission of Painterly-Sculptural-Architectural Synthesis (1919)], in *Mastera sovetskoi arkhitektury ob arkhitekture*, vol. 1, p. 344.

42. Krinsky, "Diskussii na temu 'Analiz poniatia konstruktssii i kompozitsii v moment ikh razgranicheniia (1921)' [Discussion on the Subject of 'Analysis of the Notion of Construction and Composition at the Point of their Differentiation (1921)'], in *Mastera sovetskoi arkhitektury ob arkhitekture*, vol. 2, p. 111.

43. Ibid.

44. Krinsky, "O stat'e Muteziusa 'Sovremennoe v arkhitekture' (1921)" [On the Article by Muthesius, "The Modern in Architecture"], in *Mastera sovetskoi arkhitektury ob arkhitekture*, vol. 2, p. 113.

45. Lipps's ideas on the theory of "empathy" were amplified in his *Asthetische Faktoren der Raumschauung* (Hamburg, 1897), and *Raumästhetik und geometrisch-optische Täuschungen* (Leipzig, 1897), with the fullest elaboration contained in his monumental *Ästhetik*, 2 vol. (Hamburg, 1903-06). An English translation of an extract from one of Lipps's articles on the subject is rendered as Theodore Lipps, "Empathy, Inner Imitation, and Sense-Feelings," in *A Modern Book of Aesthetics*, ed. Melvin Rader (New York: Holt, Rinehart and Winston, 1960), pp. 374-82. The term *Einfühlung* was first used by Robert Vischer in his *Das optische Formgefühl. Ein Beitrag zur Ästhetik* (1873). The idea of

"empathy" was also taken up by Johannes Volkelt and Karl Groos in Germany, by Victor Basch in France, and in England by Vernon Lee, the pen name of Violet Paget. See n. 1 for the application of the "empathy" theory to architecture.

46. Ladovsky, "Psikho-tekhnicheskaiia laboratoria arkhitektury (v poriadke postanovki voprosa)," [A Psychotechnical Laboratory of Architecture (By Way of Raising the Question)], *Izvestiia ASNOVA*, no. 1 (1926), [7].

47. A discussion of the Constructivists' appropriation of scientific management principles in formulating their functional doctrine is found in my dissertation, "Trends in Soviet Architectural Thought," Chap. 4. In addition, as will be discussed below (see n. 100 and accompanying text), Moisei Ia. Ginzburg, the chief theoretician of the Constructivist movement, also referred to principles of perceptual psychology to rationalize his own ideas of what constitutes suitable architectural form. That the appropriation of science and psychology in modern architecture had become *de rigueur* by the 1940s is indicated by the fact that the Museum of Modern Art, in its booklet *What is Modern Architecture* (New York, 1942), could assert with seeming authority that "the modern architect is a scientist . . . and a psychologist . . . and an artist" (p. 5).

48. Ladovsky, "Psikho-tekhnicheskaiia laboratoria arkhitektury . . ." p. [7]. Ladovsky continued: "There, the following research, which has a bearing upon architecture, has been conducted: the equilibrium of simple forms (Pierce), unequal division (Angier), symmetry (Puffer), the repetition of spatial forms (Rowland), vertical division (Davis), simple rhythmic forms, etc." These experiments were published between 1894 and 1907 in the *Harvard Psychological Studies* and the *Psychological Review* as: Edgar Pierce, "The Aesthetics of Simple Forms;" Robert MacDougall, "The Structure of Rhythmic Forms;" Ethel D. Puffer, "Studies in Symmetry;" Roswell P. Angier, "The Aesthetics of Unequal Division;" and Eleanor H. Rowland, "Study in Vertical Symmetry" and "Aesthetics of Repeated Space Forms." Ladovsky's article proposed establishing an architectural laboratory of perception at the VKHUTEIMAS. Ladovsky succeeded in doing so in 1927 in the famous "black room" set aside for the purpose. Among the chief aims of the laboratory was measuring the ability of students to perceive accurately the basic visual aspects of spatial form, encompassing its linear, planar, volumetric, angular, and spatial magnitudes. He devised and built five apparatuses for conducting such measurements: the *Liglazometr* (Linear Eye-Meter), for measuring the perception of linear magnitudes; the *Ploglazometr* (Surface Eye-Meter), for measuring planar magnitudes; the *Obglazometr* (Volume Eye-Meter), for measuring volumetric magnitudes; and the *Uglazometr* (Angle Eye-Meter) and *Prostrometr* (Space Eye-Meter). Ladovsky maintained that the results obtained from such testing were more relevant determinants of a student's aptitude for architecture than the conventional aptitude tests for drawing skills and so on. For contemporary accounts of the laboratory's work, see Vitalii Lavrov, "Iz poslednikh rabot Arkhitekturnogo fakul'teta VKHUTEIMa" [From the Latest Work of the Architecture Faculty at the VKHUTEIM], *Stroitel'stvo Moskvy*, no. 10 (1928): 16-17, and especially Georgii Krutikov, "Arkhitekturnaia nauchno-issledovatel'skaia laboratoria pri Arkhitekturnom fakul'tete Moskovskogo Vysshego Khud.-Tekhnich. Instituta" [The Architectural Scientific Research Laboratory in the Architecture Faculty at the Moscow Higher Artistic-Technical Institute], *Stroitel'naia promyshlennost'*, no. 5 (1928): 372-75. A more detailed account is contained in Krutikov, "Arkhitekturnaia nauchno-issledovatel'skaia laboratoria pri arkhitekturn. fakul'tete VKHUTEIM. Rabota laboratorii v 1928-29 uch. godu" [The Architectural Scientific Research Laboratory in the Architecture Faculty at the VKHUTEIM. Work of the Laboratory in the Academic Year of 1928-29], *Arkhitektura i VKHUTEIM*, no. 1 (January 1929), [2-4]; see also Krutikov's report of his own work at the laboratory: "Prilozhenie teorii soedinenii k issledovaniiu i izmereniiu sposobnosti prostranstvennogo kombinirovaniia" [Applying the Theory of Combination to Research and Measurement of Aptitude for Spatial Combination], *Arkhitektura i VKHUTEIM*, no. 1 (January 1929), [5-6]. A recent discussion of Ladovsky's laboratory is Selim O. Khan-Magomedov, "Psikhotekhnicheskaiia laboratoria VKHUTEIMa, 1927-1930" [The Psychotechnical Laboratory at the VKHUTEIM, 1927-1930], *Tekhnicheskaiia estetika*, no. 1 (1978): 16-22.

49. Münsterberg did not confine himself to his laboratory. As one of the founders of applied psychology, he set out to extend psychology into neighboring and allied fields of law, business, industry, teaching, medicine, and sociology as well. Until recent times, however, his work and contributions, which were controversial in his lifetime, lay in virtual obscurity. The most concise and descriptive account of Münsterberg's enigmatic career is still William Stern, "Hugo Münsterberg: In Memoriam," *Journal of Applied Psychology*, vol. 1 (June 1917), pp. 186-88. A few secondary sources earlier alluded to his place in the history of psychology: a chapter in A. A. Roback, *History of American Psychology* (New York: Library Publishers, 1952), pp. 192-208; a broader chapter in Antonio Aliota, *The Idealist Reaction Against Science* (London: Macmillan, 1914), pp. 196-273; and George S. Brett, *A History of Psychology*, vol. 3 (New York: Macmillan, 1921). In the past decade, a number of significant studies have shed fresh light on both the substantive and the enigmatic aspects of Münsterberg's career. The most probing of these is Matthew Hale, Jr., *Human Science and Social Order: Hugo Münsterberg and the Origins of Applied Psychology* (Philadelphia: Temple University Press, 1980), an indispensable guide for unraveling the diverse substance and context of Münsterberg's ideas. Another excellent introduction, framed against the background of his academic career and difficulties at Harvard, is the chapter in Bruce Kuklick, *The Rise of American Philosophy: Cambridge, Massachusetts, 1860-1930* (New Haven: Yale University Press, 1977), pp. 196-214. A chapter in Phyllis Keller, *States of Being: German-American Intel-*

lectuals and the First World War (Cambridge, Mass.: Harvard University Press, 1979), pp. 31-67, illuminates the highly provocative role that he avidly cultivated of intercultural ambassador of good will, or spokesman for German culture in America and for American culture in Germany. None of these sources, however, deals with his theories of esthetic perception; Hale touches upon this aspect in a cursory and inadequate manner (pp. 142-147). An isolated aspect of Münsterberg's esthetic theory has been examined in a recently published dissertation: Donald L. Fredericksen, *The Aesthetic of Isolation in Film Theory: Hugo Münsterberg* (New York: Arno Press, 1977), which analyzes the theory of film that he outlined in his *The Photoplay* (New York: D. Appleton, 1916; reissued by Dover in a 1970 paperback as *The Film: A Psychological Study*). Although useful for its general insights into the historical significance of Münsterberg's work on esthetics, Fredericksen's study is too focused on film to encompass the psychologist's prescriptions on the fine and spatial arts. Two of Münsterberg's books provide a good general introduction to his theories of esthetic perception: *Psychology and Life* (Boston: Houghton, Mifflin, 1899), pp. 145-78; and *The Eternal Values* (Boston: Houghton Mifflin, 1909), pp. 165-82. More detailed discussion is contained in *Psychology: General and Applied* (New York: D. Appleton, 1914), *Grundzüge der Psychotechnik* (Leipzig: J. A. Barth, 1914), pp. 601-67; and *The Principles of Art Education* (New York: Prang Educational, 1905). See also his "Problem of Beauty," *Philosophical Review*, vol. 18 (March 1909): 121-46. Although he has not been associated with perceptual and esthetic psychology, the importance of his contributions in this area were recognized in 1917 by Theodor Ziehen and Max Dessoir, "Zur Erinnerung an Hugo Münsterberg," *Zeitschrift für Ästhetik und allgemeine Kunstwissenschaft*, vol. 12 (1917): 236-38.

50. The publication in 1912 of Max Wertheimer's experimental study of the perception of apparent movement (for which Wolfgang Köhler and Kurt Koffka were the chief observers) is generally considered to mark the founding of the Gestalt school. The firm establishment of the school dates from 1920, however, when Köhler published his *Die physischen Gestalten in Ruhe und im stationären Zustand*, which provided a methodological foundation for Gestalt psychology by treating the general dynamics of the formation of form. For more than a decade Köhler, Wertheimer, and Koffka investigated perception, especially visual perception. In the 1930s the three leaders of the Gestalt school and many of their students emigrated to the United States. The underlying conception of Gestalt psychology had first been posited in 1890 by Christian von Ehrenfels, who argued in his *Über Gestaltqualitäten* that form is a quality immediately perceived. A square, for example, is composed not merely of four equal straight lines and four right angles, but of an additional aspect as well that he termed "squareness." Other comparable perceptual, or "Gestalt," qualities, such as angularity, slenderness, and roundness, were likewise regarded by him to be additional aspects over and above those constituting the geometrical whole. Ehrenfels further maintained that such perceptual qualities can be transposed to an entirely different set of elements without affecting the Gestalt quality of the whole. The chief tenet of the Gestalt approach elaborated subsequently by Köhler, Wertheimer, and Koffka held that the analysis of the parts, however thorough, cannot provide an adequate understanding of the whole of a form. In order to comprehend the full nature of the whole, the observer must analyze "from above down," or from the structure of the whole that is a Gestalt to the characteristics of its constituent parts. These parts, however, have no meaningful identity independent of their place and function in the whole, inasmuch as it is the structure of the whole that imposes salient characteristics on each part composing it. Hence the axiom of Gestalt psychology that the whole is greater than the sum of its parts, which has governed the attempts of Gestalt studies to discern the patterns by which form is organized and perceived. For writings on Gestalt psychology, see, inter alia, Wolfgang Köhler, *The Task of Gestalt Psychology* (Princeton: Princeton University Press, 1969); Kurt Koffka, *Principles of Gestalt Psychology* (New York: Harcourt, Brace & World, 1935); *A Source Book of Gestalt Psychology*, ed. Willis D. Ellis (London: Routledge and Kegan Paul, 1938), and Kurt Koffka, "Problems in the Psychology of Art," in *Art: A Bryn Mawr Symposium* (Bryn Mawr, Pa.: Bryn Mawr College, 1940), pp. 180-273. Since the 1940s, Rudolph Arnheim has carried forward extensive research on the application of Gestalt psychology to art analysis. He has published prolifically on the subject, beginning with his *Art and Visual Perception* (Berkeley: University of California Press, 1954) and ranging from *Toward a Psychology of Art* (Berkeley: University of California Press, 1966) to *Entropy and Art* (Berkeley: University of California Press, 1971) and the remarkable *Dynamics of Architectural Form* (Berkeley: University of California Press, 1977). The most succinct discussion of the subject is his "Gestalt Psychology and Artistic Form," *Aspects of Form*, ed. Lancelot L. Whyte (New York: American Elsevier, 1968), pp. 196-208.

51. In his *Grundzüge der Psychotechnik* (Leipzig: J. A. Barth, 1914), p. 615, Münsterberg claimed that his Harvard Psychological Laboratory had been the only one in the world up to that time to maintain continuous experimentation in the psychology of esthetics. That claim was supported by Theodor Ziehen, "Zur Erinnerung an Hugo Münsterberg," *Zeitschrift für Ästhetik und allgemeine Kunstwissenschaft*, vol. 12 (1917): 237-38. Ziehen also observed, however, that the work of his students and associates on the subject was more significant than Münsterberg's own; he doubtless had in mind that Münsterberg himself did not conduct any of the actual experiments.

52. Hugo Münsterberg, *Psychology: General and Applied* (New York: D. Appleton, 1914), pp. 15-18.

53. Edwin G. Boring, *Sensation and Perception in the History of Experimental Psychology* (New York: Appleton-Century-Crofts, 1942), p. 586.

54. A descriptive summary of Münsterberg's kinesthetic principle of perception is contained in his *Principles of Art Education* (New York: Prang Educational Co., 1905), pp. 77-83. For a more detailed exposition, see his *Psychology: General and Applied*, Chap. 11.

55. *Ibid.*, p. 76.

56. *Ibid.*, p. 88.

57. Ethel D. Puffer, *The Psychology of Beauty* (Boston: Houghton Mifflin, 1905), p. 110. Her book summarizes well, and in some cases more descriptively, her earlier published findings: "Studies in Symmetry," *Psychological Review*, vol. 4 (January 1903): 467-539.

58. Münsterberg, *Psychology: General and Applied*, p. 458.

59. Puffer, *The Psychology of Beauty*, pp. 110-12.

60. *Ibid.*, pp. 112-13.

61. Münsterberg, *Psychology and Life* (Boston: Houghton Mifflin, 1899), p. 57.

62. Münsterberg, *Principles of Art Education*, p. 89. He continues, almost as if to cover himself: "but even the simple symmetrical design is completely beautiful because it corresponds, by the energies which its lines express, completely to the energies of our own personality." Earlier in the book, Münsterberg again revealed his preference for the "movements and tensions" in *space-form*, to use his term, which takes its characteristics from its "limiting lines." Using an ornament as an example, he observed: "Follow with an open mind the play of lines in any ornament [space-form], and you feel how these movements, these impulses and tendencies, speak to you. This line tries to lift itself up; this line, with its noble swing, shows you its freedom; while that, with its forced bending, is pressed down; this which connects two others pulls them together, and that one pushes two lines to their distance; this curve returns in graceful movement to itself, and that carries you away with it; this moves on in a straight impulse, and that plays easily in its wave form, this closed curve presses the space together, and that other one gives you the freedom of unlimited space. No one understands the language of these lines better than the architect, whose work gets life through the movement impulses and movement suggestions of the parts" (pp. 58-59). Here, then, is anticipated a salient aspect of the dynamic space form that Ladovsky and the Rationalists discovered in the space-defining elements of modern art.

63. Puffer conceded the apparent similarity between the "empathy" theory and the one advanced by Münsterberg, but stressed the profound differences in causation; see her *Psychology of Beauty*, pp. 116-25.

64. Hale contends (*Human Science and Social Order*, p. 142) that Münsterberg's prescriptions "dispossessed the artist of his creative role and transformed him into a draftsman . . . and . . . reduced communication to techniques of manipulation." This characterization is much too simplistic; it appears, unlike the rest of Hale's fine book, to have been made on the basis of a rather superficial reading of Münsterberg's statements on esthetics and perceptual psychology.

65. Münsterberg, *Psychology: General and Applied*, pp. 354-55.

66. *Ibid.*, p. 460.

67. *Ibid.*, p. 462. Ladovsky used a quote from Münsterberg in support of his proposal to establish a "psychotechnical" laboratory at the VKHUTEMAS: "Psychotechnics cannot create artists . . . but it can give all of them a base from which to achieve in the most reliable way certain goals to which they aspire and, most reliably of all, to avert certain dangers . . . A broadly developed psychotechnics can, in the future, place its prescriptions before composers, even if it were constantly affirmed that genius finds unconsciously that which science develops with great effort." The source of the quotation was not noted, but probably was Münsterberg's *Grundzüge der Psychotechnik*, which was translated into Russian as: *Osnovy Psikhobotekhniki* [Foundations of Psychotechnics]. Trans. from German and ed. by B. N. Severyn and V. M. Ekzemplarskiy. 2 vols. (2d ed.; Moscow: Izd-vo "Russkii khudozhnik," 1924-25).

68. Nikolai V. Dokuchaev, "Poisnitel'naia zapiska k kursu 'iskusstvo arkhitektury' dlia khudozhestvennykh tekhnikumov" [Explanatory Notes for the Course, "The Art of Architecture," for B. N. Severyn and V. M. Ekzemplarskiy], *Sbornik materialov po khudozhestvennomu obrazovaniiu* (Moscow: Gosizdat, 1927), pp. 79-80.

69. *Ibid.*

70. Dokuchaev, "Sovremennaia russkaia arkhitektura i zapadnye paralleli" [Contemporary Russian Architecture and Western Parallels], pt. 2, *Sovetskoe iskusstvo*, no. 2 (1927): 13.

