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Florian Sauter

PAINTING THE SKY BLACK

LOUIS KAHN AND THE ARCHITECTONIZATION OF NATURE

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Managing Editor: Steve Pantazis

Language Editor: Marion Endt-Jones

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For Joachim
1961-1971

Fig. I: Louis I. Kahn in his Office, c. 1958.

Abbreviations

AEKC : August E. Komendant Collection
AGTC : Anne Griswold Tyng Collection
ENBC : Edmund Norwood Bacon Collection
GEPC : George Erwin Patton Collection
ILMC : Ian Lennox McHarg Collection
LHC : Lawrence Halprin Collection
LIKC : Louis Isidore Kahn Collection
PSC : Peter Shepheard Collection
RLRC : Robert Le Ricolais Collection
RSWC : Richard Saul Wurman Collection
SAKC : Sue Ann Kahn Collection
VSBC : Venturi Scott Brown Collection

All abbreviations refer to documents in the Architectural Archives of the University of Pennsylvania

The universal relates only to the physical, whereas the eternal relates to everything which concerns man. This to my mind gives a marked predominance to the universal and it also defines order. Order envelopes all natural laws, and not only those few that we have today; these laws will be revealed one day and their discovery will change existing physical laws (as happened when relativity was defined); the same will happen with all measurable things that we are able to investigate. No-one can explore eternity.

Louis I. Kahn, Lecture in Paris, 1974

Introduction: Architecture Is Not a Horse

This book was motivated not so much by what I knew about the architecture of Louis Isadore Kahn, but rather by the many questions it raised. Veiled in an intriguing obscurity, the American architect's œuvre seemed replete with paradoxes both in its theory and practice, while its spatial richness was difficult to grasp. Moreover, Kahn's strange life story demanded answers: how was it possible that one Leiser-Itze Schmuilowksy – a Jew born in Estonia in 1901, who immigrated to the United States at five years of age and was raised, at least from a material perspective, in poverty, but who showed an early artistic talent and fascination for architecture – could realize his first mature project at the unusually late age of 50, and then, within the next two decades, as the result of an exceedingly productive period, flourish into a living paragon and one of the first globally active architects of the 20th century? From an educational perspective, how did he, considered by some the last "heroic architect" and "master," as a teacher inspire a whole generation of laudable architects? What did one of these successors, Charles Moore, mean when he remarked that Kahn in a "kind of rabbinical sense […] was the grand bearer of a sacred architectural message […]"?[1] In terms of his buildings, what were the principles he employed to make his architecture endure as a Stoic point of order within the apparently unstoppable flux of daily life? What were his reasons for poetically employing wind, light, water and earth to manifest an elemental architectural reality that increasingly seems lost in the virtual realms of digital technology? How could he be original in both the sense of going back to historical sources and of transcending these to invent something new?

More questions like these could be added, and the few answers I present here only make evident that Kahn purposefully resisted the temptation to make everything explainable. Insistently, a certain mystery prevailed in his works, an inscrutable aura causing astonishment and wonder. Consequently, Kahn's architecture in many ways defies categorical classification, since it possesses manifold dimensions transgressing geographical, historical, and cultural barriers. Essentially, this concealment – and at the same time, this candor – offers a plurality of possible readings and interpretations. One, namely the argument that not only the past, but also nature inspired his creations occupies the center here. Returning to *beginnings* in both architectural and natural terms, I interpret Kahn's buildings as the result of a general pursuit to comprehend the lawfulness of the natural world; I scrutinize his endeavor to put spatial compositions into an analogy with organisms' principles of growth and form; I illustrate his engagement with the elements and environmental forces to empower the inert materials of his structures and *vice versa* to unveil the world through the

1 From unpublished notes for the publication of Richard Saul Wurman, (ed.), *What Will Be Has Always Been: The Words of Louis I. Kahn* (New York: Rizzoli, 1986); Cf. 288.I.106, RSWC.

architectonization of nature; furthermore I exemplify Kahn's increasing willingness to make the surrounding landscape and cosmos an integrated part of the architectural project. On a more theoretical level, I reflect on Kahn's ambiguous attitude with regard to man's position within and beyond nature.

Naturally, the use of nature as an interpretative instrument does not limit the possible interrogations. *Nature*, a term of very uncertain extent, encompasses a polyphony of meanings ranging from the atomic to the cosmic, the scientific to the spiritual, the formal to the conceptual. It is from this uncertainty – this tendency to change like water – that nature derives its peculiar appeal, which, since time immemorial, has inspired the most adventurous attempts to gain fresh insights into its workings. Because this dialogue between man and the universe is boundless, the aspects of nature presented here might rather be considered *particles*, since every gaze at the stars and each stroll through the fields only reveals the fragmentary character of the knowledge presented here. By implication, it also goes without saying that an investigation like this can in no way be exhaustive and is necessarily selective. At the same time, though, no unifying theory concerning the relationship of Kahn's architecture with nature has yet been written. This is not surprising in light of the abstract naturalism of Kahn's built œuvre, which only at second glance reveals itself as more empathic. However, it is quite astonishing considering the architect's extensive use of the term "nature" and related metaphors in his theory.

Because of the frequent application of natural terminologies and allusions, practically every scholar tackling Kahn has unavoidably also targeted my central topic – a particularly strong focus has been placed on the relationship of Kahn's architecture with natural light, his humanist understanding of geometry and nature, and more recently the "grounding" of his works in the land. Incorporating and extending these studies, however, my analysis is more inclusive and unitary. The research is based to a large degree on a re-evaluation of Kahn's archival material at the Architectural Archives of the University of Pennsylvania, as well as that of some of his collaborators and close colleagues, including Anne Griswold Tyng, Robert Le Ricolais, August E. Komendant, Ian L. McHarg, George E. Patton, Luis Barragan, Robert Venturi and Denise Scott Brown. Additional oral information has been gained from the latter, as well as from Carlos Vallhonrat, Blanche Lemco van Ginkel, Balkrishna V. Doshi, and Harriet Pattison. Many phenomenological aspects could only be experienced in reality, and it was important, thus, to visit a vast majority of the discussed projects *in situ*.

Every attempt to generate new meanings from Kahn's buildings will ultimately not interfere with their present capacity to act as central institutions in the lives of many people. However, historical vision allows relating occurrences that in reality might not have been consciously linked, and beyond a narration of past facts and events, historical writing is unavoidably also a constructive and creative act.[2] In this sense, I deliberately tried to follow T. S. Eliot's advice that "[t]he past should be altered by the present as much as the present is directed by the past."[3] My aim, too, was not merely to present an appraisal of a great architect, but also to deduce in the light of one historic example more general, practical axioms concerning the complex juxtaposition of architecture and nature. In this regard, and based on the hypothesis that man's existential encounter with the natural cycles and elements remains quite constant over time, the present deliberations are also an appeal for an ecologically sound, down-to-earth approach, which takes into account passive strategies, the impulse of the primitive, and works *with* natural energies rather than against them. Concerning such general considerations, Vincent Scully, Kahn's first biographer, noted:

> Indeed, the relationship of manmade structures to the natural world offers [...] the richest and most valuable physical and intellectual experience that architecture can show, and it is the one that has been most neglected by Western architectural critics and historians.[4]

From a practical standpoint, human constructive activity has been in relation to nature since its beginnings, both in terms of *connection* when seeking to employ the larger environmental forces to ameliorate a building's microclimate, and *opposition* when exploiting nature's material basis. The very act of building, the setting of the foundations, supposes a connection with, but also a destruction of, the given land. Like mountains, the roof and walls help the rainwater to descend, perforations block or channel the breeze, and louvers shield or welcome the sun's rays. It is important, however, not to abuse nature semantically when setting it into relation with architecture: as much as a building might be envisioned to function like an organism, in which no element can be eliminated without making the entire system fail; as much as an edifice might, in terms of energy use, function self-sufficiently like a plant, a building is ultimately not an organic being. Animals are mobile because of their need for food, but a house rarely moves. Plants, in most cases, possess such small dimensions and great resilience in supporting their own weight that, unlike buildings, they are practically insensible to the effects of seismic force.

Yet, the main difference between a building and an organic configuration is their varied modus of animation. When animal bones break, they tend to knit together on their own, whereas the structure of a building does not mend itself after collapse. In

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2 Similarly George Kubler noted: "The historian communicates a pattern which was invisible to his subjects when they lived it, and unknown to his contemporaries before he detected it." Kubler, *The Shape of Time: Remarks on the History of Things* (New Haven: Yale University Press, 1962) p. 13.

3 T. S. Eliot, "Tradition and Individual Talent" (1919), in Eliot, *Selected Essays* (New York: Harcourt, Brace & World, 1964) p. 5.

4 Vincent Scully, *Architecture: The Natural and the Manmade* (New York: St. Martin's Press, 1991) p. xi.

other words, animals and plants are self-activated, whereas a building does not come into being by itself. A building does not grow, since it possesses no innate vital power that stimulates and controls its development. Closely linked with this differentiation is the epistemological meaning of the term *nature*, deriving from the Greek *physis*, literally "to bring forth," "produce," or "make to grow." Similarly, in Latin, the term *natura* derives from *natus* or *nasci*, again both implicating birth and origin. This focus upon an inner, organic dimension stands in clear contradiction to the more common use of *nature* today delineating a set of outer, hybrid artificial-natural environments.

All these issues will be discussed in further detail in the main part of this book, which is structured into the four sections of Optimization, Organization, Adaptation and Expression. Following a chronological order, each one addresses a different perspective of Kahn's changing comprehension of nature. In an add-up process the principles employed earlier will not be neglected later, but in a synthetic manner lead to a more holistic recognition of the term's complexity. At the outset, *Optimization* deals with Kahn's premature phase; it culminates in the discussion of the Yale Art Gallery and his proposal for a helical City Tower in Philadelphia. Reduced to a mechanism, nature, oversimplified and abstracted, appeared as an all-knowable entity. The architectural project resulted from the attempt to make its all-pervasive order and eternal striving for economy applicable in the practical realm. Kahn's idea of optimization did not imply repeating nature's superficial appearance, but rather decoding and employing its inherent laws of creation.

Organization, which centers on the design of the Trenton Bath House and ultimately coalesces in the Richards Medical Research Building, focuses upon compositional questions. Acknowledging nature's hierarchical ordinance, it reveals a shift from a universal to a more individuated space conception. No longer appear Kahn's designs as merely efficient from a structural perspective; now, they also achieve spatial optimization following the imperatives of an orthodox Functionalism and its pursuit to articulate a space's inner character. At the same time, the humanist conception of the system as a whole, where "served" and "servant" spaces were mutually interlinked, was paralleled by Kahn's interest to use geometry as a mediator between the micro- and macrocosm. Notably, this return to classical precepts was extended to the treatment of the larger environment as well, while theoretically the perception of nature as a mere instrument collided with its appreciation as a conscious living thing.

Adaptation, targeting issues of contextual and environmental integration, pays tribute to the formative design agencies effective from without. As form changes with changing conditions, Kahn's buildings as a geological and climatic reality began in the early 1960s to merge more intimately with the given constraints. Analyzing the crucial development of the *second wall*, the chapter pinnacles in the discussion of the Salk Institute, where Kahn paradigmatically manifested architecture's power to bring nature to presence. Besides, this chapter helps situate Kahn's development in a larger historical context without diminishing his ability to formulate a highly personal idiom of spatial articulation. While the period saw the decline of Modernism and the search for alternatives by the members of Team X, it was also a time of growing ecological awareness. For many it became evident that mankind's power to change the face of the earth had increased faster than its understanding of the manipulations' profound effects.

Expression, following and further developing the directives of *Adaptation*, deals in many ways with that which nature is not: it targets the particular human capacity to make architecture with all its implied meanings and metaphors plumb the unfathomable depths of the mind. Most vividly expressed in the design of the National Assembly in Dhaka and the Hurva Synagogue in Jerusalem, this chapter illustrates Kahn's ambition to create buildings that were more than a sole fulfillment of utilitarian needs but relevant to people on a collectively-unconscious level. Attempting to stir the emotions, Kahn did not seek self-expression, however, but abrogated his own preferences by following the natural flow of things to express a sense of in-commonness. In that vein, lastly also Kahn's enigmatic comprehension of "light" as "the source of all being" in contrast to "silence" is being examined.

Transferring from theme to thesis, I argue that nature was an essential counterpart to Kahn's work, which, reciprocally involved with the built structure, activated the latter, while it was also itself in this process of domestication raised to a higher level of consciousness in man's perception through it. Offering a kind of Rosetta stone to decipher Kahn's philosophical statements, this focus upon nature shows that his comments were not the expressions of a romantic mystic, but often paraphrased contemporary scientific thought. Bridging the opposition between confronting and participating in nature, Kahn sought to logically integrate nature's laws of creation while believing in a holistic interconnectedness of all life. At the same time, however, he acknowledged that only mankind, endowed with the faculty of choice and judgment, could appreciate the beauty of a flower or gleaming sunset. In sum, Kahn's architectonization of nature did not invent, but rather transform reality through the establishment of carefully calibrated spatial frames that staged the cosmic spectacle we witness every day.

Paris, 2017

Acknowledgments

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1 Doing More With Less.
Towards An Architecture Of Optimization

With the airdrop of the atomic bomb over Hiroshima on Monday, August 6, 1945, a new era in human history began. Almost to the date six years earlier, Albert Einstein had warned the American president Franklin D. Roosevelt of the dramatic consequences the newly gained knowledge of nuclear fission might have. Regardless of all the pacifist efforts, the atomic bomb detonated and caused unprecedented devastation in Japan. On all frontiers, the Second World War had escalated into a war of scientists against scientists, which also raised questions of man's relationship with nature, and more precisely, of whether the implementation of science through technology led to actual progress. Mankind, meditating upon its immense and destabilizing powers, gradually came to realize that it was carrying in its hands the seeds of its own welfare, but also its own destruction.

Kahn's architecture of the pre- and early post-war era was strongly influenced by the scientific credo of *optimization*, in which the machine based on the lawfulness of nature acted as a model for an efficient architecture. Historically, it was Babylonian astronomy that introduced the concept of universal order in the cosmos. Yet, the human relation to natural phenomena still took on the form of mythopoeic accounts instead of sober analysis, so that every sun- or moonrise had additional spiritual significance. As a logical consequence, the sacred was understood in both the primitive ages and the first higher civilizations as being *immanent* in nature, and only the advent of the first monotheistic religions in the Near and Middle East would establish a *transcendent* order. As Ernst Cassirer pointed out, nature was, henceforth, no longer "the great and benign mother, the divine lap from which all life originates," but rather "conceived as the sphere of law and lawfulness."[5]

At this point, the workings of the universe as an expression of the immanent reason or *logos*, as implemented either by a theological God or a Socratic *Good*, lay open to human decipherment. Unbiased by mythological speculation, man commenced to break through the imaginary boundaries of the celestial spheres and penetrate into the deeper rhythms of nature. The Western *uomo universale* found its antecedent in the figure of the *hakeem*, the polymath of the Islamic Renaissance, as both emphasized the cohesion of the sciences. With the crusades in the late 11th century, the wealth of Oriental knowledge came to the Occident through the intermediate agency of the monasteries, cathedral schools and universities. Scholasticism acted thereby as a vehicle and modifier of Christianity, yet, unlike the latter, which asked to silence the inner voice of analytical reason, it suggested God to reveal himself through nature; all to the point that mathematical knowledge became synonymous with faith.

5 Ernst Cassirer, *An Essay on Man* (New Haven: Yale University Press, 1944) p. 100.

The medieval era also witnessed the invention of the weight-driven mechanical clock; an instrument that Lewis Mumford regarded as "the key-machine of the modern industrial age."[6] His reasons were quite evident: compared with the sundial, which was apt to be disturbed by clouds, and the water-clock that could freeze, the measurement of time by an artificial agent strongly encouraged the belief in an independent order – the peculiarly abstract sphere of science: factual, precise and accurate. Besides, in agriculture the improvement of plows enhanced man's power to *conquer the earth*. Technology, thus, served as a link between nature and man: it translated theoretical advancements into practical results and promoted a mental constitution of *mastery over nature*.

Based on the Renaissance's development of perspective and its first attempts in descriptive geometry, the mathematization of space also set in. Transcending the two-dimensionality of Euclidean geometry, now space as a hierarchy of allegorical values was superseded by space as an infinite system of points with absolute coordinates. In direct relation with this abstract delineation of space stood the development of better lenses, which led around 1600 to the invention of the telescope and the consequent de-stabilizing realization that not the earth including man, but the sun stood at the center of the universe. The Age of Reason witnessed, too, the final disruption of the idea of the world being a perfectly functioning machine, and the simultaneous re-conceptualization of God as its mechanic. In the new cosmology the inert universe made up of dead matter acted selflessly like an automaton – the utter technological promise as exemplified by Jacques de Vaucanson's *Canard digérateur* of 1739 (Figure 1). In short, mechanics became the new religion, and the machine emerged as its messiah.

Consequently, nature was defined as a sequence of deterministic events – an essentially trivial affair, completely predictable in its orderly behavior. The mathematical agencies of number and geometry resolved and substituted the apparent complexity of the world with general prototypes and the harmony of an underlying regime. Truth became transparent, but only in as much as it avoided the irregularities of lived experience, which were thought to be resolved in larger systems of regulation. Arguably, nature's striving for optimization enabled the first scientists to derive the laws of its workings, while somewhat in a reverse process, the aspiration to produce similar forms of organization informed technological production, or the creation of a *second* nature through man's dictate. In this vein, laying the corner stone of the mechanistic materialism characteristic of the 19th century, Francis Bacon wrote: "Nature to be commanded must be obeyed; and that which in contemplation is as the cause is in operation as the rule."[7] With his credo of "knowledge is power," Bacon

6 Lewis Mumford, *Technics and Civilization* (New York: Harcourt, Brace & World, 1963; 1934) p. 14.
7 Francis Bacon, "New Organon," (1620) in *The Complete Essays of Francis Bacon* (New York: Washington Square Press, 1963) I, § iii.

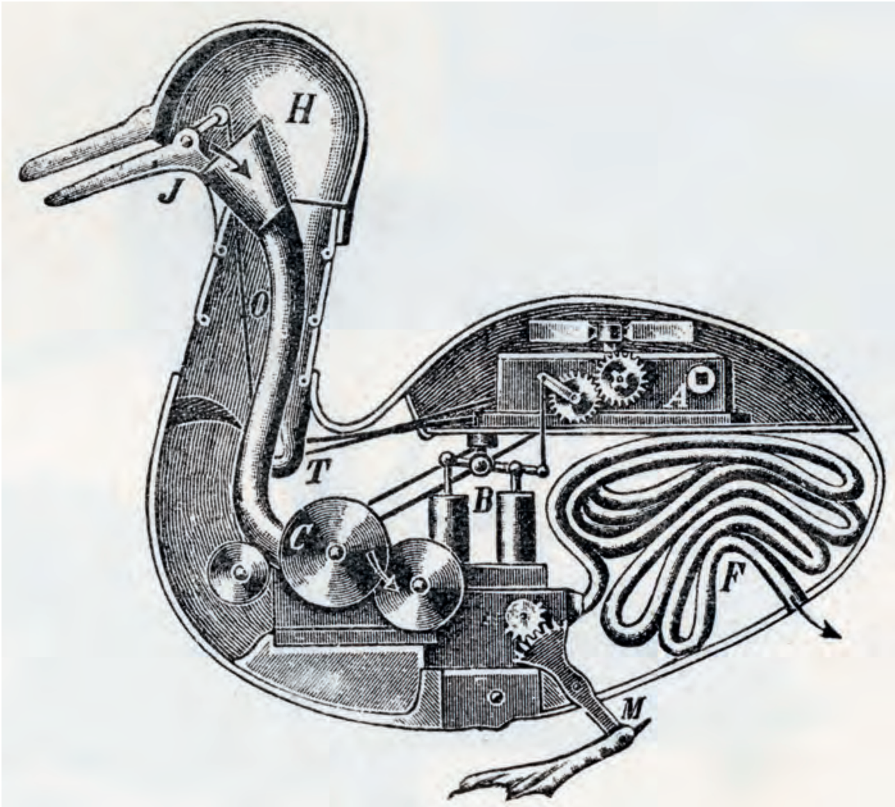

Fig. 1: Jacques de Vaucanson, *Canard digérateur*, 1739.

regarded man as a *living god*, who through the comprehension of nature appropriated the skills to command the world. Shortly before his death, Bacon also wrote about gardening, a practice he believed to be the purest of human pleasures:

> Where does the Wisdom and the Power Divine
> In a more bright and sweet Reflection shine:
> Where do we finer stroaks, and colours see
> Of the Creators Real Poetry.[8]

As is evident in these last lines, early science was cast into a complex matrix of religious thought. Instead of defending a purely theological world hypothesis, in

8 Francis Bacon and Abraham Cowley, *On Gardens: Two Essays* (Whitefish: Kessinger Publishing's Rare Reprints, 2007; 1625) p. 21.

which the actual, experienced world was regarded as a valueless shadow of the heavenly order – St Augustine's "City of God" – the progressive accumulation of scientific knowledge conveyed the belief that it was not a fallen world, but rather that Divine value was immanent in the perceivable here and now. In Newton's Natural Philosophy, according to Voltaire, "[i]f matter gravitates [...] it received its gravitation from God,"[9] and yet, if the French philosopher had hoped this kind of metaphysics could arrest the burgeoning atheism characteristic of the impending industrial age, he erred. While rational thinking shifted its focus from questioning *why* things came about to asking *how*, "[t]his situation," according to Alberto Pérez-Gómez, "advanced the transformation of applied mathematics into a powerful instrument for the technological domination of reality."[10] Based on cold reason, geometry and mathematics became "purely formal disciplines, devoid of meaning, value, or power except as instruments [...]."[11]

At the same time, the earlier water, wind and wood complex, was replaced by an advanced industry based upon iron and coal. Coal, mineable in advance and capable of being stored, released the new industrial complex from seasonal influences.[12] Yet, inasmuch as the mechanization of nature was a technological success story, a general impoverishment of life with bad sanitary conditions characterized the new industrial towns. The workers in the factories – all conceptualized as large-scale machines through the breakdown of the production process into a series of specialized operations – were degraded to human robots following the steam engine's pace. More woods and groves were cut down than ever before, the waters poisoned by the washing of ore, and the air darkened by the smoky dust of the furnaces' exhalations. Where a sense of humility had still characterized 18th-century scientific research with its prerogative to reconcile with *Divine* nature, it was now debased to a mere resource of industrious exploitation.

1.1 From the Correlation of Parts to Medieval Space-Structures

In architectural terms, the new utilitarian creed of Positivism, which according to Pérez-Gómez "created the illusion of the infinite capacity of human reason to control, dominate, and put to work the forces of nature"[13] was intuitively captured in the

9 Voltaire, *Eléments de la philosophie de Newton* (Paris: Édition Garnier, 1738).
10 Alberto Pérez-Gómez, *Architecture and The Crisis of Modern Science* (Cambridge: The MIT Press, 1983) p. 103.
11 Ibid., p. 11.
12 Altogether the mine spurred technological advancement: in its milieu emerged the steam pump and by derivation the steam engine, in which through the boiling of water the expanding vapor set a rotary motion in action that could perform mechanical work and be later transformed into electrical power.
13 Pérez-Goméz, op.cit., p. 272.

tactile glass and iron structure of the Crystal Palace in London (1851; Figure 2). Its architect, the English landscape gardener Joseph Paxton, found inspiration in the platter-like foliage of a *Victoria regia* (Figure 3), a marvel of economy with regard to its web-like cantilevers stiffening the leaf's membrane.[14] Paxton made use of only a limited number of standardized and serially produced elements, whose subsequent montage replaced the former act of building on-site.[15]

At the same time in France, more rigorous mathematical stress analysis was introduced at the beginning of the 19th century,[16] initially necessitated by the erection of large domes like the Panthéon (Ste Geneviève) by Jacques-Germain Soufflot in Paris (1755-92) and the planning of cast-iron bridges, railway stations and exhibition halls. Trained at the École polytechnique (in operation since 1794 and derived from the École des ponts et chaussées, founded in 1756), the engineers' new analytic methods were based upon differential calculus, projective geometry and the quantitative study of material properties in order to better determine the dimensions of a building's structural elements in relation to the prevailing loads they needed to support. Altogether, the process of planning and construction became generalized through *theory*, whose primary objective was to make practice more economical and precise.[17]

The professor of architecture of this new breed of engineers was Jacques-Nicolas-Louis Durand. Teaching his students a modular design approach based on abstract grids and the combination of simple formal elements, he made designing through the

14 In 1850, in a conservatory specifically designed to duplicate the lily's original hot-humid environment, Paxton had managed to make the plant bloom for the first time in Europe. Cf. Karel Honzik, "A Note on Biotechnics," in J. L. Martin, Ben Nicholson, and Naum Gabo, (eds.), *Circle* (New York: Praeger Publishers, 1971; 1937) p. 257.

15 The testing ground for Paxton's endeavors had been the Duke of Devonshire's pleasure grounds at Chatsworth. Supplementing the picturesque landscape design by Lancelot Capability Brown, Paxton erected in Chatsworth a number of wooden greenhouses with sophisticated heating and ventilation systems. The father-in-law of the Fourth Duke of Chatsworth was Lord Burlington, whose Renaissance-inspired Chiswick Palace in the boroughs of London had, from 1723 onward, offered William Kent the first opportunity to introduce a less formal style of landscape design. While the formal garden practice – as manifested in the Islamic tradition, the medieval monasteries, the gardens of the Italian Renaissance and the parterres of the French Baroque palaces – relied on the biblical vision of the Garden of Eden to recreate abodes of heaven on earth, the informal tradition sought to acknowledge the apparent disorder in all its eerie beauty and take advantage of the natural disposition of the grounds. Thus, just as Newtonian physics had set its focus on the existing reality, so the picturesque landscape gardener felt at home in *this* world.

16 The founder of modern structural analysis was Claude-Louis Navier with his *Résumé des leçons données à l'École des ponts et chaussées sur l'application de la mécanique à l'établissement des constructions et des machines* (Paris: Firmin-Didot père et fils, 1826).

17 For instance, Jean-Baptiste Rondelet's *Traité théorique et pratique de l'art de bâtir. Avec atlas de planches* (Paris: Firmin-Didot frères, 1817) was a first attempt in defining how building practice could be objectified in its process of realization.

Fig. 2: Joseph Paxton, Crystal Palace, London, England, 1851.

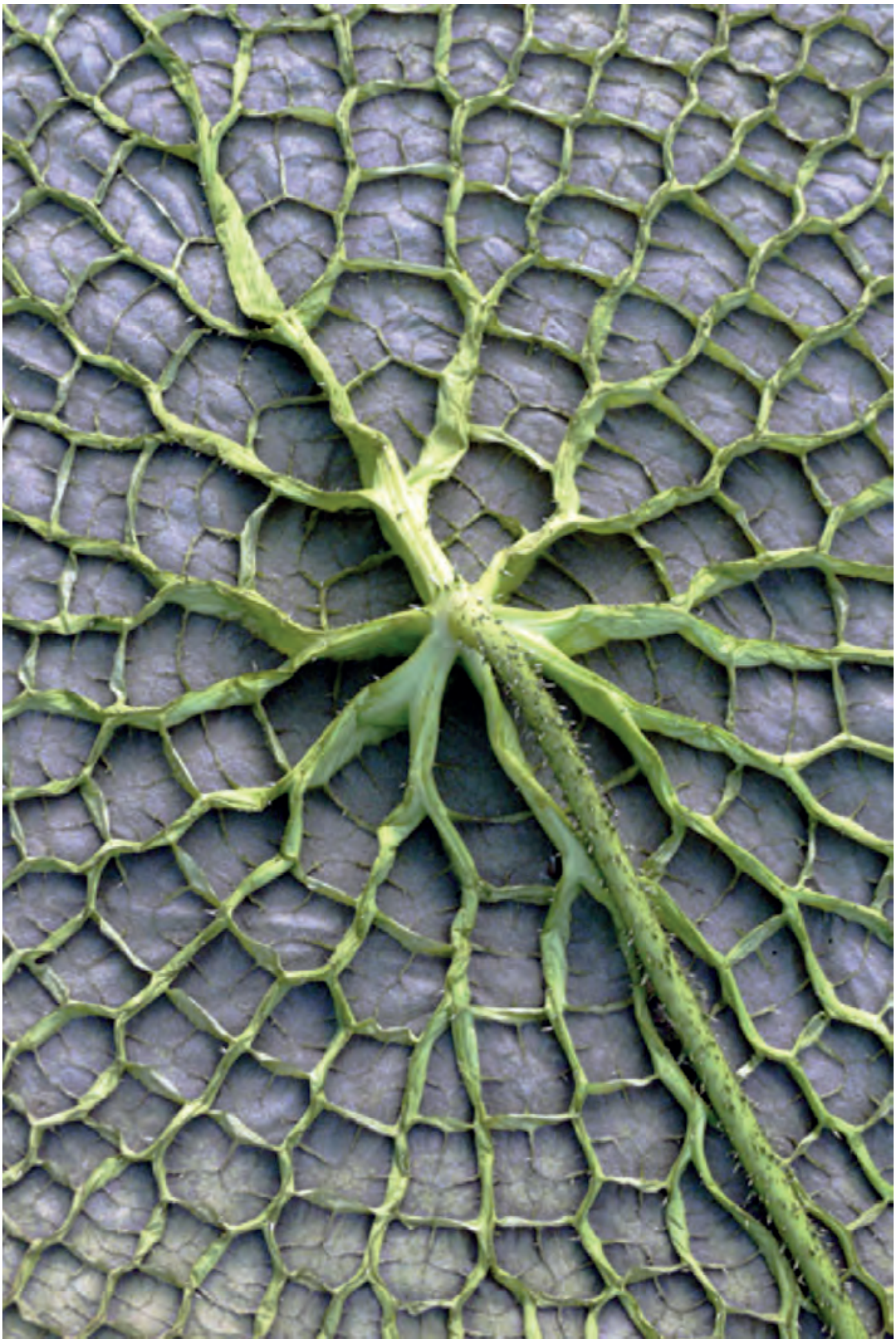

Fig. 3: *Victoria regia*.

"mécansime de la composition" similar to the resolution of an algebraic equation. Durand's method was summarized in the *Précis des leçons d'architecture donnés à l'École polytechnique* (1802-5), which in a sort of building catalogue collected all sorts of building types on the same scale through plans, sections and elevations while eschewing any atmospheric perspectives. In his historical overview, *Parallel of Architecture*, which Kahn owned, masterpieces from all ages were presented on the basis of the aforementioned graphical parameters, leaving out any trace of the context.[18] Notably, Durand was the most famous pupil of Étienne-Louis Boullée, who had been a teacher of architecture at the École des ponts et chaussées himself. The latter's clear and austere stereo-metric forms which lacked embellishment and were ruled by a basic recognition of the lawfulness of the Newtonian finite world, could just as well be used as a model to exemplify the rationalist spirit in French theory at the time.

In parallel with the training of engineers, the ideal of a new *truthfulness* manifested itself in France's architectural circles. Headed by Eugène-Emmanuel Viollet-le-Duc, a group of architects admiring the cathedrals' structural honesty set out to translate their objectives into the theory of contemporary cast-iron architecture. Viollet-le-Duc's drawings for a number of unrealized projects, such as a lecture hall with a web-vaulted, triangulated ceiling-structure supported on an independent iron framework (Figure 4), emphasized lightness and the appropriation of the new materials' constructive possibilities. In the same vein, Auguste Choisy's *Histoire de l'architecture* (1899), deeply influential for Kahn, assimilated the development of new architectural styles with the advancement of novel structural methods and materials. Following Choisy's logic, the Tour Eiffel (1887-9) marked the dawn of a new age in iron construction, while Anatole de Baudot's church of St Jean de Montmartre (1899-1905) in Paris gave birth to *ciment armé* construction, which, resisting compression and suspending tension, created undreamt-of possibilities of architectural expression.[19]

Viollet-le-Duc compiled his theoretical investigations in the *Dictionnaire raisonné de l'architecture française du XIe au XVe siècle* (1854–1868), of which Kahn also owned a copy. Notably, his analysis deriving from the restoration work on several medieval structures drew reference from the work of the French zoologist and paleontologist Georges Cuvier, who, around the turn of the 19th century, had begun to develop a theory of how to piece together the fossil remnants of extinct species. With his principle of the "correlation of the parts," Cuvier argued that every organism formed a functional unity, and every part allowed conclusions concerning the entire ensemble and *vice*

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18 Kahn owned Durand's *Recueil et parallèle des édifices de tout genre anciens et modernes* (Paris: Gillé fils, 1799-1801). If not indicated otherwise, all information concerning the books in Kahn's library stems from the "Catalogue of Louis I. Kahn's Personal Library," compiled by Joseph A. Burton between 1978-80, LIKC.