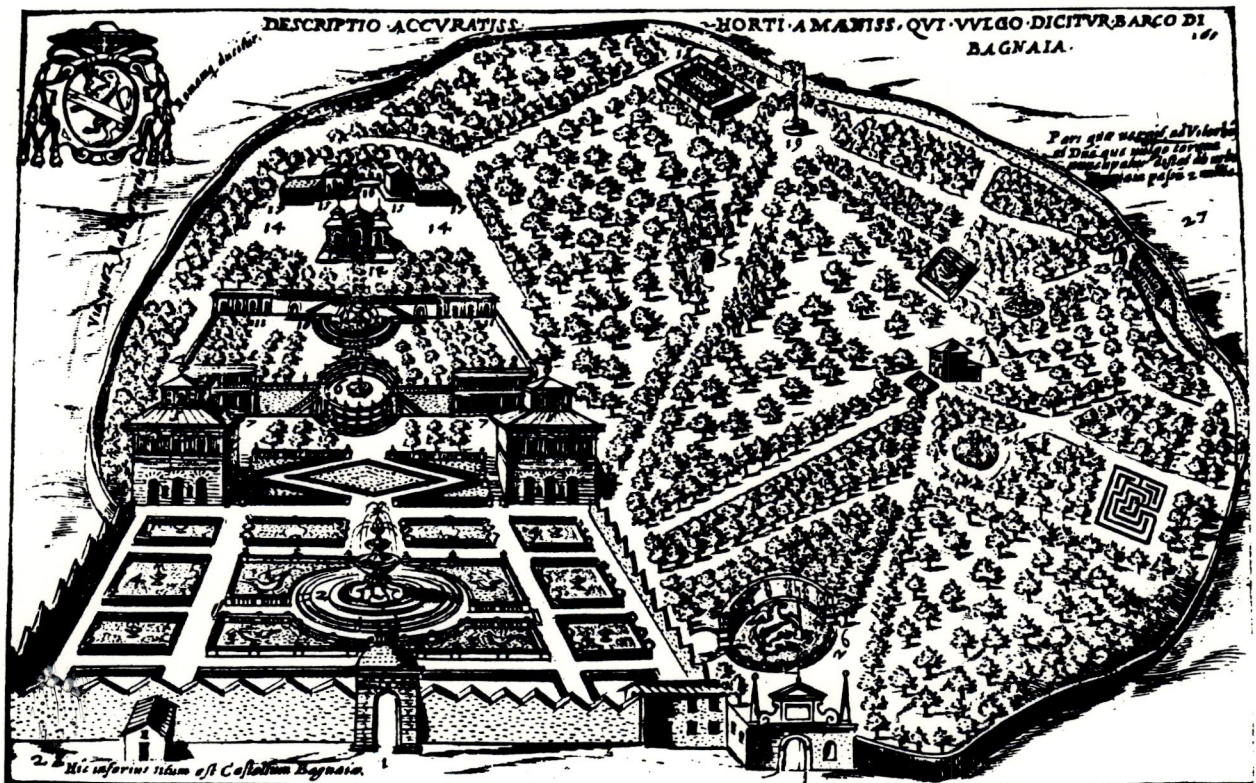
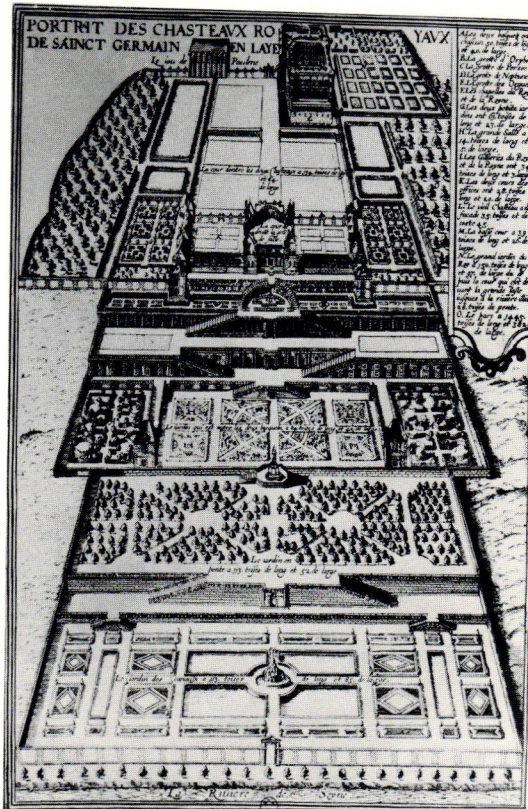
71. Krinsky, "Novoe v obuchenii kompozitsii" [New Developments in Teaching Composition], in *Mastera sovetskoi arkhitektury ob arkhitekture*, vol. 2, p. 125.

72. No studies on the Architecture Faculty at the VKHUTEMAS have yet been produced. The best primary sources are *Arkhitektura VKHUTEMAS. Raboty arkhitekturnogo fakul'teta VKHUTEMASa, 1920-1927* [The Architecture of the VKHUTEMAS. The Work of the Architecture Faculty at the VKHUTEMAS, 1920-1927] (Moscow: Izd-vo VKHUTEMAS, 1927), and *Arkhitektura i VKHUTEIN*, no. 1 (1929).

73. Quoted from the course syllabus in L. Marts, "Prostranstvennyi kontsentri" [The Space Center], Pt. 4 of his "Propedevicheskii kurs VKHUTEMASa-VKHUTEINa (Osnovnoe otdelenie)" [Preparatory Course at the VKHUTEMAS-VKHUTEIN (The Primary Department)], *Tekhnicheskaiia estetika*, no. 4 (1969): 27.

74. Ladovsky, "Osnovy postroeniia teorii arkhitektury (Pod znakom ratsionalisticheskoi estetiki)" [Foundations for Constructing a Theory of Architecture (Under the Banner of a Rationalist Aesthetic)], *Izvestiia ASNOVA*, no. 1 (1926): [3].

75. Ibid, p. 4.
76. Nikolai V. Dokuchaev, "Metodicheskaia zapiska po kursu 'Osnovy arkhitektury'" [Methodical Notes on the Course "Foundations of Architecture"], in *Sbornik materialov po kbudozbestvennomu obrazovaniiu* (Moscow: Gozizdat, 1927), p. 89.
77. Ibid, p. 100.
78. Ibid, p. 94.
79. Ibid.
80. The parallels between these particular exercises and the effects achieved in numerous buildings by Frank Furness in Philadelphia are striking and worthy of note. His Provident Life and Trust Company Building in Philadelphia (1876-77; demol.) exhibits the same kind of crunching under the apparent action of forces. O'Gorman put it both picturesquely and well when he wrote: "The pressures Furness introduced here make those of his earlier buildings seem weak. Overweight details come together with a violent crunch we now associate with the pro football field[!]. Masses of stone pressed down over the entrance, forcing the columns into stumps. The segmental arch above the entry struggled against the rest of the facade to maintain a passage into the interior. The visitor rushed beneath the overhanging cliffs of chunky masonry . . ." (*Architecture of Frank Furness*, p. 44). Here is the quintessence of "empathy" and of Ladovsky's "physical" and "mechanical" qualities of expressiveness—though it is doubtful whether Münsterberg would have associated all that with the football field. A comparable analogy could be drawn to Furness' Guarantee Trust and Safe Deposit Company building in Philadelphia (1875), in which, again in O'Gorman's vivid commentary, the central opening "was squeezed further by the taller corner masses: the pressure on the entrance was immense" (p. 39).
81. Dokuchaev, "Metodicheskaia zapiska po kursu 'Osnovy arkhitektury,'" p. 95.
82. Ibid.
83. Ibid, p. 101.
84. Ibid, p. 88.
85. Ladovsky, "Osnovy postroeniia-teorii arkhitektury," p. [4].
86. Enael, "Neboskreby SSSR i Ameriki [Skyscrapers of the USSR and America], *Izvestiia ASNOVA*, no. 1 (1926): [4-6]. The designated name for the author, "Enael," looks suspiciously like the handiwork of Lissitzky, as it appears to be a phonetic rendering of Ladovsky's initials: N. A. L. (en-a-el). Lissitzky's use of "El" in place of his own first name, Lazar, seems likewise to be a phonetic rendering of the letter *l*. Lissitzky was renowned for being quite clever that way; as editor of this issue, he filled it with all the clever devices in his repertoire! Apart from that, the measured tone of the article bears the unmistakable mark of Ladovsky's methodical approach.
87. Ibid. Ladovsky's reference to the American "penchant" for adorning skyscrapers with Gothic motifs must doubtless have been provoked by the vogue stemming from Cass Gilbert's 1923 Woolworth Building in New York City, and Hood and Howell's winning design for the *Chicago Tribune* competition of 1922.
88. Louis H. Sullivan, "The Tall Office Building Artistically Considered," *Lippincott Magazine*, vol. 57 (March 1896); reprod. in his *Kindergarten Chats and Other Writings* (New York: Wittenborn, 1947), p. 206.
89. Ladovsky, "Neboskreby SSSR i Ameriki," p. [5].
90. The basic *parti* of clusters of ascending rectilinear shafts around a core is reminiscent of the one employed in the recent Sears Tower in Chicago, designed in 1971 by Bruce Graham and Fazlur Khan of Skidmore, Owings and Merrill. On the other hand, the deeply recessed window bays echo Sullivan's Schlesinger and Meyer (now Carson, Pirie Scott) Store in Chicago; some of the schematic diagrams accompanying Ladovsky's article strongly suggest an awareness of Sullivan's technique of recessing spandrels to allow the verticals to predominate.
91. Mayakovsky's poem was quoted by Krinsky in his "Novoe v obuchenii kompozotsii," p. 124.
92. For an excellent recent discussion of Ladovsky's *oeuvre*, see Selim O. Khan-Magomedov, "Nikolaj Ladovskij: An Ideology of Rationalism," *Lotus International*, 20 (September 1978): 104-126.
93. ASNOVA has not been dealt with as such in this essay, as the principal objective of this study is not a history of the movement but an elucidation of the Rationalist doctrine.
94. Dokuchaev, "Sovremennaia russkaia arkhitektura i zapadnye paralleli," p. 13.
95. He is listed as a member in Vigdaria E. Khazanova, *Iz istorii sovetskoi arkhitektury, 1926-1932* (Moscow: Nauka, 1970), p. 40. Krinsky noted merely that "K. Melnikov designed and built a good deal in the twenties and frequently appeared among us, telling us about his projects," Krinsky, "Vozniknovenie i zhizn' ASNOVA," p. 27.
96. S. Fredrick Starr, *Melnikov: Solo Architect in a Mass Society* (Princeton: Princeton University Press, 1978), p. 88. Starr has also suggested the presence of Expressionist overtones, which seems plausible in a general sense rather than in terms of specific links to particular Mendelsohn projects, as both were kindred spirits; that indeed applies to the Rationalists as well. On the other hand, Starr's ascribing the bold geometrical forms employed by Melnikov to what he loosely terms "Romantic Classicism" is problematical. To begin with, the classical phenomenon invoked by Starr was far more characteristic of the eighteenth and early nineteenth centuries than of the tendencies at the turn of the century, even though the latter sought to revive it. More important, though the classical aspects of Melnikov's education were undeniably significant, other factors intervened to shape his innate sensibilities for dynamic architectural form. Not the least of these was the short-lived episode of "Romantic Symbolism," a brief period of exuberant visionary design of which Ilya Golosov was a prime exponent and to which the early crystallization of Melnikov's bold form-rendering may be linked. Ladovsky's and Krinsky's experimental design work at ZHIVSKULPTARKII and INKIIUK were also related to the general thrust of "Romantic Symbolism." For a discussion of this phenomenon, see Selim O. Khan-Magomedov, *Teoreticheskie kontseptsii tvorcheskikh techenii sovetskoi arkhitektury* [Theoretical Conceptions of the Creative Tendencies in Soviet Architecture] (Moscow: Gosgrazhdanstroi, 1974), pp. 14-19; and Vigdaria E. Khazanova, *Sovetskaia arkhitektura pervykh let Oktiabria* [Soviet Architecture in the First Years of October] (Moscow: Nauka, 1970).
97. Dokuchaev, "Sovremennaia russkaia arkhitektura i zapadnye paralleli," p. 14.
98. Quoted in Selim O. Khan-Magomedov, "Konstantin Mel'nikov: Arkhitektor" [Konstantin Melnikov: Architect], *Nedelia*, no. 7 (February 1966): 8.
99. Dokuchaev, "Arkhitektura i tekhnika" [Architecture and Technology], *Sovetskoe iskusstvo*, nos. 8-9 (1926): 9.
100. Ginzburg, *Stil' i epokha*, p. 112. See note 62, above, and accompanying text for a contrasting interpretation by Münsterberg that was adapted by the Rationalists.
101. Lubetkin, "Architectural Thought Since the Revolution," p. 202.



1. Château-Neuf, Saint Germain-en-Laye, engraving by Alexandre Francine.

2. Villa Lante, Bagnaia, engraving by Laurus.

# LE NOSTRE AND OPTICAL ILLUSION

Hamilton Hazlehurst

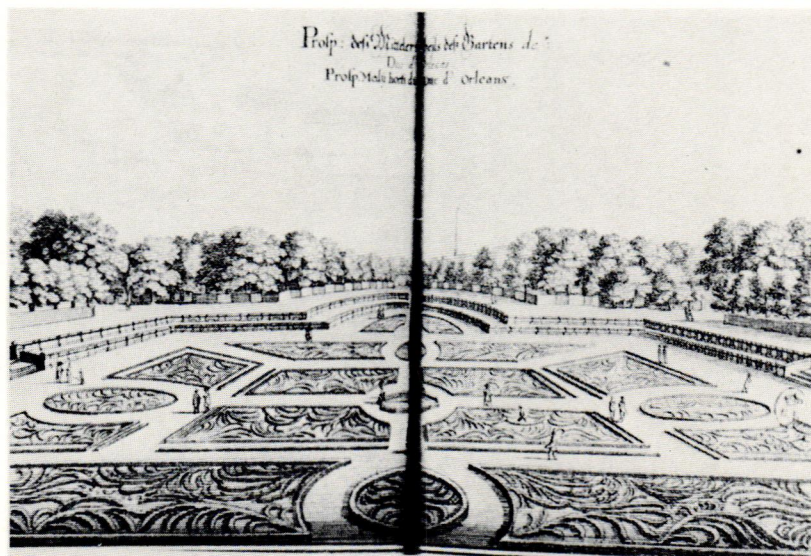
THE FRENCH FORMAL GARDENS OF LOUIS XIV and his nobles were created to provide a splendid stage for ritual and to express royal authority at its height in the seventeenth century. At Versailles, long before the palace was complete, Le Nostre had built his great garden. It was there that most of the festivities marking the highlights of the king's reign took place; it was there, more often than not, that Molière's plays were enacted and Lully's music performed. The elaborate fêtes at Versailles, with their theatrical extravaganzas on land and water, fireworks, and great feasts, were all enacted within this outdoor frame for majestic living.

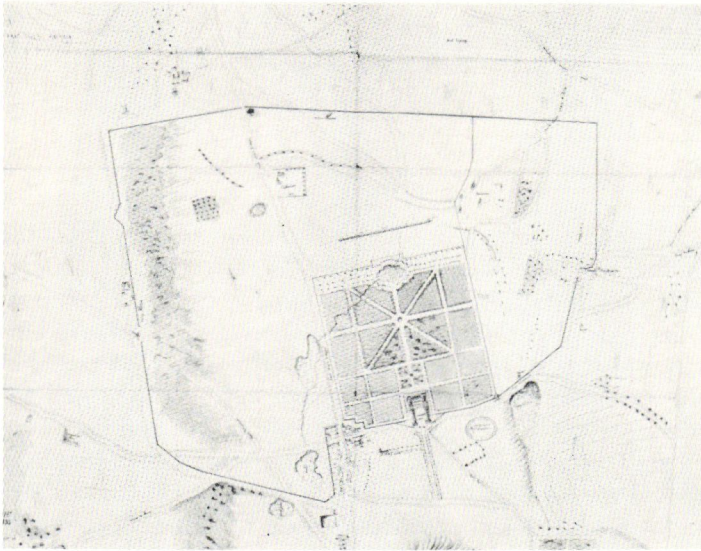
The French seventeenth-century garden imbued with the concept of "forcer la nature," impresses us with the nobility of its conception and the grandeur of its scope. The harmony that exists between the various individual components of the garden prevents the often monumental scale of the whole from overwhelming the viewer by its sheer dimensions. Many of the components—parterres, paths, pools, fountains, sculptures, trees, and shrubs—are designed to be seen singly; yet, at the same time, they combine with one another to create a perfectly balanced compositional unity.

The sophisticated Frenchman of the seventeenth century, with his ever-rational way of examining the world about him, demanded and could respond to the broad, formal vistas created by André Le Nostre. The unparalleled harmony of the designs deriving from Cartesian principles appealed to his mind and to his sensibilities; he nevertheless delighted in having the very logic of his conclusions questioned and his responses thereby quickened. And this Le Nostre did with remarkable success in his garden designs, principally through the use of optical illusion. The actual size of a Le Nostre garden is often elusive, as are the multifarious parts composing these structured landscapes, many of which are concealed from view. The active participation of the visitor to the site is a prerequisite for understanding the real "treasures" and the many subtleties of the garden complex.

André Le Nostre's use of optical illusion in the realm of the garden was not without precedent. As early as classical antiquity, architects leaned on architectural design as a means of bringing visual unity to a site. For example, in the multi-terraced plan of the Roman Temple of Fortuna at Praeneste, the various levels are brought together into an intricate and interlocking whole by means of stairs and ramps, as if they were all drawn on a single vertical plane. Bramante, in his design for the Cortile del Belvedere, and Pirro Ligorio, in his Villa d'Este at Tivoli, may well have used a similar technique. The notion of designing a complex scheme as if it were composed on a vertical surface found its way to France in the later sixteenth century and is perhaps best illustrated in the gardens and château complex of Henry IV's Château-Neuf at St. Germain-en-Laye (Fig. 1). In these projects, the architect clearly drew on a knowledge of the Italian layouts at the Villa d'Este and, in this case, to the Villa Lante at Bagnaia (Fig. 2). In all of these gardens, the readability and harmony of the total design depends on the tiered buildup of components that, when collapsed onto a single plane—as they would have been optically when seen from afar—produce a visual unity.

This "system," while lending itself to the steep, hilly sites common in Italy, could not be widely adapted to the French landscape, particularly in the region of the Île-de-France, where so many châteaux and gardens were being built in the seventeenth century, for the French terrain was marked by gentler slopes and occasionally by monotonous flatness. Thus, in the second decade of the century, when Jacques Boyceau designed the gardens for Marie de Médicis' new Palais du Luxembourg, he turned to the Boboli gardens for inspiration, but found it difficult to create at the Luxembourg the visual impression of diversified levels present in the Florentine site.<sup>1</sup> Boyceau's solution for the area lying immediately in front of the garden facade of the palace involved an optical trick. The landscape architect used an embroidered parterre design terminating in a semi-circular contour, making the whole appear to tilt upward.

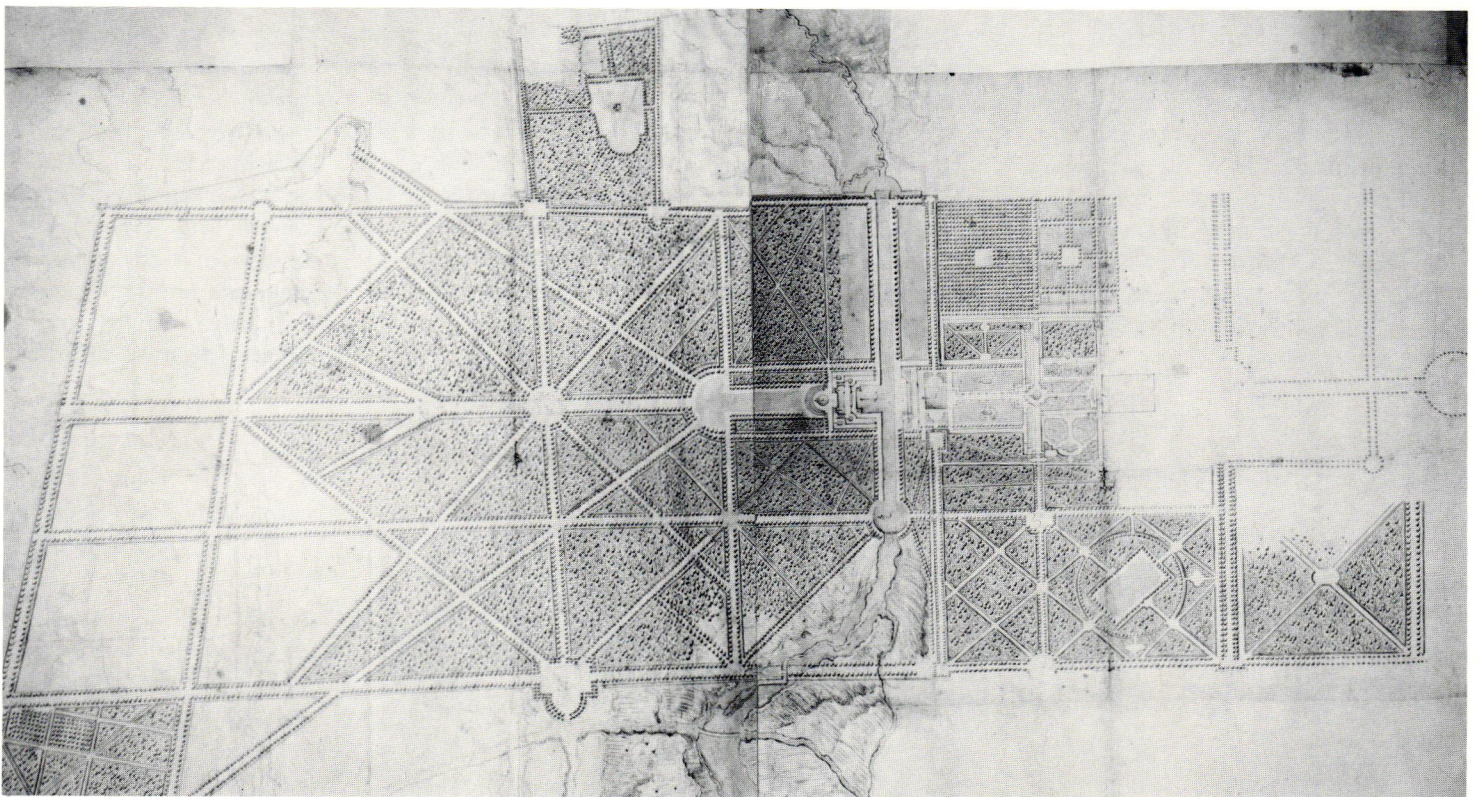




4. Versailles, "Du Bus" plan.

By surrounding this with a raised terrace, Boyceau was able to produce the visual effect of changing levels adding variety in his design. This impression was particularly marked when the area was viewed as a whole from the palace (Fig. 3). It is evident from the so-called Du Bus plan (Fig. 4) that soon afterward, in the 1630s when Boyceau and his nephew, Jacques de Menours, were laying out the gardens of the first Versailles, they sought visual equilibrium in the proportions of near and far elements within the design.<sup>2</sup> In this scheme the three pools placed along the central axis are progressively larger as they are removed in distance from the château. As a result, the basins, when viewed from the building, appear to be of equal size and of the same shape, because of the trees concealing the actual quatrefoil form of the largest pool along the axis. In the Du Bus plan, Boyceau planned a "surprise" for the visitors to his garden—in this case, the discovery of actual discrepancies in both the size and shape of the pools, which are noticeable only upon walking through the space. Le Nostre must have seen and admired optical tricks such as these, for he subsequently brought them to their fullest expression; they became, in truth, the counterpoint in his otherwise coldly formal schemes.

From the treatises of Jacques Boyceau (*Traité du jardinage selon les raisons de la nature et de l'art*, Paris, 1638) and Claude Mol-



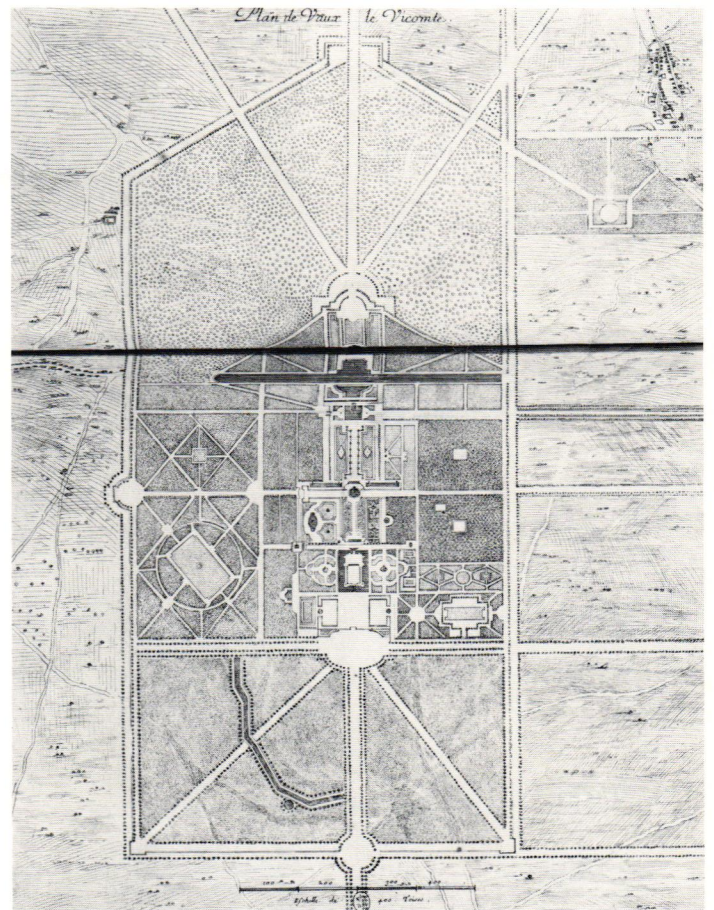
5. Vaux-le-Vicomte, plan, drawing by André Le Nostre.

let (*Tbâtre des plans et jardinages*, Paris, 1652), and from actual garden practice learned at the knee of his father, Jean,<sup>3</sup> André Le Nostre gradually evolved a masterly style of his own. His early interest in optical illusion in the realm of the garden was doubtless whetted by a number of treatises on optics that appeared at that time, and it is not difficult to imagine the young landscape architect poring over *La perspective avec des ombres et miroirs* of Salomon de Caus, which was published in 1612, and, perhaps more significantly, Père Jean François Nicéron's *La perspective curieuse*, published in Paris in 1638. These studies surely left a lasting impression on the young gardener.

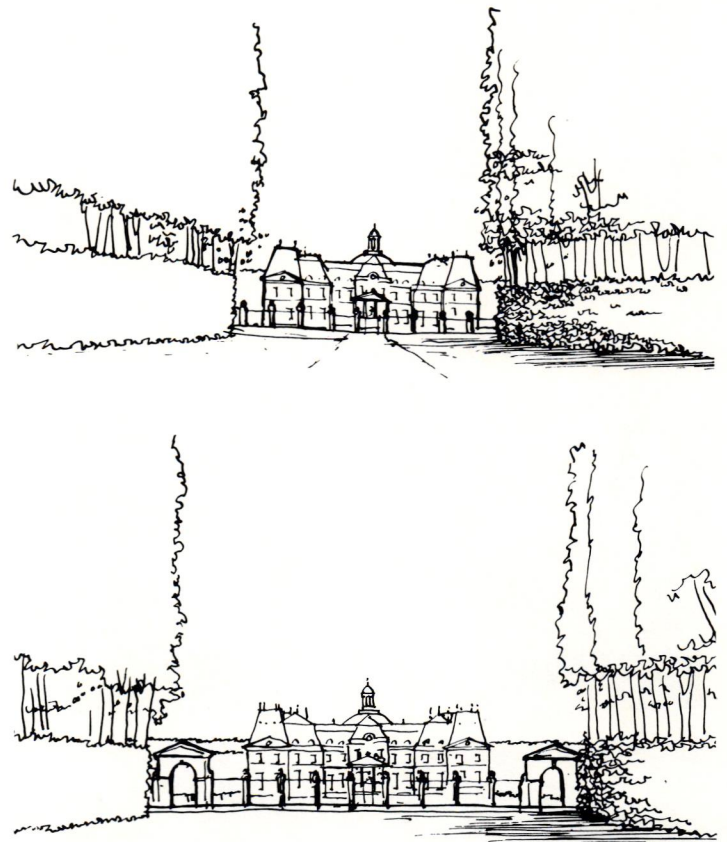
To illustrate Le Nostre's deep concern with optical illusion, I have chosen three sites which effectively span the garden architect's long and productive career—his earliest known masterpiece, Vaux-le-Vicomte, Chantilly, and a late work, the gardens of the Château de Pontchartrain.<sup>4</sup> My observations will necessarily be limited to certain specific aspects of their design since all three gardens are complex reflections of their author's interest in optics. Indeed, each successive visit to the sites reveals additional "surprises" for those receptive to the visual subtleties employed by Le Nostre.

The magnificent plan of Vaux-le-Vicomte in the Institut de France (Fig. 5), which has been identified as by the hand of the master himself, underscores the formality of the overall arrangement.<sup>5</sup> Following the established French formula, the garden is laid out along a single axis which perfectly bisects the composition.<sup>6</sup> Since the building, designed by Louis Le Vau, is only barely indicated on Le Nostre's unfinished plan, an engraving by Israel Silvestre is helpful in ascertaining the exact placement of the château (Fig. 6). Clearly the gardens were designed to lend focus to the structure, and even today at Vaux-le-Vicomte, the building is the chief actor on the stage, regardless of the vantage point in the garden from which it is viewed. When approaching Vaux-le-Vicomte by the long advancing avenue, Le Nostre allowed the first view of the château from considerable distance (Fig. 7). Precisely framed by convergent wedges of graveled *allée*, green hedges, trees, and sky, the building appears to abut directly upon the avenue of approach in the midst of what appears to be a totally flat terrain. As one proceeds up this avenue the vista broadens laterally to include two symmetrically-placed masonry portals (Fig. 8). This expansion in width continues until finally, one emerges into a large quatrefoil-shaped forecourt and the service buildings, placed to left and right of the composition, come into full view (Figs. 9–10). In this progression forward, Le Nostre led the visitor to feel that the closer he came to the end of the tree-lined *allée*, the more distant the château appeared. Upon emerging, the viewer learns that he must traverse not one forecourt but three, in order to arrive at the château itself. In addition, the terrain in front of the château, which from a distance appeared relentlessly flat, is found to slope appreciably downward toward the building.

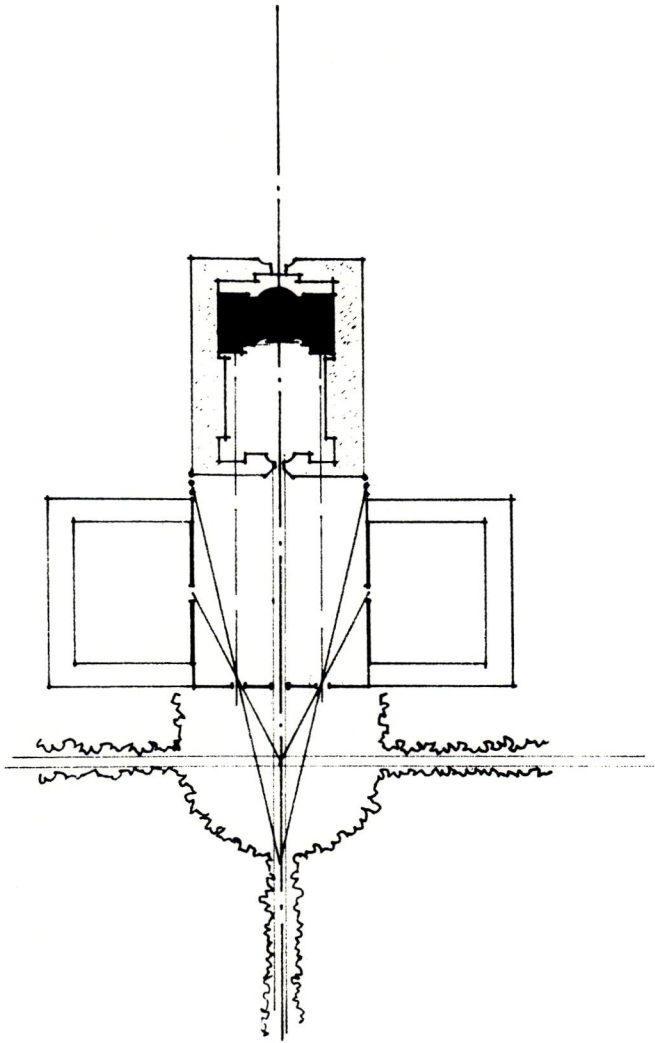
The proportions of the château are calculated to harmonize with those of the outlying buildings, and in turn the scale of the wrought-iron fencing, divided at regular intervals by male and female herms, is carefully adjusted to the scale of the buildings. As a result the complex does not appear exceptionally large in the overall view. Thus, one appreciates the immense size of the scheme as a whole only after experiencing the space beyond the entrance gateway. This monumentality, revealed strategically by degrees, constitutes one of the "surprises" of which the seventeenth-century Frenchman was to grow increasingly fond.



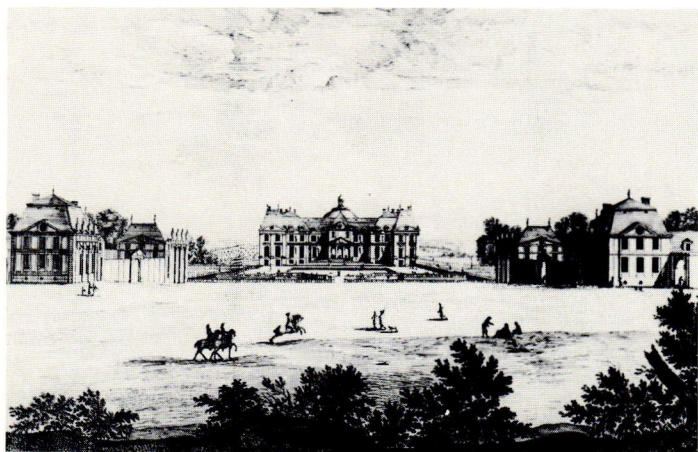
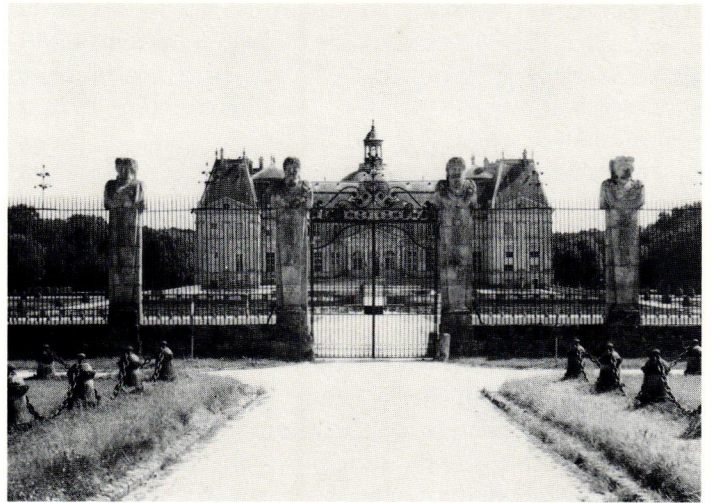
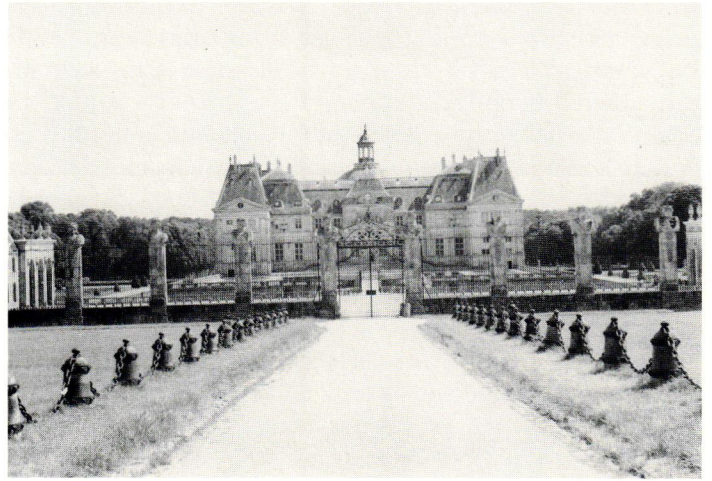
6. Vaux-Le-Vicomte, plan, engraving by Israel Silvestre.



7-8. Vaux-Le-Vicomte, approach.



9. Vaux-Le-Vicomte, plan.



10. Vaux-Le-Vicomte, entrance facade, engraved by Israel Silvestre.

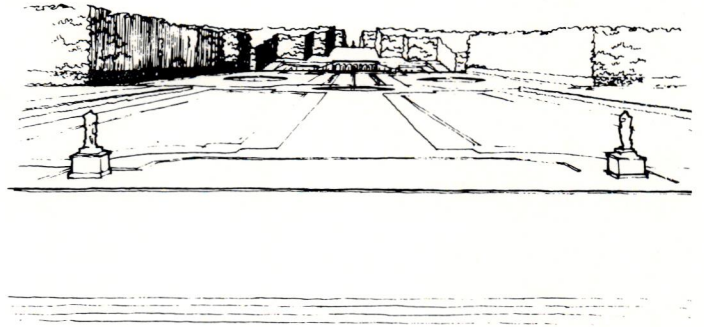
11-14. Vaux-Le-Vicomte, approach.

The splendid harmonies existing between the château of Vaux-le-Vicomte and its surroundings could not have been realized without the very close collaborative efforts of the architect and garden designer: the optical subtleties encountered at every turn were clearly born of a sympathetic working understanding between Le Vau and Le Nostre. A case in point is the wrought-iron gateway, whose rectilinear and curvilinear forms attach themselves visually to similarly contoured architectural motives in the building beyond. As can best be demonstrated, perhaps, by a series of photographs (Figs. 11–14), the near and far objects constantly change in relation to one another, but always maintain a visual rapport. It is a game of optical gymnastics that Le Vau and Le Nostre are playing, a game in which the perceptive visitor is invited to participate. The juxtaposition of near and distant objects, exemplified in the gateway, may be said to provide the key to much that follows in the gardens at Vaux-le-Vicomte.

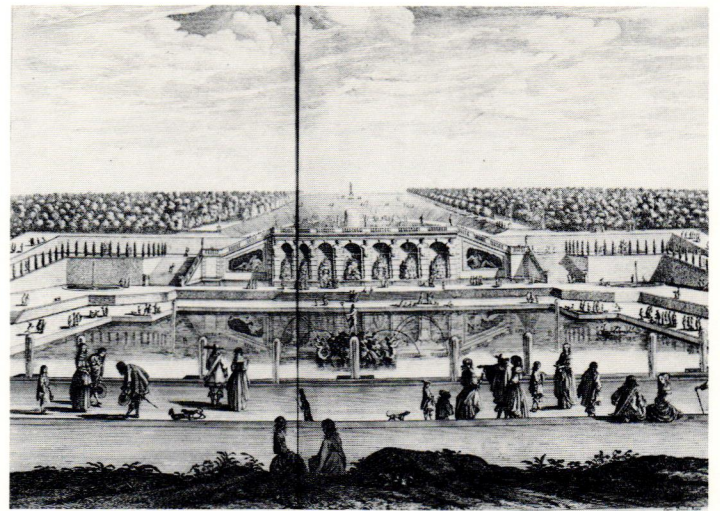
For the visitor approaching the château, Le Nostre offered little indication of the magnificent gardens in the rear since they are largely concealed by the building. In fact, only tantalizing glimpses of a landscape terrain are visible in the spaces separating the château from the service buildings. And yet these calculated glimpses are enough to quicken one's stride across the forecourt, up the steps, and into the château where, from the oval salon, the eye can embrace the gardens in all their formal splendor.