19 In 1972, Kahn paraphrased reinforced concrete with "molten stone" that "really wants to be granite […]." Kahn, "I love Beginnings," in *Architecture and Urbanism*, October 1975, p. 282.

Fig. 4: Eugène-Emmanuel Viollet-le-Duc, *Salle voutée*, 1864.

versa. In his opinion, the forms of animal skeletons were a precise counter-image of the functions that different animals performed. For instance, an animal that was to run would have a skeleton whose form was entirely conducive to the maximization of speed. What was true for the overall skeleton was likewise valid for all its individual parts, each of which was perfectly attuned to the particular role it had to fulfill in the organism's overall function.

Fascinated by Cuvier's doctrines, Viollet-le-Duc embedded his convictions of a similar organic architecture in the public discourse, and jeopardized the monopoly of the École des beaux-arts. Transgressing from a formal to a morphological understanding of architecture, he challenged the rigid application of historicist elements with his understanding of forms logically deduced from given causes. Equating a building with a living organism, Viollet-le-Duc argued:

> There is nothing excessive or superfluous about them, any more than there are any features that serve no purpose. If you make a change in any part of such a delicate organism, the other parts are automatically changed as well.[20]

Tracing the development of Gothic architecture from the crudities of the Romanesque basilicas to the finesse of the grand cathedrals with their finely balanced thrusts and counterthrusts, Viollet-le-Duc observed a constant effort to acquire statically more optimized systems in order to reduce the amount of precious stone. Likewise, his English contemporary, John Ruskin noted in *The Seven Lamps of Architecture* (1849), another treatise Kahn possessed:

> There are hardly any of the magnificent and serene methods of construction in the early Gothic, which have not, in the course of time, been gradually thinned and pared away into skeletons, which sometimes indeed, when their lines truly follow the structure of the original masses, have an interest like that of the fibrous framework of leaves […].[21]

The Gothic builders' most groundbreaking invention was the flying buttress that apparently caught Kahn's attention, too: when sending a postcard from Paris in late 1950, he chose as motif the back of Notre-Dame Cathedral with its external supports (Figure 5). The slender, interior columns carrying the skeletal ribs were in fact only an illusion, as their diameter did not respond to the actually impinging forces. Appearing to transcend the structural requirements, the entire organism avoided collapse only through a careful correlation of parts. Even going further and anticipating the logic of *space frames*, the Master of Bristol developed in the eastern parts of its Cathedral

20 Eugène-Emmanuel Viollet-Le-Duc, *The Foundations of Architecture: Selections from the Dictionnaire raisonné* (New York: George Braziller, 1990) p. 224.

21 John Ruskin, *The Seven Lamps of Architecture* (New York: Dover Publications, 1989; 1849) p. 39. Kahn also owned Ruskin's *The Stones of Venice* (1851). The latter's description reminds one of the vegetal fan-vaults in King's College Chapel in Cambridge (1446-1515), for instance.

Fig. 5: Notre-Dame Cathedral, Paris, France, 1163-1345. Postcard from Louis I. Kahn to Anne Griswold Tyng, 1950.

a series of extraordinary skeletal vaults with *flying ribs*. Kahn, who owned Francis Bond's *Gothic Architecture in England* (1905),[22] kept in his personal slide collection a collage of these experimental ceilings (Figure 6), which consisted of the vaults of the south aisle of the chancel (1298 – c. 1320, left), the vaults of the anteroom of the Berkeley Chapel (c. 1305-10, top right), and the ceiling structure of the outer north porch of St Mary Redcliffe Church in Bristol (14th century, bottom right). Regarding the chancel vault, Nikolaus Pevsner remarked that its weight, in a virtuoso manner, was conveyed to the outer aisle walls by "flying buttresses," thrown across the aisles in the "form of bridges from arcade pier to outer wall."[23] Turning the aisles into naves,[24] on top of the bridges tiptoed pointed arches that formed the skeletal framework of the ceiling's contiguous cells to enclose the space.

22 According to Francis Bond, "a premium on economy of ashlar" dominated Gothic architecture's development. Cf. Bond, *Gothic Architecture in England* (London: B. T. Batsford, 1905) p. 58.
23 Nikolaus Pevsner, *The Buildings of England: North Somerset and Bristol* (Middlesex: Penguin Books, 1958) p. 375.
24 This attempt to make the outer buttresses obsolete climaxed in Antonio Gaudí's Sagrada Familia in Barcelona (begun 1882), where inclined columns in torsion bifurcated into triangulated branches to carry the hyperbolic ceilings.

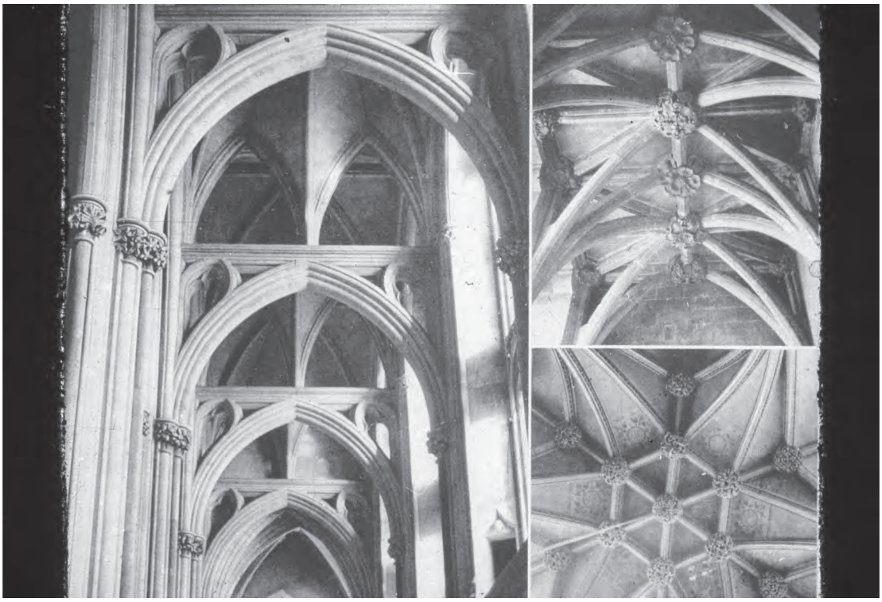

Fig. 6: Bristol Cathedral (left: south aisle of the chancel, 1298 – c. 1320; top right: anteroom of the Berkeley Chapel, c. 1305-10) and St Mary Redcliffe Church, Bristol, England, 14th century (bottom right).

1.2 Machines for Living in Virgilian Settings

Looking out across the Atlantic, advances towards the formation of a more rational architecture were taking place in America as well; notably, Kahn's hometown of Philadelphia, as rendered in one of his sketches of a factory complex (1930-5) (Figure 7), served as the United States' industrial capital throughout the 19th century. When the Brooklyn Bridge in New York, designed by John A. Roebling and his son Washington, opened its pathways in 1883, it was the longest suspension bridge in the world. Combining neo-Gothic pointed-arch piers and technologically advanced steel cables, the structure became an emblem of the time's striving to make things bigger, faster and higher. Also in New York, one of Kahn's favorite buildings, the Pennsylvania Train Station (1910), designed by Charles McKim, William Mead and Stanford White, exemplified the new utilitarian creed. A Beaux-Arts inspired entrance hall with a barrel-vaulted and coffined ceiling – rendered in magnitude after the Roman Baths of Caracalla (212-16 AD), but in fact a travertine covered steel structure – contrasted with the open platforms that were reminiscent of Henri Labrouste's airy Bibliothèque nationale in Paris (1862-8).

At around the same time, Chicago witnessed the development of the skyscraper: only through a fusion of the new technical and constructive capacities was the actual ascent of these high-rise buildings possible. In an instant the architecture of the past –

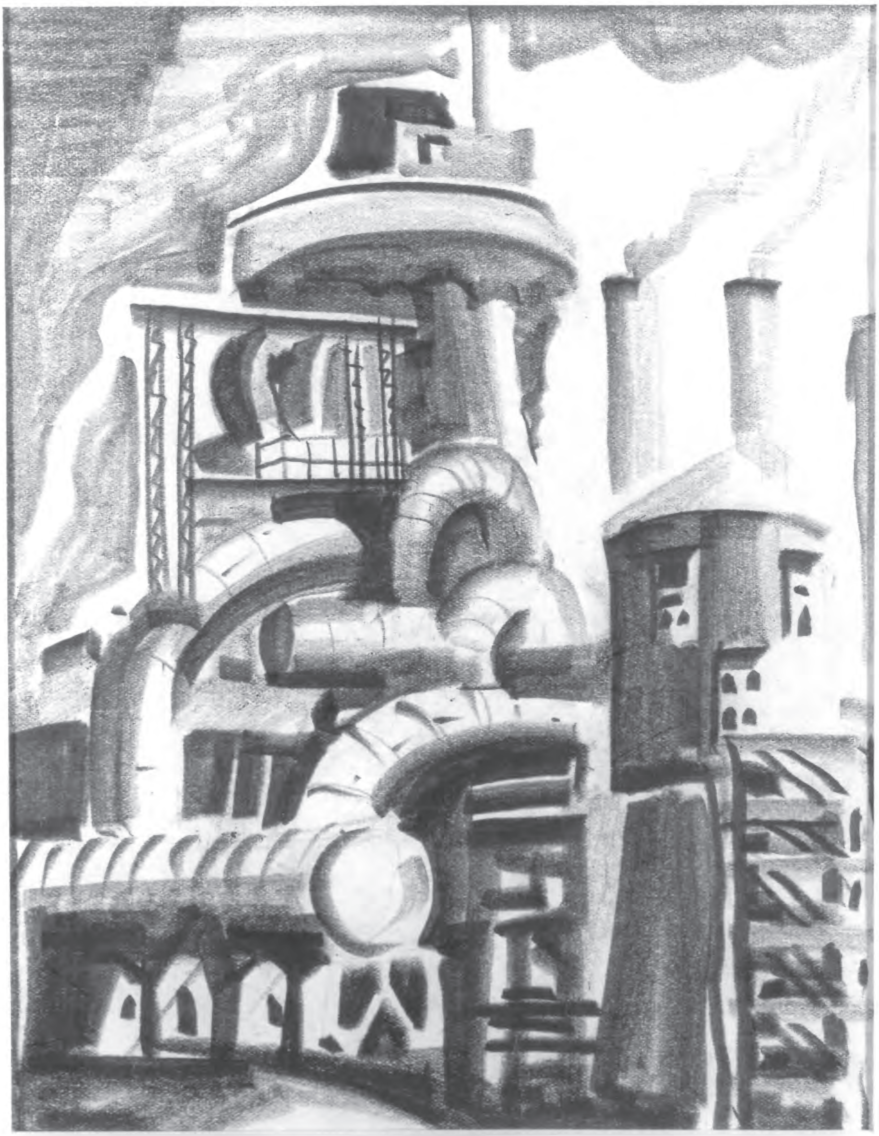

Fig. 7: Louis I. Kahn, *Factory Complex*, Philadelphia, Pennsylvania, 1930-5.

massive, solid and protective – encountered the architecture of the future – light, airy and open. However, the very height of these structures imposed difficulties, as the wind pressures increased significantly with greater altitude, making conventional ventilation through the opening of windows impossible. Besides, due to their enhanced slenderness, the outer *curtain walls* lost their favorable thermal qualities to insulate, store and retain heat. Consequently, to produce appropriate working conditions in all weathers, it became necessary to create an artificial climate.[25] Soon, "man-made weather" would completely liberate buildings from the constraints of size and location: in 1902, the American engineer and inventor Willis Haviland Carrier succeeded in controlling the water content and temperature of air by drawing it, paradoxically, through a fine spray of water to create a sort of regulated fog.[26]

As industrialization proceeded, the demand for large-scale industrial infrastructures increased. The cast-iron truss carried on slim pillars developed as an answer to the factories' need for more openness and flexibility, while grain elevators in the American Midwest – for example, the Standard Elevator designed by the engineer Alfred E. Baxter in Buffalo in 1928 (Figure 8) – emerged as self-referential monuments to the culture's esprit. These reinforced concrete constructions of colossal scale, aesthetically dominated by formal reductionism, seemed to be derived directly from the rational production process. The silos' naked forms, with their inherent and abstract beauty, were closer to the objectivism of a machine than to any prior architectural canon. Neutral, without décor and formal pretense, they correlated directly with their practical cause.

These motives to assimilate the machine as an agent of cultivation also guided the French architect Tony Garnier in his utopian renderings of an industrialized city. The production of electricity, which emerged in the late 19th century as the backbone of a supposedly *cleaner* industrial society, no longer depended on coal, since other natural resources, such as water, wind or sunlight, could be employed as well. In addition, electricity was more convenient for human service, since once converted at a central power station it was transportable and could be re-converted into mechanical power at any local outlet. Garnier's territorial layout of a utopian town, drafted between 1901 and 1904 and published as *Une cité industrielle* in 1907 (Figure 9), relentlessly visualized man's ability to put nature to work, as an entire region merged into one unified machine. Simultaneously, the Italian Futurists realized that the contemporary scenario had to be accepted and taken full advantage of. In 1914, summarizing the group's intentions, Antonio Sant'Elia wrote:

> We must invent and rebuild *ex novo* our Modern city like an immense and tumultuous shipyard, active, mobile and everywhere dynamic, and the modern building like a gigantic machine.[27]

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25 In its pioneering days the development of air-conditioning was spurred by efforts to ameliorate the foul air quality in English factories. For this purpose several technological advancements were indispensable: firstly, electric lighting, which reduced the heat emission and eliminated the soot of the former gas lights; secondly, large blowing fans, which allowed the directing of artificially treated air into the desired locations; and lastly, air-conditioning, the control of the humidity and temperature of air.

26 Cf. Margaret Ingels, *Willis Haviland Carrier: Father of Air Conditioning* (Garden City: Country Life Press, 1952).

27 Reyner Banham, *Theory and Design in the First Machine Age* (Cambridge: The MIT Press, 1980; 1960) p. 129.

Fig. 8: Alfred E. Baxtor, Standard Elevator, Buffalo, New York, 1928.

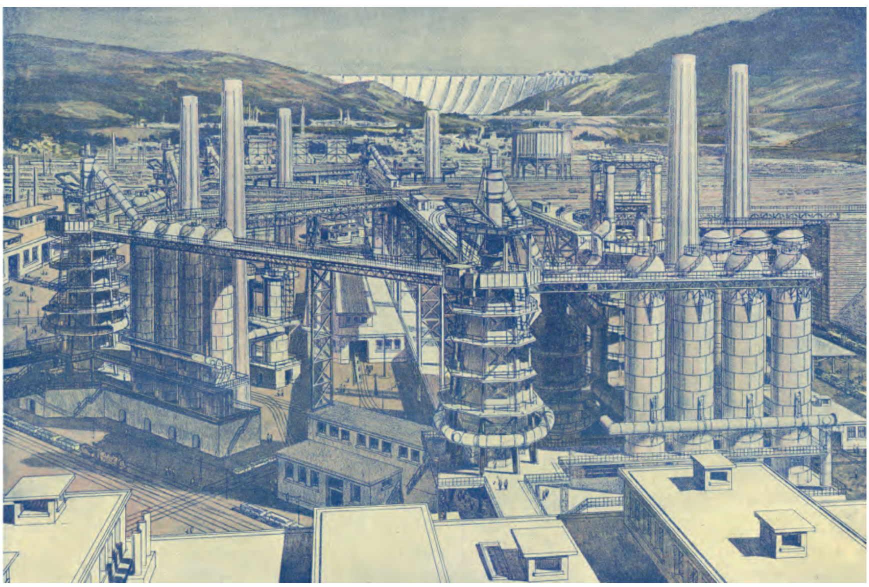

Fig. 9: Tony Garnier, *Une cité industrielle*, 1907.

While Garnier and the Futurists sought in their architectural utopias a more deeply rooted integration of architecture and technology, Auguste Perret set his focus on exploiting the new constructive possibilities. Searching for an authentic expression of his era with the help of nature, the "main nutrition of the imagination, true source of inspiration, of all prayers the most effective, mother tongue of every creator,"[28] the French architect synthesized in his Concrete Gothicism the values of trabeated Greek architecture with the structural verve of Viollet-le-Duc. Both the utopian vistas of Garnier and the constructive rigor of Perret came together in the work of Le Corbusier, the great champion of Kahn. According to the Swiss-French architect, building should be an applied form of scientific inquiry and draw on the industrial ideals of

> standardization, mass production, efficiency: three connected phenomena that rule contemporary activity pitilessly, that are neither cruel nor atrocious but, on the contrary, lead to order, to purity, to liberty.[29]

With the serial production of houses, Le Corbusier implied a transfer of industrial rigor to the domain of architecture, since his "machines for living in" should be manufactured just like cars. Trained as a watchmaker in La Chaux-de-Fonds, he recalled that in his youth,

> nature was the setting where, with my friends, I spent my childhood. [...] I knew flowers inside out, the shapes and colors of birds, how a tree grows and how it keeps its balance even in the eye of a storm.

Overwhelmed by the miracles of nature, Le Corbusier realized "we could be no more than humble imitators of her forms and her wonderful materials."[30] From early on he collected "objets à reaction poétique" – stones, sea shells, fruits, bones, crystals, flowers, wasps' nests, or leaves – to trigger his creative process,[31] while his publications were filled with descriptions of the human body's skeleton and blood circulation system, plants' retroactivity to the dictum of the sun, and the earth's inclined axis as enabler of the seasons. For him, the engineer – "l'homme moderne par excellence" – worked detached from cultural mannerisms in harmony with universal law. Le Corbusier also intended to "look at things from the point of view of architecture," but

28 Auguste Perret, *Zu einer Theorie der Architektur* (Berlin: Verlag der Beeken, 1986; *Contribution à une théorie de l'architecture*, 1952) n.p., transl. by the author.
29 Le Corbusier, *Precisions: On the Present State of Architecture and City Planning* (Cambridge: The MIT Press, 1991; *Précisions: Sur un état present de l'architecture et de l'urbanisme*, 1930) p. 36.
30 Sarah Menin and Flora Samuel, *Nature and Space: Aalto and Le Corbusier* (London: Routledge, 2003) pp. 16-9.
31 Cf. Niklas Maak, *Le Corbusier: The Architect on the Beach* (Munich: Hirmer, 2011). Le Corbusier's term "objets à reaction poétique" was derived from Paul Valéry's description of the "objet ambigu" in *Eupalinos, or the Architect* (Oxford: Oxford University Press, 1932; *Eupalinos ou l'Architecte*, 1921).

"in the state of mind of the inventor of airplanes."[32] Dedicating with *Aircraft* (1935) an entire volume to the subject, he was delighted that man had realized his age-long dream to fly and valued the new bird's-eye visions in *aerial* scale. Shortening time and distance, together with the new forms of telecommunication, a truly *international* culture appeared on the horizon.

Le Corbusier's interest in technology directly influenced the *environmental software* of his buildings, too. Facing thermal problems with the Cité de Refuge in Paris (1929-33), in an add-on process a *brise-soleil* and a *mur neutralisant* needed to be installed.[33] This second device consisted of a double-layered wall with airspace of a few centimeters in between (Figure 10). Through this void, clean air either hot or cold depending on the building's location and season, circulated to provide a constant interior temperature of 18° Celsius:

> Every nation builds its houses in response to its climate. At this time of general diffusion, of international scientific techniques, I propose: only one house for all countries, the house of exact breathing.[34]

This airtight and autonomous building system – Le Corbusier believed at the time that windows were made for lighting and not for ventilation, just as no noise or dust should enter a truly hygienic building – relied on a bulky external factory, where the used air was regenerated and then blown back into the circulation system by fans.

Le Corbusier's delineation of the general landscape, however, appeared in opposition to such mechanistic-architectural impositions. In the Ville verte (1930), cross-shaped high-rise buildings with a minimal footprint hovered above a symphony of greenery. Similarly sentimental in attempting to conserve the purity of the native landscape with its ravishing views were Le Corbusier's proposals for the suburban planning of singular residences that took the Villa Savoye in Poissy of 1931 as a prototype. Grass should grow along the edge of the roads, while trees, flowers, and herds remained undisturbed: "The inhabitants, who came here because this countryside with its rural life was beautiful, will contemplate it," he prophesized: "Their home life will be set in a Virgilian dream."[35] Describing the Villa Meyer in Paris (1925), Le Corbusier considered the surroundings: "Comme à Robinson, comme un peu sur les peintures de Carpaccio."[36] Both these references are informative: Robinson as the role model of the *noble savage*, who, unaided by technological help,

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32 Le Corbusier, *Toward an Architecture* (Los Angeles: The Getty Research Institute, 2007; *Vers une architecture*, 1923) p. 161.
33 Cf. Reyner Banham, *The Architecture of the Well-Tempered Environment* (London: The Architectural Press, 1969) pp. 154-7.
34 Le Corbusier, *Precisions*, p. 64.
35 Ibid., p. 139.
36 Willi Boesiger and Oscar Stonorov, (eds.), *Le Corbusier et Pierre Jeanneret: Œuvre complète de 1910-1929* (Zurich: Les éditions d'architecture Erlenbach, 1929) pp. 88-9.

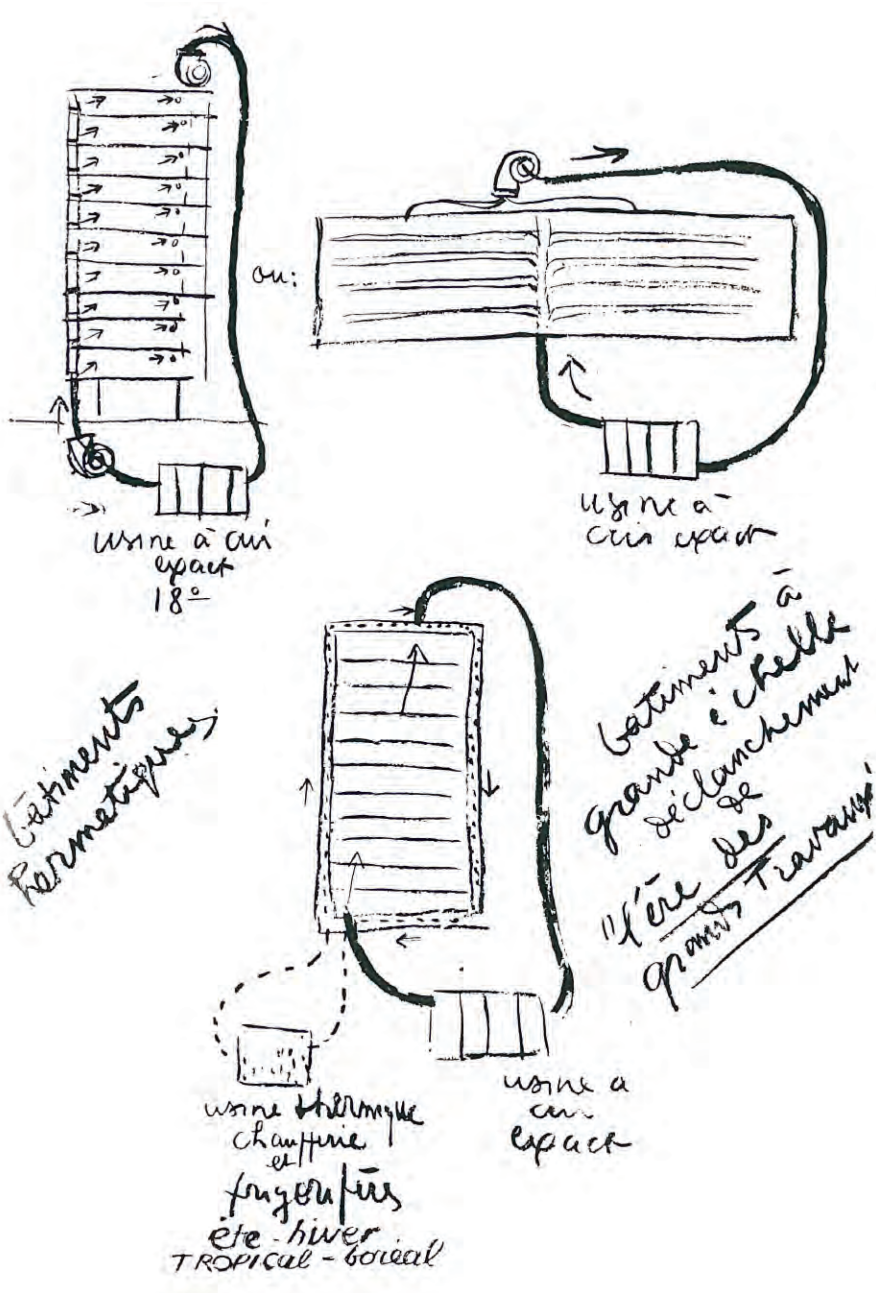

Fig. 10: Le Corbusier, *Mur neutralisant*, 1930.

encountered the brute wilderness of his lonely exile; and Carpaccio, who exemplified with his mathematical clear-headedness the analytical, but also poetic examination of nature. This confrontation and ambivalence of forces would continue to be central in Le Corbusier's work, yet also gain prevalence in Kahn's architectural proceedings.

1.3 Biotechnics and the Illusionary Nature of the Glass House

In Germany, a stronghold of the Romanticist tradition, the French concept of comparing natural organisms with mechanisms had found considerable opposition, and the counter-doctrine of Vitalism asserted that an inner, metaphysical life force was present at all times. However, German natural philosophy acknowledged that vital development itself followed the logical tenets of science, and under the strict rules of necessity enunciated an organism's form from the inside out. In this vein, the photographer Karl Blossfeldt, a representative of the *Neue Sachlichkeit*, for whom the plant was to be regarded as an "artistic-architectural constitution," emphasized:

> Alongside an ornamental-rhythmic creating original force, which is apparent everywhere in nature, the plant builds only useful and functional forms.[37]

According to these objectives, Ludwig Mies van der Rohe conceived in the 1920s a series of visionary projects, which with clarity and sobriety in mind expressed the material characteristics and the functions they were to perform. In the Concrete and Brick Country Houses of 1923 and 1924, and the Barcelona Pavilion of 1929, for instance, the static symmetry of classical composition was transformed into an asymmetrical and vivid configuration that responded more closely to the inner functions. Building upon a primary structural skeleton, a *fluent space* solidified, which seamlessly defined spatial zones, while the freestanding walls projected into the wider landscape. A similar flow of space also characterized the living floor of the Villa Tugendhat in Brno (1928-30). Facing south and annexed to the west by a winter garden for the growth of tropical plants (Figure 11), its interior climate was artificially controlled, but any device indicating this fact was discretely hidden from sight.[38] In summer, to counteract the southern exposure, textile screens blocked the sun's rays, while two floor-to-ceiling high steel-frame windows could be retracted into the floor with the help of an electric motor, and, thus, open up half the façade.

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37 Karl Blossfeldt, *Wundergarten der Natur* (Berlin: Verlag für Kunstwissenschaft, 1932) preface; transl. by the author.

38 The air of the main living space was *à priori* prepared in the basement that included a depot for the storage of cold air, a regulated fine-spray humidifying chamber, a rainwater tank and a boiler-room. Controlled in warmth and coolness, but also cleaned, freshened and aromatized with sea salt since Mrs. Tugendhat suffered from asthma, the treated air was lastly blown into the living space.

Fig. 11: Mies van der Rohe, Villa Tugendhat, Brno, Czech Republic, 1928-30.

Mies van der Rohe's *greenhouse* was a utopian statement of how technological ingenuity could liberate modern man. Likewise aiming to master the consequences of mechanization by means of a synthesis of architecture and technology, the Swiss art historian and trained engineer Sigfried Giedion emphasized in *Mechanization takes Command* (1948): "What matters is to domesticate mechanization, rather than to let the mechanical core tyrannize the house."[39]

Mies van der Rohe's architecture of "less is more," abstracted and reduced to its essentials, found theoretical backing in the writings of Raoul H. Francé.[40] According to the Austrian-Hungarian philosopher every natural process had a precisely corresponding form. Francé distinguished between seven constitutional letters of the organic alphabet, whereby each was constantly tested in its viability to obtain optimized forms. These insights could be transferred to cultural production as well, as he argued:

39 Sigfried Giedion, *Mechanization takes Command* (New York: Oxford University Press, 1948) p. 627.
40 Cf. Fritz Neumeyer, *Mies van der Rohe: Das kunstlose Wort* (Berlin: Siedler Verlag, 1986) pp. 137-42. According to Neumeyer, books by Raoul H. Francé like *Die technischen Leistungen der Pflanzen* (1919) or *Die Pflanze als Erfinder* (1920) were the most frequent in the architect's library.

> All technical forms can be deduced from forms in nature. The laws of least resistance and of economy of effort make it inevitable that similar activities shall always lead to similar forms.[41]

László Moholy-Nagy also relied on the resulting concept of "biotechnics" in his book *The New Vision* (1928), wherein he enforced that *organic* might be a more appropriate term than functional for describing the correlation between a building's form and use.[42]

In 1938, Mies van der Rohe received the commission for the planning of the Illinois Institute of Technology. The ideals of the Bauhaus not only prospered in Chicago, however, where in addition to Mies van der Rohe's activities Moholy-Nagy had installed the New Bauhaus in 1937; but by the early 1950s, practically all American architecture schools had substituted their former Beaux-Arts curriculum with an educational system based upon the German paragon. Walter Gropius became dean at Harvard's Graduate School of Design, and as the first act of his tenure removed history from the curriculum to accentuate his own credo of the collaborative approach: the students should join the building industry and learn in large teams to compose buildings from prefabricated parts.[43]

Trained under the new authority, a younger generation of American architects rapidly assimilated the Modernist tenets. Among them, Philip Johnson designed a Glass House in New Canaan between 1945 and 1949, which paid tribute to Mies van der Rohe's congruent development of the Farnsworth House in Plano, Illinois (1945-51), and his earlier studies for the Resor House in Jackson Hole, Wyoming (1937-8). In each case, unrestricted glass façades opened up unobstructed views of the surroundings. The buildings' puritanical order framed the landscape, which took on a distinctly pictorial, almost stage-like presence. These houses epitomized the changed relationship between man and nature, which became most obvious during the winter months: only with the most up-to-date advancements in mechanical engineering were such architectural *absences* actually possible. Just as the Gothic cathedrals would collapse without the help of the outer buttresses, invisible technical equipment made the organisms of these edifices work. In fact, the reliance upon environmental management devices reduced the internal-external relation to visibility only.[44]

41 László Moholy-Nagy, *The New Vision and Abstract of an Artist* (New York: Wittenborn, 1946; 1928) p. 29.
42 Ibid.
43 "Gropius appraises Today's Architect," in *The Architectural Forum*, vol.96, no.5, 1952, pp. 111-4; 030.II.A.60.34, LIKC. Not surprisingly, Gropius was proud of the fact that it was difficult to differentiate the work of one his pupils from that of another. Cf. Joan Ockman, (ed.), *Architecture Culture 1943-68* (New York: Rizzoli, 1993) p. 138.
44 To solve the crux that the glass inside became a solid black mirror at night, Johnson's, but also Kahn's later lighting consultant Richard Kelly illuminated the exterior surroundings to create a "landscape wallpaper," while during the day, dimmers adjusted the illumination level to counteract abrupt contrasts. Cf. Matthew Tanteri and Renee Cooley, (eds.), "Richard Kelly: Selected Works" (New York: IESNY: The Center for Architecture, 1993).