Standing upon the steps of the garden facade (Fig. 15), one is struck by the all-inclusive harmony of Le Nostre's design. The vista extends outward along the single axis defined by the symmetry of château as well as garden. This axis is immediately marked by a rounded basin fairly near the building itself, and originally this was followed by an *allée d'eau*, so named because of the water jets which sprang up at regular intervals at its sides.<sup>7</sup> Beyond this water *allée*, now simply a series of marble basins, is a pool that, when seen from the château, appears to be rectangular. Along the outer margins of this basin is an artificial grotto, highly architectural in character and embellished with niches in which jets rise and seem to spill back into the rectangular pool. Finally, the vista continues above the grotto along a tree-lined greensward, at the end of which stands a replica of the Farnese Hercules raised on a stone pedestal.

For the visitor standing on the steps of the château, a near-perfect symmetry of parts prevails, in a terrain that appears to be essentially flat. But, as was the case on the entrance side of the château, so too on the garden side few things are as they appear to be. Le Nostre planned surprise after surprise for the visitor bent on walking to the figure of Hercules. As with the entrance facade, most of the components of the garden are of a similar scale; and, because they are consistently larger than life, the vast dimensions of the garden can only be appreciated by walking through the landscape. A walk along the axis reveals a number of different levels descending into the distance—levels which are connected with one another by grand staircases that unexpectedly appear before the viewer. These levels contain bodies of water invisible from the château. Pools, which from the building had seemed rectangular, elliptical, or perfect quatrefoils turn out on closer inspection to be square, round, or elongated quatrefoils. The excitement of discovery inevitably draws the visitor forward and with each passing step additional surprises catch the eye. The most astonishing *trompe l'oeil* is a hugely proportioned square basin beyond which the Grand Canal, heretofore completely hidden, suddenly comes into view (Fig. 16).



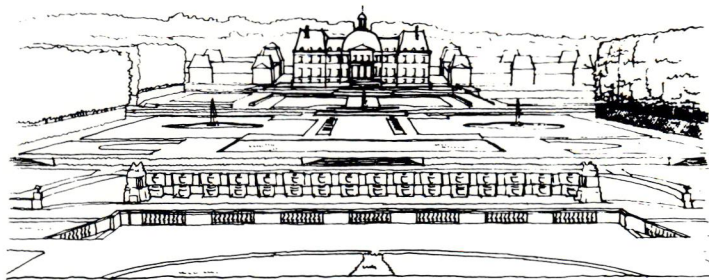
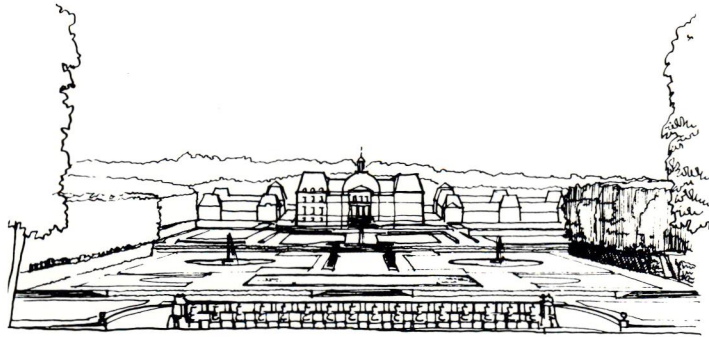
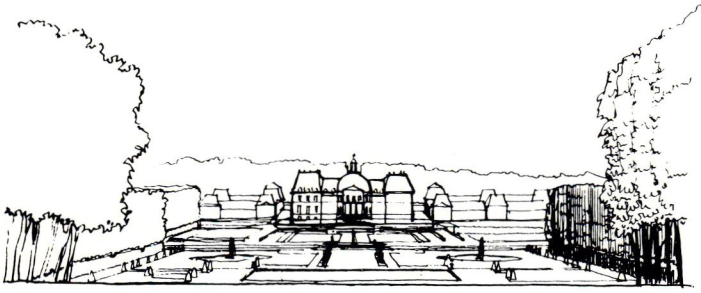
15. Vaux-Le-Vicomte, general view of garden from château.



16. Vaux-Le-Vicomte, grotto and part of canal, engraving by Israel Silvestre.



17. Vaux-Le-Vicomte, replica of Farnese Hercules.

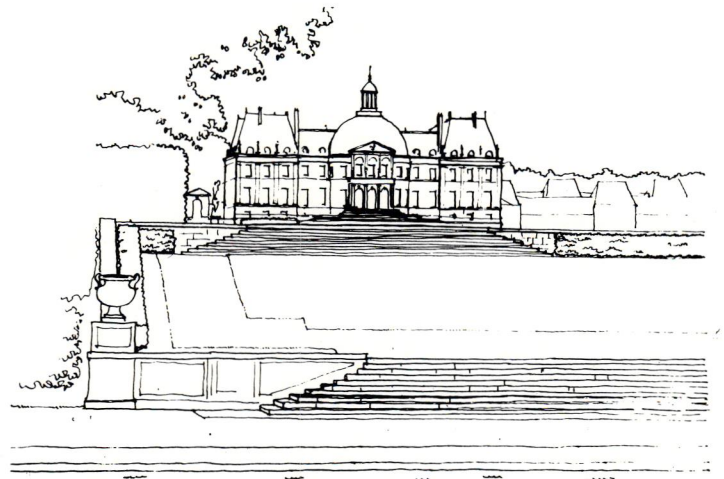


18-21. Vaux-Le-Vicomte, chateau and gardens from distance.

As if the “magical” appearance of the canal were not enough, from the face of the screening embankment emerge the Grandes Cascades, perhaps the most impressive water effect within the gardens. The sound of their tumbling waters must have been audible from afar—at first only a murmur, building to a roar as one approached. Immediately beyond the cascades and before the grotto, the canal broadens to form an enormous pool. Thus the visual impression that the grotto abuts on the square basin proves to be incorrect; and it soon becomes apparent that the grotto has its own rectangular basin, which receives water from its sculpted jets.

Having reached the borders of the canal, Le Nostre designed another obstacle for the visitor, for the figure of Hercules is not so accessible as had first appeared: in order to reach the statue, one must walk to one end or the other of the canal before doubling back to regain the central axis—quite a long walk. As with so many of Le Nostre’s designs, the exertion demanded of the visitor proves altogether worthwhile, for upon reaching the Hercules, Le Nostre produced a threefold surprise. First, the sculpture itself is immense, although it had not seemed so from the chateau (Fig. 17). Further, the vista, which from the chateau had appeared to terminate in the statue, is now seen to continue, not in one *allée*, but in a series that extends as far as the eye can see. Surely the most satisfying of these “surprises” is the panorama back towards the chateau from the bench at the base of the pedestal of Hercules (Fig. 18). From this spot, all of the visible components of the garden interact to give focus to the structure of the entire design. Perfectly framed by greensward, trees, parterres, pools, *allées*, and sky, the building assumes its all-important place in this remarkably orderly design.

The view of the chateau complex from the bench below the Hercules statue contains a startling visual effect. The carefully manicured gardens appear once more to be virtually flat even though one has just experienced the many different levels present in the terrain. Astonishingly, this image of flatness is subject to change; for upon further contemplation, the chateau, with all lines converging upon it, assumes a position at the summit of a steep incline, and the various parterres, transverse axes, and other garden components read as a series of superimposed terraces connected to one another by stairways. The gardens now seem strongly reminiscent of the vertical plan designs of Italian gardens.



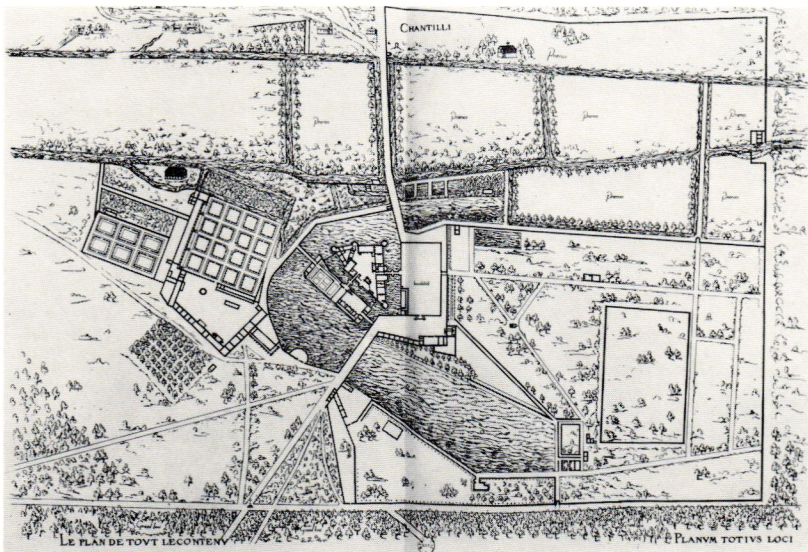
22. Vaux-Le-Vicomte, chateau viewed from left side of gardens.

From the bench, many aspects of the garden which had been concealed from the château, notably the canal and the Grandes Cascades, have once again assumed their cloak of invisibility. As the visitor walks down the greensward, these features gradually come back into view, and as they do, the relationship between the objects in the total design changes, adding richness to the overall harmony of the total composition (Fig. 19); the gardens continue to serve as the attractive handmaiden to the distant château. The optical interplay of near and far objects, alluded to earlier, finds its place in the gardens as well. Thus, in one view of the central axis across the canal (Fig. 20), one encounters a rather simple but broad flight of steps. The steps, seen from the level of the canal (Fig. 21), serve as the perfect visual base for the château and make the building appear to move closer. Similar flights of steps symmetrically disposed on either side of the garden, immediately to left and right of the Grandes Cascades, repeat the function of the central staircase, serving as visual foundations for the château beyond (Fig. 22).

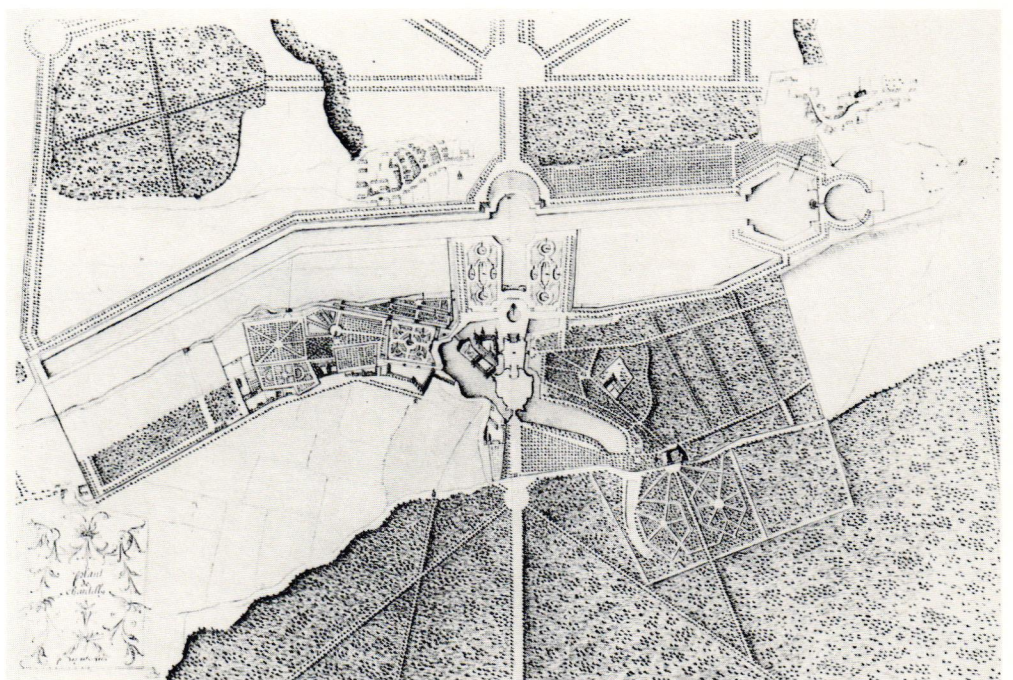
If one stands directly on the central axis before the huge square basin on a calm day, one can see the château and its outlying buildings perfectly reflected in the water. From this same

vantage point, the distant structure appears to be preceded by one mighty flight of steps leading up to the grandly scaled oval salon. This single flight only “unravels” as one walks up the central *allée*, rediscovering en route that a number of flights, separated by broad intervals of flat terrain, are involved. This subtle game continues until one reaches the final stairway, which leads up to and over the bridge across the decorative water moat.

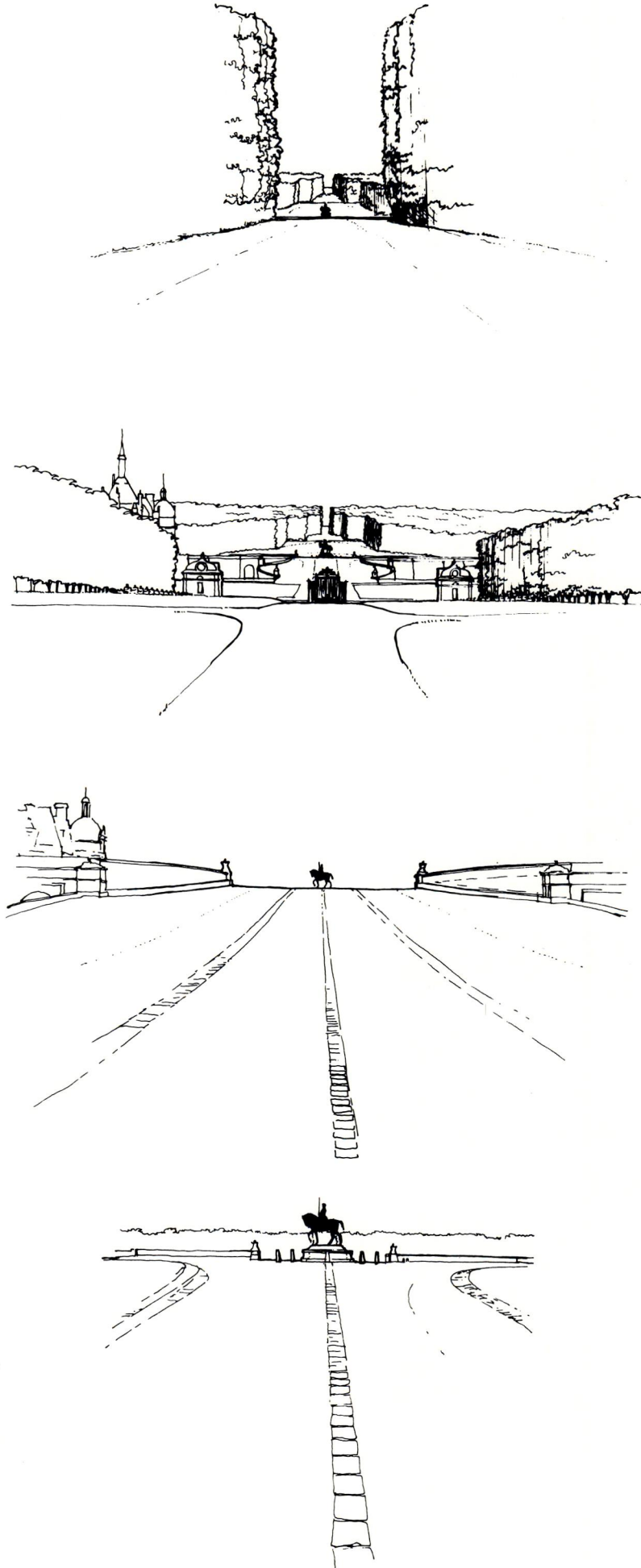
At Vaux-le-Vicomte, Le Vau and Le Nostre had little difficulty imposing upon the landscape an axial design which exactly bisected the château. Such was not the case when Le Nostre was asked by the Grand Condé to rework the existing gardens of his country residence at Chantilly, much of which dated to the time of Anne de Montmorency, Grand Connétable de France.<sup>8</sup> The building that Le Nostre encountered upon his arrival at Chantilly was highly irregular in plan (Fig. 23). In fact, it was so singularly lacking in homogeneity of both design and style that Le Nostre quite clearly was unable to use the building complex as the focal point of his composition. Instead, he elected to raise before the château an enormous terrace, in the center of which he placed an equestrian statue of



23. Chantilly, plan, engraving.



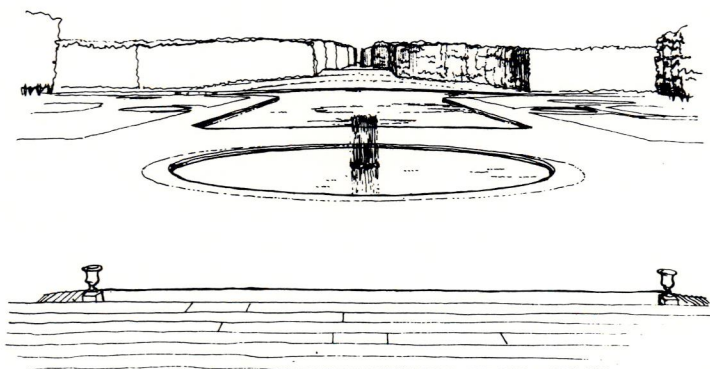
24. Chantilly, plan by Pierre Desgots, c. 1673.



25-28. Chantilly, statue of the Connétable.

the Grand Connétable.<sup>9</sup> The principal axis that he then drew into the plan did not extend outward from the entrance portal to the building, but lay at right angles to it in an undeviating line out into infinity (Fig. 24).

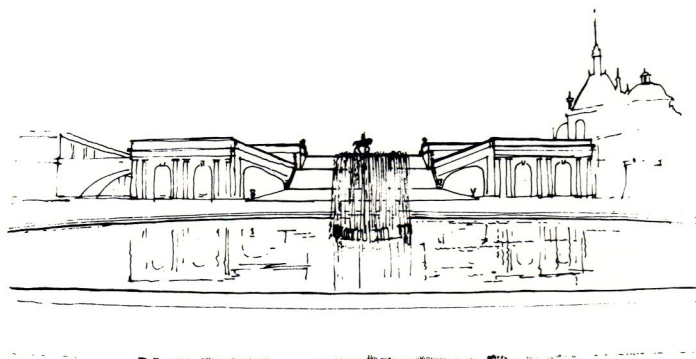
On approaching the château along this axis, which cuts through miles of dense forest, one catches a glimpse of light in the far, far distance—a beckoning light that appears to mark the end of the avenue. Shortly thereafter an equestrian figure placed in the center of the axis comes into view in the distant reaches of the landscape (Fig. 25). It is the statue of the Grand Connétable, the focal point of the composition and the implied destination of the visitor (Fig. 26). No distracting elements are permitted to intrude upon his concentration on the figure, for all marginal elements—trees, hedges, paths, entrance pavilions, and the gateway—consort to isolate and to reinforce the relationships of forms in space that culminate in the equestrian figure.