As far as Mies van der Rohe's work in America is concerned, it is noteworthy that with his arrival in the United States a major shift occurred in his architecture. Obviously, the recent obsession with simple volumes and symmetrical orders contradicted his earlier subscription to a free and unbound spatial continuum. In other words, if Mies van der Rohe had broken free from the box in Europe, he would reconstitute it in the United States. Furthermore, while the column as part of the structural frame had earlier been a freestanding interior element, it was now externalized to become a part of the enclosing wall membrane. In this way, on the one hand, structure and space became an integral element, and on the other, a *universal space* resulted that was not fixed to one particular use, but interchangeable. The more classical stance in Mies van der Rohe's work had its roots in the writings of his friend Romano Guardini:

> Singular forces, especially steam, electricity and chemical energy, were released from their natural connectivity. Their rational laws were deciphered and based on that knowledge their potency was unleashed. And something in humanity, a certain attitude toward these unleashed natural energies, an ethos, a mentality, the very will to work mechanically and rationally uncoiled and allocated itself to this force.[45]

This quotation from 1927 should not be misread, since Guardini, a Catholic priest remained highly critical of the described *rational mentality*. In fact, in his *Briefe vom Comer See* he called for a new Humanism, which re-awakened a classical in-touchness with the natural elements.

In any case, with the impending Second World War, the United States were propelled into a position of global leadership and appeared as a beacon of opportunity. The country quickly became – at least in terms of quantity – the homeland of Modernism in the post-war years. As the visually unifying element, the curtain wall transformed the urban landscape: with glittering transparency a new vernacular culture of mechanization burst forth that ignored all climatic constraints.[46] With the development of coated glass, the total rupture between the inner and outer climate was finally accomplished, since these all-glass buildings paradoxically relied on the permanent use of artificial lighting. Simultaneously, the suspended, multipurpose ceiling came into practice, which, integrating acoustic panels, air-conditioning elements and fluorescent tubes to homogenously illuminate the interiors, arrived

45 Romano Guardini, *Briefe vom Comer See* (Mainz: Matthias-Grünewald-Verlag, 1927) p. 64; transl. by the author. Mies van der Rohe referred to 1926 as the decisive year in which he realized that architecture should release itself from the rational one-sidedness of industrialization. Most explicitly, this new striving manifested itself in the tripartite design of Crown Hall on the IIT campus, erected between 1950 and 1956.

46 Two basic methods for the conditioning of air were applied: The first, a small, self-contained box called the *Weathermaker*, which had been available on the market since late 1928, needed only to be connected to an electrical outlet in order to cool, dehumidify and circulate air. The second, the *Conduit Weathermaster System*, developed in 1939 for large-scale projects, distributed filtered and moisture-controlled air from a central station to local air conditioning units. Cf. Ingels, *Carrier*, pp. 76-95.

in standardized panels. According to Reyner Banham, "[t]he tyranny of the tile format was to become almost absolute,"[47] leading to the endless repetition of the same modules. A monotonous order of technologically optimized buildings spread throughout the country, creating a generic sameness that obliterated local and programmatic differences.

One might assume that the advent of atomic warfare and the revelation of genocide on a previously unfathomable scale could only engender a profound crisis in rationalist thought. In marked contrast, though, the trajectory of technological optimism continued. During the Atomic Age, natural forces would more than ever be made serviceable to mankind, and in a climate of exaltation critical voices remained scarce. In 1951, the Experimental Breeder Reactor I in Arco, Idaho became the world's first electricity-generating nuclear power plant. Three years later, in Obninsk, Russia the nuclear power station Atom Mirny ("Peaceful Atom") commenced its production, and, thus, the split of the atom also split its lines of utilization in halves: one being military, the other civil. While atomic energy had eliminated thousands of lives during the war, it was now supposed to provide energy for entire populations and transmute the molecular structure of synthetic materials. In regard to this "new philosopher's stone," the *Architectural Forum* announced proudly in 1954:

> The sober facts indicate that science has at last achieved the ancient dream of transmuting a base material into a material as different as a Damascus blade from a tobacco push and vastly more valuable, though nothing is added – no alloy, no combination.[48]

Nevertheless, in the fall of 1952 the small Pacific island of Elugelab had been vaporized by the test of the first American hydrogen bomb. Numerous additional explosions followed, each of the "awesome fireballs" – like the one on the cover of *Life Magazine* on April 19, 1954 (Figure 12) – being watched by the wider public. Calculations revealed that a hydrogen bomb multiplied the power of an atomic bomb about a thousand fold. With the belief that the Russians had achieved a similar scientific breakthrough, anxiety began to spread around the globe. The Indian president Jawaharlal Nehru called for an immediate halt to the tests, and Mumford underlined in an open letter to *The New York Times* that "submission to Communist totalitarianism would still be far wiser than the final destruction of civilization."[49]

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47 Banham, *Well-Tempered Environment*, p. 216.

48 "Building in the Atomic Age," in *The Architectural Forum*, vol.101, no.3, September 1954, pp. 94-6.

49 Lewis Mumford, "Policy on Bomb Examined," in *The New York Times*, 28 March 1954, p. 10. Kahn was also affected by the politic turmoil of the post-war years. An ardent supporter of the ideas of the United Nations, in 1947 he asked Howard Myers, editor of *The Architectural Forum*, to introduce and recommend him to the UN Building's chief executive architect, Wallace K. Harrison, for a possible collaboration; Myers' letter of recommendation, 14 January 1947, 030.II.A.61.29, LIKC. Beginning in 1946, Kahn also attended meetings and collected bulletins of the "World Government" organization, which intended to replace each nation's legislation with a single global institution. Cf. 030.II.A.63.19, LIKC.

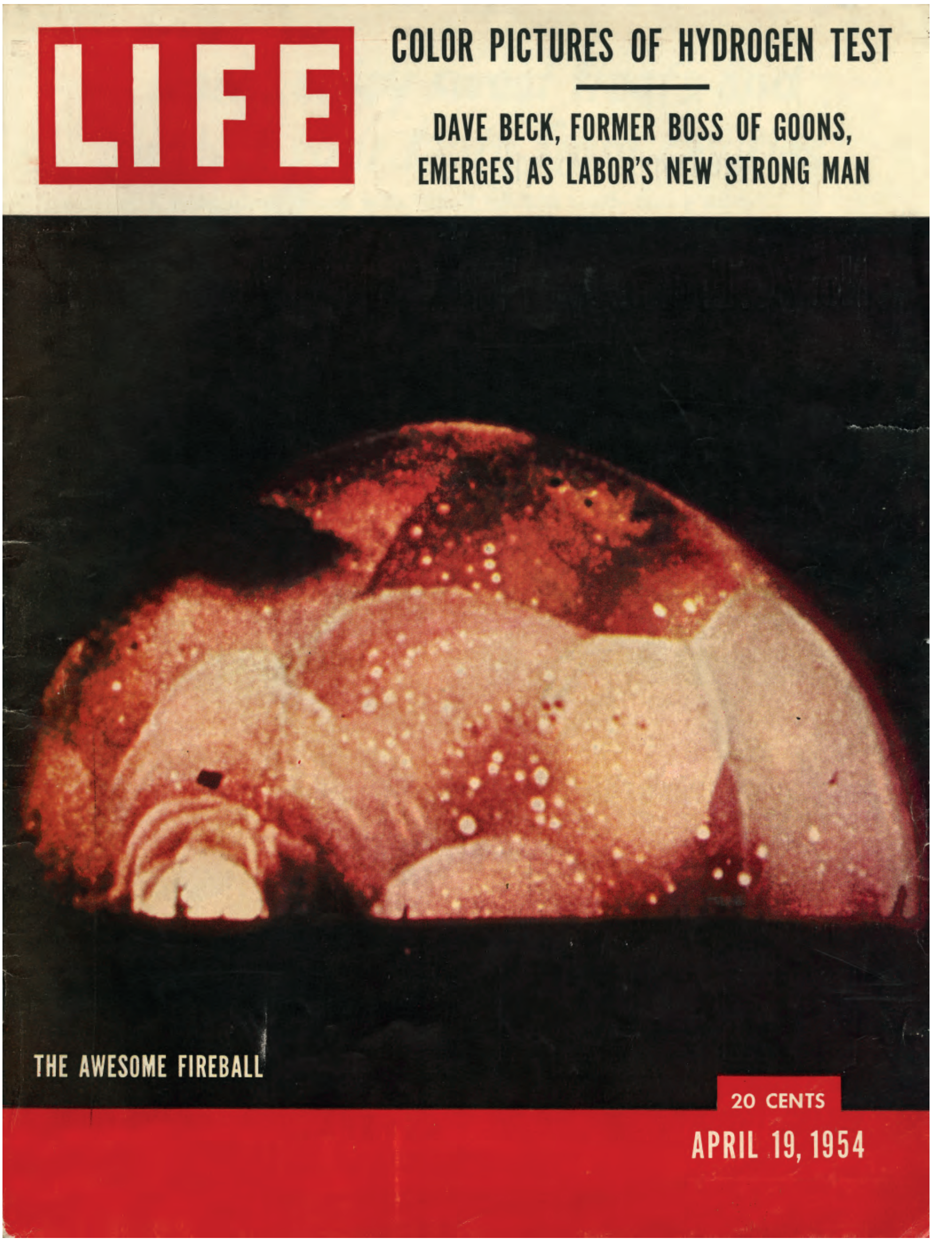

Fig. 12: Explosion of a Hydrogen Bomb on the Cover of *Life Magazine*, 1954.

Between the 1930s and ’50s, as part of his “Renewal of Life” series, Mumford had surveyed in an all-encompassing manner Western society in relation to technology.[50] He remained thoroughly skeptical of the total change brought by the machine, and was especially concerned about its destructive effects upon nature. In his theories, strongly influenced by his mentor, the Scottish biologist, sociologist, and town planner Patrick Geddes, he followed the latter’s distinction between a Paleo- and Neotechnic phase of industrialization, but added an Eotechnique time of preparation. While the Paleotechnic epoch had dissipated energies inefficiently, the electricity-powered Neotechnic period should use technology as a key to improve life. Recognizing the connection between filth and disease, the general criterion for the performance of a building should be its contribution to the health of its occupants.[51] Mumford recognized an emergent “biotechnic régime” that had the potential to better adapt technology. Targeting architecture, he maintained, “a good part of our mechanical substitutes are superfluous,” since their mechanical effects could be reproduced by the proper utilization of the “available knowledge of geography and climatology, of the strength of materials and the properties of insulations.”[52]

1.4 First Steps in the Realm of Optimization

Kahn’s acknowledgement of the architecture of optimization had not really been a question of choice, but rather one of survival. After an almost yearlong journey around Europe in 1928 and 1929 to make a “study of Modern Architecture,” he returned to Philadelphia in the midst of a devastating economic crisis.[53] Educated under Beaux-Arts guidelines at the University of Pennsylvania between 1920 and 1924, Kahn, after a short stint of employment in the office of his former teacher Paul Philippe Cret (April 1929 to September 1930), found himself unemployed during the Great Depression.[54] He came to realize that a quintessential change in outlook was unavoidable. Beginning

50 The “Renewal of Life” series comprised the four volumes *Technics and Civilization* (1934), *The Culture of Cities* (1938), *The Condition of Man* (1944), and *The Conduct of Life* (1951).

51 As a member of the Regional Planning Association of America, Mumford triggered the planning of suburban towns of limited size that were surrounded by green belts. Emphasizing self-sufficiency, open spaces, individual gardens and the closing of large blocks to vehicular traffic, the association’s ideals followed Ebenezer Howard’s tenets of the *Garden City* – a first reaction to the overcrowding, squalor and inadequate housing conditions caused by the Industrial Revolution in Great Britain.

52 Lewis Mumford, “The Death of the Monument,” in Martin, Nicholson and Gabo, *Circle*, p. 269.

53 Kahn traveled mostly alone, but also with Edward Durell Stone and Louis Skidmore. His travels took him to England, the Netherlands, Germany, Denmark, Sweden, Finland, Latvia, Estonia, Lithuania, Czechoslovakia, Austria, Hungary, Italy, Switzerland and France.

54 Cf. 330.I.B.5 “Louis I. Kahn: Draft Resume, c. 1930,” SAKC. Kahn, between his graduation and journey to Europe, had worked in the Philadelphian offices of John Molitor (1925 to 1926) and William H. Lee (1927 to 1928).

to study the rational doctrines on his own, he came to revere Gropius and "to live in a beautiful city called Le Corbusier."[55]

As mentioned before, while Kahn learned indirectly from both Gropius and Le Corbusier, his actual mentor had been Cret. Educated like Garnier and Perret under Julien Guadet at the École des beaux-arts in Paris, the French architect had been teaching in Philadelphia since 1903.[56] While Cret continued to adore the forms of the past, he recognized that the needs and manner of contemporary life called for different expressions. In his essay "The Architect as Collaborator of the Engineer" (1927), Cret, directly following the constraints of Le Corbusier in *Vers une architecture* (1923), demanded a reunion of the architect and the engineer since their occupations were complementary to each other:

> The 'new' influence that has come from modern mechanics, from the creation around us of forms evolved by the effort to realize absolute utility and absolute economy, has simply aroused us to a fresh realization that 'the laws of number are the laws of order and reason,' and that beauty is as much the child of cold reason as of imagination.

Cret remained skeptical of a *total* optimization, however, as he admonished, "[w]e must guard against a tendency to make a fetish of the rigid forms that are produced by pure mechanics."[57] In 1931, with quite similar prospects, Kahn helped establish an ad hoc association "of unemployed architects, engineers and draughtsman to study new trends in planning and construction," which was initially termed the "Society for the Advancement of Architecture" (S.A.A.), and later renamed to "Architectural Research Group" (A.R.G.).[58] The group's policies were founded on the principles of optimization:

> Architecture should be the visual resultant of the manifold co-operations of thought, social relations, biological activities, and cosmic backgrounds of a civilization. As such, the true architecture of today must therefore be logical as well as scientific and must encompass all the natural tendencies of our civilization in order to ensure the maximum of comfort, efficiency, and at the same time strive for the greatest possible economy.[59]

By implication, the A.R.G. strove to promote the use of prefabricated modules, with the objective to correlate "the various materials and their uses based on aims

55 Vincent J. Scully, *Louis I. Kahn* (New York: George Braziller, 1962) p. 15.

56 Cf. Kenneth Frampton, "Louis I. Kahn and the French Connection," in *Oppositions*, no.22, 1980.

57 Theophilus B. White, (ed.), *Paul Philippe Cret: Architect and Teacher* (Philadelphia: Art Alliance Press, 1973) p. 63.

58 Letter of J. Robert Buffler, the A.R.G.'s secretary, with a brief outline of the activities and aims of the group to Mr. Lohman of the State Employment Office, 19 December 1933, 330.I.B.8 "A.R.G. – General," SAKC.

59 "Outline of the Principles and Policies of the Society for the Advancement of Architecture (S.A.A.);" n.d. and no author, but with remarks by Kahn, 330.I.B.8 "A.R.G. – General," SAKC.

toward standardization, unification, and economy."[60] The architectural contribution was intended to lead to a "good life," which also required "the introduction of fine mechanical equipment such as manufactured weather and illumination."[61] In a lecture given to graduate students at the University of Pennsylvania in 1933, the A.R.G.'s spokesperson, possibly Kahn, underlined that

> a true, straight-forward solution is one that is stripped of all non-essentials, such as inappropriate ornament, false breaks in walls, unnecessary columns, rooms put in only to balance a plan, cornices, where they are not needed to shed water or keep off the sun, and so on. I believe this sort of solution is prerequisite to beauty. It is the law the architect should never vary from.[62]

Alongside his involvement with the A.R.G., Kahn was associated with *The T-Square Club Journal of Philadelphia*, which under its new editor George Howe embraced the rational design directives as well. Together with his partner, the Swiss immigrant William Lescaze,[63] Howe also succeeded in his practical efforts to become instrumental in the introduction of Modernism to America. Their design for the Philadelphia Savings Fund Society from 1932 proved to be the first completed Modern skyscraper,[64] and according to Howe was "straightforwardly economic and not falsely mystical or vainglorious." Following the dictum of a building's function,

> the sculptural quality of architecture resides first and foremost in the moulding of its internal volumes, which are the expression of the human problem, and only secondarily in the moulding of the external shell, which in its essential form must follow the convolutions of the organism.[65]

In addition, Norman N. Rice, a former classmate of Kahn's and the first American to work in the office of Le Corbusier, would occasionally write for *T-Square*, too. For Kahn these essays represented the clearest statements on the premises of Modern

60 Ibid.

61 "Architecture and Modern Housing;" lecture held at the University of Pennsylvania, 9 January 1933, no author, 330.I.B.13 "Lecture 1933," SAKC.

62 Ibid.

63 Lescaze had studied at ETH Zurich between 1915 and 1919. After spending a brief period working for Henri Sauvage in Paris, he immigrated to the United States in 1920. His houses from the early 1930s with glass-brick walls akin to Pierre Chareau and Bernard Bijvoet's Maison de verre in Paris (1927-32) are among the earliest Modernist buildings in Manhattan.

64 After the Milam Building in San Antonio, it was also the second fully air-conditioned high-rise building. In order to achieve greater economy in the distribution of the necessary ductwork, a distribution floor was installed midway up the tower. Influenced just as much by the planning of the UN Headquarters in New York (1946-52; design by Le Corbusier and Oscar Niemeyer), Kahn applied the slab typology in the Jefferson National Expansion Memorial in St. Louis (1947), the Triangle Redevelopment Project in Philadelphia (1946-8) and the Plan for Midtown – City Center in Philadelphia (1947-8; Kahn in collaboration with Oscar Stonorov).

65 George Howe, "A Design for a Saving and Bank Office Building," in *The T-Square Club Journal of Philadelphia*, vol.1, no.4, 1931, p. 11.

architecture.[66] Rice observed in "This New Architecture" (1931) that the controversy between the fundamentalists, who swore to the "Alma Mater of the historic styles," and the other "relatively small group of radicals, the avowed disciples and the young neophytes," who prayed in the name of the new religion, was becoming more intense. It was obvious for him that to follow form was not to follow tradition and that function should determine form as it had done in medieval times. Following the tenets of optimization, the task of the architect was "to visualize the building as an organism whose every part is necessary and obeys a necessity." Only this could be a truthful architecture, because it advocated the inherent beauty of industrial production and redeemed the academic falsehood that "tries to fit function to arbitrary forms."[67]

In 1932 Le Corbusier published the essay "We Are Entering upon a New Era" in *T-Square*. With prophetic words he proclaimed that the contemporary changes were so tremendous "that we can only regard it as the beginning of a new cycle in the history of the human race."[68] In the following issue, focusing on the opening of the groundbreaking "International Style" exhibition in New York, the journal gathered the exhibition's curators Henry-Russell Hitchcock and Johnson as guest-editors. The questions raised by Mumford at a related symposium and printed in the same issue –

> Are you ready to abandon the outworn theories of individual design and ornament that were fastened on your architectural education: can you think and design in rational values?[69]

– must have been especially relevant for Kahn. In 1935 he passed the State Board Examination for Architects,[70] and in the following years began to work on a number of large-scale housing projects. Planning the Jersey Homesteads Development in Hightstown (1935-9), Kahn collaborated with the German Alfred Kastner, who had designed previously with Oscar Stonorov, another German immigrant,[71] the Carl Mackley Houses in Philadelphia (1931-4) – the first *Siedlung* rendered after European prototypes in America.

Catherine Bauer, the author of *Modern Housing* (1934) and an associate of Mumford's in the Regional Planning Association of America, was another important member of Philadelphia's architectural community at the time. In 1940, she launched the United States Housing Authority in Washington D.C., which offered funds and

66 Kahn's letter recommending Rice to the jury of fellows of the American Institute of Architects, 29 December 1961, 030.II.A.58.20, LIKC.
67 Norman N. Rice, "This New Architecture," in *The T-Square Club Journal of Philadelphia*, vol.1, no.4, 1931, pp. 14-33.
68 Le Corbusier, "We are entering upon a New Era," in *T-Square*, vol.2, no.2, 1932, p. 14.
69 Lewis Mumford, "Symposium: The International Architectural Exhibition," in *Shelter*, vol.2, no.3, 1932, p. 4.
70 Cf. 330.I.B.17 "LIK, Documents for Architectural Registration," SAKC.
71 Stonorov had earlier worked with the André Lurcat in Paris and was co-editor of Le Corbusier's *Œuvre complète*; the first volume just being published at the time of his arrival in America in 1929.

gave guidelines to coordinate urban and suburban development, besides emphasizing the architectural and political significance of low-cost mass-housing. Initially this agency allowed Kahn to prepare an exhibition contribution, which resulted in the Rational City Plan (1939) shown at the Museum of Modern Art in New York. Clearly in analogy with Le Corbusier's Ville contemporaine for three million inhabitants of 1922, in Kahn's urban proposal of a city for two million people a series of cruciform towers levitated above wide, empty fields that were grid-segmented by the main traffic system. Besides, for a number of Kahn's projects in the 1940s and '50s, Bauer's Housing Authority acted as client, for instance the Carver Court Housing Development in Coatesville, Pennsylvania (1941-4, Kahn in collaboration with Howe and Stonorov). Working as landscape consultant on the project, as well as on several of Kahn's other housing schemes, was Daniel Urban Kiley.[72] He would be the first in a series of prolific landscape architects to collaborate with Kahn over time, and he definitely helped Kahn to appreciate the whole terrain as a single unit of three-dimensional design, in which some spaces were under cover and others simply were not.

Before his encounter with Kahn, after a four-year apprenticeship with Warren Manning, who himself had worked for Frederick Law Olmsted, Kiley had enrolled in the landscape program at Harvard's Graduate School of Design in 1936. Among his classmates were Garrett Eckbo and James Rose, who shared his dislike for the conservative tone of the department. As Kiley recalled, neither Gropius nor Bremer Pond, the head of the landscape department, were "willing to accept the currency of a fluid spatial dialogue between building and land."[73] As a consequence of this rejection of Modernist ideals in the education of landscape architects, he left Harvard without a degree, but remained in close contact with Eckbo and Rose. Together, they co-authored three interrelated articles around the turn of 1940 that would become seminal for the further development of their profession.

Dividing the contemporary environment into three broad categories – the *urban*, mainly the result of industrial progress, the *rural*, largely influenced by agriculture, and the *primeval*, nature *per se* and only partially exploited – Kiley, Eckbo and Rose promoted to value the landscape in functional, rather than purely aesthetic terms. Seeking release from the classical principles of design, "[t]he approach has shifted, as in building, from the grand manner of axes and façades to specific needs and specific forms to express those needs."[74] Their ultimate goal was to produce landscapes of the utmost efficiency:

72 Kahn and Kiley worked together on the following housing developments: Pine Ford in Middletown, Pennsylvania (1941-2; Kahn in collaboration with Howe), Lily Ponds in Washington D.C. (1942-7; Kahn in collaboration with Stonorov), Mill Creek Project in Philadelphia (1950-4), and the Row House Studies for the City Planning Commission of Philadelphia (1951-3).

73 Dan Kiley and Jane Amidon, *Dan Kiley: In his Own Words* (London: Thames & Hudson, 1999) p. 11.

74 Garret Eckbo, Dan Kiley and James Rose, "Landscape Design in the Urban Environment," in *Architectural Record*, vol.85, May 1939, p. 77.

> The irreducible requisite of any successful planning is that the forms developed will direct the flow of energy in the most economic and productive pattern.[75]

Kahn, while engaged with those large-scale housing developments, quite naturally also confronted questions of communal identity. While the totalitarian regimes in Europe had implemented a neo-classical monumentality, after the war the Modern movement was to provide the built counter-symbols of the regained freedom. In 1943, Giedion together with José Luis Sert and Fernand Léger published "Nine Points on Monumentality," in which they called for new means of collective expression. A year later Giedion clarified his position in "The Need for a New Monumentality," published in Paul Zucker's anthology *New Architecture and City Planning* (1944). Therein, he stipulated the need for no more "pseudomonumentality," no more "classical masks," and no more following of routines from bygone ages that had lost their inner significance. Simultaneously, though, in order to avoid the "empty shells" produced by the International Style – a general failure that Mumford summarized in his witty remark, "if it is a monument, it cannot be modern, and if it is modern, it cannot be a monument"[76] – the new communal architecture was in Giedion's opinion "forced to seek the monumental expression [...] beyond functional fulfillment."[77]

In the same collection, Kahn also contributed his first more widely distributed essay "Monumentality," which argued for "living memorials" that indicated a striving for structural perfection. Significantly, for Kahn, form not only had to follow function, but also *force*. In his conception of a new monumental architecture, a vehement structural component took hold that sought to derive more graceful forms from a more precise analysis of the physical stresses involved. Accordingly he called for new methods of calculation, "based on the effect of continuity in structures," as these would yield efficient shapes that eschewed improvident moment coefficients. His accompanying biomorphic illustrations of a pointed arch steel structure glorified the material's inherent capacities of fluid construction (Figure 13).

Notably, alongside his gazelle-like rendering, Kahn included a sketch of Beauvais cathedral that was drawn after an illustration by Choisy. The reference to the French architectural historian, who had proclaimed that architecture in changing its structural means also changed its form, made obvious that Kahn's search for a new monumentality was – not unlike Mies van der Rohe's – directed towards the exploitation of the technical resources of his time: "Beauvais cathedral needed the steel we have. It needed the knowledge we have."[78] For Kahn, the engineering achievements attained during the war were paving the way towards a new art:

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75 Garrett Eckbo, Dan Kiley and James Rose, "Landscape Design in the Rural Environment," in *Architectural Record*, vol.86, August 1939, p. 68.

76 Mumford, "The Death of the Monument," p. 264.

77 Sigfried Giedion, "The Need for a New Monumentality," in Paul Zucker, (ed.), *New Architecture and City Planning* (New York: Philosophical Library, 1944) p. 552.

78 Louis I. Kahn, "Monumentality," in Zucker, op.cit., p. 581.

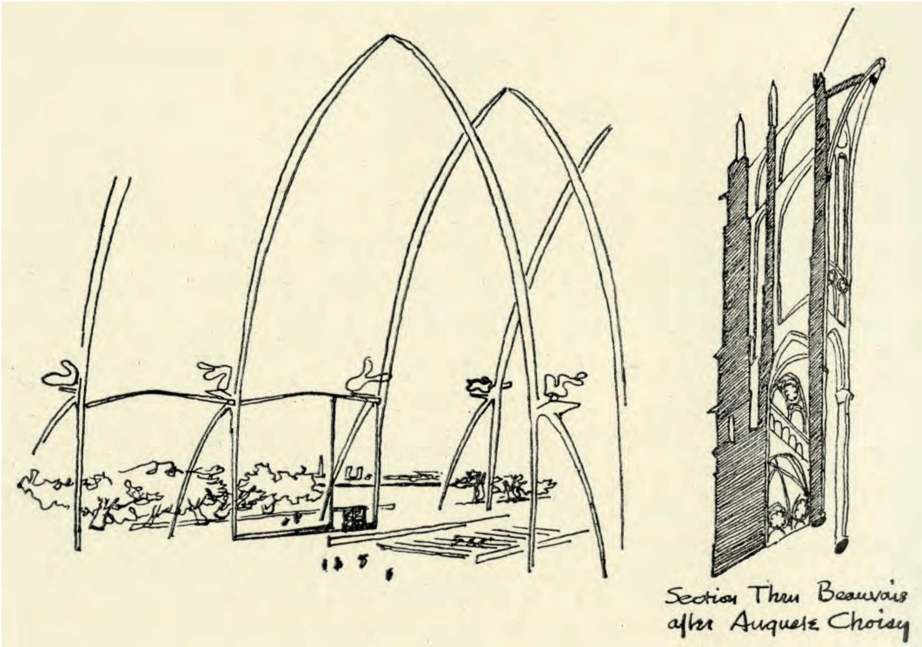

Fig. 13: Louis I. Kahn, “Monumentality,“ 1944.

> Standardization, prefabrication, controlled experiments and tests, and specialization are not monsters to be avoided by the delicate sensitiveness of the artist. They are merely the modern means of controlling vast potentialities of materials for living, by chemistry, physics, engineering, production, and assembly, which lead to the necessary knowledge the artist must have to expel fear in their use, broaden his creative instinct, give him new courage, and thereby lead him to the adventures of unexplored places.[79]

1.5 Following the Logics of Structural Continuity

The Parasol House of 1944 – designed in collaboration with Stonorov as an answer to the call by the furniture company Knoll to develop prototypical low-cost “Equipment for Living” – offered Kahn a further opportunity to extend his rational design specifications. In the unrealized design, the entire structure was subdivided into smaller segments of modular lightweight ceilings, while only one column carried each. Underneath these large canopies, non-load bearing walls constituted the individual apartments. Kahn’s use of a tree-like structure – a theme that both structurally and

79 Ibid., p. 587.

metaphorically would accompany him for the rest of his career – was inspired by the dendriform construction of Frank Lloyd Wright's Johnson Wax Administrative Building in Racine (1936-9).[80] With this building, Wright, whose work Kahn praised in his notebooks as "the most wonderfully true architecture Amerique," had set a perfect example of reinforced concrete construction that followed the principles of *structural continuity*.[81] In the working space, numerous pillars, akin to tree trunks in a forest, merged in a fluent manner into cantilevered ceiling plates.

Kahn's fascination with continuous structures, where shape, space, and structure interlocked, also became apparent in his schemes for the Jewish Agency for Palestine Emergency Housing from 1949. After Israel's declaration of independence in 1948, and because of the expected mass immigration,[82] an advisory board of American experts, including Kahn, was formed to study the expected housing shortage.[83] Putting into practice his ideas from the essay "Monumentality," Kahn proposed the establishment of several prefabrication centers, which would turn the country into a center of building fabrication in the Near East. After the evaluation of various material choices, Kahn arrived at the conclusion that "Israel's material in building is concrete," because also

> in France, Belgium, Switzerland and South America where concrete has been used extensively for the modern design of buildings and bridges have developed grace and power arriving from necessity and economy.[84]

To solve the crux of prefabrication and to enable the required rapid erection at various sites, with the assistance of the Philadelphian engineer Carl Billner, Kahn proposed the construction of a series of parabolic shell structures (Figures 14, 15).[85] Concrete should be poured into a framework fitted with vacuum mats that would immediately absorb the water not required for the setting of the cement, and, hence, lead to a faster hardening and higher crushing strength of the material. The parabolic section, in which wall and roof became a continuous element, required a minimum of material for the required span. In appearance similar to a catenary curve – the section that

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80 In German the words *Bau* ("building") and *Baum* ("tree") are intrinsically connected.
81 "Notebooks," 288.III.15, RSWC. Cf. Wurman, *What will be has always been*, reproduction of Kahn's notebooks at the end.
82 Cf. Gershon Meron, "Israel's Economic Program," in *Economic Forum*, 030.II.A.35.29, LIKC.
83 The group visited Israel in 1949 for three and a half weeks, and on his return Kahn stopped in Paris for a brief visit to the Gothic cathedrals of Rouen and Chartres. Cf. Anne G. Tyng, "Louis I. Kahn: A Modern Architect's Response to Egypt, Greece and Italy;" from a symposium in Evanston, 1 November 1980, 074.II.C.72, AGTC.
84 Kahn's handwritten notes on Israel's proposed building program without date, and the "Preliminary Report on Housing in Israel," 7 June 1949, 030.II.A.35.33, LIKC.
85 Cf. Memorandum regarding the method and estimated cost of erecting a parabola shaped shell, 2 June 1949, 030.II.A.35.30, LIKC.

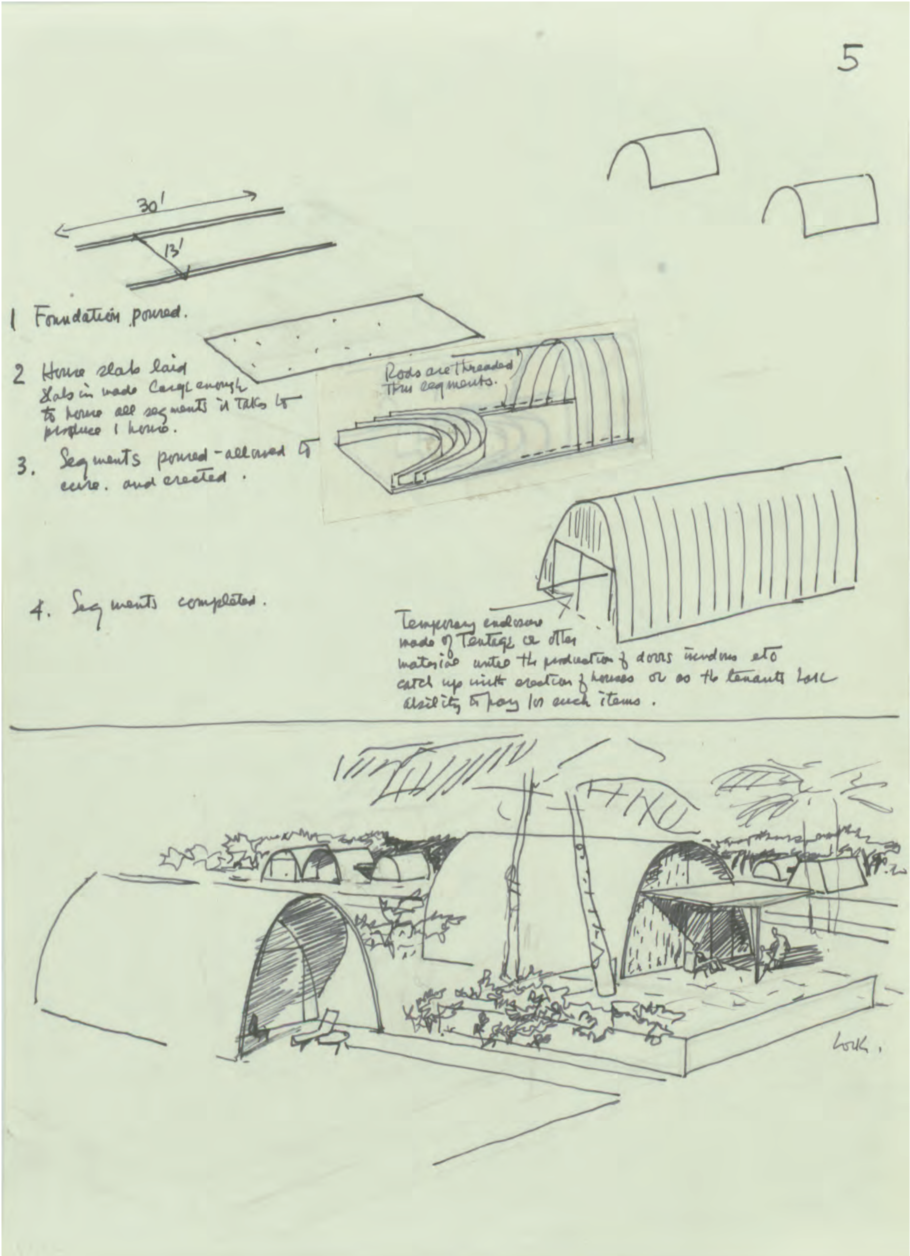

Fig. 14: Louis I. Kahn, Palestine Emergency Housing, Israel, 1949.

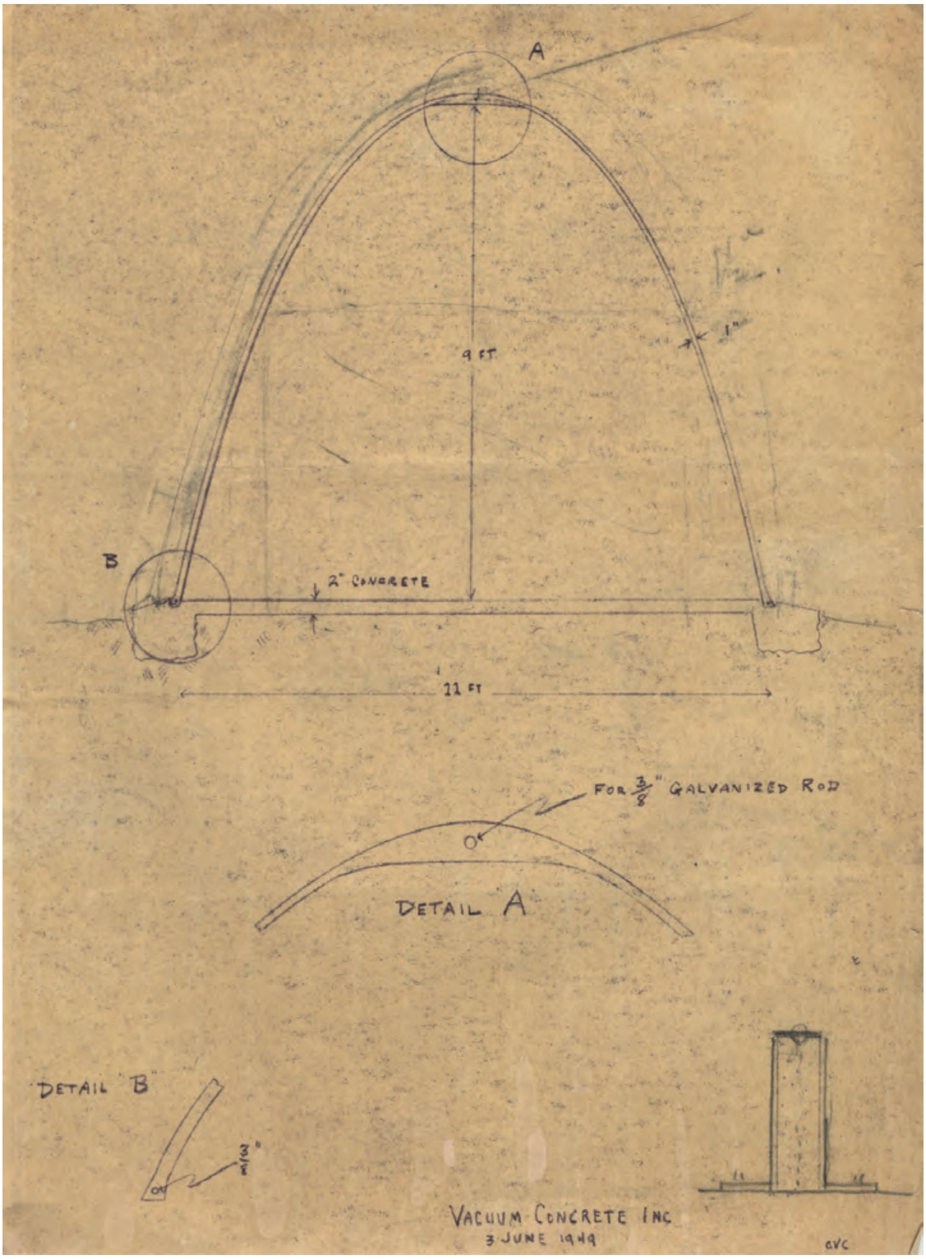

Fig. 15: Louis I. Kahn, Palestine Emergency Housing, Israel, 1949.

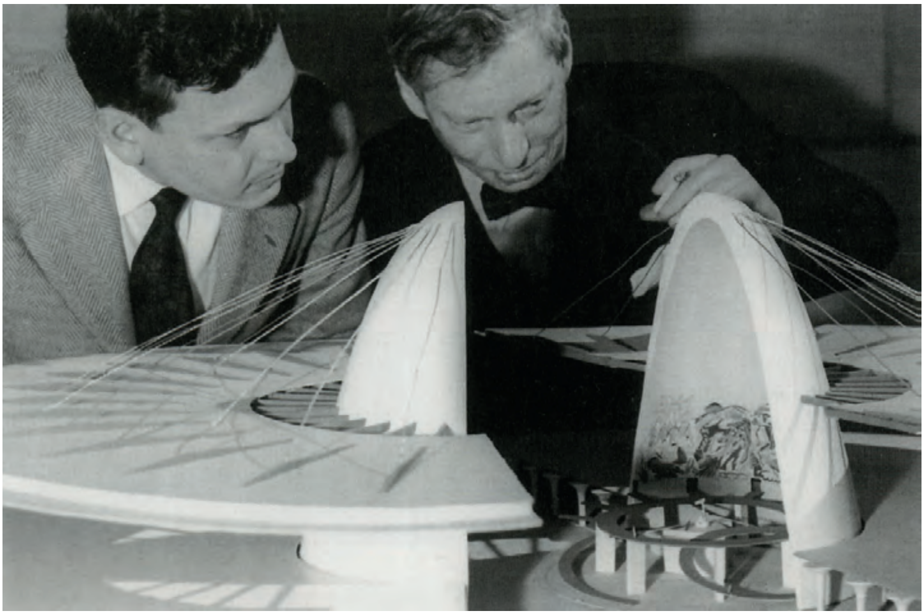

Fig. 16: Louis I. Kahn (right) inspecting a Student Project, "National Center for UNESCO," Yale University, 1949.

a suspended chain assumes when supported only at its ends and, thus, resembling most closely the line of thrust – it allowed for extreme thinness. One can glean Kahn's interest in this form also when seeing him look at the parabolic shell structure of one of his students working on the problem of a National Center for UNESCO in the spring of 1949 (Figure 16). The project relied on a brief from his unsuccessful competition submission for the Jefferson National Expansion Memorial in St. Louis (1947) – notably won by Eero Saarinen proposing a giant concrete arch with the profile of a catenary curve.[86]

Altogether, warps, waves, droops, shells and other non-rectangular forms became ever-increasingly the order of the day. Scientific studies of the air-resistance of birds

86 Cf. Eeva-Liisa Pelkonen, "Toward Cognitive Architecture," in Stanislaus von Moos and Jochen Eisenbrand, (eds.), *Louis Kahn: The Power of Architecture* (Weil am Rhein: Vitra Design Museum, 2012) p. 139. Between 1916 and 1924 the French engineer Eugène Freyssinet erected some enormous parabolic Concrete Hangars in Orly, comparable in size only to the obliquely shaped mud-brick barrel-vault hovering over the audience hall of the Palace of Ctesiphon (531-79 AD). In relation to Kahn's smaller-scale parabolic vaults in Israel, one may also reference mud-brick vaults that without the need of scaffolding had been employed since ancient times by Nubian masons – a building technique revived by the Egyptian architect Hassan Fathy, for instance, in the planning and partial execution of New Gourna between 1945 and 1948.

and the water-resistance of fishes appropriated shape as a decisive factor in terms of efficiency, and set the general basis for a more *streamlined* society. One of the first to attack the *cube-ism* of both classicism and the International Style was the Austrian immigrant Frederick Kiesler, who later taught with Kahn at Yale. In his "Manifesto of Tensionism" (1925), Kiesler had demanded an organic architecture that transcended "the coffins with airholes" to more adequately accommodate the "elasticity of life."[87] The result of his deliberations was the unexecuted Endless House (first version in 1950), a self-bearing *monocoque* construction that, without beams and columns, enunciated a spatial continuum. Such a construction was in Kiesler's opinion more natural, since nature's method of building was continuous, and also in architecture the number of joints should be decreased in order to increase a building's strength.[88]

Before Kiesler, at the turn of the century, a number of European Art Nouveau architects had figuratively employed a fluid set of organic forms. Among these, the Spanish architect-engineer Antonio Gaudí avidly observed nature's architecture in the peaks of the Montserrat mountain range, while in a eucalyptus tree standing outside his atelier he discerned the geometrical model for his "Mediterranean Gothic:"

> Everything is in equilibrium. And this is nothing other than a series of hyperbolic paraboloids. Then I saw that hyperbolic paraboloids are the mountains, the valleys, the waves of all nature.[89]

Working in an empirical way, Gaudí suspended catenoids of hanging cords in his *Bauhütte*, which were then distorted into funicular polygons by attaching weights at the points where the loads charged. Inverted photographs of these hanging structures revealed upright polygons that adhered most closely to the operative forces. Achieving unity between the structural and architectural expression, Gaudí's inclined piers and vaults of double curvature absorbed the static resultants and made the use of supplementary buttresses irrelevant.[90]

Subsequent to Gaudí's endeavors, the Swiss engineer Robert Maillart also broke away from the atavistic construction principle of bearing and loading. Exploiting

87 Frederick Kiesler, "Manifesto of Tensionism," in *Zodiac*, no.19, 1969, p. 25; first printed in *De Stijl*, April 1925. Cf. Frederick Kiesler, "Pseudo-Functionalism in Modern Architecture," in *Partisan Life*, vol.16, July 1949, pp. 733-42.

88 Cf. Frederick J. Kiesler, "On Correalism and Biotechnique: A Study on the Genetics of Building Design," in *Architectural Record*, vol.86, no.3, 1939, p. 67.

89 George Roseborough Collins and Juan Bassegoda Nonell, (eds.), *The Designs and Drawings of Antonio Gaudí* (Princeton: Princeton University Press, 1983) p. 41. Cf. Robert Descharnes and Clovis Prévost, (eds.), *La vision artistique et religieuse de Gaudí* (Lausanne: Edita, 1969; based on Francesc Pujols, *La visió artística i religiosa d'en Gaudí*, 1927).

90 Gaudí's "ruled-surfaces" of double-curvature consisted of conoids, paraboloids, and hyperboloids: mathematically difficult to project, they could be erected with ease using straight timber forms.

the potential of the parabolic shell in his Cement Pavilion for the Swiss National Exhibition in Zurich in 1939, in the factory buildings he designed mushroom-columns merged in a fluid manner into beamless slabs. No longer differentiating between the horizontal and vertical members, and thus no longer thinking of beams and columns as separate structural elements, Maillart treated the structure as a *whole*. This pursuit to construct ever more fluid structures carried well into the 1960s through the work of such engineers as Eduardo Torroja, Pier Luigi Nervi and Felix Candela. For Nervi structural correctness was identical with functional, technical and economic truthfulness; and thus, beauty expressed nothing less than structural fitness.[91] In America, the North Carolina State School of Design in Raleigh emerged as the center of structural exploration. Led by Kahn's friend Henry Kamphoefner, the school counted among its permanent and visiting faculty Matthew Nowicki, Eduardo Catalano, Richard Buckminster Fuller, Felix Samuely, Robert Le Ricolais, as well as Torroja and Candela.[92] Kahn visited several times as a lecturer,[93] and in the introduction to the winter 1952 issue of the *Student Publication of the School of Design North Carolina State College*, Kamphoefner put forward the architect-engineer as "the coordinator of the structural dynamics in the over-all pattern of life."[94]

Paradoxically, the structural engineers, who had been praised for their mathematical rigor, themselves demanded more empirical techniques of stress analysis. In line with Kahn's claim to obtain better calculation methods, Candela stated, "any pretense of obtaining *exact* estimations mathematically is an absolute illusion."[95] His experimental concrete umbrella, erected in Vallejo in 1953 (Figure 17), on the one hand masterfully exemplified the objective to think the structure as a whole, and on the other underlined his argument that mathematics idealized incidents, which in reality never occurred in such an isotropic manner.[96] Promoting the same idea, the translated preface of Felix Cardellach's *Filosofia de las estructuras* (1910) was reprinted in the *Student Publication of the School of Design North Carolina State College* in 1956. Cardellach, a Barcelonan contemporary of Gaudí, had from early on attacked the "Parnassus of mathematics," believing that its results were often imperfect due to the impossibility of knowing the entirety of

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91 Cf. Pier Luigi Nervi, *Structures* (New York: Dodge, 1956) p. 26.

92 Nowitzky's design for the multi-purpose Dorton Arena in Raleigh, the "Paraboleum," (1948-53) in which a saddle-shaped roof supported by steel cables was held in place by two intersecting parabolic concrete arches, made widely visible the school's focus upon structural issues.

93 Cf. Roberto Gargiani, *Louis I. Kahn: Exposed Concrete and Hollow Stones, 1949-1959* (Lausanne: EPFL Press, 2014) p. 225.

94 Henry L. Kamphoefner, "The School of Design," in *Student Publication of the School of Design North Carolina State College*, winter 1952, p. 38.

95 Felix Candela, "Structural Digressions around Style in Architecture," in *Student Publication of the School of Design North Carolina State College*, vol.5, no.1, 1955, p. 21.

96 Cf. Felix Candela, "Toward a Philosophy of Structures," in *Student Publication of the School of Design North Carolina State College*, vol.5, no.3, 1956, p. 4.

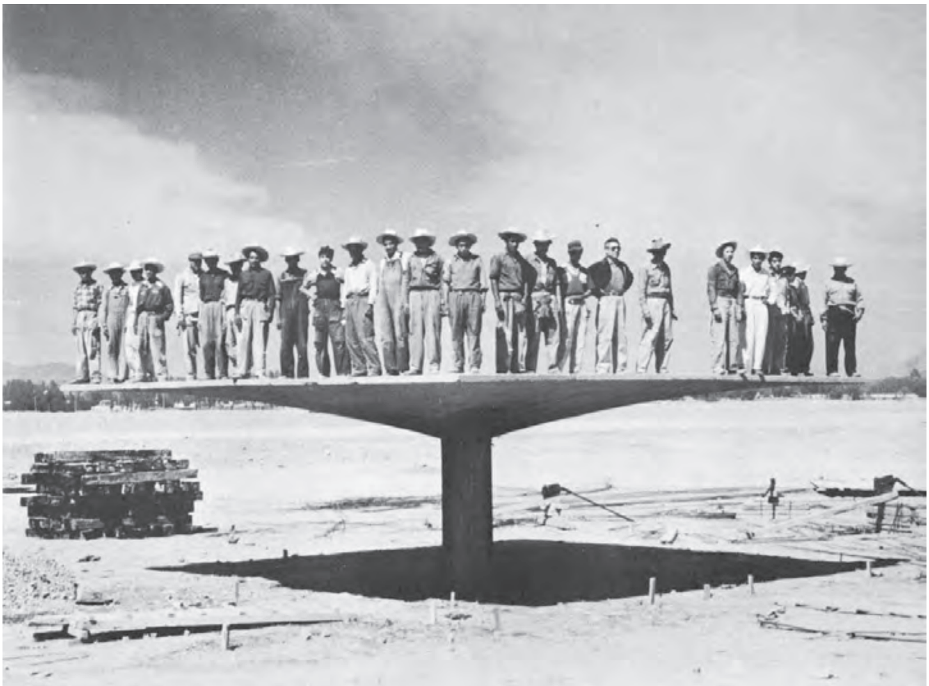

Fig. 17: Felix Candela, Concrete Umbrella, Vallejo, Mexico, 1953.

reality. Torroja, one of the pioneers in the structural study of reduced scale models, also confirmed that mathematics in its traditional forms of application was becoming ineffective.[97]

Leaving this discussion aside, however, Kahn's interest in the principle of continuity was mostly fueled by his study of D'Arcy Wentworth Thompson's *On Growth and Form* (1917).[98] In 1951, the Institute of Contemporary Arts (I.C.A.) in London devoted an exhibition called "Growth and Form" to its contents, and Kahn also treasured the related catalogue *Aspects of Form – A Symposium on Form in Nature and Art* by Lancelot Law Whyte, a Scottish scientist, banker and natural philosopher.[99] In *On Growth and*

97 Cf. Eduardo Torroja and Carlos Benito, "Experimental Testing of Thin Shells by Means of Reduced Scale Models," in *Student Publication of the School of Design North Carolina State College*, vol.9, no.2, 1960, pp. 3-15.
98 According to Kahn it was the one book that people ought to choose if they were to read only a single book in their life. Cf. Joseph A. Burton, "Notes from Volume Zero: Louis Kahn and the Language of God," in *Perspecta*, no.20, 1983, p. 84.
99 Whyte was in Kahn's opinion a unique man, who had "realized the meaning of Form in the universal sense;" letter to G. Holmes Perkins concerning the engagement of Whyte to lecture at the

Form, Thompson attempted in a pioneering effort to study biological phenomena in relation to mathematical and physical laws, "all the while regarding the fabric of the organism, *ex hypothesi*, as a material and mechanical configuration."[100] While zoological and morphological studies had hitherto been slow to accept numerical analysis, Thompson was reluctant to prove that efficient causation also concerned organic constitutions and their growth.[101] Setting his focus upon a physical analysis of such processes and forms, Thompson saw no reason why these should not just as adequately be solved by reference to their antecedent phenomena in a material system of mechanical forces. He was quite aware that

> [t]hey have also, doubtless, their immanent teleological significance; but it is on another plane of thought from the physicist's that we contemplate their intrinsic harmony and perfection, and 'see that they are good'. Nor is it otherwise with the material forms of living things. Cell and tissue, shell and bone, leaf and flower, are so many portions of matter, and it is in obedience to the laws of physics that their particles have been moved, moulded and conformed.[102]

While other agents might exist acting in a living body than in an inorganic substance, according to Thompson, these forces, as far as they caused mechanical actions, were of quite the same character. In other words, their effects were also ruled by necessity and always obeyed the same rules when being acted upon under similar conditions. Regarding the momentous natural condition as an optimized solution in a continuous process of transformation, elemental beauty resided in the efficient form, since it derived its material constitution by means of strict adherence to given imperatives. In biological terms, the slender leg of a gazelle and the sturdy leg of an elephant answered to the same set of physical preconditions: both were beautiful in relation to nature's relentless dictate of optimization. However, while small creatures were governed in their corporeal morphogenesis by capillarity, gaseous pressures, surface tension, electric charge and the intermolecular force of cohesion, gravitation and climatic forces mainly targeted larger ones. Taking reference from Galileo Galilei's "Principle of Similitude," Thompson argued that everywhere nature worked true to scale, because

University of Pennsylvania, 23 September 1965, 030.II.A.57.107, LIKC. In the same letter, Kahn mentions that Anne G. Tyng had met Whyte in London, although without indicating a date. In Tyng's archive are several letters addressed to Whyte from the mid-1960s, 074.II.A.6, AGTC. Whyte was trained as an experimental physicist under Ernest Rutherford at Cambridge. In 1928, he received a Travelling Fellowship by the Rockefeller Foundation to continue his studies in Berlin, where he contacted Albert Einstein. His later writings found great response among architects, designers and visual artists in the United States. Cf. Lancelot L. Whyte, *Focus and Diversions* (New York: George Braziller, 1963).

100 D'Arcy Wentworth Thompson, *On Growth and Form* (Cambridge: Cambridge University Press, 1952; 1917) p. 14.

101 As Thompson noted, "to treat the living body as a mechanism was repugnant, and seemed even ludicrous, to Pascal; and Goethe, lover of nature as he was, ruled mathematics out of place in natural history." Ibid., p. 2.

102 Ibid., p. 10.

> [t]he thing will fall to pieces of its own weight unless we either change its relative proportions, which will at length cause it to become clumsy, monstrous and inefficient, or else we must find new material, harder and stronger than was used before.[103]

In accordance with Kahn's argument that the builders of Beauvais cathedral needed contemporary steel, Thompson stated that "[p]ractical applications, undreamed of by Galileo, meet us at every turn in this modern age of cement and steel."[104] Touching upon more architecture-related matters in the chapter "On Form and Mechanical Efficiency," the British scientist, again noting that Galileo had first solved the problem, arrived at the conclusion that in order to save weight, the engineer, just like nature, should avoid the dead middle zone, and "giving a parabolic outline to our beam, we have its simple and comprehensive solution."[105] To further support his argument, Thompson shared a story about the Swiss engineer Karl Culmann, who in 1866 had entered by chance into an anatomist's dissection room at ETH Zurich (Figure 18):

> The engineer, who had been busy designing a new and powerful crane, saw in a moment that the arrangement of the bony trabeculae was nothing more nor less than a diagram of the lines of stress, or directions of tension and compression, in the loaded structure: in short, that Nature was strengthening the bone in precisely the manner and direction in which strength was required [...].[106]

1.6 Platonic Solids, Space Frames and the Tenets of Structural Addition

However, Kahn did not solely pursue the direction of continuous structures, but in the late 1940s began to experiment with other modes of lightweight construction as well. Consequently, he became increasingly interested in optimized forms not shaped by force, but derived from the ideal mathematical *division of space*. Kahn's shift was critically informed by his employee Anne Griswold Tyng, who according to him knew of "the aesthetic implications of the geometry inherent in biological structures."[107] Tyng had been one of the first women to attain a master's degree in architecture from Harvard in 1944, and beginning in 1945, she was employed in Kahn's office. There she acted as "geometrical analyst" and drew his attention to phenomena such as atomic orders of spatial distribution. Through Tyng, Kahn was also introduced to the Platonic Solids (Figure 19), depicted here in an illustration by Leonardo da Vinci

103 Ibid., p. 27.
104 Ibid.
105 Ibid., p. 996-7.
106 Ibid.
107 Kahn's letter recommending Tyng to John D. Entenza, director of the Graham Foundation for Advanced Studies in the Fine Arts, 2 March 1965, 030.II.A.55.63, LIKC.

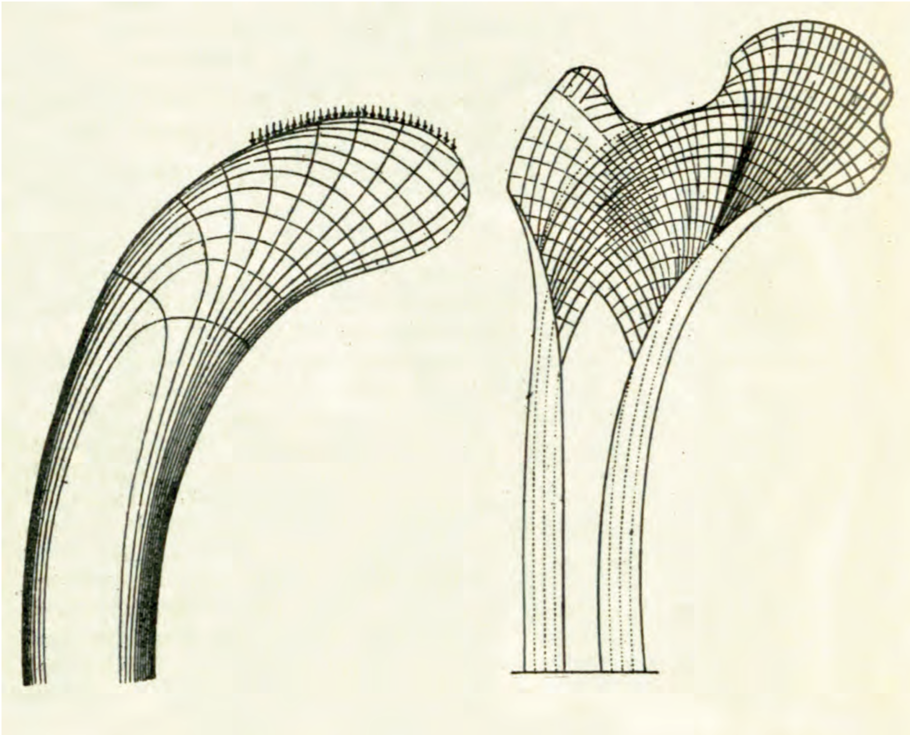

Fig. 18: Crane-Head (left) and Femur (right).

that she used in her article "Geometric Extensions of Consciousness," published in *Zodiac* in 1969. According to Tyng, these polyhedral forms – the "archetypal dice" – were the ones from which all others derived,[108] and as the electronic microscope revealed, they "are involved in the way in which 'fundamental' particles – protons and neutrons – are built up into atoms of about a hundred different elements [...]."[109] Initially presented in Plato's *Timaeus* (c. 360 B.C.), these constellations were the only possible polyhedra to enclose space uniformly, and each one represented one of the classical four elements (*rhizomata*) as established by Empedocles of Agrigentum in *Perì Phýseōs* ("On Nature," Fr.6):[110] the tetrahedron corresponded with fire, the cube

108 Cf. Ingrid Schaffner, (cur.), *Anne Tyng: Inhabiting Geometry* (Chicago and Philadelphia: The Institute of Contemporary Art University of Philadelphia and the Graham Foundation for Advanced Studies in the Fine Arts, 2011) p. 13.

109 Anne Griswold Tyng, "Geometric Extensions of Consciousness," in *Zodiac*, no.19, 1969, p. 137.

110 According to Vitruvius, "Phythagoras, Empedocles, Epicharmus, and other physicists and philosophers affirmed that there are four principles: air, fire, earth, water [...]." Vitruvius, *On Architecture* (London: William Heinemann, 1931; edited from the Harleian Manuscript 2767; *De*

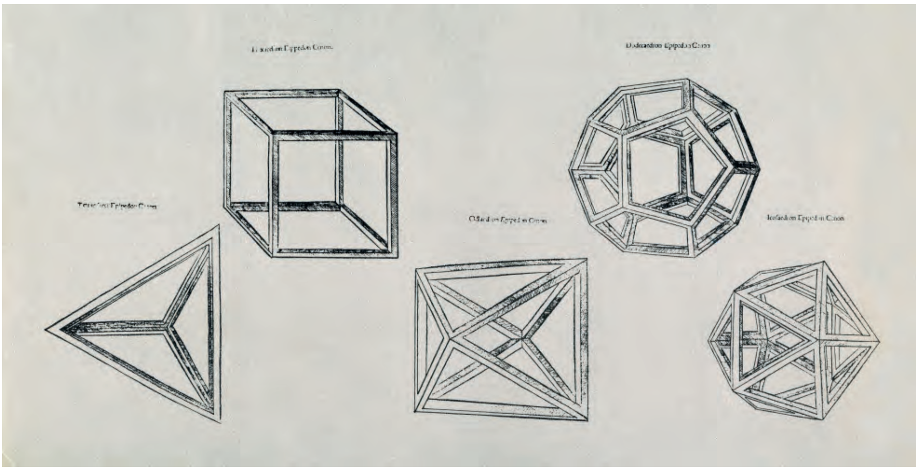

Fig. 19: Leonardo da Vinci's Platonic Solids, 1509, in Anne Griswold Tyng, "Geometric Extensions of Consciousness," 1969.

with earth, the octahedron related to air, the icosahedron to water; and lastly, the dodecahedron, a fifth element added by Plato, represented the all-encompassing receptacle or *aether*. However, these elements and their geometric bodies were not stable, but continually passed into one another through a process of rarefaction and condensation to combine in an array of indefinite proportional relationships, thus, creating the manifold constitutions of the material world.

If it was essentially Tyng who influenced Kahn's interest in such formative matters, three sources from which her own knowledge of these geometrical bodies derived should be mentioned: first, her contact with the German architect Konrad Wachsmann; second, the multi-layered spatial arrangements of Alexander Graham Bell's early flight-machines; and third, the synergetic philosophy of Fuller. Wachsmann, who had immigrated to the United States in 1941, initially awakened Tyng's enthusiasm for modular geometric coordination. After graduation, she worked briefly in his New York office, remarkably at a time when he developed the Mobilar Structure for the Atlas Aircraft Corporation (1945): underneath a wide cantilevering

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architectura libri decem, 1st century BC) VIII, Preface, § 1. Describing a universe that is cyclically generated and destroyed by the opposing forces of love (*philia*) and hate (*neikos*), Empedocles, who according to legend died in the fires of Mount Etna, added to Thales of Miletus's water (*hudor*), Anaximenes of Miletus's air (*aer*), and Heraclitus of Ephesus's fire (*pyr*), the fourth substantial element, earth (*ge*), and clarified: "No, these are all, and, as they course along through one another, now this, now that is born – And so forever down eternity." Empedocles, *Fragments* (Chicago: The Open Court Publishing Company, 1908) Fr.17.