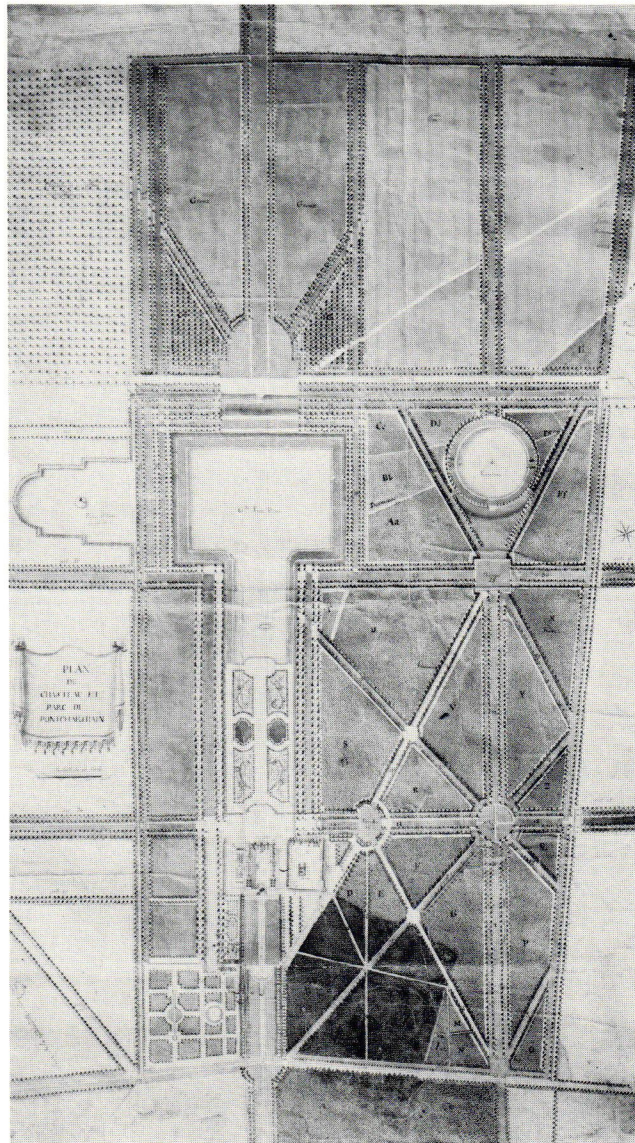
29. Chantilly, vista to north of Grande Terrasse.

After passing through the gate and traversing the decorative water moat, the visitor realizes that the ground has begun to slope upward, providing a grandly scaled ramp to the top of the *Grande Terrasse*. Having quite naturally looked down on perceiving the change of grade underfoot, one looks up at the top of the slope and sees the figure of the Grand Connétable appearing on the skyline (Fig. 27). Here is the Connétable as the great warrior returning to his residence after a day on the battlefield. Only at a point some halfway up the ramp does one discover that the equestrian figure is actually raised on a low pedestal (Fig. 28).<sup>10</sup>

Arriving at the level of the statue, the visitor is treated to yet another “surprise.” Beyond the Constable an immense parterred garden, hitherto hidden from view, opens up below, and beyond this a tree-lined greensward extends the axis onward (Fig. 29). The parterres, which are of truly monumental proportions, are decorated with pools and surrounded by large bodies of water, the principal one of which ultimately proves to be an arm of the Grand Canal. The parterre is reached by an impressive flight of steps placed along the principal axis. On reaching the bottom of the stairs, one normally walks to the margins of the large circular basin in the middle of which a water jet of considerable volume plays. Turning back towards the *Grand Escalier* at this point, one once again sees the Grand Connétable returning “home” (Fig. 30). And if one then takes up a vantage point beyond the circular basin, the exuberant waters of the jet serve as a perfect visual base for the Constable (Fig. 31).<sup>11</sup> Thus, at Chantilly, Le Nostre’s principal concern is to bring unity to a site where, at first glance, such unity would appear impossible. In addition, he provides the visitor to his garden at Chantilly with a dynamic approach to the complex, at once homogeneous and exciting, titillating his sensibilities with the gradual unfolding of unexpected optical illusions and endless variety.



30-31. Chantilly, view of terrace from before Grand Escalier.

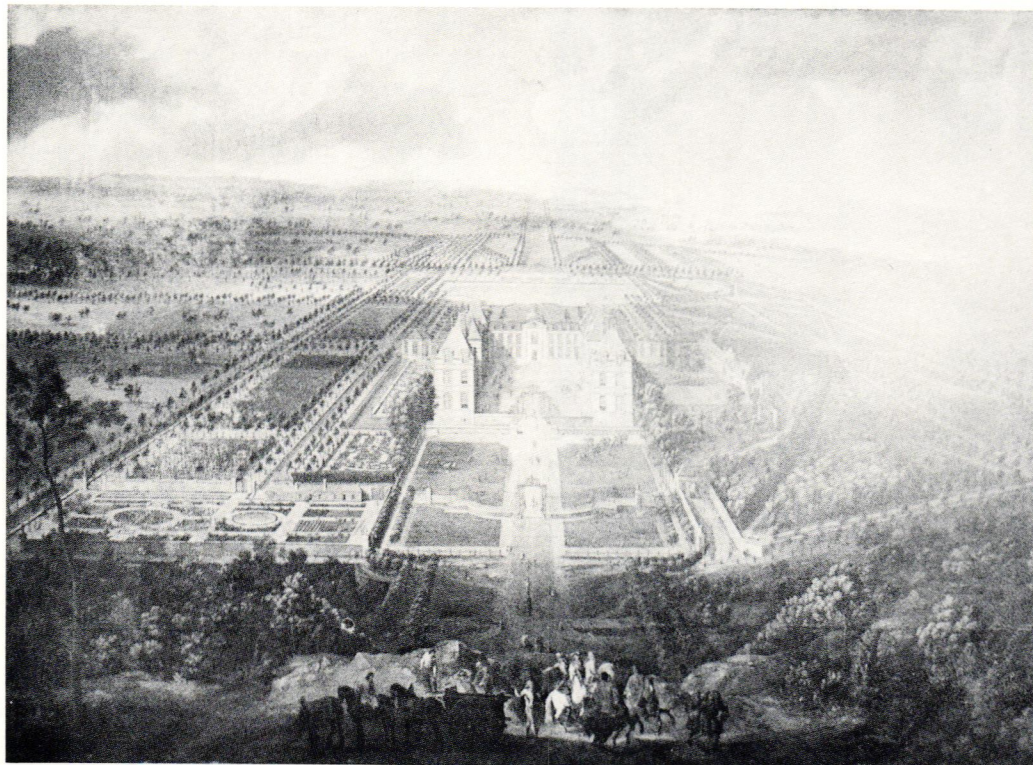


32. Pontchartrain, plan.



33. Pontchartrain, plan.

As Vaux-le-Vicomte had been a collaborative effort of Louis Le Vau and André Le Nostre, so the Château de Pontchartrain was the product of the joint geniuses of Jules Hardouin-Mansart and André Le Nostre. Although Pontchartrain is one of Le Nostre's last works, there are no indications of a slackening of either his imagination or his ability in the conception and execution of the plan. As at Vaux-le-Vicomte, architect and landscape gardener could work on a project which required both a new building and surrounding gardens. Hence they were not encumbered by existing structures, as at Chantilly. The solution for Pontchartrain was a familiar one based on an undeviating axis that would lead directly up to and through the middle of the chateau before plunging onward to infinity (Fig. 32). The greater part of the site near the chateau was featureless and flat. A dramatic approach was made possible, however, by an access route that began at a large circular *place*, designated on an early plan as *La place de la grande croix*, and located on the summit of a high hill (Fig. 33). It was from this spot that the chateau would first come into view, straddling the axis in the valley below (Fig. 34). From here, the building complex would have appeared as an entirely balanced design, marked by a *corps de logis* surmounted by a clock tower in its center and possessing two symmetrically placed wings that extend forward to left and right of center to form a U-shaped inner courtyard. From the summit the axis could be seen to continue beyond the chateau to include parterres and a lake, to culminate, in the farthest reaches, in a tree-lined *tapis vert* leading to open sky (Fig. 35). Modifications in the plantings, and the loss of the gateway and other features of the original design, make it difficult today to reconstruct the changing visual impressions that one would have had on progressing along the

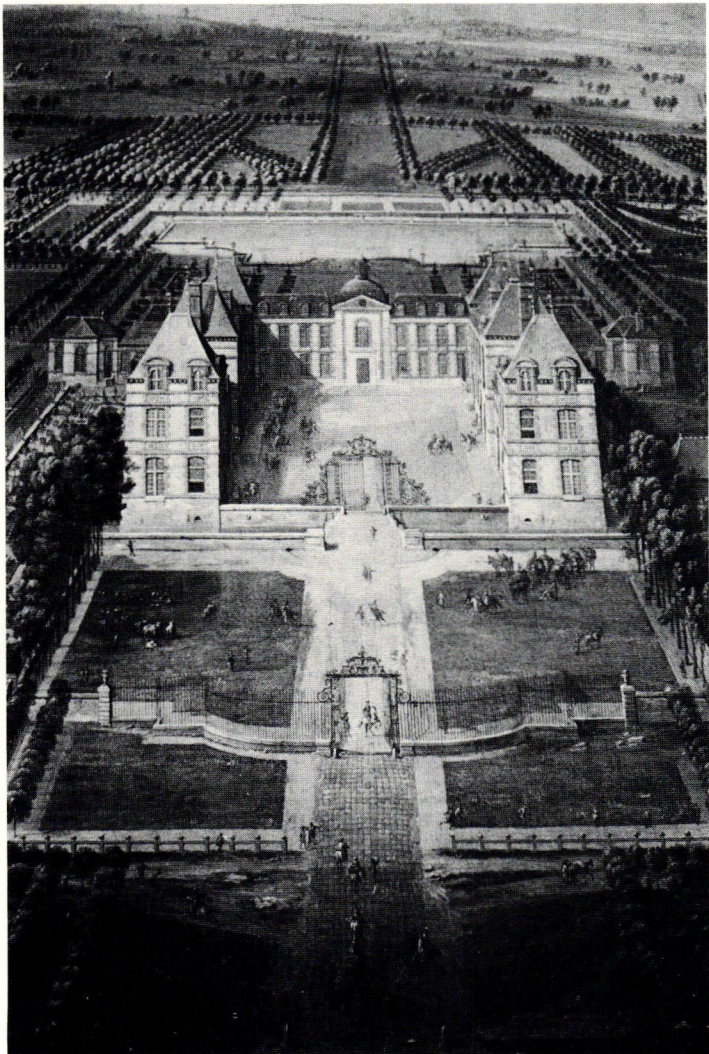


34. Pontchartrain, painting by J. B. Martin.

avenue of approach. The gardens have now fallen into a lamentable state of disrepair; the parterres are overgrown, the margins of the lake have collapsed, and, in addition, two circular islands have been added to the lake since the time of Le Nostre. Still, with a little imagination, it is possible to recapture something of the landscape gardener's original scheme. This can only be accomplished, however, by taking a long walk, so often the essential requirement for comprehending a Le Nostre design. When one is standing immediately in front of the lake and looking back towards the château (Fig. 36), the embroidered parterres are perfectly adjusted to the proportions of the building and, because of optical foreshortening, do not appear long and narrow as they are in plan. Since the outer arms of the lake would not have been seen from the château because of the trees and the relatively high banks that surrounded this body of water, the visitor would have found the walk to the end of the lake far longer and more demanding than he had first suspected. Thus, as at Vaux-le-Vicomte, Le Nostre placed a bench on the far side of the lake directly on axis with the château. A seemingly incidental object in a vast landscape, it serves a key function in the unfolding design. From the bench (Fig. 37), the breadth of the lake fairly embraces the spectator as he discovers he cannot grasp the outer margins of the huge pool in a single glance. Owing to optical foreshortening, the broad expanse of the lake appears diminished when viewed

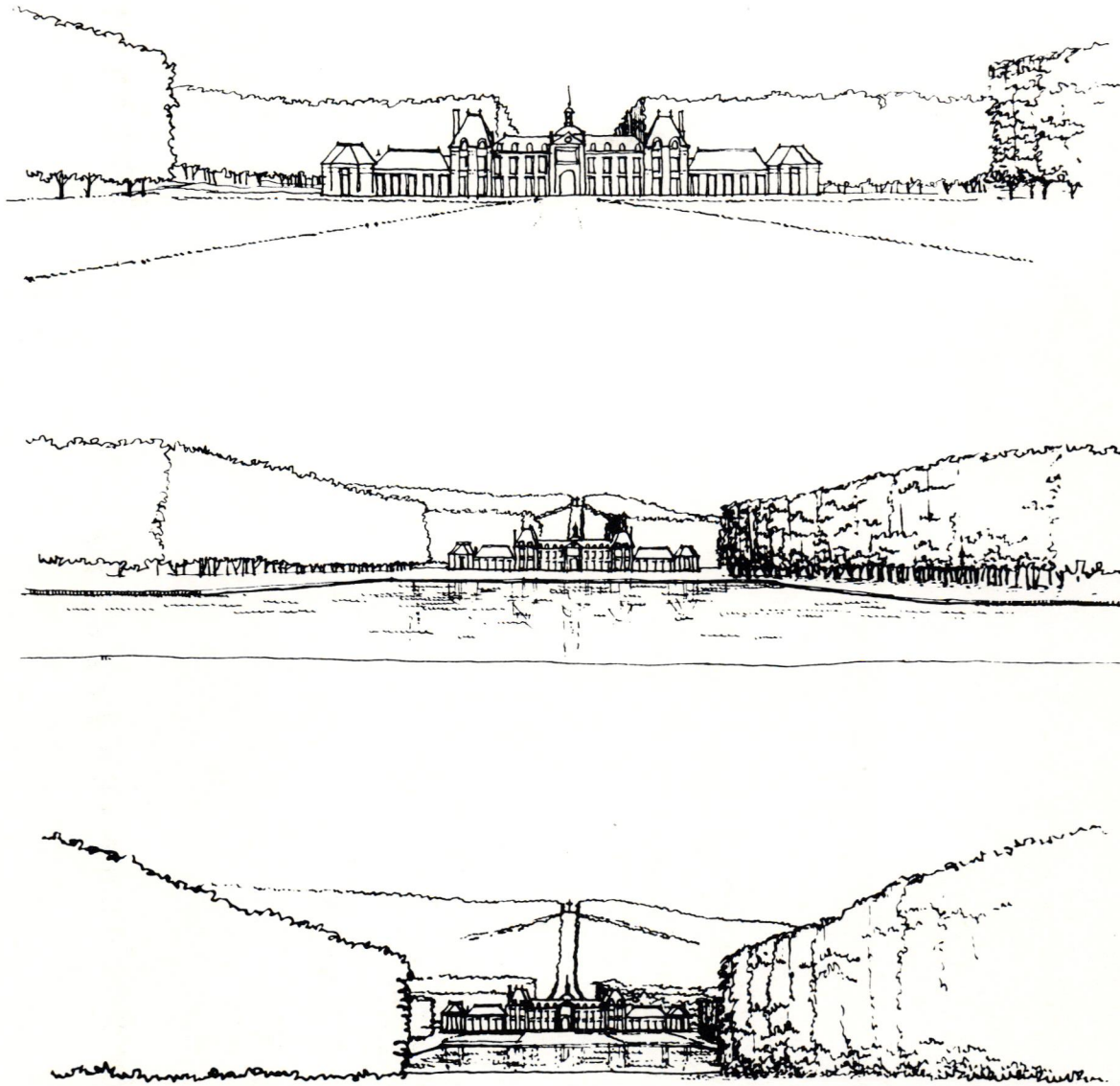
from the bench, and, together with the distant parterres, visually embraces the entire facade of the château to assure a harmonious whole. Perhaps cleverest of all in this vista of the château complex is the impression that the dome of the clocktower is now surmounted by a cross—a terminal element clearly not present earlier and a surprise increased by the realization that the cross was in reality an enormous cross raised in the center of the *Place de la grande croix* on the far distant summit. The interplay of near and far objects in space was, as we saw earlier, first announced at Vaux-le-Vicomte; at Pontchartrain, it has become a tour de force. Once privy to Le Nostre's "secret," the viewer of this apparition must have hastened to continue up the axis in order that he might get a better vantage point. He would, however, have been frustrated and not a little surprised to find his way blocked by a low wall that surrounded the garden. And any tendency to leap the wall was discouraged by a deep water-filled moat immediately behind it. These unexpected obstructions at Pontchartrain—were born of the same rationale as the intervening canal at Vaux-le-Vicomte. In order to circumvent these hazards, one was forced to seek out the small bridges located in the far corners of the garden; these alone permitted one to cross the stream and ultimately, to regain the central axis. A walk to the top of the slope of the greensward—a slope, incidentally, that was far more pronounced and of longer extent than had appeared from afar—gave one yet another dramatic vista of the château and its cross (Fig. 38). When viewed from here, the cross surmounted a tall spire that rested comfortably upon the domed clock pavilion. The spire was the advancing avenue of approach which, in this partially foreshortened view, perfectly assumed the desired image. It would be difficult to imagine an optical illusion of greater originality. The most exact calculation was required in order to achieve the desired visual impression—an impression that constantly changed with the backward and forward movement of the spectator.

From these three examples of Le Nostre's work, it is clear that this masterly landscape architect constantly sought and achieved the element of surprise in his gardens. These, in fact, constituted the refreshing leaven in his grandly formal designs. The "hidden treasures" in the form of pools, fountains, and cascades with their lively water effects make a heady assault on the senses, at first through sound and then by sight. Water is used, too, to simulate other materials and other forms, including grilles, balustrades, and pedestals. Water, the many concealed levels of the garden, and the backward and forward play of objects in space all contribute to deceiving the eye. And, after all, it is the use of deception as an enlivening agent that is ever the game in the seventeenth-century French garden—a game at which Le Nostre was the consummate master.



35. Pontchartrain, painting by J. B. Martin, detail.

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36-38. Pontchartrain, château and gardens from distance.

## Notes

1. For a detailed analysis of Jacques Boyceau's involvement in the gardens of the Luxembourg, see F. H. Hazlehurst, *Jacques Boyceau and the French Formal Garden*, Athens, Georgia, 1960, p. 48 ff.

2. The "Du Bus" plan is found in the Bibliothèque Nationale, Géographie, Collection Anville 833. See Charles Du Bus, "Le plus ancien Plan de Versailles," *Gazette des Beaux-Arts*, Paris, 1926, II, pp. 183-97.

3. Jean Le Nostre's name is associated primarily with the gardens of the Tuileries. In 1605, he is referred to as "Jardinier du grand jardin du Palais des Tuileries" (Archives Nationales, *Minutiers Contrats*, VIII, 566). By 1610, he had been promoted to "Premier jardinier du Roi demeurant au grand Jardin du Palais des Tuileries" (Archives Nationales, *Minutiers Contrats*, CV182 and 105).

4. André Le Nostre, Louis Le Vau, and Charles Le Brun were at work at Vaux-le-Vicomte in 1656, but the project may have been begun even earlier. In the dedication to Nicolas Fouquet of Claude Mollet's *Tbéâtre des plans et jardinages*, published in 1652, the publisher, Charles de Sercy, writes,

*Vous cherchez dans l'innocence de la vie champêtre des douceurs qu'on ne scauroit rencontrer autre part: et vous prenez plaisir de sortir des Parterres de Themis, pour entrer dans ces superbes Jardins de Vaux le Vicomte, où vous faites agréablement combattre l'Art avec la Nature, et où vous adjoustez tous les jours de nouvelles beautez et de nouveaux enrichissemens.*

*Chantilly was, by Le Nostre's own admission, his favorite undertaking. From*

*1662 until late in the century the landscape architect worked on these gardens of the Grande Condé. Pierre Desgots, Le Nostre's brother-in-law, seems to have been in charge of implementing the actual designs.*

*The gardens of Pontchartrain, begun in 1691, were all but completed by 1693.*

5. For an analysis of the drawing, see F. H. Hazlehurst, *Gardens of Illusion: The Genius of André Le Nostre*, Nashville, Tennessee, 1980, p.