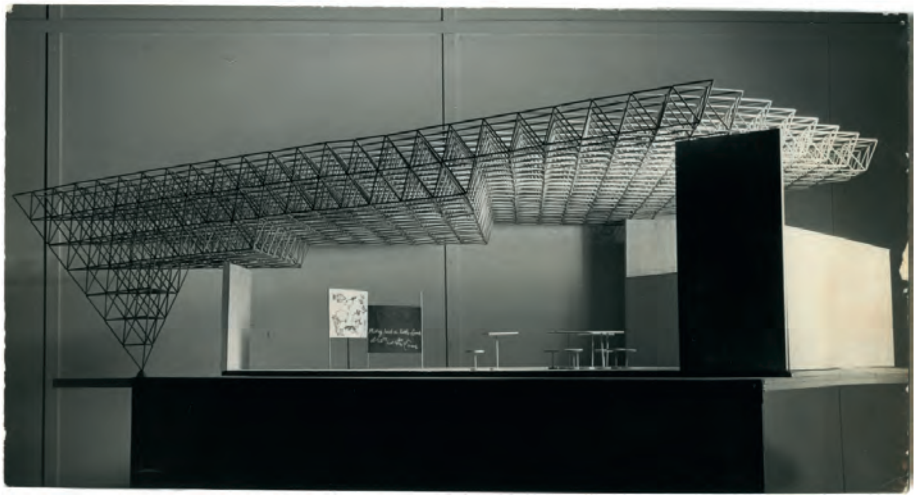

Fig. 20: Anne Griswold Tyng, Elementary School, Bucks County, Pennsylvania, 1949-51.

roof consisting of a single layer triangulated truss, secondary mobile space partitions enabled a flexible division of the ground. Wachsmann's proposal would be influential for Tyng's project of an Elementary School in Bucks County (Figure 20), which she developed independently between 1949 and 1951. Using tetrahedron-octahedron geometry, she recalled,

> instead of being used as a single layered space frame truss, the geometry was thickened in layers toward the point of support to become its own vertical support as a 'tree trunk'.[111]

Tyng's idea to use a multiple layer space-structure was subsequently also taken up by Wachsmann, who, having been contacted by the American Air Force, conceived another, much larger hangar between 1951 and 1954 (Figure 21). Applying industrialized production methods that gave new life to Paxton's credos, he developed a standard unit, which permitted flexibility in arrangement and fast assembly. For Wachsmann, numerous structural cells termed "building molecules" should converge to establish the final shape.[112] He was well aware that this synthesis of smaller elements to form a stronger whole was comparable to Roman masonry construction, where single bricks as "building atoms" arranged in a proper way collectively spanned vast distances.

111 Anne Griswold Tyng, "Louis I. Kahn's 'Order' in the Creative Process," in Alessandra Latour, *Louis I. Kahn: l'uomo, il maestro* (Rome: Kappa, 1985) p. 282.
112 Cf. Konrad Wachsmann, "Ein Konstruktiossystem für Hallenbauten," in *Baukunst und Werkform – Die neue Stadt*, no.9, 1954, p. 549.

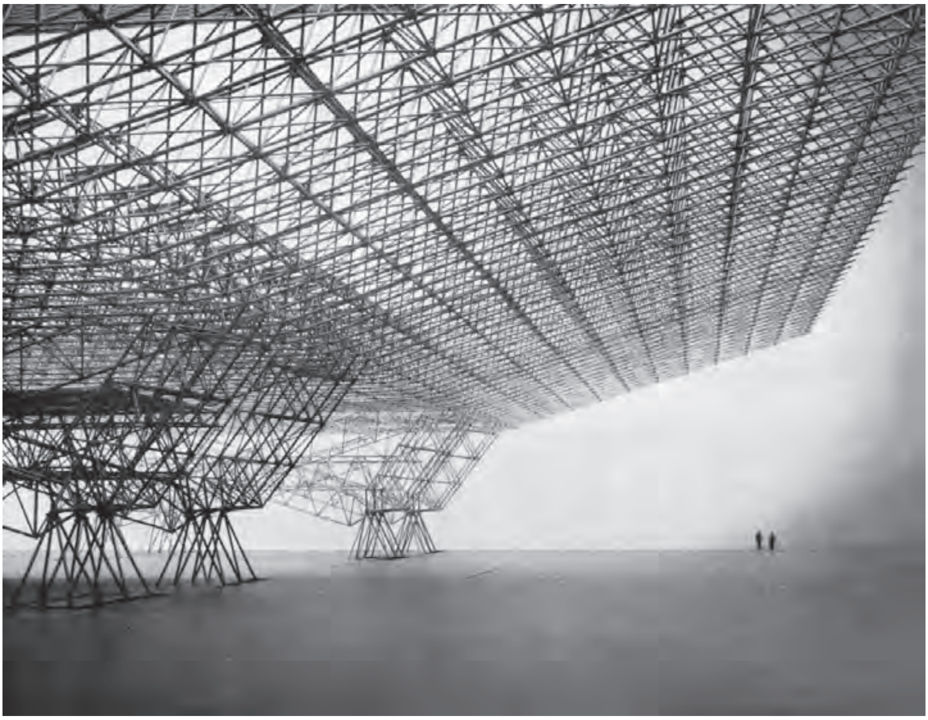

Fig. 21: Konrad Wachsmann, American Air Force Hangar, 1951-4.

Similarly, Bell had been a pioneer in the experimentation with kites of cellular structure such as the tetrahedron-octahedron “Cygnet” (1907) that Tyng used again as an accompanying illustration in “Geometric Extensions of Consciousness” (Figure 22). The American inventor realized that tetrahedral and octahedral cell configurations possessed “three-dimensional strength,” and was astonished by their lightness, but also their functional logic following the *principle of addition*: a large number of single rods, themselves weak, when connected in an appropriate way manifested a much stronger entity.[113]

The case of Fuller is insofar more complicated, as both Tyng, who heard a two-day talk delivered by him at the University of Pennsylvania in 1949,[114] and Kahn,

113 Cf. Beatriz Colomina, Annmarie Brennan and Jeannie Kim, (eds.), *Cold War Hothouses* (New York: Princeton Architectural Press, 2004) p. 159.

114 Cf. Tyng, “Geometric Extensions of Consciousness,” p. 173. Buckminster Fuller lectured on relationships of close-packed spheres with atomic configurations in 1949, printed as *Item 0* by the North Carolina State School of Design in 1955. As indicated in later correspondence between Fuller and Tyng, their families were distantly related through the artist Margareth Fuller Tyng. Cf. Tyng’s letter to Fuller, 27 March 1965, 074.II.A.6, AGTC.

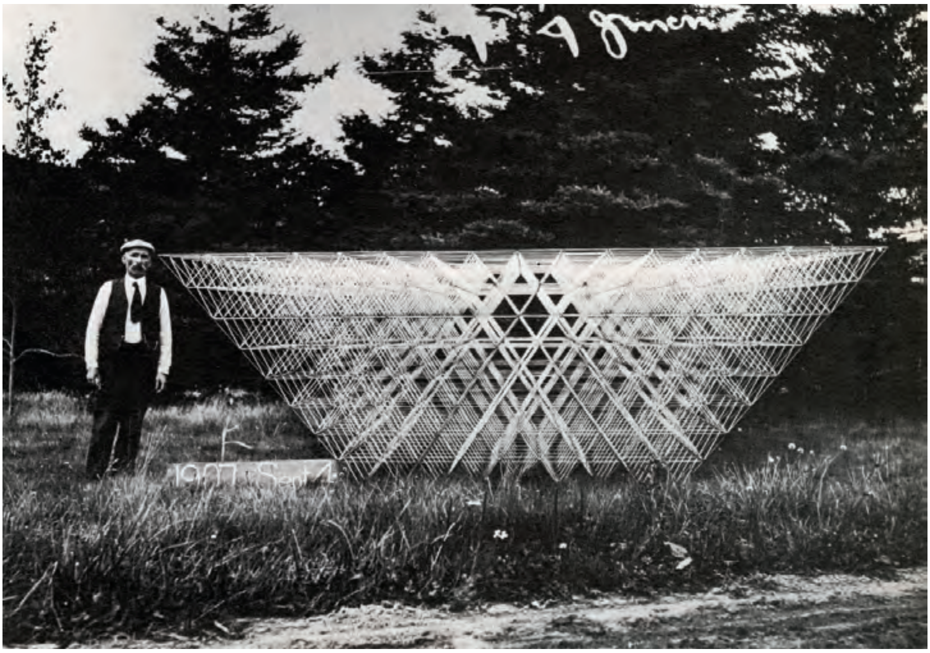

Fig. 22: Alexander Graham Bell, “Cygnet,“ 1907.

who knew him since the early 1930s, were familiar with his ideas.[115] Fuller had been developing his *Dymaxion* philosophy since the late 1920s, which envisioned an industrially fabricated, easily transportable and mountable lightweight house. The Dymaxion House bore no geographical stamp; it just used on-site resources, could be erected within a day and delivered by airplane. In the best sense of optimization, Fuller announced that he had found a way to reap the largest dividend of human advantage from the most economical appliance of energy and material resources. Kahn had become familiar with his concepts during the depression years, when Fuller contributed a series of articles entitled “Universal Architecture” to *T-Square*, and even replaced Howe as editor in 1932. The renaming of the publication as *Shelter* underlined his holistic design approach: Acknowledging the harsh consequences of the economic crisis, but also noticing what potential damages hurricanes, earthquakes, fires and floods might cause, Fuller turned into an early *ecological prophet*. He was alarmed

115 It is possible that Kahn was also aware of Bell before his acquaintance with Tyng, since he remembered becoming “at a very early time very interested in some of the experiments which Graham Bell had made in just the turn of the century, of the concern of those shapes.” Jules Prown and Karen E. Denavit, (eds.), *Louis I. Kahn in Conversation: Interviews with John W. Cook and Heinrich Klotz 1969-70* (New Haven: Yale University Press, 2014) p. 194.

that a “quasi Functional Style,” which was merely dogmatic in its formalism and withdrawn from its original economic roots, was infiltrating the United States.[116] Polemically he interrogated his readers: “How much does your house weigh?”[117]

Fuller’s concept of *ephemeralization* or “doing more with less” derived directly from his observations of sea- and airborne weaponry during his time as a Navy officer. Following the rather one-dimensional military logic that supremacy was to be achieved by carrying the greatest fire power a maximum distance in the shortest time with ever-increasing accuracy, ever lighter and at the same time more stable rockets had to be constructed.[118] Taking into account that all the forces operative in nature resulted in a complex progression of least-effort arrangements, Fuller conceived triangulated webs, which, following a mathematical logic, represented the most economic networks of energy distribution in plane and space. He asserted that tetrahedral forms had been overlooked in man’s illogical obsession with “rectilinearity,” and in his opinion, nature did not use the fragile square, but employed the stable triangle.

The concepts of both mass-produced lightweight house and tetrahedral arrangement were synthesized in Fuller’s research on the Geodesic Dome. Setting a network of 60° parallels across a sphere, his dome-structure unified the structural virtues of both the sphere and the tetrahedron: while the sphere enclosed the most space with the least surface and was strongest against internal forces, the tetrahedron enclosed the least space with the most surface and was most rigid against external pressure. *Synergy*, as Fuller defined it, arose when the behavior of the whole system could not be predicted by any of its parts or subsystems. Thus, being just another term for the principle of addition, synergy produced a compound structure with vastly improved properties. In the summer of 1948, Fuller realized his first geodesic structure at Black Mountain College. Even though it collapsed, he continued his endeavors, and in 1954, the first airlift of a dome took place.[119]

Alongside, a number of scientific discoveries proved Fuller’s assumptions regarding nature’s geometrical coordination to be correct. As early as 1885, Jacobus Van’t Hoff, laying the foundations of mathematical chemistry, had discovered that carbon, a basic constituent of organic life, was tetravalent. During the 1930s, the German-American chemist Linus Pauling discovered via x-ray analysis that metals were tetrahedrally arranged as well, and verified that protein shells were a type of spherical geodesic structure. Furthermore, algae known as *diatoms* and the

116 Richard Buckminster Fuller, “Universal Architecture,” in *T-Square*, vol.2, no.2, 1932, p. 22.

117 Ibid., p. 35.

118 Cf. Richard Buckminster Fuller, *Nine Chains to the Moon* (London: Fever & Simons, 1938) p. x.

119 Fuller’s explorations culminated in the *Biosphere* that he erected at the Expo in 1967. The gigantic dome’s outer layer was inset with transparent acrylic panels that were adjustable via a computer program to allow a controlled amount of light to enter. As a model of a self-contained and hermetically sealed environment, a year afterwards Fuller proposed a giant dome with a radius of one mile to cover New York City.

cornea of the eyeball proved to be structural derivatives of geodesic geometry.[120] Lastly, radiolarians like the appended *Aulosphaera* were akin to geodesic domes (Figure 23).[121] Their polygonal mesh-works of geometric regularity also caught the attention of Thompson, who suggested that their close-packed arrangements followed the rules of *areae minimae*, i.e. that the edges were liable to meet at co-equal angels, usually three at a time, thus forming a basic hexagonal pattern.

1.7 A Breathing Ceiling in a Modernist Setting

Kahn often met with Fuller in 1952, a year in which both made frequent railway trips to New Haven, where they acted as visiting critics at Yale University.[122] Fuller remembered having personally introduced Kahn to certain fundamentals of nature's structuring principles during these journeys.[123] Kahn also took the opportunity to closely observe the erection of a geodesic dome in New Haven between September and November of the same year, and kept a number of images of this event in his slide collection (Figures 24, 25). In the second issue of *Perspecta* (1952), Yale's newly founded architecture journal, Kahn underlined his interest in nature's strategy to obtain efficient structures:

> In Gothic times, architects built in solid stones. Now we can build with hollow stones. [...] The desire to express voids positively in the design of structure is evidenced by the growing interest and work in the development of space frames. The forms being experimented with come from a closer knowledge of nature and the outgrowth of the constant search for order.[124]

As quasi-proof for his argument, in the following issue of *Perspecta* Kahn presented his recently finished design of the Yale Art Gallery (1951-3). He had received its

120 Cf. Richard Buckminster Fuller, "Conceptuality of Fundamental Structures," in Gyorgy Kepes, (ed.), *Structure in Art and Science* (New York: George Braziller, 1965) pp. 72-80.

121 The German zoologist Ernst Haeckel had carefully investigated these minute shell structures built by unicellular organisms called *foraminifera* in the late 19th century.

122 In October 1947, Kahn had become visiting critic at Yale University's School of the Fine Arts, replacing Niemeyer, whose admission to the United States had been blocked due to his overtly communist views. Having rejected a year earlier the opportunity to teach at Harvard, Kahn discovered himself in New Haven in a stimulating atmosphere that included Saarinen, Johnson, Kiesler, Stone, Pietro Belluschi and Paul Rudolph among the faculty.

123 From Fuller's letter recommending Tyng to John D. Entenza, 5 April 1965, 030.II.A.55.42, LIKC. As Stan Allen rightly observed, this shared interest in geometry would ultimately lead to completely opposite results: while Kahn's architecture of compression eventually became defined by solidity, mass and an intrinsic wedding to the ground; Fuller, by contrast, developed structures of pure geometry that were indifferent of place and material. Cf. Allen, "Postscript: R. Buckminster Fuller and Louis I. Kahn," in Daniel López-Pérez, *R. Buckminster Fuller: World Man* (Princeton: Princeton University Press, 2013).

124 Louis I. Kahn and Anne G. Tyng, "Proposed City Hall Building," in *Perspecta*, no.2, 1953, p. 23.

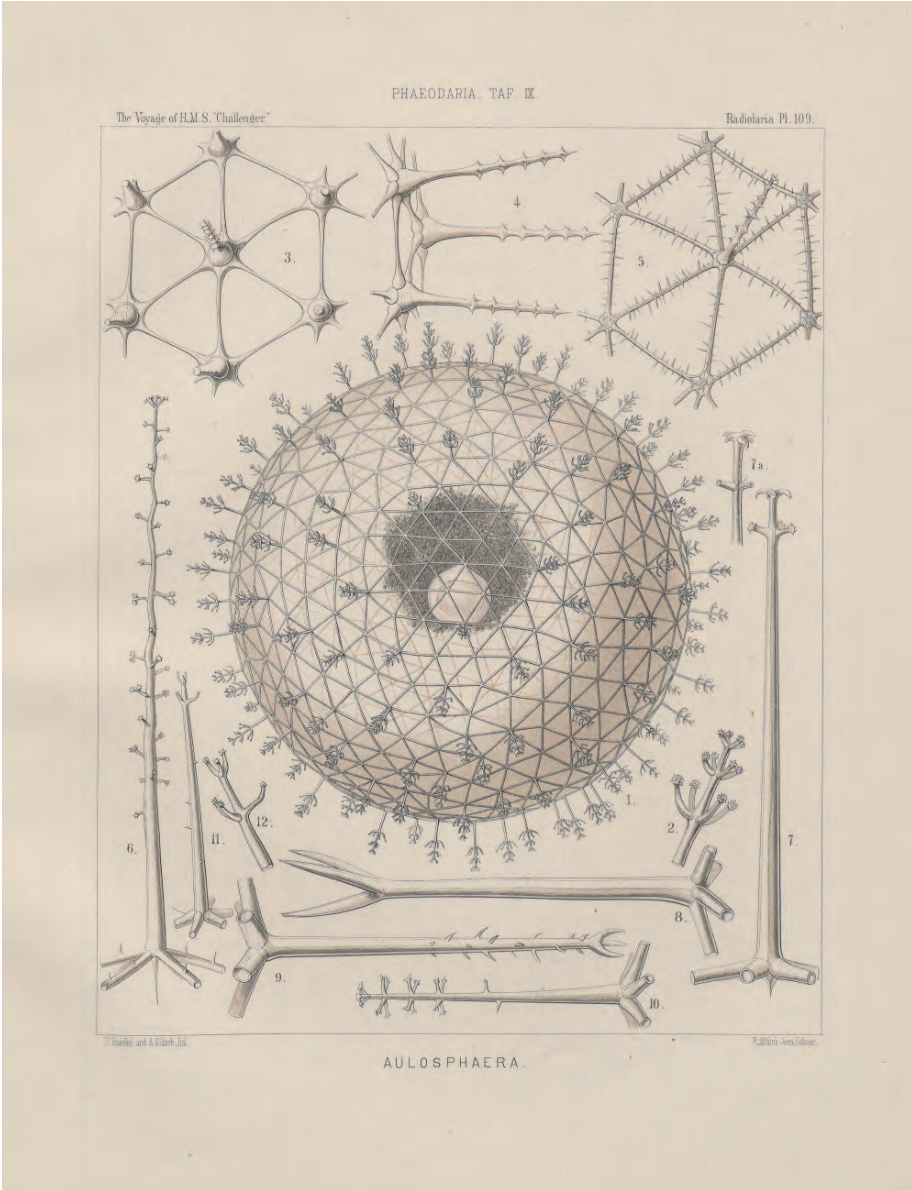

Fig. 23: Ernst Haeckel, *Aulosphaera*, 1873-6.

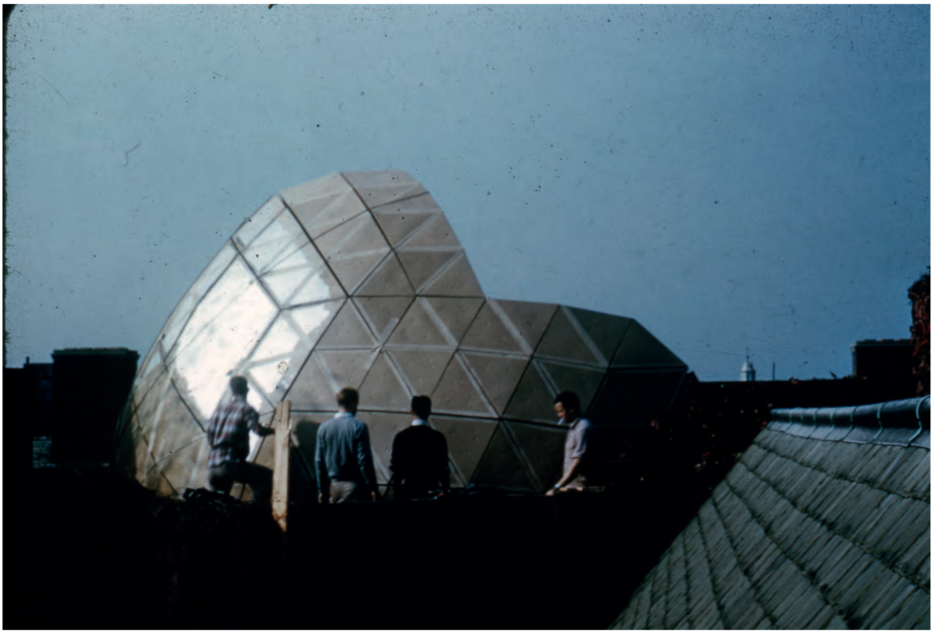

Fig. 24: Richard Buckminster Fuller, Geodesic Dome, New Haven, Connecticut, 1952.

Fig. 25: Richard Buckminster Fuller, Geodesic Dome, New Haven, Connecticut, 1952.

commission, an addition to a historicist Romanesque palazzo by Egerton Swartwout, during a four-month stay as architect-in-residence at the American Academy in Rome. On January 8, 1951, Charles H. Sawyer, the dean of the school, informed Kahn that,

> Philip Goodwin, who has been […] the architect for the Art Gallery building, faces an emergency operation on one of his eyes […] George Howe, Eero Saarinen and I had a meeting here on Sunday and came to the unanimous conclusion that we would recommend to the University an association between you and the office of Douglas Orr […].[125]

Therefore, while in Europe, contemplating the ancient monuments of Italy, Greece and Egypt, Kahn could with pleasant anticipation prepare his return. During his stay in Rome, Kahn came to "realize that the architecture of Italy will remain as the inspirational source of the works of the future." A re-interpretation of the classic works was required, though,

> as it relates to our knowledge of building and needs. […] I find it of little difficulty translating the masonry construction into steel and concrete […].[126]

The Pyramids of Gizeh (c. 25th century BC) especially (Figure 26), "the most wonderful things I have seen so far,"[127] would have an immediate effect upon the upcoming design. Most conspicuously, the Yale Art Gallery openly concealed an artificial lighting and air-conditioning system within a concrete, multidirectional space slab (Figure 27) – a "breathing ceiling" made up of pyramid-like hollow cells that acted as the "servant" element to the "served" exhibition spaces beneath. According to Kahn, the ceiling was

> beautiful and it serves as an electric plug and as a lung. It breathes. Air is forced in through these vent pipes and through the corrugations […].[128]

Distinctly breaking up the two components of the functional and spatial, the loft-like gallery spaces were left undisturbed in the tradition of Mies van der Rohe's universal space. In constructive terms, the concrete space frame – in appearance similar to Fuller's hollowed out triangular structure of the Yale-Dome – was cast-in-place on

125 Sawyer's letter to Kahn, 8 January 1951, 030.II.A.107.42, LIKC. When Goodwin, who had been the partner of Stone in the design of the Museum of Modern Art in New York (1938-9), withdrew, he had initially proposed Johnson to replace him. However, Johnson, too, insisted on Kahn.

126 Eugene J. Johnson and Michael J. Lewis, *Drawn from the Source: The Travel Sketches of Louis I. Kahn* (Cambridge: The MIT Press, 1996) p. 72.

127 "No Pictures can show their monumental impact. They are any color you wish them to be and as clouds pass the movement and change of color is overwhelming." 074.II.A.81-b, AGTC.

128 Louis I. Kahn interviewed by Henry F. S. Cooper, "The Architect Speaks," in *Yale Daily News*, special dedication supplement, "The New Art Gallery and Design Center," 6 November 1953.

Fig. 26: Gizeh Pyramid Complex, Cairo, Egypt, c. 25th century BC. Postcard from Louis I. Kahn to Anne Griswold Tyng, 1951.

Fig. 27: Louis I. Kahn, Yale Art Gallery, New Haven, Connecticut, 1951-3.

prefabricated tetrahedral formworks (Figure 28), and from a structural viewpoint the ceiling defined a parallel chord, multi-planar truss system of equilateral triangles with the entire top surface filled in to provide the actual floor.[129] In order to avoid a construction joint between the floor slab and the space frame, one side of the tetrahedrons was solid, and thus the resulting longitudinal ribs additionally functioned as beams.[130]

The enhanced plans from *Perspecta* show the layout of the reflected ceiling plan with two overlaid transparent layers (Figure 29): the first indicating the ventilation network, the second the electrical ductwork. Pursuing his objective to liberate a maximum of space with a minimum of structure, Kahn also made in the composition of the ground plan a broad distinction between a primary column structure carrying the vertical loads and a non-bearing, but space-defining and functional middle zone. The cylindrical, apparently massive, and freestanding concrete shaft containing a triangular stair fulfilled no structural role, as it did not even touch the ground. This compositional element is noteworthy for several reasons: first, its application of a primary canon of forms; second, its utilization of zenithal light, and third, if structurally activated, it would have been Kahn's first "hollow column," which like the Pillars of Victory erected for Roman emperors accommodated additional uses in their voided hearts.

The reasons for employing concrete – with its plastic properties diminishing the possibilities of synergetic behavior – were primarily pragmatic: on the one hand, as a consequence of the Korean Conflict in 1952, steel had been rationed by the government, and on the other, fireproofing restrictions made a three-dimensional metal space frame impossible. Nevertheless, heated discussions arose concerning the future ceiling. In a meeting on March 11, 1952, the building committee decided to abandon the tetrahedron floor system and proposed to use a common beam and slab floor system instead. The committee found no justification in Kahn's proposed system, as it made 90% more use of steel and required three times as much formwork at a higher unit cost. In their opinion, the depth-weight ratio was far from optimized due to the thickening of the concrete beyond theoretical requirements to satisfy local fireproofing regulations, and real-size test structures had to be built.[131] Dean Sawyer, however, stuck to Kahn's proposal, considering it worth the additional costs

129 Cf. Description of the structural system by the consulting engineer Henry A. Pfisterer, 23 February 1954, 030.II.A.107.42, LIKC. The Philadelphian office of Keast & Hood assisted Pfisterer, the local engineer. Within their team, Nicholas Gianopulos was responsible for the mathematical analysis of the tetrahedral structure. However, "the analytical tools to assess the structure did not exist yet," and "the only way to test it was to build a full-size model, load it with sandbags, and measure it with instruments." Wendy Lesser, *You Say to Brick: The Life of Louis Kahn* (New York: Farrar, Straus and Giroux, 2017) p. 139.

130 Cf. Vernon Read's draft "Tetrahedral Floor System" for *The Architectural Forum*, 030.II.A.107.44, LIKC.

131 Cf. H. D. Palmer, memorandum of the meeting "The Tetrahedron Floor System," 11 March 1952, 030.II.A.107.42, LIKC.

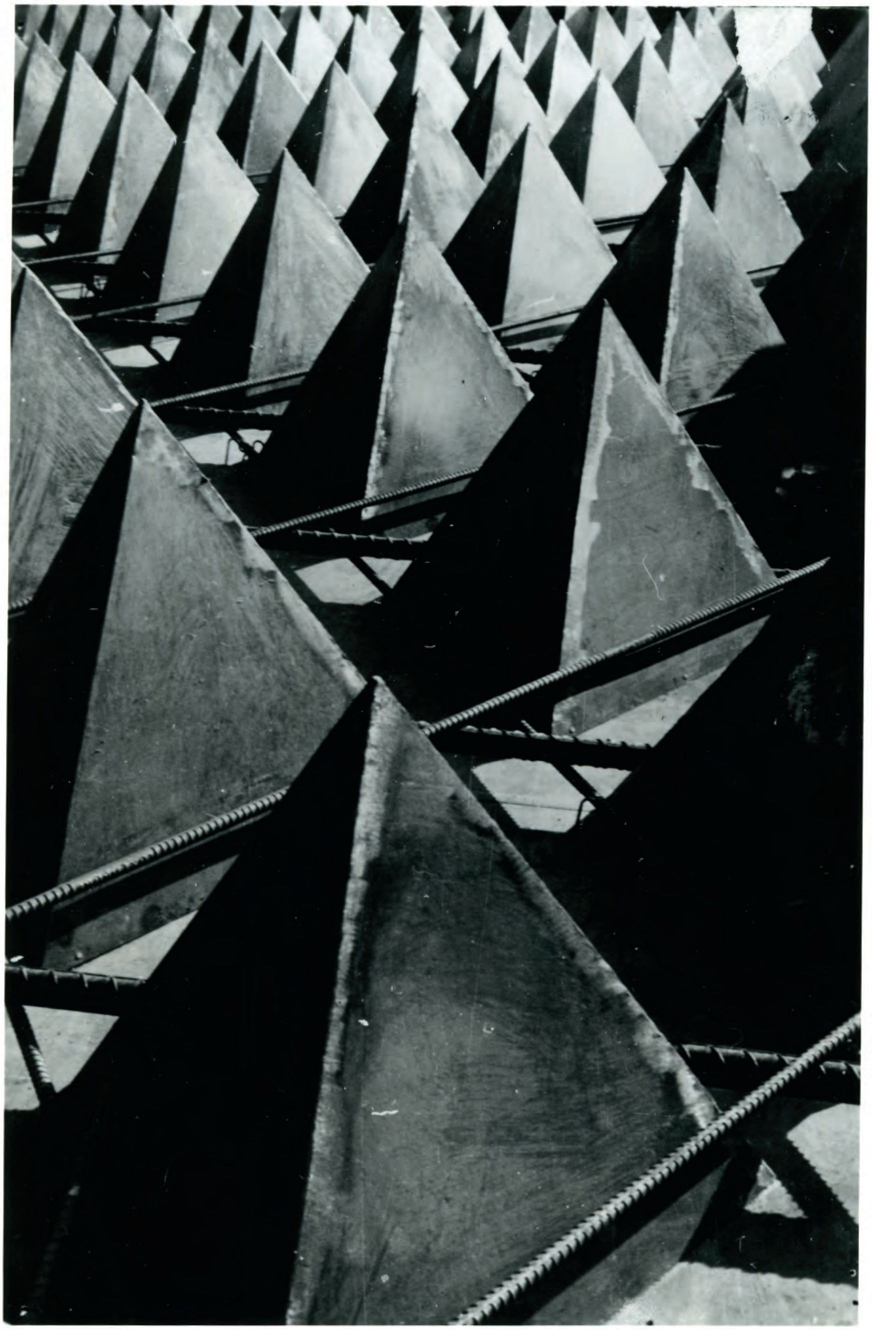

Fig. 28: Louis I. Kahn, Yale Art Gallery, New Haven, Connecticut, 1951-3.

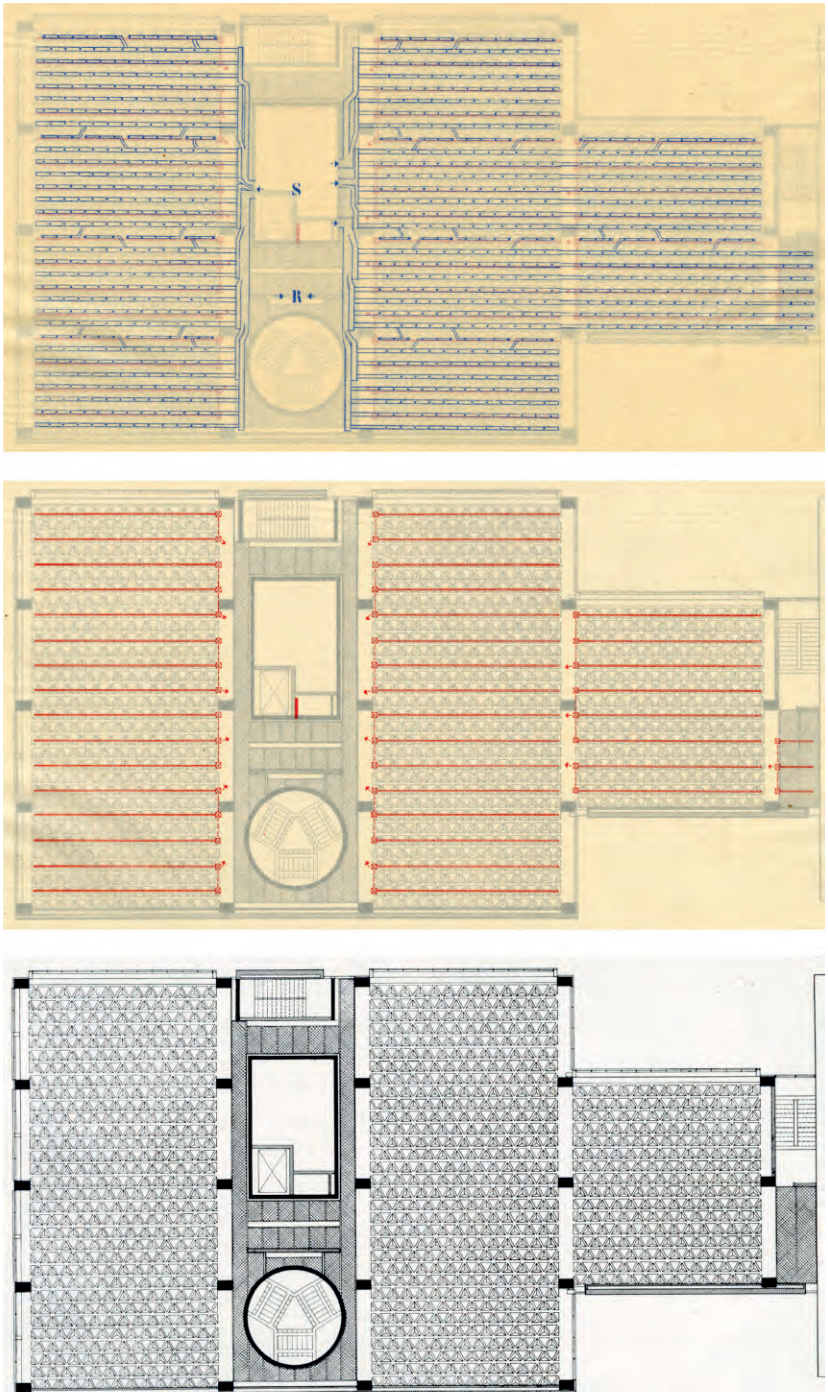

Fig. 29: Louis I. Kahn, Yale Art Gallery, New Haven, Connecticut, 1951-3.

and structural complications involved. He defended the multifunctional ceiling by pointing out that it first, gave a greater sense of space; second, provided better acoustical properties; and third, allowed for a flexible distribution of light.[132]

What Kahn did not foresee in his conception was the simple fact that the space could be altered and changed. Having learned from the dispute with his colleague Paul Rudolph, who in 1956 had modified the flexible space divisions without consulting him, Kahn tried to abandon similar spatial continuums in the future. In fact, many of the Modernist principles he had applied in this first significant public commission of his career were questioned in later projects. Altogether, the gallery building was absolute in its contextual placement: from the south, the bare brick façade, attached like a mask to the inner skeletal structure (Figure 30), was a monumental urban statement.[133] In contrast to its emphasis on tactile properties stood the otherwise more visually appealing usage of glass and steel that opened the gallery towards the west and north with its annexed sculpture gardens (Figure 31). A truly integrative setting between context and building was denied; in fact, nature was actually repelled by mirroring, as in Mies van der Rohe's buildings on the IIT campus (Figure 32). Principally developed from the inside out, the building was quiescent and resolute in its outer appearance. Its architecture of complete encapsulation called for technical assistance and foreclosed an open dialogue with the natural surroundings.

It should be noted, however, that Kahn put considerable effort into the planning of the northern sculpture garden – a kind of terraced landscape with concrete and masonry walls projecting outwards from the building to connect the garden and the building – as the accompanying drawing and letter to Lamont Moore, a local consultant, indicates (Figure 33). In this intermediate scheme, Kahn proposed the planting of ivy against the garden's northern wall, and the placement of five crabapple trees with a small fountain on the terrace next to it, which together would produce a "green wall" facing the Gallery. Kahn's actual landscape architect on the job was Christopher Tunnard, the author of *Gardens in the Modern Landscape* of 1938, the principal manifesto on landscape architecture in the first half of the 20th century.

Tunnard had started teaching at Harvard in 1939, and he remained there until the outbreak of the war. Afterwards, he received an invitation from Yale to conduct research on city planning, during which time he also encountered Kahn, since they co-taught a course in the fall semester of 1952. Tunnard gave Kahn further advice on the South-West Temple and Poplar Redevelopment and Housing Scheme (1950-2; not built), which formed part of the larger Mill Creek Redevelopment Plan (1950-54) in Philadelphia. On this occasion, they developed the "greenways" concept that should prefigure Kahn's "city of movement" (Plan for Midtown, 1952-3). The greenways were

132 Cf. Sawyer's letter to Kahn, 17 April 1952, 030.II.A.107.42, LIKC.

133 Only three stripes of dripstones gave a certain measure of scale: "As a matter of fact, I considered rain so important that I did not want it to wet the wall for so many feet, so I stopped the rain from wetting the wall every so often with a little wash." Prown and Denavit, *Kahn in Conversation*, p. 30.

Fig. 30: Louis I. Kahn, Yale Art Gallery, New Haven, Connecticut, 1951-3.

Fig. 31: Louis I. Kahn, Yale Art Gallery, New Haven, Connecticut, 1951-3.

Fig. 32: Mies van der Rohe, Illinois Institute of Technology, Chicago, Illinois, 1938-58.

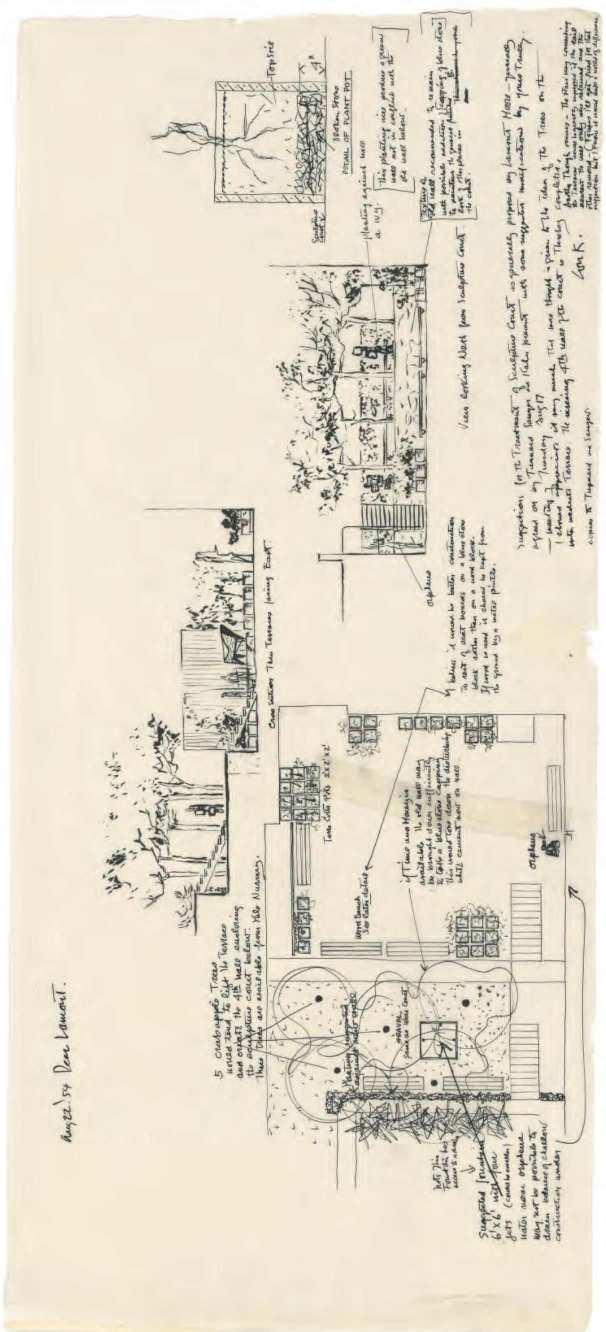

Fig. 33: Louis I. Kahn, Yale Art Gallery, New Haven, Connecticut, 1951-3; Landscape Design by Christopher Tunnard.

intended to turn the central axes of the urban proposal into lushly planted and shaded promenades, to connect important landmarks, and to produce a network of greenery for common use in the city fabric.[134]

Originally from Canada – although he spent his formative years in England – Tunnard, like Kiley, Rose and Eckbo, sought to extend Modernism's rational approach to the planning of landscapes and gardens:

> Just as the design of the locomotive, the aeroplane, and, for that matter, the modern house, is being changed by scientific invention, in a similar way science will transform the garden of the future.[135]

Eschewing all the ostentatious rhetoric of both formal and informal gardening styles,

> [t]he modern garden should be the logical outcome of the principle of economy in statement and the sociological necessities which have influenced modern architecture.[136]

Altogether, for Tunnard, the functional was not really a question of style, but rather an attitude expressing fitness in response to utilitarian purposes. Both his garden designs for Bentley Wood in Halland, Sussex (1935; architecture by Serge Chermayeff) and for his own residence at St Ann's Hill in Chertsey (1936-7; designed by Raymond McGrath) turned out to be perfect examples of how Modern houses and gardens could coalesce within the context of grander picturesque estates. The same holds true for the Yale Art Gallery: while on an experiential level the rupture between an artificial interior climate and the exterior reality was as sharp as the thin layer of glass dividing it, in terms of integrating the project within the wider environment, Tunnard's Modernist approach helped unify both the building and garden as it used the same underlying formal logic.

134 Cf. Eleanor Smith Morris, "New Urban Design Concepts: Greenways and Movement Structures – The Philadelphia Plan," in *Architects' Year Book*, no.11, 1965, pp. 26-40.

135 Christopher Tunnard, *Gardens in the Modern Landscape* (London: The Architectural Press, 1948; 1938) p. 62.

136 Ibid., p. 75. The resulting asymmetry was emphatically understood as deriving from far-Eastern models of spiritual balance. According to Tunnard, landscape architects were again to incorporate the directives of contemporary art as well – the abstract and fluid tendencies in the work of Joan Miró, Wassily Kandisky or Paul Klee, for instance – just as in the past they had profited from painters such as Poussin or Le Lorraine, and later, from Monet or Van Gogh.

1.8 New Unity of the Arts and Sciences

A pivotal aspect of the Yale Art Gallery was its blatant revealing of the mechanical entrails and material traits. No trace of the construction process was concealed; the undisguised formwork imprints of the narrow, vertical wooden boards remained visible and everything spoke of genuine being and truth. For Kahn, in an Existentialist sense, a building was "a struggle, not a miracle, and the architecture should acknowledge this."[137] Kahn – himself marked by facial scars from a severe fire accident he had as a child – in revealing the authentic nature of materials and by not hiding the mechanical services, strongly opposed Modern practice that had stashed away all technological aids. Searching for reasons for his unveiling of the supportive intestines, he stated:

> I do not like ducts; I do not like pipes. I hate them really thoroughly, but because I hate them so thoroughly, I feel they have to be given their place.[138]

The forthrightness of Kahn's project made apparent a central contradiction within Modernist ideology: having preached truthfulness and straightforwardness above all matters, the International Style visually denied the existence of the devices that artificially controlled its interior atmospheres. A major flaw, Modernism's *Achilles heel* so to speak, had been uncovered: in order to achieve its pure volumes and flexible spaces, *honesty*, one of the movement's most basic imperatives, was flouted.

Different contemporary developments informed Kahn's sincere architectural expression. During his stay at the American Academy, Kahn had visited the construction site of Le Corbusier's Unité d'habitation in Marseille (1945-52). With its *béton brut* aesthetic, the Unité appeared rather hand crafted than machine made,[139] and the sculptural foul-air stacks on the roof announced visibly its mechanical core. In America, *Abstract Expressionism* – derived from *art brut* and *tachisme* in France – emerged as a major creative outlet in the post-war years. Willem de Kooning, a seminal exponent of the movement, joined the Yale faculty in 1950. Besides, the German artist Josef Albers, a former Bauhaus educator who later taught at Black Mountain College, arrived at Yale following Kahn's suggestion.[140] Albers prompted his students to focus

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137 Cooper, "The Architect Speaks."

138 Louis I. Kahn, "Not for the Faint-Hearted," in *AIA Journal*, vol.55, no.6, 1971, p. 31.

139 William S. Huff recalls an anecdote regarding a visit of Le Corbusier to the United States that he had also told Kahn: "Why do you people have all those fussy little boards in your concrete?' The reply was, 'Because you do it, master.' Corbu then said, 'But you have all that wonderful plywood that comes in great sheets; in Europe we are poor and must use old floor boards, taken up from buildings being demolished, for our formwork." Latour, *l'uomo, il maestro*, p. 423.

140 Kahn helped persuade Albers to join the Yale faculty, first as a visiting critic in 1949 and later as a full-time professor. Cf. Pelkonen, "Toward Cognitive Architecture," p. 139. In late 1949 and early 1950, they co-taught a course called "An Idea Center for Plastics." Kahn outlined in the brief that it should be a "setting for the demonstration of the effect that light, color and force can have on plastics on the creation of objects that were not representations of something else, but rather presences in themselves; that is, paintings or sculptures should be treated as *things*, not signs. The German artist encouraged his students to discover that there was "no extraordinary without the ordinary," and heightened their awareness of unfinished artifacts during the artistic process.[141] Working with basic geometric forms that slowly transformed into more complex patterns, also for Albers' wife Anni artistic creation did not imply "the desire to do something, but listening to that which wants to be done, the dictation of the materials."[142]

Adding the work of the British architect couple Alison and Peter Smithson, who in their Hunstanton Elementary School (1950-4) had openly revealed the buildings' electrical conduits, plumbing devices and sanitary fixtures, a general countertendency to the smooth and stereotyped buildings of the International Style appeared. Initially grouped by Reyner Banham in his article "The New Brutalism" in 1955, the Brutalists based their approach on the "valuation of materials for their inherent qualities 'as found'."[143] The Smithsons in particular endeavored to construct a genuine rhetoric from the raw facts of reality, or as Alison recalled: "We were concerned with the seeing of materials for what they were, the woodenness of wood, the sandiness of sand."[144] As part of the Independent Group with the photographer Nigel Henderson and the artists Eduardo Paolozzi and Richard Hamilton, their new empiricism approached poetically the prosaic normality and willingly accepted the *ugly solution* that answered the *ugly problem*. In 1951, still a student, Hamilton had organized the "Growth and Form" exhibition at the I.C.A. under the conceptual lead of Henderson (Figure 34). In their opinion, modern science had

> made available a rich world of new forms and opened up a new source of inspiration to artists and industrial designers. Owing to the cleavage between science and art, this material, potentially revolutionary in its significance for modern design, has not yet been sufficiently noticed.

Presenting models, images and two films – one showing the growth of a snow crystal and the other the development of a sea urchin – the exhibition included

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of various shapes and textures." Proposal for Collaborative Problem to be discussed at Meeting, 9 July 1949, 030.11.A.61.27, LIKC.

141 Cf. Sarah Williams Goldhagen, *Louis Kahn's Situated Modernism* (New Haven: Yale University Press, 2001) pp. 48-52.

142 Anni Albers, "Constructing Textiles," in *Design 47*, no.8, April 1946, p. 22.

143 Reyner Banham, "The New Brutalism," in *The Architectural Review*, vol.118, no.708, December 1955, pp. 354-61. Banham extended his observations in *The New Brutalism: Ethic or Aesthetic* (New York: Reinhold Publishing Company, 1966).

144 Sarah Williams Goldhagen, "Freedom's Domiciles: Three Projects by Alison and Peter Smithson," in Goldhagen and Réjean Legault, (eds.), *Anxious Modernisms: Experimentation in Postwar Architectural Culture* (Cambridge: The MIT Press, 2000) pp. 75-95. Smithson's statement is almost a paraphrase of Frank Lloyd Wright: "I now learned to see brick as brick, to see wood as wood, and to see concrete or glass or metal." Wright, *An Autobiography* (New York: Barnes & Noble, 1998; 1932) p. 148.

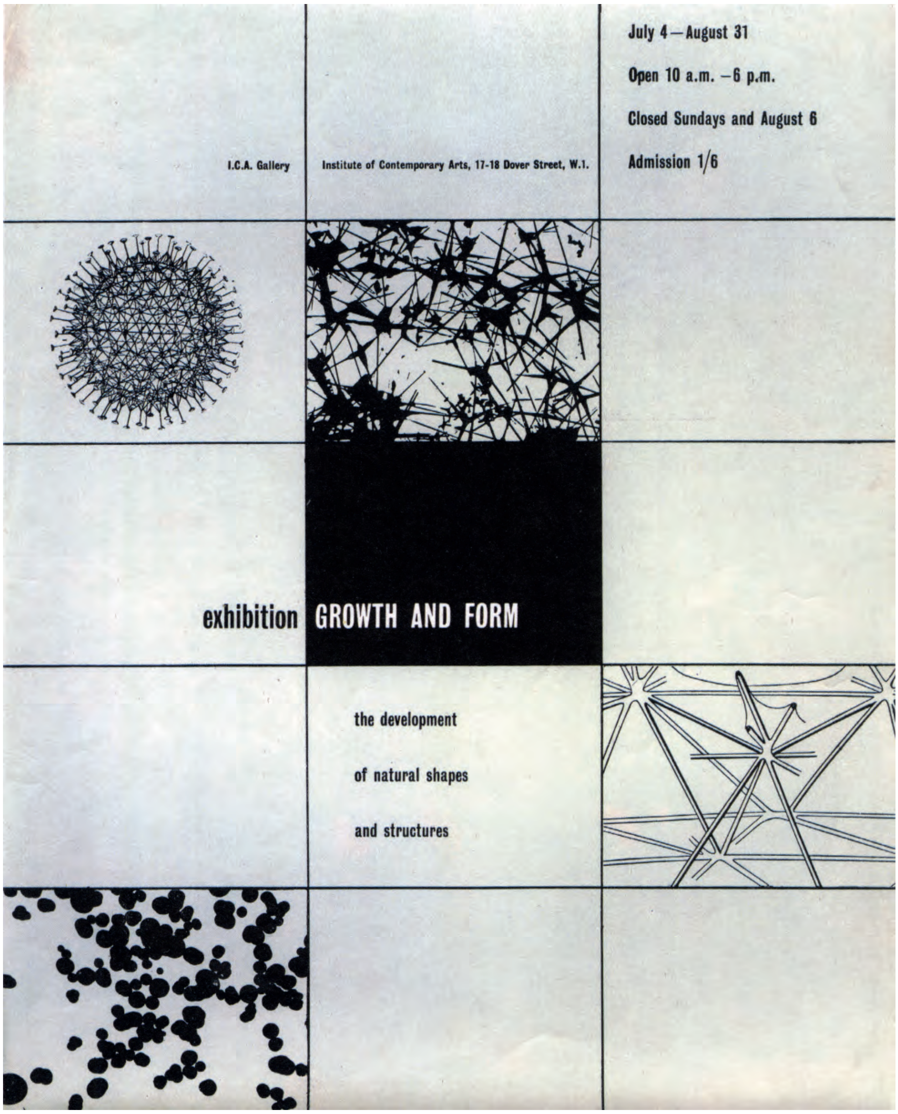


Fig. 34: Poster of the Exhibition “Growth and Form,” Institute of Contemporary Arts, London, England, 1951.

mathematical forms, atomic particle traces, plankton, vertebrates, a molecular model of dicalcium silicate, a photomicrograph of a lobster, an electronic micrograph of a rabbit, and a radiograph of a nautilus shell. Le Corbusier, delivering the opening speech, remembered being deeply moved by the show, as it represented a new “unity of thought:”

> Earlier this evening before coming to the microphone, I was taken into a hall which is small as the Dome of Discovery is large. It is the Gallery where the 'Growth and Form' exhibition is held and there again I was enchanted.[145]

In the Independent Group's follow-up exhibition "Parallel of Art and Life" (September 11 to October 18, 1953) at the I.C.A. – with an x-ray image on the poster of a man shaving that was borrowed from Moholy-Nagy's *Vision in Motion* (1947; Figure 35) – this fascination with the *visuality* of science was further developed through the juxtaposition of images taken from life, nature, industry and the arts. The bewildering confrontation enabled a simultaneous grasp of the entire visible and invisible spectrum attainable by contemporary technological means. Insisting on the significance of technology, which had enabled the artist to expand his field of vision to a new dimension, the Group's intention read as follows:

> The exhibition will provide a key – a kind of Rosetta stone – by which the discoveries of the sciences and the arts can be seen as aspects of the same whole. Related phenomenon, parts of that New Landscape which experimental science has revealed and artists and theorists created.[146]

Coincidentally these new territories of scientific inquiry had also been exposed two years earlier at an American exhibition directed by Gyorgy Kepes. A Hungarian polymath and former student of Moholy-Nagy, Kepes had immigrated in 1937 and joined his teacher at the New Bauhaus. In the spring of 1951, the same year that Kahn met him while serving on a jury at Yale, "The New Landscape" exhibition opened at MIT,[147] (Figure 36) where Kepes had been teaching since 1947. Once again juxtaposing works of art and science, the numerous telescope, x-ray and electronic microscope images stressed the fact that human beings only perceived the world through a narrow filter. Beyond that lay another fascinating universe; yet, in order to make it discernible, mankind relied on the most up-to-date technological aids. Both exhibitions signalized that the time was ripe for a more encompassing architectural expression – a new Renaissance – that regarded the arts and science in mutual cohesion.

Among the numerous visualizations presented at these exhibitions, the internal bone structure of a vulture's wing was especially informative for Kahn. He kept a depiction of it with an enclosed delineation of the radiolarian *Aulonia hexagona* (Figure 37) – both taken from a page in Whyte's *Aspects of Form* – in his slide collection.[148] Nature's octet truss, just like Kahn's ceiling in Yale worked through

145 Anne Massey and Gregor Muir, *Institute of Contemporary Arts, 1946-1968* (London: ICA, 2014) p. 48.
146 Claude Lichtenstein and Thomas Schregenberger, (eds.), *As Found: The Discovery of the Ordinary* (Baden: Lars Müller, 2001) p. 39.
147 Cf. Gyorgy Kepes, *The New Landscape in Art and Science* (Chicago: Paul Theobald, 1956).
148 Cf. Conrad Hal Waddington, "The Character of Biological Form," in Lancelot Law Whyte, (ed.), *Aspects of Form: A Symposium on Form in Nature and Art* (Bloomington: Indiana University Press, 1968; 1951) p. 53. Both images were originally published in Thompson, *On Growth and Form*, p. 708 resp. p. 981.

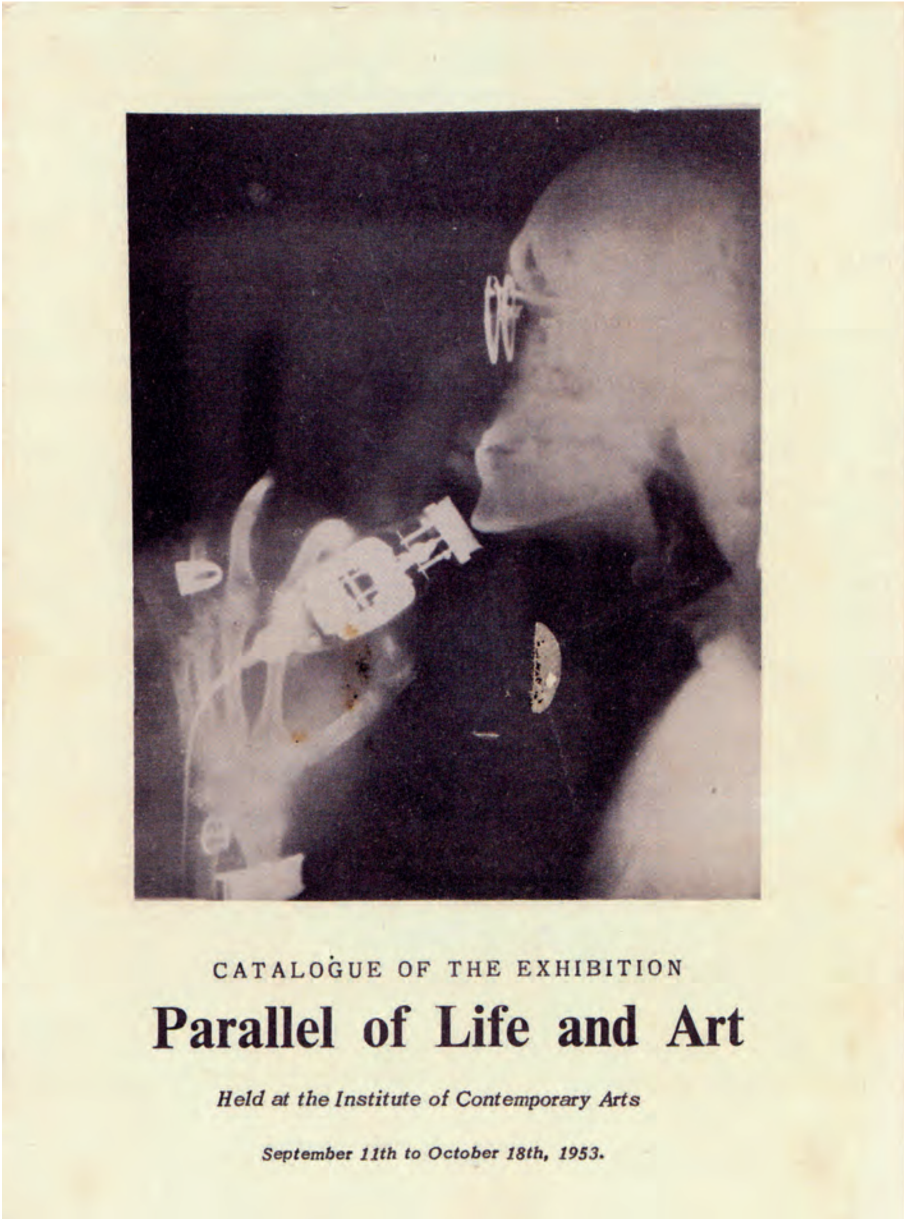


Fig. 35: Cover of the Exhibition-Catalogue “Parallel of Art and Life,” Institute of Contemporary Arts, London, England, 1953.

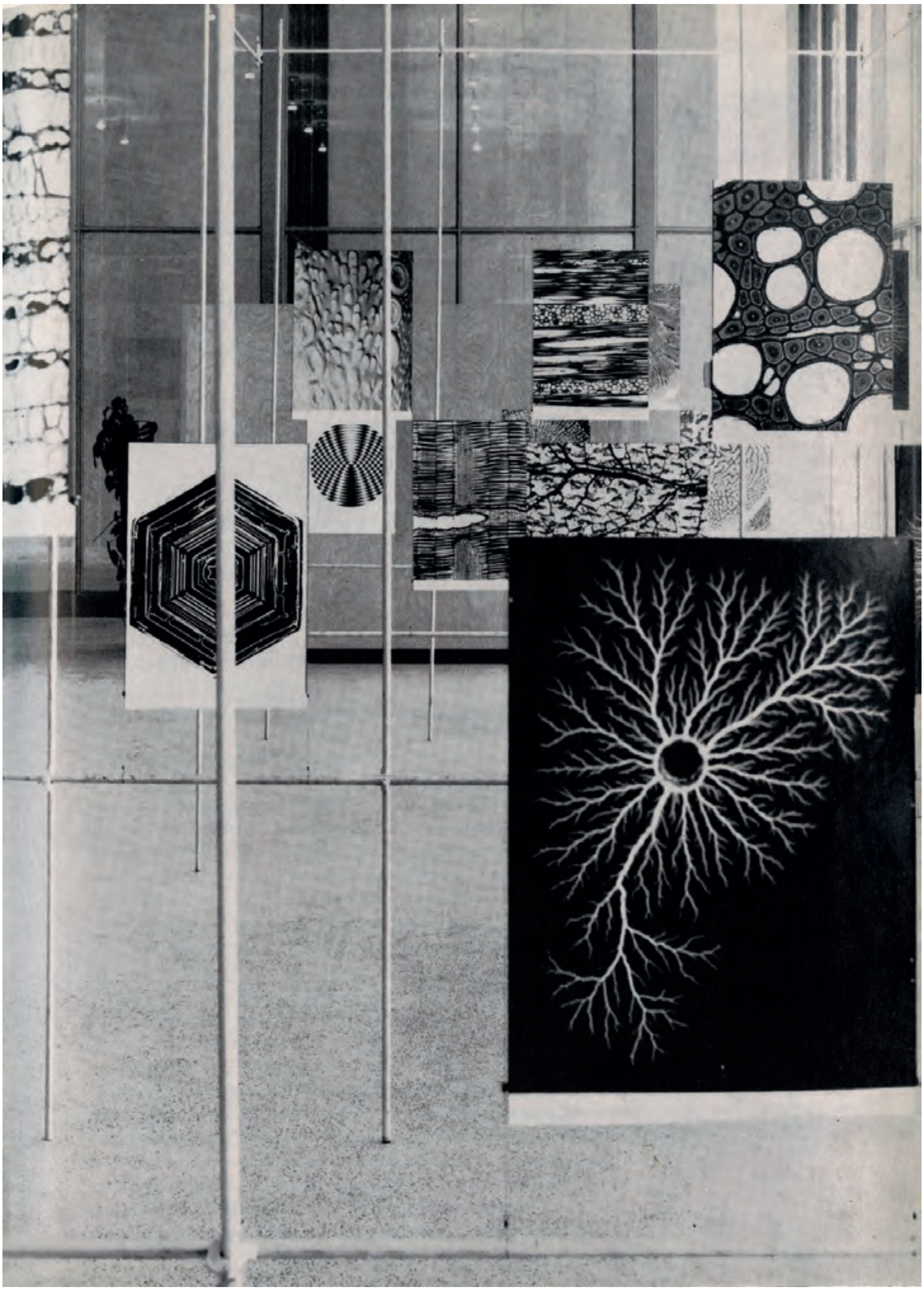


Fig. 36: Exhibition “The New Landscape,” Massachusetts Institute of Technology, Boston, Massachusetts, 1951.

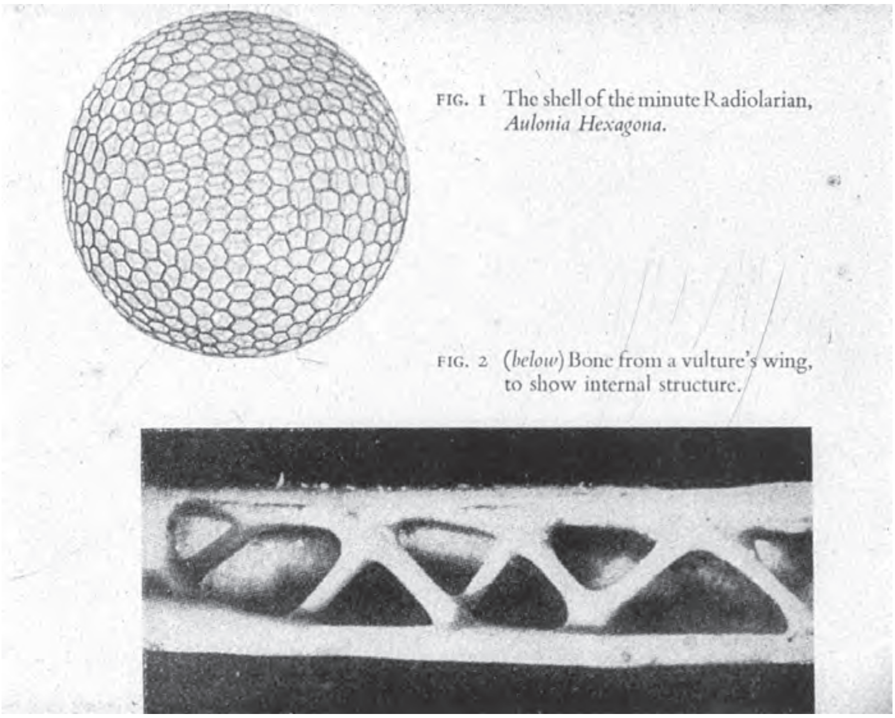


Fig. 37: *Aulonia hexagona* (top) and Bone Structure of a Vulture's Wing (bottom), in Lancelot Law Whyte, *Aspects of Form*, 1951.

a unification of the principles of continuity and addition. In Kahn's case, while following the logic of addition in terms of the geometrical arrangement, his hollow ceiling did not incorporate synergetic modes of behavior due to the presence of a uniform material. Thus, Kahn effectively neutralized both concepts of continuity and addition to transform them into a novel state of *connectivity*.