6. The practice of designing château and gardens along a single axis may have been introduced in France by Sebastiano Serlio in his scheme for Ancy-le-Franc. This axial emphasis appears in a number of later sixteenth century plans, such as Anet and Charleval.

7. This was one of the few features of the garden not restored to its original condition.

8. Anne de Montmorency's château was built between 1528 and 1534; additions by his son, Henri, were carried out between 1560 and 1614.

9. The statue, executed in 1612, was destroyed during the French Revolution. A replica, made by Paul Dubois in 1866, was placed on the same spot.

10. In the restoration of the equestrian group the height of the pedestal was increased so that the visual impression so carefully devised by Le Nostre was lost.

11. Documents of the period refer to the difficulty of achieving the proper volume and height in the water jet.



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1. The west facade of Biltmore House, near Asheville, North Carolina, designed by Richard Morris Hunt, 1888–1895; landscape designed by Frederick Law Olmsted, 1888—about 1897.

# BILTMORE

Gerald Allen and Mark Hewitt

SOMETIME IN THE MID-1800s, George Washington Vanderbilt visited Asheville, North Carolina, a resort that was popular then, as it is now, for its mild climate.<sup>1</sup> One day while riding some three miles from the town, he came on a plot of land on the brow of a hill. Beneath it lay the French Broad River, and beyond in the distance were the Blue Ridge Mountains. George Vanderbilt liked the land, and so he bought it and built a house there. The result is Biltmore, which by virtue of its size alone is a major work of American architecture and landscape. It is also the last important work of two great figures in late nineteenth-century American art, Richard Morris Hunt and Frederick Law Olmsted.

The creation of Biltmore was both a self-consciously artistic endeavor and a practical demonstration of systematic land management, the first of its kind in the United States. It was also a vivid exercise in self-assertion on the part of its fortunate owner. The estate once consisted of nearly 125,000 acres, and the mansion, done in the French Renaissance style, is very large indeed: at 255 rooms it is easily the biggest single-family house in the country.

Biltmore is fantastic and numinous. It summons up dreams of châteaux and deep forests, and it bears the stamp of vast personal wealth used to shape a physical landscape of quite sizable dimensions—and an imaginary world still larger. It attracted throngs of tourists when it was completed in the 1890s,<sup>3</sup> and it still does today.

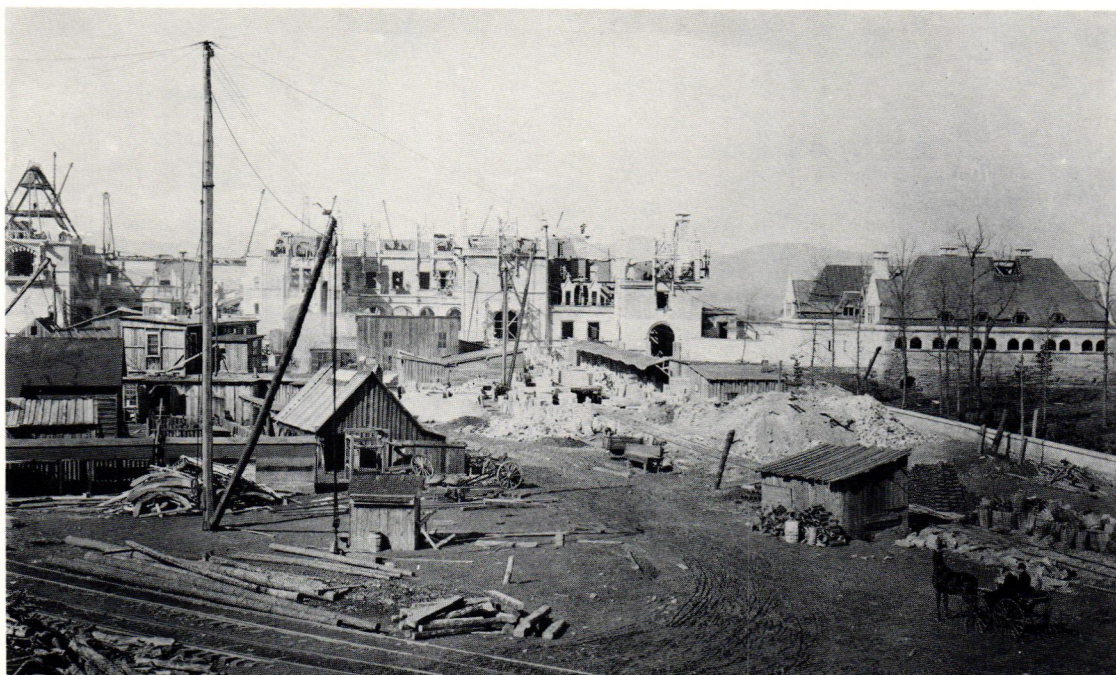
Biltmore is also important because it is one of the relatively few works by Hunt and almost the only one by Olmsted to survive in nearly perfect condition. Nevertheless, it has been regarded as rather insignificant in the annals of American building and landscape architecture. Just after its completion, it was mentioned favorably in the architectural press,<sup>4</sup> but

from then until only recently it was virtually ignored in print except for passing and usually condescending references in history books,<sup>5</sup> awe-struck descriptions in travel guides,<sup>6</sup> and chapters in picture books of great houses.<sup>7</sup>

Recently it has been written about more fully, though these descriptions have been mainly historical and biographical.<sup>8</sup> Until now, no floor plan of the house has ever been published, and only one site plan, at tiny scale.<sup>9</sup>

That Biltmore has seemed to most twentieth-century eyes an extraordinary, curious, but slightly preposterous exercise is not surprising, since it was completed at virtually the same time that the cultural epoch whose values it embodied drew to a close. Soon a more regulated capitalist economy with new structures of taxation would make the accumulation of great fortunes like the one that paid for it virtually impossible, since developing social ethics were beginning to find such fortunes a dubious asset. Also dubious—this time in the realm of architecture—was the habit of making places that were inspired by grandiose European models. Instead, a younger generation of architects began in the twilight of the Gilded Age to aspire more consciously than before to what they regarded as an American artistic independence.

Biltmore was thus out-of-date even when it was brand new. It is contemporary with the early architecture of Frank Lloyd Wright; it is only a few years earlier than Thorstein Veblen's *The Theory of the Leisure Class* and is a copybook example of his notion of conspicuous consumption. When the values it reflected passed quickly into history, Biltmore itself was perceived as merely freakish, the mindless embodiment of the false hopes and bad guesses of a previous age. But today, virtually at the end of the twentieth century and nearly a hundred years after it was conceived, what seemed fantastic and bump-



tious now can be seen to possess a muted and sober solemnity that is much more precisely articulate of itself and its ambiguous predicament than we would hitherto have suspected.

What follows here, after a chronology of important events in the history of Biltmore, is a description of the house and the estate as a visitor can see them today, a literary tour informed by reflections and memories, a phenomenal appreciation. It is from the imagined vantage of the actual observer that we think Biltmore can be understood best, and it will become apparent along the way just why we think so.



3. A portion of the approach road under construction in about 1892.

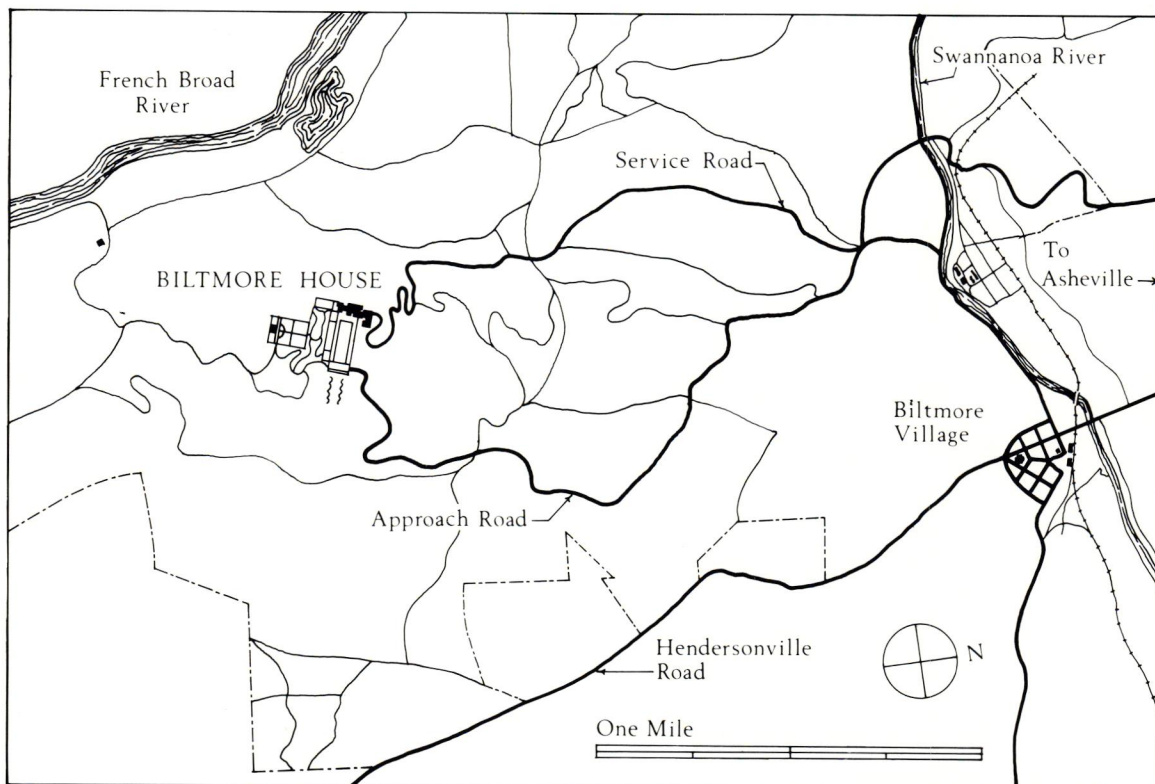
### *An Imperfectly Esthetic Young Billionaire*

George Washington Vanderbilt was born in 1862. He was the grandson of Cornelius Vanderbilt and son of William Henry Vanderbilt.<sup>10</sup> Unlike his grandfather and father and his older brothers Cornelius II and William K., he showed little interest in business and was instead bookish, fond of the arts, and occasionally devoted to public causes—an “imperfectly esthetic young billionaire,” Henry James once called him.<sup>11</sup>

After Vanderbilt’s visit to Asheville he began purchasing land, and by 1888 he had assembled some 2,000 acres. He then hired Olmsted, who had already worked for him on several projects, as the landscape architect for Biltmore. Olmsted’s office immediately began collecting surveys and other data. At about the same time, he hired Hunt—who had also worked for him before and, of course, for other members of his family—to design the house. At this point Olmsted was 66 years old, Hunt was 61, and each was the acknowledged dean of his profession. Vanderbilt was 26.

In March, 1889, Olmsted reviewed Hunt’s preliminary plans. What had apparently begun as a fairly modest scheme for a house in Vanderbilt’s mind had rapidly expanded and become grand. Olmsted made, as we shall see later, a number of important suggestions about its siting and massing, and Hunt accepted these. In October Olmsted visited the site for the first time.<sup>12</sup> He found the land poor, and instead of a park, which the owner had wanted, he recommended turning most of the estate into a forest, tactfully pointing out that forestry would be a suitably dignified business for someone like his client and that the creation of a large and well managed timbering operation would be a significant public service. Vanderbilt agreed, and so by 1890 Biltmore’s double role as a large estate of considerable pretension and a place for agricultural experiment had been firmly established.

By 1890 also, the precise location of the house had been settled on, with Olmsted’s opinions again prevailing. A village for employees had been started, and so had a kiln for producing



4. Plan of a part of Biltmore Estate, showing the house, Biltmore Village, and the main approach road.

bricks and a three-mile railroad spur to deliver other materials to the site. Several hundred workmen were clearing the forests, and work had begun on the new roads laid out by Olmsted. Hunt visited the site for the first time early in the year, and he returned in the spring, travelling this time with Vanderbilt in his private railroad car, pulled up to the house with the first train on the new railroad.

From then on the work progressed in earnest. By 1893 the second story of the house was up, and the estate had expanded spectacularly to 100,000 of the nearly 125,000 acres it was ultimately to include. By 1894 the steel rafters were being hoisted into place, and the nursery was annually producing over a million plants and trees of about 9,000 different species. At Christmas of 1895 the formal opening of the house was celebrated with a party at which George Vanderbilt's mother presided.

The previous July, however, Richard Morris Hunt had died, and at about the same time Olmsted's health and memory had begun to fail. His son became his legal guardian in 1898, and after five years' confinement in a hospital he died in 1903.

Vanderbilt is said to have spent most of his fortune building Biltmore, and in the early 1900s, following some financial difficulties, expenditures on the estate were trimmed back. In 1914 he died at the age of 52. His wife, whom he had married in 1898, deeded 80,000 acres of the estate to the federal government, and it became part of the Pisgah National Forest. An additional parcel of some 5,000 acres was developed into a suburb known as Biltmore Forest, and further acreage was sold for the Blue Ridge Parkway.

In 1930 the Vanderbilt's only child and her husband, who lived at Biltmore with their two sons, opened the formal rooms on the main floor of the house and several bedrooms on the second floor to the public; additional rooms were opened in the 1970s. In the 1960s, an interstate highway was built across the estate, passing over the main approach road at one point.

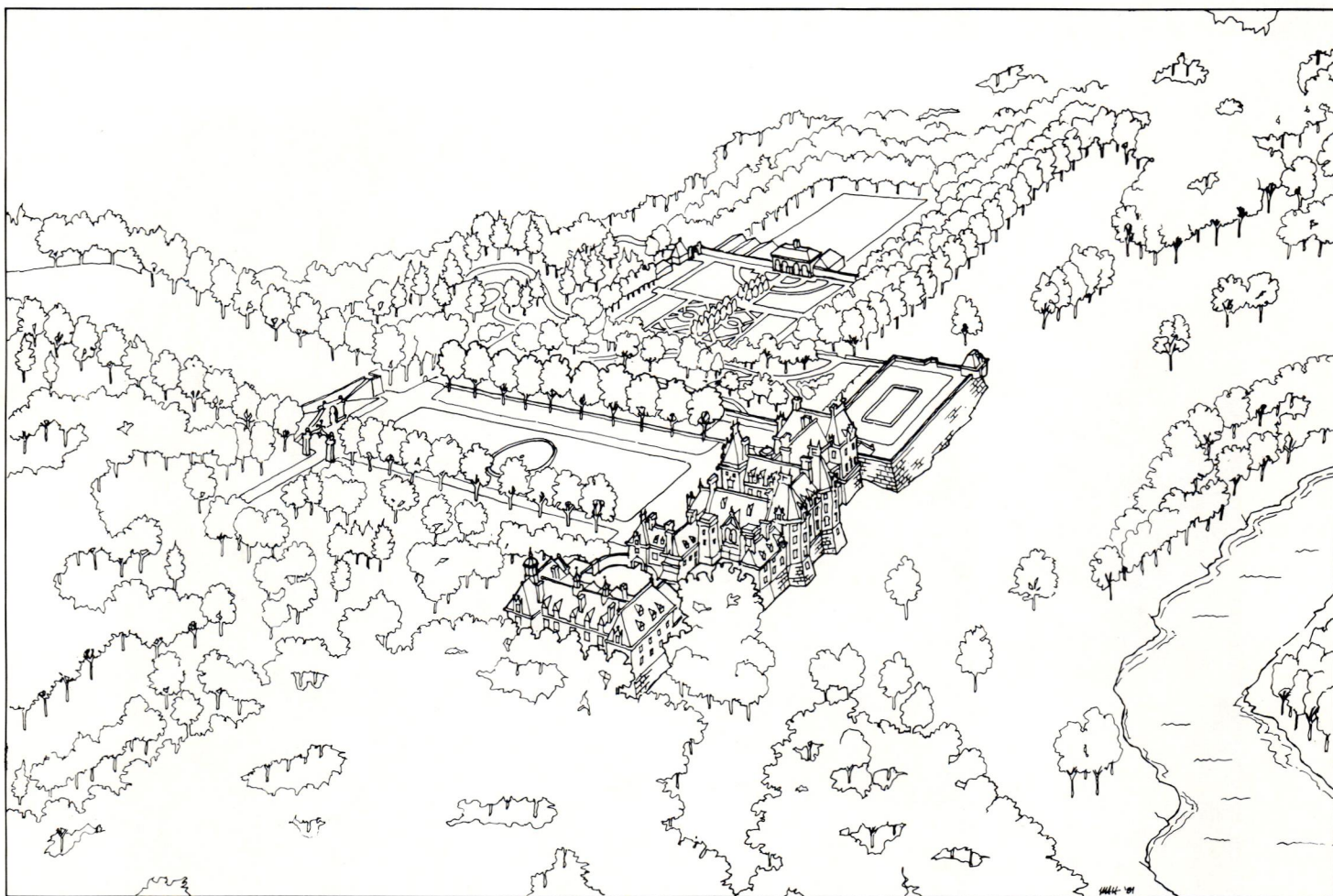
Today Biltmore remains in the possession of George Vanderbilt's heirs.

### *The Approach*

The estate village of Biltmore lies at the entrance to the main road that leads to the house. Today it is little more than a suburb of Asheville, and its original buildings have up-to-date fast-food restaurants and filling stations wedged in between them.

Still prepossessing enough to invite entry is the gatehouse, and once we pass through it we find ourselves in a deep, rustic forest, a buffer zone between the outside and inside worlds. Biltmore House is some three miles away. The route to it is fairly direct, but it is laid out in a series of gentle curves that prevent an extended view along it. On either side densely planted pine, hemlock, and hardwoods rise above thickets of rhododendrons and mountain laurel.

Travelling along the road we have a sense only of movement, not of progress. The distance could be ten miles as well as three, and since we must travel on it rather slowly, there is time to recount some of the particulars of its construction.



5. Perspective view of Biltmore House and the immediately surrounding site; the Esplanade is to the left of the house and the valley of the French Broad River to the right. The approach road enters the Esplanade at the extreme left.

In laying it out, Olmsted abandoned the path of an earlier road that led to the house site along a ridge.<sup>13</sup> The new road pursues a stranger course, following the path of a stream through sequestered ravines, and marked along the way with a scattering of visual incidents in the form of bridges, a waterfall, cascades, and pools.

This road forms one of the greatest sequences in landscape architecture in the world. Olmsted appears to have described his design for it virtually without drawings, relying instead on a long list of fairly general instructions to his builders, then suggesting more specific elaborations and modifications as the work advanced. He was a sedulous note-taker, marking down the details of each of the vistas in the emerging progression.<sup>14</sup>

All of this was characteristic of the way he had worked throughout his career. In addition to making obvious specifications like maximum grades and minimum turning radiuses, he would resort to broad exhortations to his colleagues. "Avoid all petty effects," he wrote at one point to his civil engineer. "Make one character of bank contrast with another, high banks with low, concave with convex surfaces, low shelves with high, always, of course, keeping in view the methods of nature."<sup>15</sup> Having specified stone bridges at points where the road crossed the stream, he also sent along the name of a book with illustrations of stone bridges.<sup>16</sup> Referring on another occasion to a newly constructed waterfall, he wrote to describe the aural as well as visual effect it could create: "Place stone just *under water* below the dam where the falling water will strike and rebound from it. This will make foam and sparkle, will confuse the sight and will add to the purling sound."<sup>17</sup>

Olmsted obviously placed a great deal of trust in the skills and sensitivities of the people who worked for him. Even so, his design methods would be extremely unusual today, where

everything would be described graphically, in great detail, and mainly in advance. In itself, this fact is probably not particularly significant, since it would theoretically have been possible, though certainly a great deal more troublesome, for him to have developed the same design in drawings. What is important to notice is that the two mediums—one verbal and the other graphic—inevitably carry with them their own special emphases. The verbal medium allows an emphasis on narrative effect, and it tends to focus on specific events in sequence. The graphic medium emphasizes the overall physical form, and its view is of the whole thing.

The approach to Biltmore House, designed with the former methods, is composed not with the omniscient eye of a draftsman, but with the moving, changing, cumulatively perceiving eye of someone actually on the ground. It is something that can be revealed only sequentially, not all at once, and it is to be understood phenomenally as an accumulation of experiences rather than abstractly as a physical form.

At one point, the road from the gate to the house breaks out of the dim forest into a large and open meadow with plantings of trees arranged to form a foreground, middle ground, and background. The scene is like a seventeenth-century Italian landscape painting of the kind so admired by the English that to emulate it they invented the picturesque garden.<sup>18</sup> This in turn was the formal inspiration for most of Olmsted's work as a landscape architect.

After running along the edge of the meadow for a short distance, the road returns to the woods and becomes once again an apparently endless tunnel. Not too much further along, though, it begins to ascend and then abruptly turns in a very sharp double curve, as though to alert us to the possibility that something special may be about to occur. Something special is,



6. The east facade of Biltmore House seen from the point where the approach road enters the Esplanade.

for without further warning the road plunges through a pair of large wrought-iron gates. The lines become straight and formal; the ground becomes level; and we are aware that we are entering an open space. Straight ahead the road continues, with a sharp stone embankment on its left side, and a second gate directly ahead, apparently leading us down again into the forest. There is a splendid moment of uncertainty and excitement as our attention is drawn towards the right across a broad, open esplanade. At the other end of it the enormous house—merely a few hundred feet away from us, but totally hidden until this moment—breaks suddenly and fully into view. We have arrived.

“The estate,” Olmsted had noted in his instructions to the engineer, “must be a surprise.”<sup>19</sup>

### *The Esplanade, the Gardens, and the Valley*

We are now on the esplanade in front of the house, and have encountered for the first time the major thematic juxtaposition of Biltmore. This is between the idea of the place where we now are, which Olmsted described as “trim, level, open, airy, spacious,” and “thoroughly artificial,”<sup>20</sup> and that of the place where we have just been.

The difference between these is easy to perceive, though it is not easy to say exactly what it is. Olmsted had directed that the approach road be composed according to “the methods of nature,” and he clearly meant this to stand in contrast to the “thoroughly artificial” esplanade. In spite of the fact that, strictly speaking, both are equally artificial and equally natural—since both are made by the hand of man from natural materials—his distinction is still valid. The image, at least, of the one is primitive, rustic, and mysterious, whereas the image of the other is orderly and urbane. These differences, moreover, are not just esthetic, but also have epistemological and even moral dimensions to them. Since both places are representations of reality, the ways in which we perceive them are therefore meant to be taken as metaphors for the ways we may perceive reality itself—comprehensively and reasonably in the case of the esplanade; randomly and cumulatively in the case of the approach road.

The site for the house was made by building an enormous platform on the side of the hill. First a cut was made into the slope and the earth above it retained with a large stone wall, which we can ascend on a pair of gentle ramps known as the *rampe douce*. Next the esplanade was built out from the stone wall, and the fill required to keep it level was retained at the other end by a second wall, this one a great deal higher and more massive. The house itself sits on this, perched like a castle—or so it seems—on top of a rugged gneiss bastion and overlooking the valley below.

The ideas for the esplanade and the overall siting of the house were Hunt’s and so apparently was the great sward of lawn that stretches up from the *rampe douce* nearly to the top of the hill.<sup>21</sup> After Olmsted was shown the preliminary plans in 1889, however, he had a series of suggestions to make, and all of these appear to have been incorporated into what we see at Biltmore today.

When George Vanderbilt had originally consulted Olmsted about Biltmore, he asked if he had done anything “very foolish” in buying the land.<sup>22</sup> Evidently Olmsted was not entirely convinced that he had not, since he confided to Hunt that the local scenery was “not attractive” and that the soil was “extremely poor and intractable.” “There is not a single circumstance that can be turned to account,” he wrote.<sup>23</sup>



7. *The Esplanade seen from inside the main entrance to Biltmore House.*



8. *The west facade and retaining wall of Biltmore House in August, 1895.*

He went on to point out that the drive from the gates of the proposed esplanade to the front of the house was exposed to the winter winds whipping down the valley from the north and that therefore it would be a place of “very bleak character, far from welcoming the guests coming from the north with anticipations of a milder climate and Southern hospitality.” As a corrective, he suggested building as a windbreak a range of offices and stables with walled courts from the north end of the house. In addition, he noted that although the winds were often “frightful” and the temperature at times “lower than at Washington—or even, I believe, New York,” the air was often pleasant to be in when taking even moderate exercise, if only one could get out of the wind. This would suggest, Olmsted said, “more terrace work, closely associated with the house than your plan yet provides.”

Specifically, Olmsted recommended a terrace built out to the south of the house and overlooking the view towards the river and the mountains. For protection from the wind “even during a northwester and in the depth of winter,” he also recommended an area to the southeast of the house, considerably lower than either it or the esplanade or the terrace, and shielded by all of them. This is known as the Ramble or Shrub Garden.

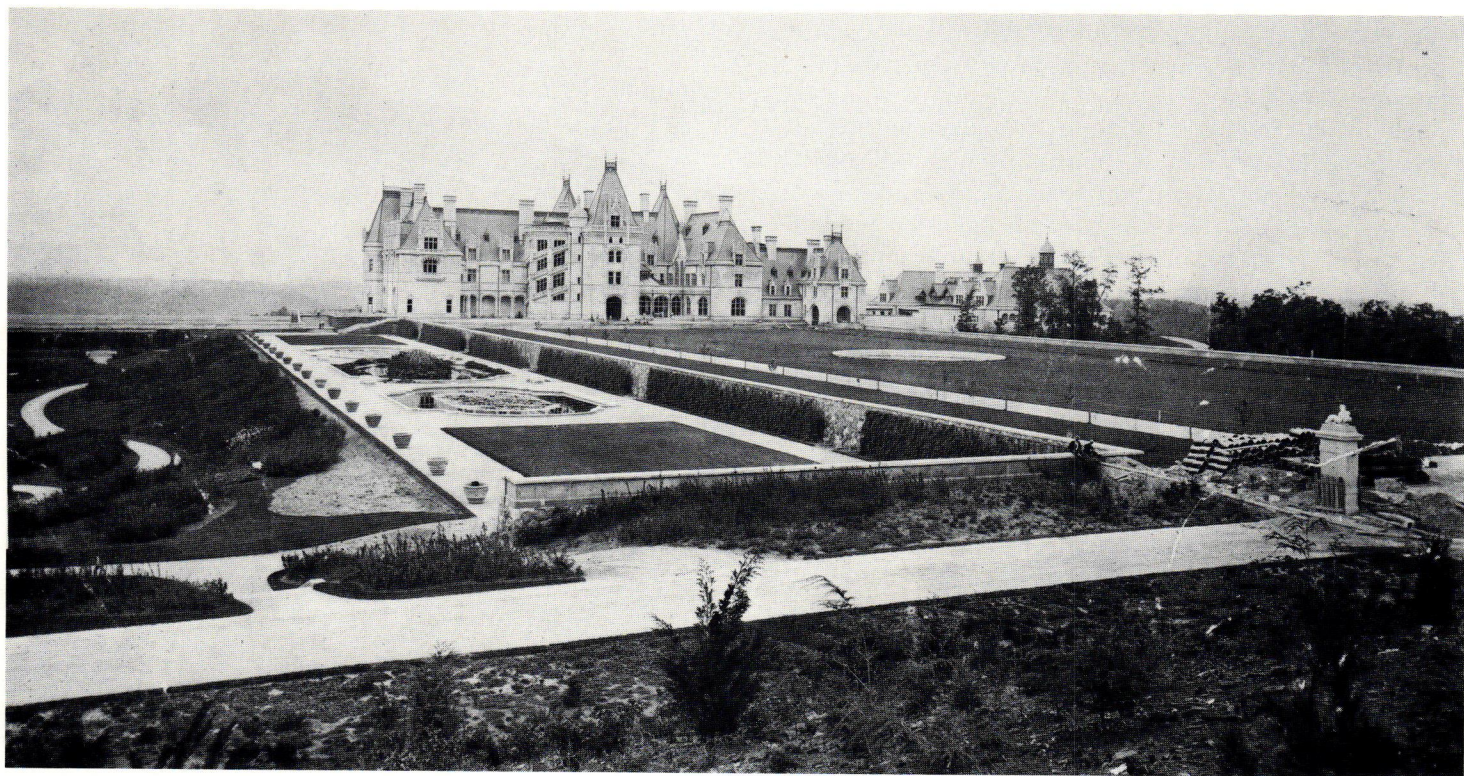
Olmsted’s consideration for climate and its relation to the siting of a building are, of course, very modern, or, if you prefer, veritably ancient. But it is more than just that. Like his care for the “purling sound” and the “foam and sparkle” of the water beneath his newly created waterfall, and like his attention to the sequential variety of effects achieved by the layout of the approach road, his concern for climate is an element in a generous and humane palette. It is thus tempting to think that Olmsted modified Hunt’s original designs for Biltmore House and breathed life into their formal urbanities by the careful consideration of what it would actually be like to experience them in their whole environment.

In 1894, when the house was nearly finished, a little dispute

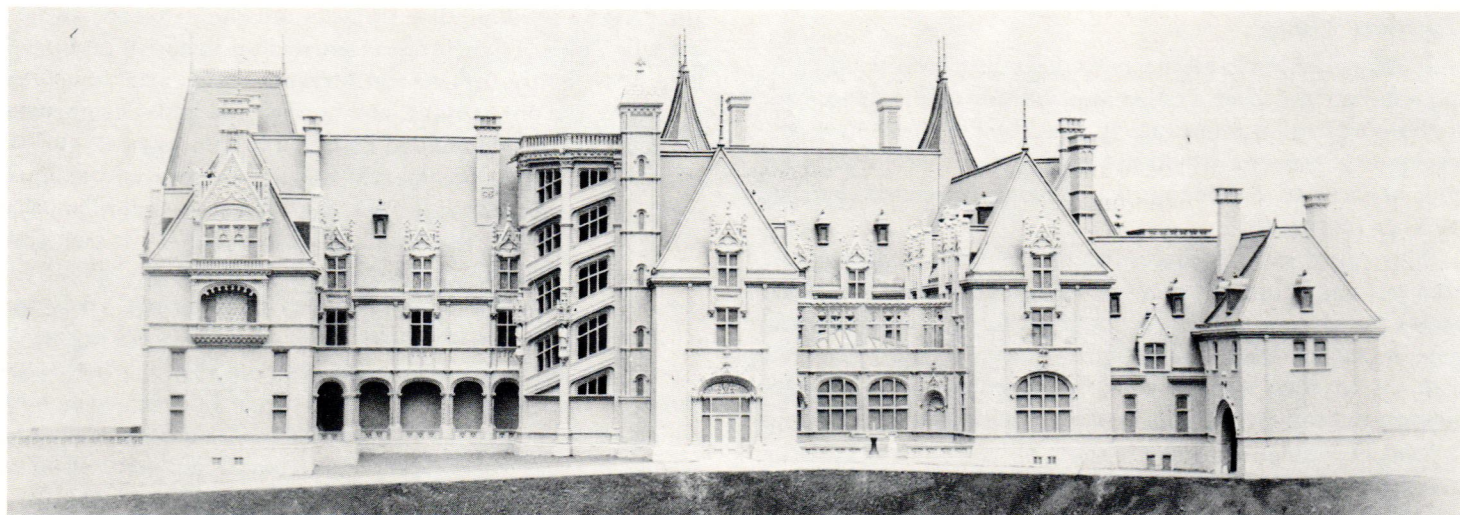
broke out between Olmsted and Hunt over whether or not to build a pergola at an extreme corner of the terrace to the south of the house—something recommended by Olmsted, opposed by Hunt, but finally built in a somewhat lackluster form. Olmsted wanted “an emphatic structure,” though its precise function was completely unimportant to him. He wrote that it could be “called a tea-room, or a tourelle, or a columbarium or a bastion,” but the real reason for putting it there, he pointed out, was simply that it would give “a reason for being at the further corner of the south terrace.”<sup>24</sup>

In the landscape immediately around Biltmore House there are many such invitations to move from one place to another, whether the movement be actually physical or only in the imagination. At the eastern end of the esplanade, the *rampe douce* beckons us up onto the lawn above. Laterally to the south, the grounds step down in three tiers from the esplanade to what is known as the Italian Garden, then to the Ramble, and finally to a walled garden and the greenhouses. The most spectacular progression, of course, is from the formal landscape on the east side of the house to the vast and wild vistas to the distant west.

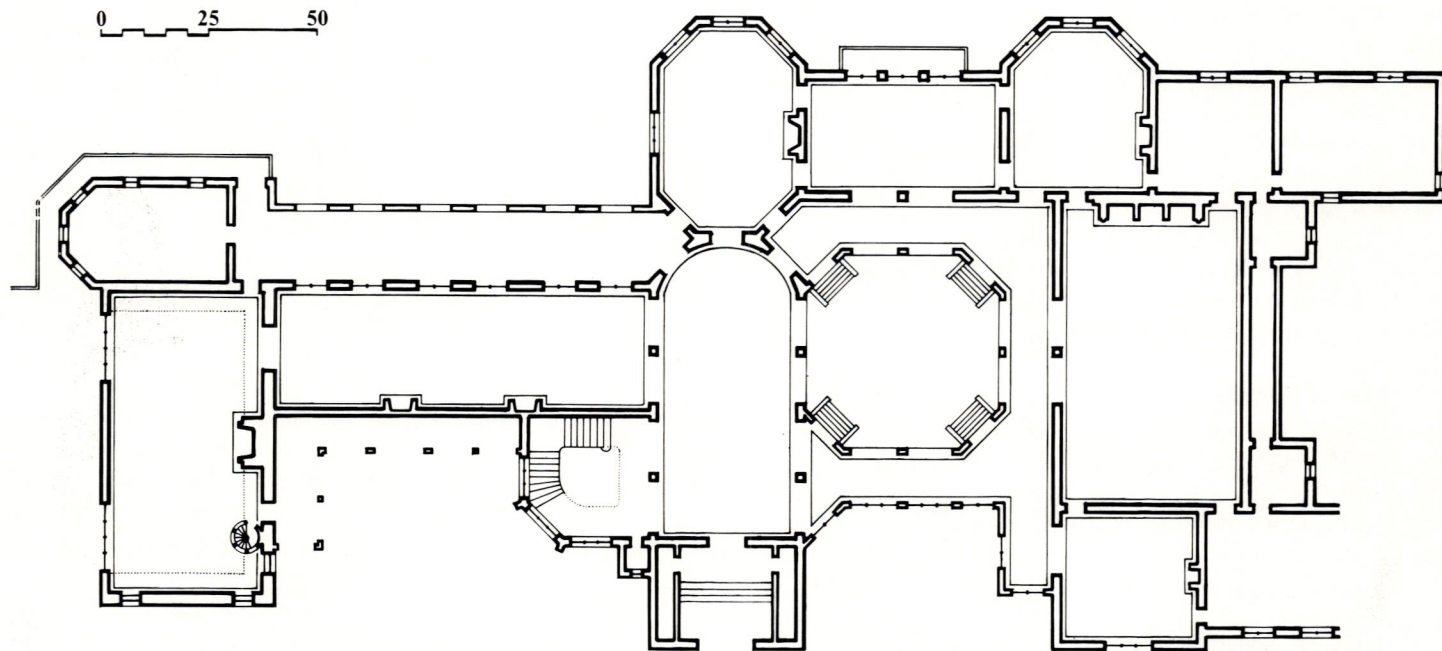
These views are really the climax of the long sequence that began some three miles back at the very gatehouse to the estate. Not surprisingly, they can be seen to great effect from inside the house, for after approaching the house across the level, formal esplanade and through its grand eastern facade and entrance hall, the views from the rooms facing west are of a space which falls away abruptly beyond the sheer retaining walls of the château, down the slopes to the river, and then to the Blue Ridge itself. They are equally dramatically revealed however, on the outside from a flight of steps that rise to a terrace immediately to the south of the building. From the lower steps, we can see only more steps. But as we go farther up we begin just to see the horizon and the intervening mountain tops, and as we go farther still the mountains themselves appear. At last, from the terrace itself, the whole valley is spread out below.



9. The east facade of Biltmore House in August, 1895; in the foreground are, from right to left, the Esplanade, the Italian Garden, and the Ramble.



10. An early study model by the office of Richard Morris Hunt for the east facade of Biltmore House; the central pavilion here has not yet achieved a height sufficient to control the rest of the composition.



11. Schematic plan of the main floor of Biltmore House.

## Biltmore House

If Richard Morris Hunt, as we have just been tempted to suggest, had only been a rather academic formalist whose work at Biltmore had been fortunately saved by Olmsted's lively interventions, then we would not at all have expected what we now in fact see: a building that is tense, animated, and altogether remarkable.

This raises several interesting puzzles. In the first place, Olmsted and Hunt, in spite of the fact that they were very nearly the same age, stood in the 1890s for two very different generations in American design, Olmsted being associated with the by then somewhat old-fashioned, picturesque mid-nineteenth century tradition associated with men like Andrew Jackson Downing and Calvert Vaux, his collaborator on Central Park in 1858. Hunt, by contrast, was associated with the new Beaux-Arts classicism that was exemplified by the World's Columbian Exposition of 1893—which he helped design—even though he had throughout his career designed buildings in a variety of other styles as well.

In the second place, almost all of Olmsted's work is of a remarkably consistent quality, while Hunt's, in spite of his very distinguished professional reputation, is artistically quite uneven.<sup>25</sup> Biltmore is Hunt's best house, and is a very good house by any standard; and it is not in the classical style. Thus it is a deviation from the manner of his later career, although it arguably represents Hunt's zenith as a designer.

How did he do it? A good client and a superb collaborator, both of which he had, may provide clues. But for the present the full explanation seems locked up in history.<sup>26</sup>

Style was an important issue both for Hunt and for his client George Vanderbilt, both of whom were ardent Francophiles. It has been said that the models for Biltmore House were French châteaux in general and those of Blois and Fontainebleau in particular. More accurately, the *image* which Hunt applied to the building recalls these. Even at first glance we can tell that Biltmore is not a French château. Its windows, with their large panes of glass and black wooden frames, are clearly of their own time and not some other, and, in spite of the elaborately articulated decoration in sharp Indiana limestone, the roof and walls look particularly planar and tight. Thus, though the recalled image is French, the result certainly is not.