Furthermore, Kahn's ceiling structure assimilated with the unconditional clarity of the Concrete Gothicism as it had emerged in the work of Nervi. Following the example of Giacomo Matté Trucco's Fiat Factory in Lingotto of 1926 (Figure 38), the Italian architect-engineer repeatedly employed a pattern of concrete ribs in his works to rigidify the lines of stress. For instance, the Gatti Wool Factory in Rome of 1953 (Figure 39), of which Kahn kept a clipping in his notes, corresponded in its distribution of ribs with the natural configuration of a leaf's spandrels, both reflecting the paths of gravity acting on them. In addition, Nervi's dome structures and airplane hangars near Rome from the late 1930s (Figure 40), of which Kahn also kept illustrations in his slide collection, functioned in a hierarchical order similar to Kahn's design, since a spacious nervature reinforced a peripheral plate.

Fig. 38: Giacomo Matté Trucco, Fiat Factory, Lingotto, Italy, 1926.

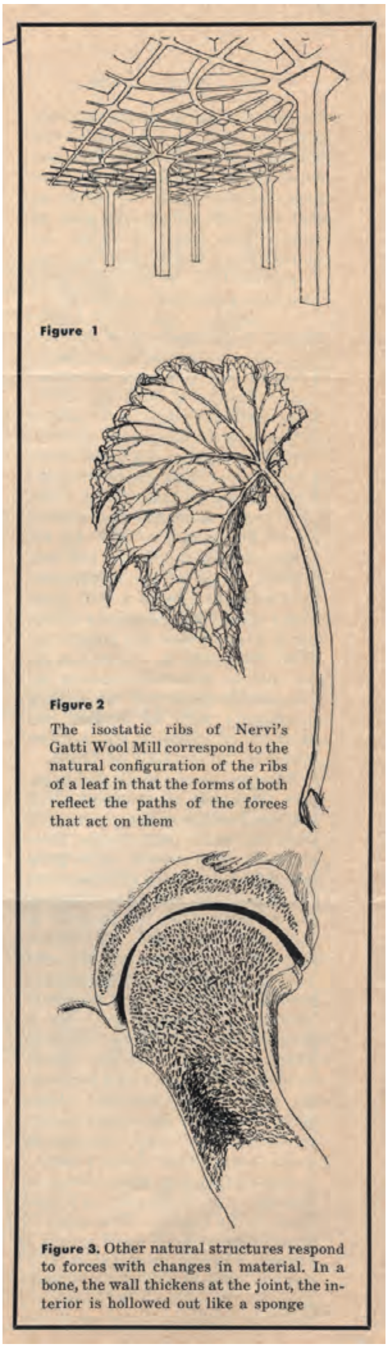


Fig. 39: Comparison of Pier Luigi Nervi's Gatti Wool Factory, Rome, Italy, 1953 (top) with a Leaf's Ribs (middle) and a Joint (bottom).

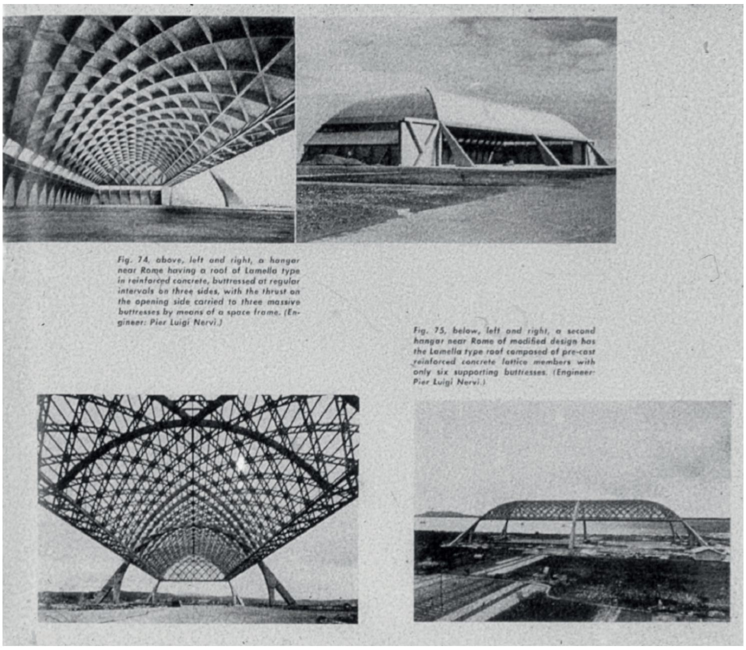


Fig. 40: Pier Luigi Nervi, Hangars in Orvieto (top: 1935-8) and Orbetello (bottom: 1939-42), Italy.

Emphasizing the importance of Nervi, it is crucial to add that in 1953, while still working in Kahn's office, Tyng applied for a Fulbright scholarship in Italy. The draft outline indicates her definitive awareness of the entire scope of contemporary developments in structural engineering. Tyng wanted to study, as it reads,

> man's architectural achievements spanning more than four thousand years. I have chosen Italy because it is the country, which perhaps possesses the most comprehensive examples of this evolutionary process, from the primitive 'beehive' huts of Trulli, Alberobello to the huge three-dimensional structures of the Italian engineer Pier Luigi Nervi. [I]n Italy and Rome especially, I hope to see the numerous examples of structures built for the needs of service and movement, forums and markets, early bridges and elaborate water works. I also hope to see the early three dimensional structures of groined vaults and domes, experimental and intuitive in their designs, and the recent examples of huge stadia, aqueducts and especially, Nervi's airplane hangars at Rome and his exhibition hall in Torino. These three dimensional structures, based on the principle of continuity pioneered by Maillart in Switzerland and Freyssinet in France, seem more advanced to me than the structures of Torroja in Spain, Samuely in England, and the work of Fuller and Wachsmann in this country.[149]

149 Draft on purpose of visit in Italy, 074.II.A.48, AGTC. Tyng did not receive the grant to study in Italy or her second choice France. She was offered a Fulbright scholarship to Finland or Germany, which she declined. Cf. Letters between Tyng and the Institute of International Education, 074.II.A.48,

Fig. 41: Apollodorus of Damascus, Pantheon, Rome, Italy, c. 126 AD.

Roman shell structures in particular attracted Kahn's interest, too. Frequently referring to the grandness of the Baths of Caracalla, Hadrian's Villa (early 2nd century AD) or the Pantheon by Apollodorus of Damascus (c. 126 AD; Figure 41), all shared in common the use of Roman concrete to span hitherto insurmountable distances.[150] The use of layered coffins reduced the weight of the soaring ceilings, and in contrast to the perfect interior shape, the exterior silhouette was not hemispherical, but bowl-shaped in order to reduce the load of the shell from top to bottom. At the same time, the stony aggregates used in the concrete mixture decreased in weight in correspondence

AGTC. Ultimately, she went to Italy on her own. Cf. Anne G. Tyng, *Louis Kahn to Anne Tyng: The Rome Letters 1953-1954* (New York: Rizzoli, 1997) p. 69; letter 2 December 1953.

150 By no means were the Romans the first to employ domes, but they substantially increased their size by changing the structural logic from one of addition to one of continuity. Already in Jericho during the Mesolithic period (c. 8350-7350) existed round and oval mud-brick houses that supported domed superstructures of clay-covered branches. Beehive-shaped *tholoi* in Arpachiyah (Mesopotamia, early 4th millennium BC) or in Khirkokitia on Cyprus (at least 5000 BC) with corbelled mud-brick domes indicate the continuous experimentation with such structures on a domestic scale. With the historic period, the Babylonians just like the Egyptians and later the Greeks, concentrated upon the outer effect of their temples as imposing artifacts in the landscape, since public contact with the deity in the shrine had drawn to a close. In Roman times with the rise of Christianity that urge reappeared and found immediate expression in the public scale of its interiors.

with the increasing height.[151] In sum, these preeminent examples of optimization epitomized structural ease and spaciousness.

However, in America Kahn remained an exception in the use of concrete in space frame configurations. In the General Motors Technical Center in Warren, Michigan (1948-56), Saarinen combined the structural depth of a welded steel truss with the horizontal distribution of the mechanical conduits. Comprehending the ceiling as a multi-purpose membrane, Saarinen, just like Kahn, set in place a diaphanous space that was free from any obstructions. Similarly, Mies van der Rohe, who at the time was sharing a studio at IIT with Wachsmann, elaborated his conception of the universal space in combination with a space frame structure. His investigations coalesced in the unrealized design for a Convention Hall in Chicago (1953-4), where a nine-meter high octet truss covered a quadratic space of heroic dimensions. Kahn was well aware of this project, as a letter to Tyng indicates:

> I keep dreaming about our space frames which are more and more important. Evidence of their importance is appearing in several places. […] Mies van der Rohe put out an analyzed (tetrahedron) roof frame 600' x 600' with no columns on the inside.[152]

At the time of the Yale Art Gallery's construction, Kahn was also in contact with two of the European pioneers of space frame construction: the English Samuely and the French Le Ricolais. Samuely had designed a space frame roof for the Pavilion of Transport at the Festival of Britain in 1951, and three years later, while teaching at the North Carolina State School of Design, he visited Kahn's office and lectured to his students at Yale.[153] The latter recalled:

> [H]e believes that the tetrahedron is basic in all structures but does not call a tetrahedron of Fuller's dimension the criteria. He believes that tetrahedra of any combination of angles becomes a structural basis of form.[154]

Altogether, Samuely predicted, "people will look back on this time as being the one when construction changed over from 'plane' to 'space'."[155]

James Walter Fitzgibbon, an Associate Professor at the North Carolina State School of Design, had introduced Kahn and Le Ricolais, the actual father of space-structures,

151 Cf. William L. MacDonald, *The Pantheon: Design, Meaning, and Progeny* (London: Allen Lane, 1976) pp. 33-43.

152 Tyng, *The Rome Letters*, p. 83; letter 26 December 1953.

153 Samuely visited Philadelphia on 24 April 1954, and lectured in Yale on 25 April 1954. Cf. Correspondence between Kahn's employee Robert Venturi and Samuely, 030.II.A.66.6, LIKC.

154 Tyng, op.cit., pp. 127-8; letter 2 May 1954.

155 Felix Samuely, "Space Frames and Stressed Skin Construction," in *Journal of the British Architects*, vol.59, no.5, 1952, p. 166.

at the 1951 American Institute of Architect's conference in New York.[156] Two years later, in February 1953, Kahn visited Raleigh and informed Fitzgibbon, a partner of Fuller in the development of the Geodesic Dome, that Yale was considering him, along with Le Ricolais, Nervi and Torroja, as a visiting critic.[157] Fitzgibbon recommended Le Ricolais, who in his opinion showed "fine Engineering competence, [a] deep understanding of natural form […] comprehensive topological and crystallographic know-how," besides having a "1st rate omnidirectional structure mind."[158] Finally, in 1954, Le Ricolais and Kahn met for an extended meeting at Yale:

> Having had very friendly contact with Le Ricolais and Samuely now I feel they are very much the equal of Nervi in his way. I find Le R. of particular sensitivity and by far the purer engineer and philosopher. […] He has a thick notebook of diagrams and formulas (of his own), which are based on Topological formulae. It is precisely the scientific knowledge which an architect needs if he is at all interested in forms and plan and intends to work in the 3 D field.[159]

In sum, Kahn considered Le Ricolais' works "full of wonder standing in their right as though they are of Nature itself […]."[160] The latter, who had worked as a hydraulics engineer in France, arrived in the United States in 1951 to teach at the North Carolina State School of Design and at Harvard, before transferring to the University of Philadelphia in 1954. During his employment in France, Le Ricolais had investigated the easing of weight in telemetric tubes and "[a]round 1937 […] approached the problem of Networks in Three Dimensions, striving to profit by the few notions of crystallography available […]."[161]

His pioneering article "Essai sur des systèmes réticulés à trois dimensions" of 1940 gave some architects their first introduction to the concept of the space frame. Le Ricolais proclaimed that the more directions a structure encompassed, the less it would deform. He did not regard spatial networks based on the square as unfit, but when dealing with external forces distributed in all directions of space, a triangular network simply yielded less deformation. During the mid-1940s, Le Ricolais first put his theoretical outlines into practice, for instance with the construction of a prototype wooden space frame hangar in Nancy (Figures 42, 43).

His mother having been a natural history professor, Le Ricolais also sought inspiration in the natural world for his structural philosophy: "I have found no better discipline in this unpredictable problem of form than to observe the prodigies created

156 Cf. Thomas Leslie, "Unavoidable Nuisances," in Von Moos and Eisenbrand, *The Power of Architecture*, p. 212.
157 Cf. Fitzgibbon's letter to Le Ricolais, 1 March 1953, 086.V.99, RLRC.
158 Fitzgibbon's letter to Kahn, 3 March 1953, 030.II.A.56.86, LIKC.
159 Tyng, *The Rome Letters*, p. 146; letter 13 June 1954.
160 Kahn's letter of recommendation for Le Ricolais to receive an honoree fellowship from the American Institute of Architects, 1 September 1971, 030.II.A.53.67, LIKC.
161 Robert Le Ricolais, "Forms and Structures," in *Zodiac*, no.22, 1973, p. 242.

Fig. 42: Robert Le Ricolais, Hangar, Nancy, France, mid-1940s.

Fig. 43: Robert Le Ricolais, Hangar, Nancy, France, mid-1940s.

by nature."[162] Spider webs, bee cells, eggshells, soap bubbles and the microstructure of crystals or bones all came under his scrutiny (Figure 44). He admired radiolarians, where the peripheral membrane was a minimal tensile surface and the inner skeletal core formed an optimized compression system (Figure 45).[163] Likewise, the French engineer envisioned structures that clearly distinguished between the components in tension and such in compression through *structural division*. In later years, he turned his interest to pure tension systems, attracted especially by their increased lightness. Also studying domed structures, the French engineer rejected Fuller's semi-circular solution, "since the presence of evenly distributed loads imposes a parabolic profile."[164] Alongside this formal criticism, Le Ricolais also emphasized that a smaller amount of larger and heavier elements reduced the number of weakening joints:

> What is striking is the fact that a geodesic dome has about twenty times more joints, and eighty times more members, than our system, and ours is still lighter in relation to the area covered.[165]

162 Peter McCleary, *Le Ricolais: Visions and Paradoxes* (Madrid: Fundacion Cultural COAM, 1987) p. 35.
163 Radiolarians from a plate of Ernst Haeckel's *The Voyage of H.M.S. Challenger* (1873-6) figured on the cover of a special issue of the *North Carolina State College Student Publication of the School of Design* (spring 1953) that was dedicated to Le Ricolais' work.
164 Le Ricolais, "Formes and Structures," p. 242.
165 Robert Le Ricolais, "Things themselves are lying, and so are their Images," in *Via*, no.2, 1973, p. 83.

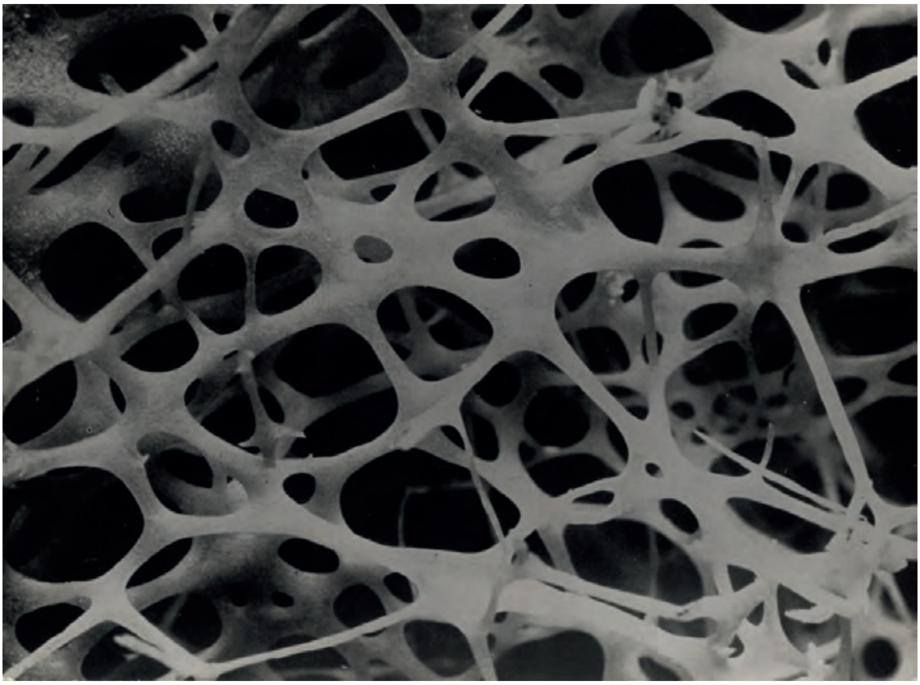


Fig. 44: Vertebral Microstructure.

The accompanying illustration shows an overview of Le Ricolais' experiments at the University of Pennsylvania (Figure 46), a sort of *productive chaos* that Kahn must have encountered occasionally, since they jointly taught a studio there from 1956 onwards.

1.9 Designing by Triangulation

The issues that Kahn had encountered with the Yale Art Gallery in terms of its alterability were not the only reason he was dissatisfied with the design, as a letter to Gropius shows:

> My work on the Yale Art Gallery has led me to think about three-dimensional construction and its implications architecturally. I failed to command the forces which could have produced a truly significant building.[166]

166 Kahn's letter to Gropius, n.d., 030.II.A.60.35, LIKC.

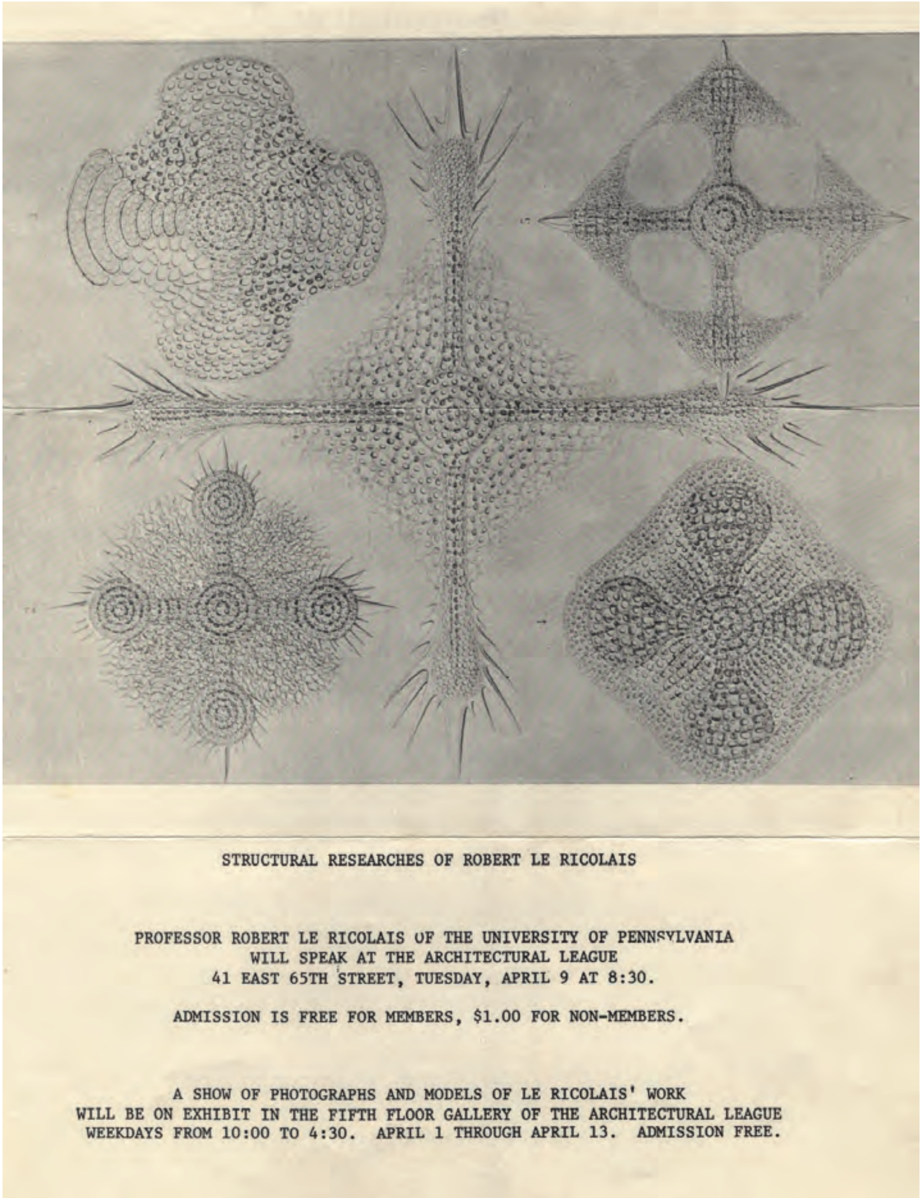


Fig. 45: Radiolarians on the Poster of Robert Le Ricolais' Lecture "Notions on Form" at The Architectural League, New York City, New York, 1968.

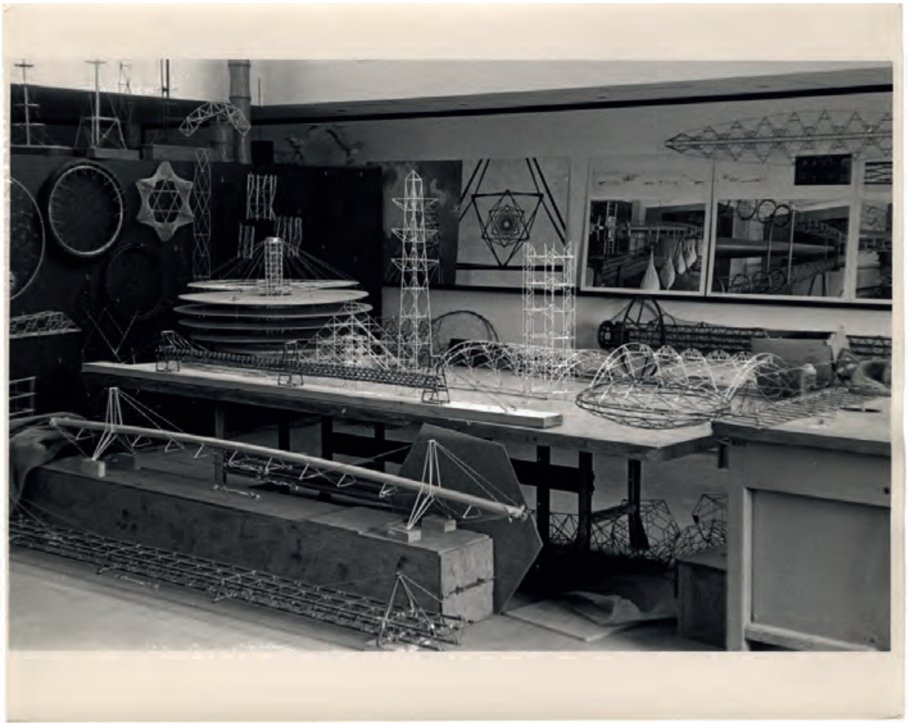


Fig. 46: Studio of Robert Le Ricolais, University of Pennsylvania, Philadelphia, 1970.

After its completion Kahn remodeled the entire composition. Now tetrahedral pillar-clusters, "hollow trunks" housing the stairs and the functional necessities, expanded in several layers from bottom to top like outspread fingers to carry a single-layered tetrahedral ceiling. At approximately the same time, Kahn was working on the design for the Adath Jeshurun Synagogue in Elkins Park, Pennsylvania (1954; Figure 47), for which he proposed a similar structure. Again, a layered space frame order was supposed to extend the three-dimensional logic throughout the entirety of the design, while the stairs and the services would be contained within the structural supports. Kahn argued: "It is what the space wants to be. A place to assemble under a tree."[167] Of course, these multilayered arrangements, in which the pillars *grew* into the ceilings, closely resembled Tyng's earlier school design. Concurrently with the erection of the Yale Art Gallery, she had planned on her own a House for her Parents on the

167 Louis I. Kahn, "A Synagogue (Adath Jeshurun of Philadelphia)," in *Perspecta*, no.3, 1955, p. 62.

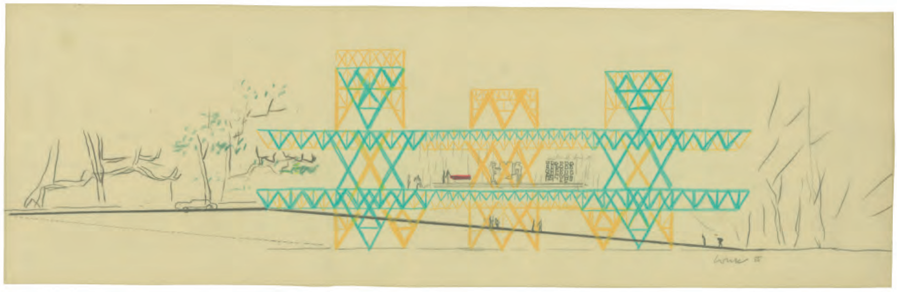


Fig. 47: Louis I. Kahn, Adath Jeshurun Synagogue, Elkins Park, Pennsylvania, 1954.

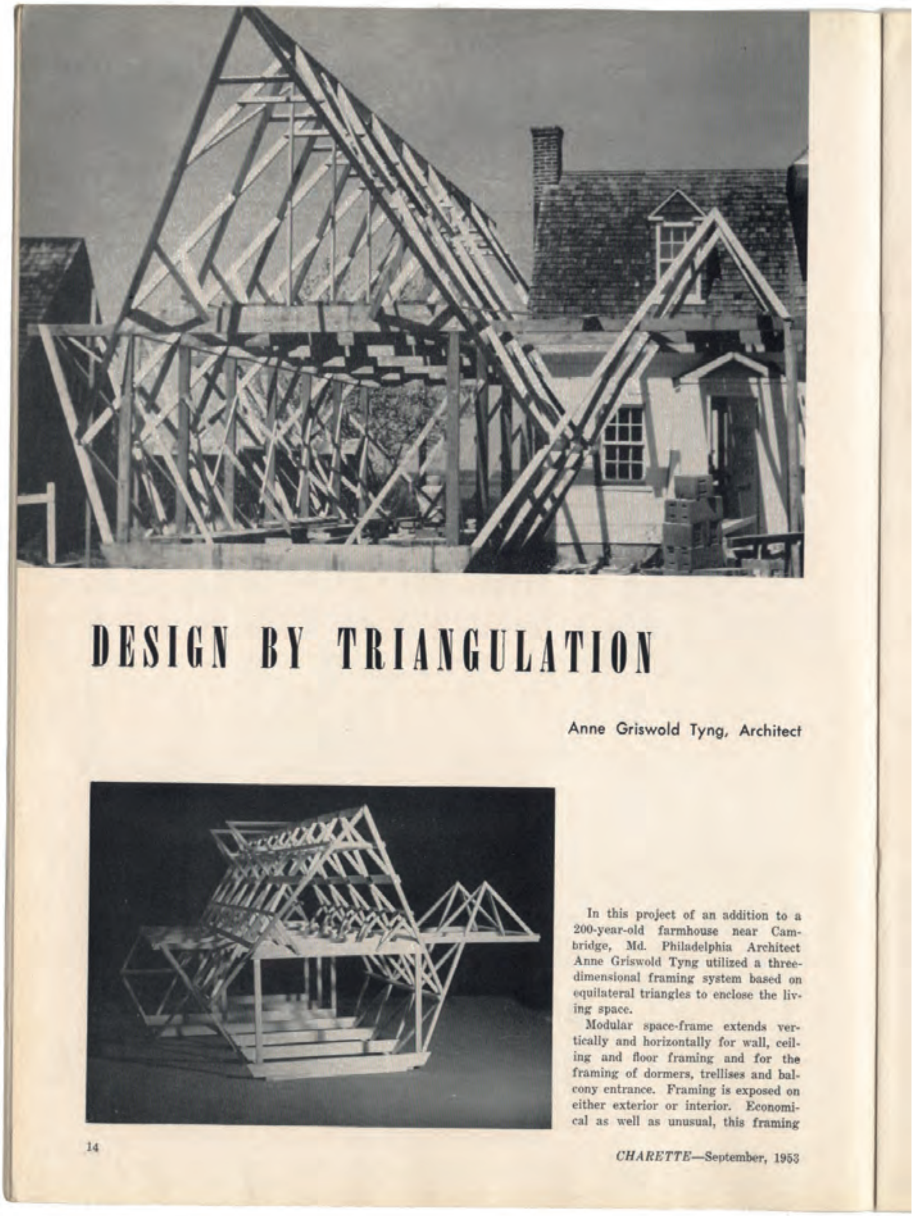
eastern shore of Maryland (1950-3; Figure 48), which she published in *The Charette* (September 1953) under the resonant title "Design by Triangulation." According to Tyng, in this first habitable space frame design, "the geometry was hollowed out for living spaces as in a bee's honeycomb."[168]

Tyng and Kahn further emphasized this idea of scaling up a space frame in their City Tower proposal, a municipal building planned for the center of Philadelphia between 1952 and 1957. As "A Concept of Natural Growth" – the project's title in an advertisement brochure by the Universal Atlas Cement Company (Figure 49) – the City Tower progressed vertically into a rotating shape, and was, according to Kahn,

> an experimental exercise in triangulation of structural members rising upward to form themselves into a vertical truss against the forces of wind.[169]

Pre-cast, pre-stressed hollow concrete struts, spanning four floors each, formed the lattice-like tetrahedral frame that was organically interrelated with all other parts through a system of unifying proportions. Most astoundingly, because of its triangulated structure, the tower did not demand any stiffening cores. Hollow tetrahedral floor slabs joined the vertical members and contained the air conditioning, lighting, horizontal wiring and piping, while human-size tetrahedral capitals housed the storage rooms, toilets and sub-stations for the mechanical services. In this complete integration of the functional elements within a hollow space frame structure, Kahn, as stated above, purposefully invoked the wind's deforming influence. Reflecting a few years later on the contemporaneous design of the Seagram Building (1954-8), Kahn noted: "She is a

168 Tyng, "Louis I. Kahn's 'Order' in the Creative Process," p. 287. Further examples of Tyng's own exploration into habitable space frame construction are the Fred Clever House (Cherry Hill, New Jersey, 1957-61; in collaboration with Kahn), an addition to the Waverly Street House (Philadelphia, 1964-7), or the unrealized Four Poster House (Mt. Desert Island, Maine, 1971-84), where a square-octagon based space-structure was lifted up into the air by a central post.
169 Louis I. Kahn, "Order in Architecture," in *Perspecta*, no.4, 1957, p. 64.



DESIGN BY TRIANGULATION

Anne Griswold Tyng, Architect

In this project of an addition to a 200-year-old farmhouse near Cambridge, Md. Philadelphia Architect Anne Griswold Tyng utilized a three-dimensional framing system based on equilateral triangles to enclose the living space.