Biltmore was designed in what was known as the French Renaissance style, something Hunt had often displayed a preference for during his career. It had also been the favorite idiom of Hector Lefuel, his atelier master at the *Ecole des Beaux-Arts* in Paris and his first employer. This style, which was revived at Lefuel's Louvre and later at Biltmore, was very different from its sixteenth-century original. It was a romantic perception of the culture of a brief epoch, and thus it was a vision not unlike those of Ruskin's Venice or Pugin's medieval England. Moreover, the thing being envisioned was itself a hybrid, the culture of gothic France discovering the reborn classicism of Italy. The French Renaissance style could therefore become for Hunt and Vanderbilt an artistic ideal with obvious parallels to America in their own lifetimes—robust, yeasty, and rich; proud of itself, but also sufficiently insecure to yearn for the support of classicizing, ordering refinements from abroad.

The east facade of Biltmore House is an extraordinary composition of disparate parts held together in the barest cohesion. At once Renaissance and Gothic in style, classical and romantic in mood, it is a collection of rather sharp geometric forms brought together in the mere semblance of symmetry and embellished with natural, botanical motifs. At its center is a

three-story pavilion that projects outwards toward the esplanade. This is the entrance; pressed up against it on the left side is a slightly bizarre and literally cranky stair tower, inspired by the one at Blois, and on the right and set somewhat further back is an enclosed court with an octagonal, sloped-glass roof. Further behind still, the main masses of the house spread out to the left and right, but with eaves and ridges that are at slightly different heights from each other. At each end, a two-story pavilion pushes forward, and from behind the tops of these pavilions, odd-shaped fragments of roofs and gable ends peer out. Windows, doors, and bays are organized around locally coherent symmetries, and the long horizontal thrust of the composition is contradicted by steep roofs with chimneys and spires that sprout upward like gigantic young plants. It is easy to imagine that it took Hunt some effort to achieve all of this, and indeed a surviving study model shows a much less successful earlier version, where the central pavilion has not yet reached a height sufficient to hold the rest of the elements in control.

Directly inside the main entrance to the house is a large, low, and rather gloomy hall. To the right of this and opening from it is the palm court whose glass roof we have seen from outside. Around this is an arcade and, beyond that, a string of rooms separated only by open archways that can, when necessary, be closed off by enormous glass doors: a billiards room, a drawing room, a family dining room, and, on the side opposite the entrance to the palm court, a banqueting hall of vast proportions.

Directly to the left of the main entrance is the staircase copied from Blois, which spirals upwards to the top of the house around a shaft of space. Just past the stair a horizontal equivalent of the stair space opens straight from the entrance hall: a long gallery that faces the valley and the mountains, and that leads to a library at the south end of the house. The library in turn opens onto an arbored porch and then into the terrace beyond, which used to contain a bowling green and now contains a swimming pool.

The plan of Biltmore is very unusual and apparently without clear precedent in the rest of Hunt's work or elsewhere. The spatial variety of the public rooms on the main floor, and the fact that they almost merge into each other, lets the house appear as big as it really is, or even bigger, as the eye catches diagonal vistas hither and yon, across and upwards. The library and the banqueting hall are rendered at enormous scale. On the other hand, the smaller rooms like the family dining room are very much smaller indeed, and are sensitively arranged for human comfort. It is always, incidentally, the small rooms, not the grand ones, that are placed to take the greatest advantage of the view. The assembly of all the rooms, then, produces a curious effect; Biltmore is a house as well as a monstrous palace. The smaller, more intimate rooms seem truly small and intimate, and the large rooms seem, as indeed they are, almost unbelievably large.

At once ordered and fragmented, an architectural thing as well as a sequence of experiences, Biltmore House contains in itself the same juxtaposition of urbane and rustic themes that we had earlier noticed in the esplanade and the approach road. Is it a whole thing or a collection of separate parts? Are we meant to perceive it as a clear entity, or as a sequence of phenomena?

These thematic questions are specifically reduced to a moving, awesome contrast between geometrical and botanical forms in one particular part of the inside of the house. This is the stair tower by the main entrance, the great vertical shaft of



12. The entrance hall at Biltmore House seen from the stair hall; the palm court is in the background.

13. The palm court at Biltmore House.

14. The banqueting hall at Biltmore House.

15. The staircase at Biltmore House from the second-floor landing.

space that rises from the ground floor to the roof of the house.<sup>27</sup> The space, bounded by the finely hewn stone of the staircase, is urbanity itself, almost a pure octagon. Dangling down through the center of the octagon in three tiers, however, is a strangely and delicately wrought gothic chandelier. And at the inside edge of the stairs stands an almost continuous handrail, made of a robust profusion of vines and leaves that tumble and weave their way upwards, ensnaring pure space with threatening emblems of tumultuous nature.

### *A Vast Parenthetical Carolinian Demonstration*

Visitors to Biltmore today leave by a road that goes down into the valley and runs along the edge of the French Broad River. This allows us for the first time to see the house in its overall setting, and in the process to recall how very few works of architecture anywhere in the world manage to look really large in a large landscape. Buildings that we remember for their great size are usually in towns and cities, and thus when we see them we measure their vastness relative to other man-made things and, since we usually see them from rather close up, relative to our own size.

Those few buildings that really do seem sizeable in the face of nature itself are almost always of an emphatic and clear form. They achieve significance as much by the purity and simplicity of their ideas as by their actual physical dimensions. Biltmore House, seen from the river valley below and against the great horizons of the Blue Ridge Mountains, is not one of these. Jagged, fragmented, and almost dream-like in quality, it makes a notable mark on the landscape, but far from dominating, it barely even stands in balance with it.

This final view of Biltmore—of the whole house standing in its whole landscape—therefore recalls and virtually summarizes all of the thematic contrasts we have earlier noticed on our tour: the formal esplanade and the mysterious forest of the approach road, the appearance of symmetry and the warring asymmetries of the east facade, the great separate rooms of the interior that nonetheless seem to shift and slide into a continuum of space, and the staircase with its garlands of vines and leaves. At the beginning of our tour, we promised that we would see Biltmore as a place that is muted, solemn, and ambiguous. In formal and symbolic terms, the ambiguities are precisely these: the pure, the ordered, and the urbane almost perilously juxtaposed with the mysterious, the limitless, and the rustic.

In human, and more specifically in social—as opposed to formal and symbolic—terms, though, what could all of these contrasts possibly mean? Henry James, the most perceptive critic by far ever to write about Biltmore House, pondered this question in his own way in a not very well known passage in *The American Scene*,<sup>28</sup> a book that he wrote after a visit to the United States in 1904 and 1905. James was then in his early sixties, and he had not returned to his homeland in twenty years. Thus the book focuses mainly on what he saw as the startling changes that had occurred here during this period.

James notes that he had travelled to Asheville by train over “crazy timber viaducts” that crossed deep gorges and “nameless and more or less torrential streams.” From the window of his car he was moved by “the sense of landscape in more quantity,” and he was also able to observe the social scene, “shabby and sordid,” as the train pulled into and out of small stations along the way. “My view of the melancholy of it has been conveniently expressed, hour to hour,” he wrote, “by the fond re-

flection, through the dreary land, that nobody cared—cared really for *it* or for anything. That fairly *made* it dreary.”

For James Biltmore was, in the first place, different from that. He described his stay at the house as “one of the most positive passages of one’s life.” The building was “a castle of enchantment” and the estate its suitably large frame—“vast brackets, applied, as it were, to the very face of nature.” But James emphasized as well that the sheer size of Biltmore had little to do with its essential effect. “The extent and splendor of such a place was but a detail; these things were accidents, without which the great effect, the element that, in the beautiful empty air, made all the difference would still have prevailed.”

What, he asks, was this element that made all the difference? “Large wealth,” he admits, was a part it, but to this he adds a list of things more crucial still: “an idea, a fine cluster of ideas, a will, a purpose, a patience,” and above all “an intelligence.” “What it thus came to, on behalf of this vast parenthetical Carolinian demonstration, was that somebody had *cared* enough—and that happily there had been somebody *to care*.”

But, as we can confirm by standing in the valley and looking back at the house in splendid isolation against the landscape, all of this caring was still parenthetical. James saw the optimistic, materialistic passion for ordering and building as peculiarly American—conductive, as he puts it, to “the particular interest and, one often feels tempted to add, the peculiar irritation of the country.” Biltmore is an example of such passion, and, as the opinions written down about it collectively show, it is simultaneously interesting and irritating. It is also a spectacular example of the ultimate futility of the human passion to order things, however vast, in the face of a tumultuous nature that is more vast still.

James compares Biltmore to a lot of stock bought on margin. Large though the initial investment may have been, the margin between it and total ownership, total control, is much larger:

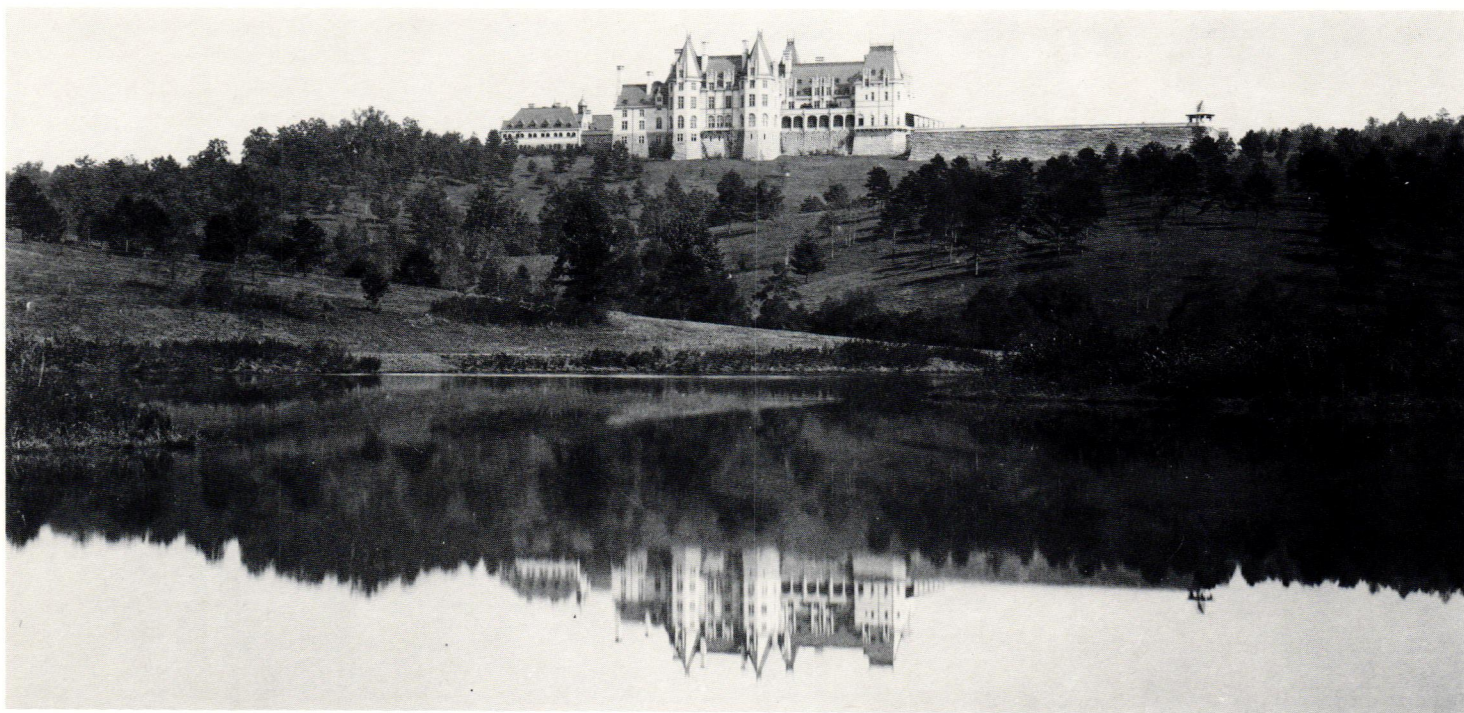
*The sense of the size of the Margin, that was the name of it—the Margin by which the total of American life, huge as it already appears, is still so surrounded as to represent, for the mind’s eye on a general view, but a scant flotilla huddled as for very fear of the fathomless depth of water, the too formidable future, on the so much vaster lake of the materially possible.*

What is actually in the future, and what is still materially possible, may be a vision of greater good, but it also may be, James warns, a “possible greater evil.”

Biltmore has often been ridiculed as an example of the foolish expense of human resources. What is poignant about James’s appreciation of it is that he sees the expense not as foolish but as loving, patient, skillful, and intelligent—and in the end still terrifyingly inadequate as a sign that human resources of any sort can finally create order in the world. What is most remarkable about Biltmore itself, and of all the things learned from our tour the one most certainly worth taking away with us, is that these somber ambiguities are not simply the result of our cultural perspectives, but lie embedded in the very structures and symbols of the architecture and the landscape.

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(16) The west facade of Biltmore House in about 1895.

## Notes

1. The 1893 Baedeker catalogues at some length the healthful properties of the climate around Asheville; see *The United States: A Handbook for Travellers, 1893*, edited by Karl Baedeker, introduction by H. S. Commager (New York, Da Capo Press, 1971), p. 344. Olmsted also described it as a "summer and winter pleasure resort" considered to be "the healthiest on the continent" and therefore suitable for George Vanderbilt and his mother, "both being a little delicate;" see Olmsted to James Gall, October 30, 1888 (MS, Library of Congress), quoted in Edward F. Turberg, "Frederick Law Olmsted at Biltmore" (thesis, University of Virginia, 1973), p. 4. Nevertheless the choice of Asheville as a site still seems somewhat odd, since although the summers there are mild the winters can be very cold and the winds, as Olmsted noted, "frightful." It was during the winter and spring that Vanderbilt intended to use Biltmore; see Olmsted to Richard Morris Hunt, March 2, 1889 (MS, Library of Congress), quoted in Turberg, pp. 53–54.

2. Various room counts have been made. This one is from Paul R. Baker, *Richard Morris Hunt* (Cambridge, MIT Press, 1980), p. 421.

3. At least the grounds were open to the public on Wednesdays and Saturdays by 1895; see Turberg, p. 44.

4. Montgomery Schuyler, "The Works of the Late Richard Morris Hunt," *Architectural Record* 5, no. 2 (December 1895): pp. 98–180; reprinted without photographs in *American Architecture and Other Writings by Montgomery Schuyler*, edited by W. H. Jordy and R. Coe (Cambridge, Harvard University Press, 1961). Barr Ferree, "Richard Morris Hunt: His Art and Work," *Architecture and Building* 23 (7 December 1895): p. 275.

5. For instance, Vincent Scully, "American Houses: Thomas Jefferson to Frank Lloyd Wright," *The Rise of an American Architecture*, edited by Edgar Kaufmann (New York, 1970), Metropolitan Museum of Art, p. 186. Also Wayne Andrews, *Architecture, Ambition, and Americans* (New York, The Free Press, 1964).

6. For instance, "Asheville and Vicinity: Where the Snow-Birds Nest" (Asheville, Press of the Citizen Co., 1898), p. 31, quoted in Turberg, p. 45; "Biltmore House & Gardens" (Asheville, The Biltmore Company, 1965).

7. For instance, Henry Lionel Williams and Ottalie K. Williams, *Great Houses of America* (New York, G. P. Putnam's Sons, 1969), pp. 173–83.

8. Laura Wood Roper, *FLO: A Biography of Frederick Law Olmsted* (Baltimore, Johns Hopkins University Press, 1973). Paul R. Baker, *Richard Morris Hunt* (Cambridge, MIT Press, 1980). Turberg, "Frederick Law Olmsted at Biltmore" (thesis, University of Virginia, 1973). Susanne Brendel-Pandich, "Biltmore in Asheville, North Carolina," *Magazine Antiques* (April, 1980): pp. 855–67.

9. Julius Gy. Fabos and others, *Frederick Law Olmsted, Sr.: Founder of Landscape Architecture in America* (Amherst, University of Massachusetts Press, 1968), p. 89.

10. Facts about the history of Biltmore are taken from Baker and Turberg; there are, however, several discrepancies between these two sources, resolved whenever possible on the basis of internal evidence.

11. Letter from James to Edmund Gosse (MS, Library of Congress), quoted in Henry James, *The American Scene*, edited by Leon Edel (Bloomington, 1968), p. 478.

12. According, with good evidence, to Turberg, p. 9. See note 23. Baker seems to imply that Olmsted had visited the site earlier.

13. Roper, p. 417.

14. Turberg, pp. 15–16.

15. Letter from Olmsted to James Gall, 8 February 1890 (MS, Library of Congress), quoted in Turberg, p. 14.

16. Turberg, p. 27.

17. Letter from Olmsted to Charles McNamee, 29 July 1891 (MS, Library of Congress), quoted in Turberg, p. 20.

18. Elizabeth Wheeler Manwaring, *Italian Landscape in Eighteenth Century England* (New York, Russell & Russell, 1965).

19. Quoted in Turberg, p. 15.

20. Letter from Olmsted to George W. Vanderbilt, 12 July 1889 (MS, Library of Congress), quoted in Roper, p. 417.

21. In his letter of 1889 to Hunt, commenting on Hunt's design, Olmsted seems to imply that at least the idea for the esplanade and the stretch of lawn above the *ramp douce* already existed; letter from Olmsted to Richard Morris Hunt, 2 March 1889 (MS, Library of Congress), quoted in Turberg, pp. 53–57. However, Roper, p. 457, attributes the design to Olmsted.

22. Quoted in Roper, p. 415.

23. These and the following quotations about the site are from a letter from Olmsted to Richard Morris Hunt, 2 March 1889 (MS, Library of Congress), quoted in Turberg, pp. 53–57. Turberg, p. 9, says that Olmsted did not visit the site until October 1889 and therefore his opinions in this letter must have been based on second-hand information. This is rather remarkable since Olmsted's opinions are so emphatic.

24. Letter from Olmsted to John Charles Olmsted, 25 February 1894 (MS, Library of Congress), quoted in Turberg, p. 39.

25. The question of the unevenness of Hunt's work is raised by Richard Guy Wilson in a review of Paul R. Baker, *Richard Morris Hunt*, in *Nineteenth Century* 6, no. 4 (Winter 1980): pp. 62–63.

26. Montgomery Schuyler in "The Works of the Late Richard Morris Hunt," *Architectural Record* 5, no. 2 (December 1895): pp. 98–180; suggested that Hunt was by nature an English romantic and only by training a French classicist; perhaps his final collaboration with Olmsted at Biltmore helped bring out his native persuasion. In any case, and in spite of Paul R. Baker's admirable biography, there is still a very great deal to be learned about Hunt's various stylistic and formal practices, their origin, and their influence on the overall development of American architecture.

27. We are grateful to our friend Kent Bloomer at the Yale School of Architecture for alerting us to the meanings of geometrical and botanical themes at Biltmore.

28. Henry James, *The American Scene*, edited by Leon Edel (Bloomington, University of Illinois Press, 1968), pp. 395–402. Edel, p. 480, notes that James's visit to Biltmore took place on 4–9 February 1905. One reason this passage is not better known may be that out of courtesy to his host, James does not mention Biltmore by name in the text. Another reason is certainly that the prose is extremely complex, even in comparison to James's other late writings, and at times is almost incomprehensible. The tone of the passage is much friendlier than that of his better-known description of Biltmore in a letter to a friend. Here the house was "a thing of the high Rothschild manner," and his bedroom was "a glacial fantasy" placed about a half mile from the "mile-long library." The place, he concluded, was a "phenomenon of brute achievement." Letter from James to Edmund Gosse (MS, Library of Congress) quoted in Baker, p. 431. See also note 11.

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