Modular space-frame extends vertically and horizontally for wall, ceiling and floor framing and for the framing of dormers, trellises and balcony entrance. Framing is exposed on either exterior or interior. Economical as well as unusual, this framing

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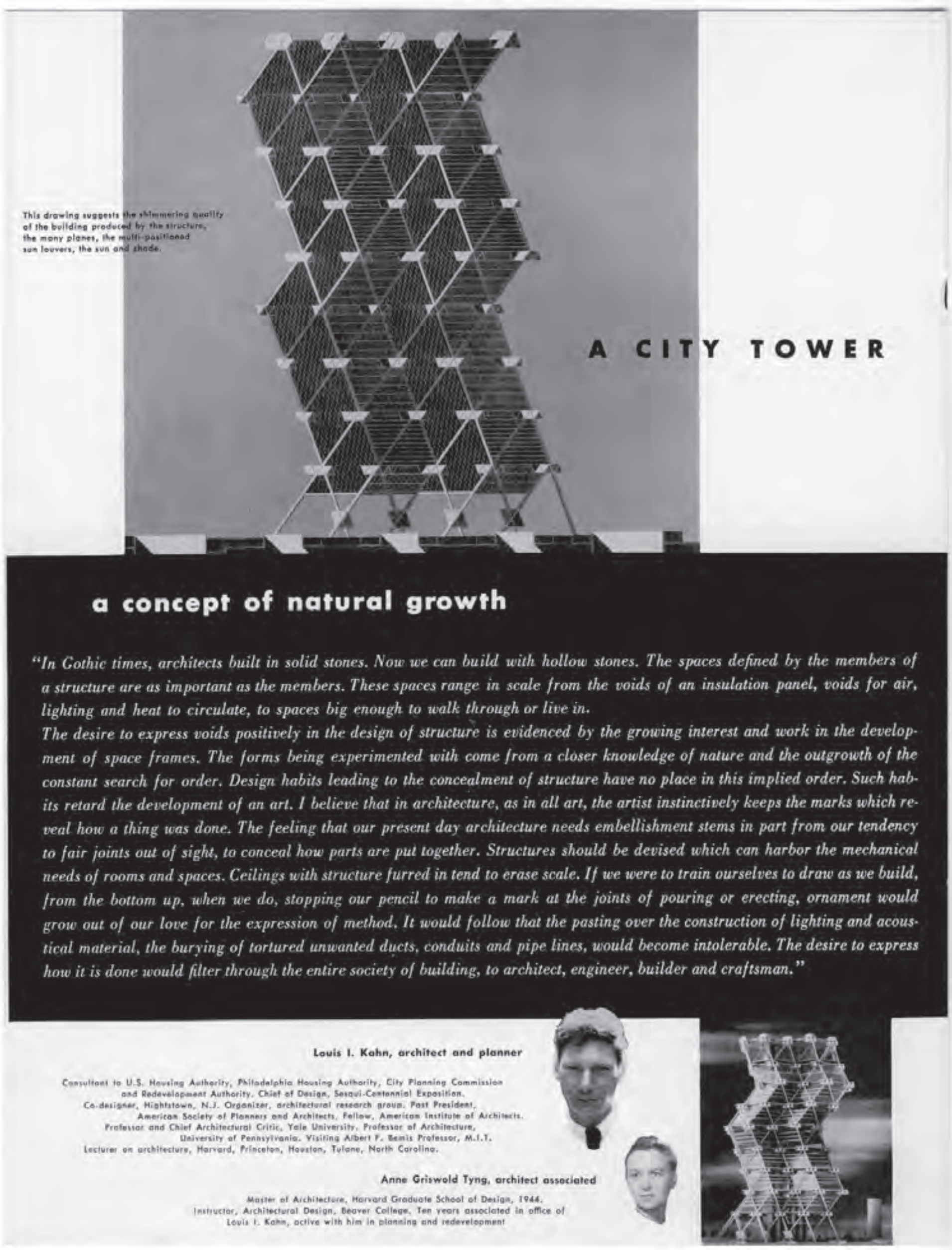
CHARETTE—September, 1953

Fig. 48: Anne Griswold Tyng, House for her Parents, Eastern Shore of Maryland, 1950-3.



This drawing suggests the shimmering quality of the building produced by the structure, the many planes, the multi-positioned sun louvers, the sun and shade.

A CITY TOWER

a concept of natural growth

"In Gothic times, architects built in solid stones. Now we can build with hollow stones. The spaces defined by the members of a structure are as important as the members. These spaces range in scale from the voids of an insulation panel, voids for air, lighting and heat to circulate, to spaces big enough to walk through or live in.
The desire to express voids positively in the design of structure is evidenced by the growing interest and work in the development of space frames. The forms being experimented with come from a closer knowledge of nature and the outgrowth of the constant search for order. Design habits leading to the concealment of structure have no place in this implied order. Such habits retard the development of an art. I believe that in architecture, as in all art, the artist instinctively keeps the marks which reveal how a thing was done. The feeling that our present day architecture needs embellishment stems in part from our tendency to fair joints out of sight, to conceal how parts are put together. Structures should be devised which can harbor the mechanical needs of rooms and spaces. Ceilings with structure furred in tend to erase scale. If we were to train ourselves to draw as we build, from the bottom up, when we do, stopping our pencil to make a mark at the joints of pouring or erecting, ornament would grow out of our love for the expression of method. It would follow that the pasting over the construction of lighting and acoustical material, the burying of tortured unwanted ducts, conduits and pipe lines, would become intolerable. The desire to express how it is done would filter through the entire society of building, to architect, engineer, builder and craftsman."

Louis I. Kahn, architect and planner

Consultant to U.S. Housing Authority, Philadelphia Housing Authority, City Planning Commission and Redevelopment Authority. Chief of Design, Sesqui-Centennial Exposition. Co-designer, Hightstown, N.J. Organizer, architectural research group. Past President, American Society of Planners and Architects. Fellow, American Institute of Architects. Professor and Chief Architectural Critic, Yale University. Professor of Architecture, University of Pennsylvania. Visiting Albert F. Bemis Professor, M.I.T. Lecturer on architecture, Harvard, Princeton, Houston, Tulane, North Carolina.

Anne Griswold Tyng, architect associated

Master of Architecture, Harvard Graduate School of Design, 1944. Instructor, Architectural Design, Beaver College. Ten years associated in office of Louis I. Kahn, active with him in planning and redevelopment

Fig. 49: Louis I. Kahn and Anne Griswold Tyng, City Tower, Philadelphia, Pennsylvania, 1952-7.

beautiful bronze lady, but she is not true. [...] The building is not honest, because the wind forces are not being expressed." Not even arguing against the *dishonest*, applied steel profiles to enforce its vertical ascension, Kahn criticized the truthfulness of the Seagram Building in purely ideological terms:

> What we have here is another example of the short-necked giraffe approach. It is forcing a thing into a preconceived notion as to what it might look like. With the other approach you simply allow it to look like what it wants to be; as nature does with the porcupine – you let it tell you something about it; about the forces of truth from which you can derive a way of life.[170]

Thus, no preconceived aesthetic ideal should infiltrate the City Tower as it was according to Kahn "full of enthusiasm for the natural way in which nature constructs [...]."[171] He considered the building as a logical materialization of the activating forces involved, and as a result an organic monumentality should establish itself, as Tyng further clarified:

> Primordial principles of form, the bonding of atoms and molecules out of which life grows, are resources for dynamic, innovative structures that can easily resist the forces of wind and earthquake. The naturally 'grown' undulations anticipate such stresses – resistance is already built into their form, as the tree on the mountaintop grows its own shape in bends and gnarls to resist forces of the wind.[172]

Despite both Kahn and Tyng's insistence that the tower's shape was quasi-automatically derived from the given pre-conditions and the project's underlying tetrahedral logic, its helical form also approached a form, notably one with far-reaching natural implications. The discovery of DNA by the American biologist James D. Watson and the English physicist Francis Crick in 1953 – precisely the time of the City Tower's design – unveiled that two helically entwined molecular strands were joined together to constitute the basic *letters of nature's alphabet*. What seemed to bring certain molecules to life was their special architecture of atomic arrangement.[173] That at least Tyng, and presumably Kahn, too, were interested in the structure of DNA, becomes apparent when looking through her files. There, she kept a "DNA Model Kit" by Van Rensselaer Potter (Figure 50), a paper cutout model of the DNA molecule based on the

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170 Louis I. Kahn, "Talk at the Conclusion of the Otterlo Congress," in Oscar Newman, *CIAM '59 in Otterlo* (Stuttgart: Karl Krämer Verlag, 1961) pp. 212-4.
171 Prown and Denavit, *Kahn in Conversation*, p. 23.
172 Tyng, *The Rome Letters*, p. 196.
173 Through the discovery of DNA, nature was no longer the mysterious other that mankind was extradited into, but now quintessentially mutable through human will. Shortly after their discovery, Watson and Crick affirmed: "It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material." James D. Watson and Francis Crick, "Molecular Structure of Nucleic Acids," in *Nature*, vol.171, no.4356, 1953, p. 737.

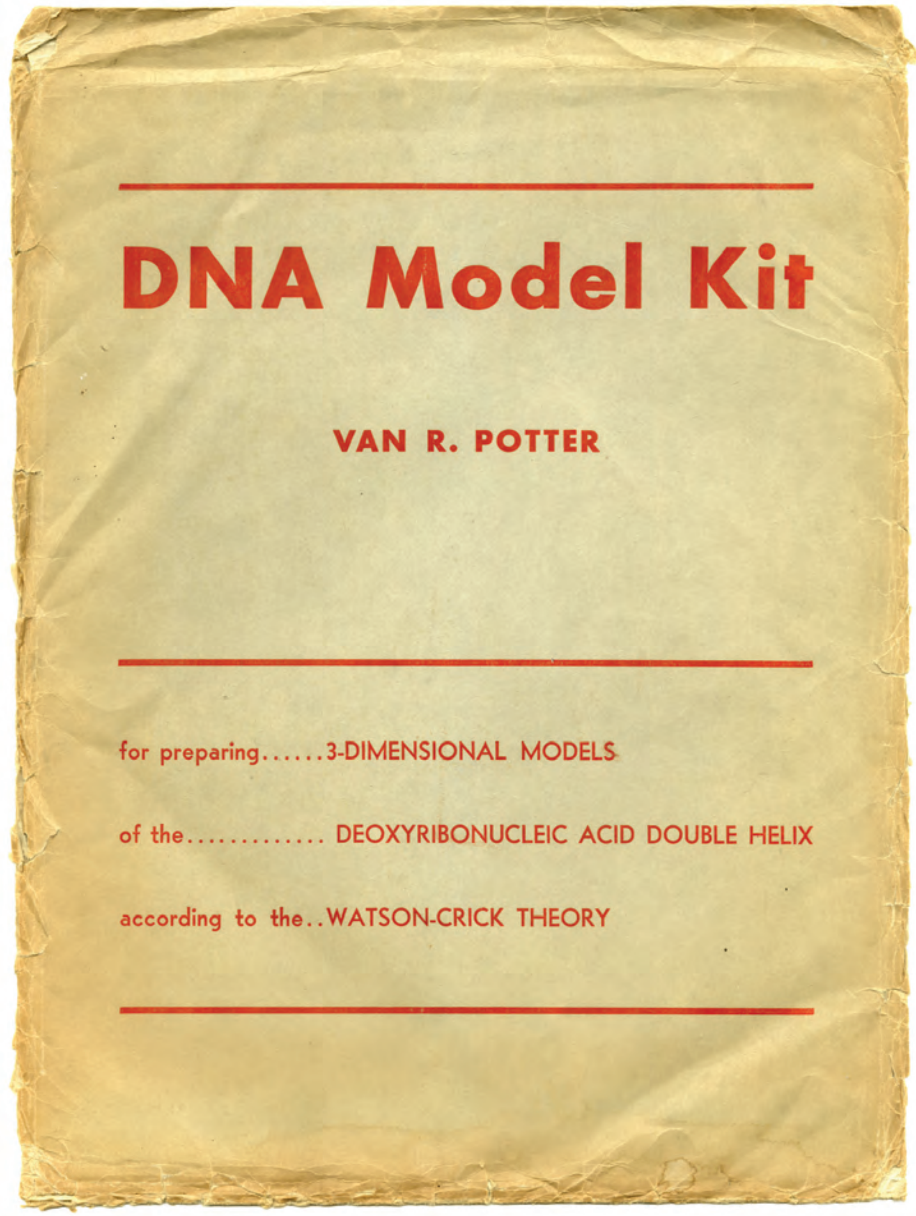
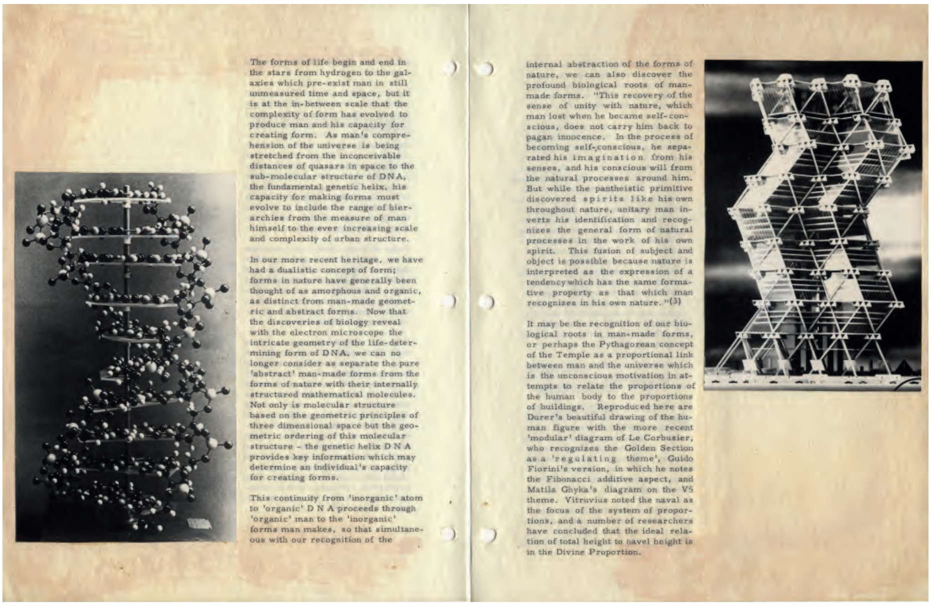


Fig. 50: Van Rensselaer Potter, DNA Model Kit, 1959.


The forms of life begin and end in the stars from hydrogen to the galaxies which pre-exist man in still unmeasured time and space, but it is at the in-between scale that the complexity of form has evolved to produce man and his capacity for creating form. As man's comprehension of the universe is being stretched from the inconceivable distances of quasars in space to the sub-molecular structure of DNA, the fundamental genetic helix, his capacity for making forms must evolve to include the range of hierarchies from the measure of man himself to the ever increasing scale and complexity of urban structure.

In our more recent heritage, we have had a dualistic concept of form; forms in nature have generally been thought of as amorphous and organic, as distinct from man-made geometric and abstract forms. Now that the discoveries of biology reveal with the electron microscope the intricate geometry of the life-determining form of DNA, we can no longer consider as separate the pure 'abstract' man-made forms from the forms of nature with their internally structured mathematical molecules. Not only is molecular structure based on the geometric principles of three dimensional space but the geometric ordering of this molecular structure – the genetic helix D N A provides key information which may determine an individual's capacity for creating forms.

This continuity from 'inorganic' atom to 'organic' D N A proceeds through 'organic' man to the 'inorganic' forms man makes, so that simultaneous with our recognition of the internal abstraction of the forms of nature, we can also discover the profound biological roots of man-made forms. "This recovery of the sense of unity with nature, which man lost when he became self-conscious, does not carry him back to pagan innocence. In the process of becoming self-conscious, he separated his imagination from his senses, and his conscious will from the natural processes around him. But while the pantheistic primitive discovered spirits like his own throughout nature, unitary man inverts his identification and recognizes the general form of natural processes in the work of his own spirit. This fusion of subject and object is possible because nature is interpreted as the expression of a tendency which has the same formative property as that which man recognizes in his own nature."(3)

It may be the recognition of our biological roots in man-made forms, or perhaps the Pythagorean concept of the Temple as a proportional link between man and the universe which is the unconscious motivation in attempts to relate the proportions of the human body to the proportions of buildings. Reproduced here are Durer's beautiful drawing of the human figure with the more recent 'modular' diagram of Le Corbusier, who recognizes the Golden Section as a 'regulating theme', Guido Fiorini's version, in which he notes the Fibonacci additive aspect, and Matila Ghyka's diagram on the V5 theme. Vitruvius noted the naval as the focus of the system of proportions, and a number of researchers have concluded that the ideal relation of total height to navel height is in the Divine Proportion.

Fig. 51: Anne Griswold Tyng, "Anatomy of Form / Atom to Urban," 1964.

Watson-Crick hypothesis and available since 1959. Furthermore, in her book proposal "Anatomy of Form / Atom to Urban" of 1964, Tyng placed a photograph of Watson and Crick's original model side by side with a depiction of the City Tower (Figure 51).[174]

Essentially, this recourse to molecular orders underlined that Kahn and Tyng's architecture of optimization was not formulated in response to a certain picturesque, imitative notion of nature, but based on more abstract geometrical principles of creation. Thus, they did not strive to copy nature's superficial appearance, but attempted to make use of its rules of growth. Mimicry in this respect did not imply repeating nature's apparent forms through formal analogy, but rather to comprehend its inner logic and order. As early as 1823, the French art historian Antoine Quatremère de Quincy had emphasized:

174 Cf. Anne G. Tyng, "Anatomy of Form / Atom to Urban," (1964) 074.II.C.3, AGTC. Besides, in the bibliography of her semester proposal "Morphology" – a course she taught at the University of Pennsylvania in 1970 – she listed a few books of interest in this context: Lancelot Law Whyte, *Essay on Atomism: From Democritus to 1960* (London: Nelson and Sons, 1961); Linus Pauling and Roger Hayward, *The Architecture of Molecules* (San Francisco: W. H Freeman, 1964); Edward Frankel, *DNA: Ladder of Life* (New York: McGraw-Hill, 1965); James D. Watson, *The Double Helix: A Personal Account of the Discovery of the Structure of DNA* (New York: Atheneum, 1968); R. W. Horne, "The Structure of Viruses," in *Scientific American*, January 1963; M. F. Perutz, "The Hemoglobin Molecule," in *Scientific American*, November 1964; Cf. 074.I.B.16, AGTC.

> To imitate does not necessarily mean to make a resemblance of a thing, for one could, without imitating the work, imitate nature thus, in making not what she makes, but as she makes it, that is one can imitate nature in her action [...].[175]

As both their involvement with natural principles progressed, Kahn and Tyng became increasingly convinced that the molecular structure of natural substances adhered to strict geometrical rules that their architecture should also follow. Supporting their argument, in the introduction to a later edition of *Aspects of Form*, Whyte emphasized:

> In the entire history of science there has been nothing similar to the dramatic advances in the new realm of molecular biology which occurred between 1945 and 1965.[176]

Mathematics, physics, and biology had fused into the new integral science of biophysics – the study of the changing arrangements of chemical atoms during organic processes. Whyte did not doubt that at the deepest levels these structures combined rather strict forms of geometric ordering as he had been

> intrigued by the fascinating idea of an Eighteenth-century Jesuit, R. J. Boscovich, that 'matter' was nothing but interacting physical *points* arranged in various patterns.[177]

Consequently, if the universe was an ordered complexity, the possible three-dimensional patterns were restricted, and it was therefore only logical that explorations into the realm of nature's geometry converged.[178]

During the course of the systematic human study of nature, the architect and the scientist, although dealing with different problems – the creation of an artificial world versus the explanation of the natural one – had to rely on similar parameters in order to establish a comprehensible order. This tool of communication between man and nature was *geometry*, deriving from the Greek, "measuring the earth." Its development directly responded to the human desire to establish certainty in the flux of worldly sensations. Abstraction, thus, denoted the wrestling of an object from its natural context and its transcription into an absolute conceptual value. Ultimately, as Thompson affirmed, there was in both the animate and inanimate world "no exception to the rule that θεὸς εἰ γεωμετρεῖ [God always geometrizes]."[179] The figure of God the Geometer as famously depicted in the frontispiece of the *Bible moralisée* of

175 Quatremère de Quincy, *De l'imitation* (Brussels: Editions des archives d'architecture moderne, 1980; 1823) pp. ii-v; transl. by the author.
176 Whyte, *Aspects of Form*, p. xi. Earlier, Whyte had published *The Unitary Principle in Physics and Biology* (New York: Holt, 1949).
177 Whyte, *Focus and Diversions*, p. 15.
178 As a further indication of the general interest in atomic structures, André Waterkeyn's *Atomium* was exhibited at the first post-war World Fair in Brussels in 1958.
179 Thompson, *On Growth and Form*, p. 10.

c. 1250 was preeminently a symbol for the unalterable consistency thought to reign in the universe. Underlining that the conception of the lawfulness of the universe was unthinkable without referring to geometry, Galileo also stated:

> Philosophy is written in this grand book – I mean the universe – which stands continually open to our gaze, but it cannot be understood unless one first learns to comprehend the language and interpret the characters in which it is written. It is written in the language of mathematics, and its characters are triangles, circles, and other geometrical figures, without which it is humanly impossible to understand a single word of it; without these, one is wandering around in a dark labyrinth.[180]

In the same vein, Johannes Kepler added:

> Geometry is coeternal with the Mind of God before the creation of things; it is God himself [...]. With the image of God it has passed into man, and was certainly not received within through the eyes.[181]

This quote, which stems from Kepler's *Harmonices mundi* (1619) and was republished in "The Influence of Archetypal Ideas on the Scientific Theories of Kepler" by Wolfgang Pauli, which Tyng in later years repeatedly cited,[182] underlined the German scientist's belief that the mind was made to grasp quantities just as the eye was made to see. Defending Copernicus' heliocentric worldview, Kepler developed a geometrical model for the distances between the planets that derived from the nesting of the Platonic Solids within each other (Figure 52). In Plato's account of the world's creation, Timaeus, a Pythagorean expert in astronomy, had offered a similar description of a mathematically configured universe. For him, scientific inquiry was inspired and enabled by "[t]he vision of day and night and of months and circling years," which "has created the art of number and has given us not only the notion of Time but also means of research into the nature of the Universe."[183]

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180 Galileo Galilei, *Il Saggiatore* (Rome: 1623); transl. by Stillman Drake in *Discoveries and Opinions of Galileo* (New York: Doubleday, 1957) pp. 237-8.

181 Johannes Kepler, *Harmonices mundi* (Linz: Sumptibus Gododfredi Tampachii bibl. Francof, 1619); quoted by Wolfgang Pauli, "The Influence of Archetypal Ideas on the Scientific Theories of Kepler," in Carl Gustav Jung, *The Interpretation of Nature and the Psyche* (New York: Bollingen Foundation, 1955) p. 166.

182 Tyng referred to the article in "Geometric Extensions of Consciousness," (p. 173) while the title also appeared in the bibliography of her semester proposal "Morphology," University of Pennsylvania, 1970; Cf. 074.I.B.16, AGTC.

183 Plato, *Timaeus* (London: William Heinemann, 1961) § 47 B.

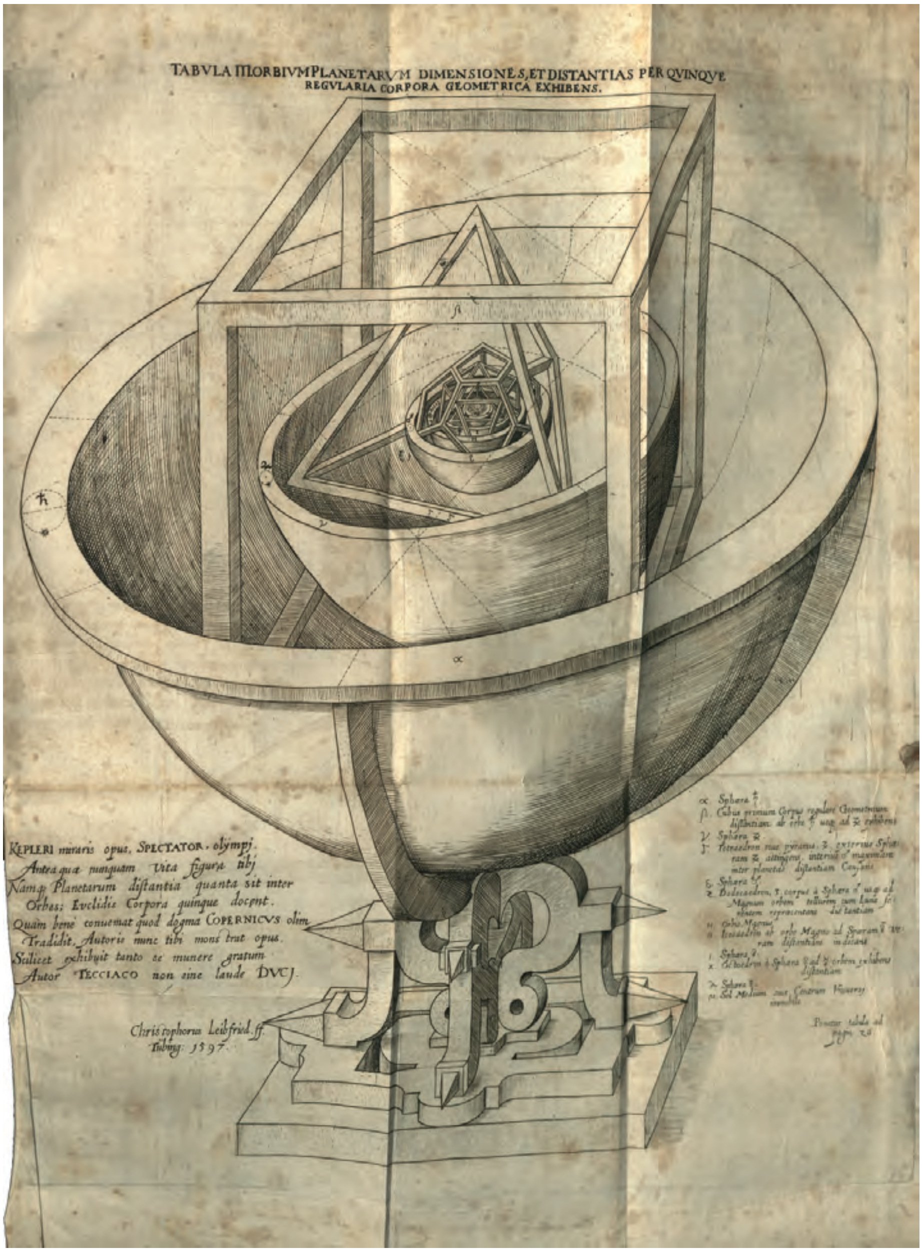

Fig. 52: Johannes Kepler, *Harmonices mundi*, 1619.

1.10 The Spirit of the Hive

In parallel with the definition of the Platonic Solids, Democritus, elaborating the ideas of his teacher Leucippus, suggested with the theory of Atomism – derived from the Greek *a-tomos*, meaning "indivisible" – the reduction of all complex appearances to irreducible and imperishable units. Lucretius' account *On the Nature of the Universe* (c. 55 BC) further elaborated this idea of the discreteness of matter, as his wish was to "reveal those atoms from which nature creates all things […]."[184] Likewise seeking to overcome the prevalent cosmology of the elemental tetrad, Robert Boyle in *The Sceptical Chymist* (1661) proposed that these foundational letters were not indivisible but composed of various chemical particles. The proof for his hypothesis came in the late 18th century in the chemical experiments of Antoine Laurent de Lavoisier, who demonstrated – initially with air, the most inconspicuous element – that all natural structures consisted of more elements than only the original four.[185]

Contemporary with de Lavoisier's chemical discoveries, French mineralogists such as Jean-Baptiste Romé de L'Isle and René Just Haüy recognized that in substances, if the internal form of a local unit repeated itself throughout a structure without dislocations, a crystalline lattice was obtained. Thus, a crystal was self-repetitive in every part of its constitution and obviated contextual interferences in order to emancipate its inner properties of cumulative growth. The impact of crystallography was heightened in 1912, when the German physicist Max von Laue demonstrated the regularity of crystal lattices using x-ray diffraction patterns. Since many materials – such as minerals, salts, metals, but also organic compounds – could form crystals, x-ray crystallography was soon not merely applied to determine atomic constellations in inorganic tissues, but also became crucial in indicating the structure of biological molecules such as DNA.

Previously, mathematical analysis had advanced considerably and led to the conclusion that there existed 230 possible crystal configurations. At the forefront of these investigations stood Lord Kelvin's research on *close packing* or the study of the homogeneous division of space into equal and like parts.[186] In consideration of planar

184 Lucretius, *On the Nature of the Universe* (Baltimore: Penguin Books, 1966; *De rerum natura*, c. 55 BC) p. 28.

185 First gathered in a periodic table by Dmitri Mendeleev's in 1869, the insights gained from this wave of chemical developments were substantially modified at the dawn of the 20th century with Ernest Rutherford's implementation of nuclear physics, i.e. the discovery that atoms were not solid and static bodies, but rather consisted of a dynamic interplay of electrical forces between a positively charged nucleus and surrounding electrons with a negative valence.

186 Cf. Lord Kelvin (Sir William Thomson), "On the Division of Space with Minimum Partitional Area," in *Philosophical Magazine*, vol.24, no.151, 1887, pp. 503 ff., and Thompson, *On Growth and Form*, pp. 544 ff. For Thompson (p. 740), "here and elsewhere an apparently infinite variety of form is defined by mathematical laws and theorems, and limited by the properties of space and number. And the whole matter is a running commentary on the cardinal fact that, under such *foedera Naturai* as Lucretius recognized of old, there are things which are possible, and things which are impossible, even to Nature herself."

arrangements, Kelvin acknowledged that only triangular, hexagonal and square repetitions could fill space uniformly. In terms of spatial dispositions, among the five Platonic Solids, only the cube tessellated space regularly. Besides the cube, eight other polyhedrons divided space homogenously, and among these the only Archimedean Solid to fill space without leaving intervals was Kelvin's truncated octahedron or *tetrakaidecahedron* (a figure with 14 faces: eight hexagons and six squares).

Deduced from circular close packing, the hexagon was the most economical two-dimensional partition of space.[187] Contemplating its significance in *The Six-Cornered Snowflake* (1611), another treatise referred to by Tyng, Kepler speculated:

> Is it because this is the first of the regular figures to be essentially flat, incapable, that is, of combining with itself to form a solid body? For triangle, square, pentagon, all form bodies.[188]

Altogether, snow crystals define an infinite range of hexagonal patterns (Figure 53), which vary depending on the temperature and humidity when these ice-flowers materialize. Microscopic examinations revealed that their form, just as in the case of a crystal, was an outward manifestation of their internal atomic disposition as illustrated here with the hexagonal pattern of their oxygen (black) and hydrogen (white) atoms (Figure 54).

In addition, the Belgian physicist Joseph Plateau had in the second half of the 19th century conducted experiments with wire frames submerged in *liquide glycérique*. The resulting soap films, besides creating least surface areas, always met in threes and symmetrically arranged themselves at angles of 120°.[189] In space, at all vertices four such borders intersected at an angle of approximately 109°, the *Maraldi* or Tetrahedral angle. The same angle occurred in the rhombic dodecahedron, whereas half of this solid added to a hexagonal prism and joined with others in the opposite direction is used by bees to uniformly fill space in their honeycombs (Figure 55). Evidently, bees economized wax to the utmost and illustrated nature's striving for *geometrical*

187 The Swiss mathematician Jacob Steiner demonstrated in the middle of the 19th century that the least sum of distances joining three or more points always resulted in the hexagonal angle of 120°. Cf. Richard Courant and Herbert Robbins, *What is Mathematics?* (London: Oxford University Press, 1946) pp. 354-60.

188 Johannes Kepler, *The Six-Cornered Snowflake* (1966 (Oxford: Clarendon Press, 1966; 1611) p. 41. Tyng listed this treatise in the bibliography of "Simultaneous Randomness and Order: The Fibonacci-Divine Proportion as Universal Forming Principle" (Ph.D. diss., University of Pennsylvania, 1975). For Whyte, Kepler's treatise was "the first attempt ever made to provide a mathematical theory of formative processes and to show exactly how regular forms come into existence." Whyte, *Focus and Diversions*, p. 76.

189 Cf. Joseph Plateau, *Statique experimentale et théorique des liquides soumis aux seules forces moleculaires* (Paris: Gauthier-Villars, 1873).

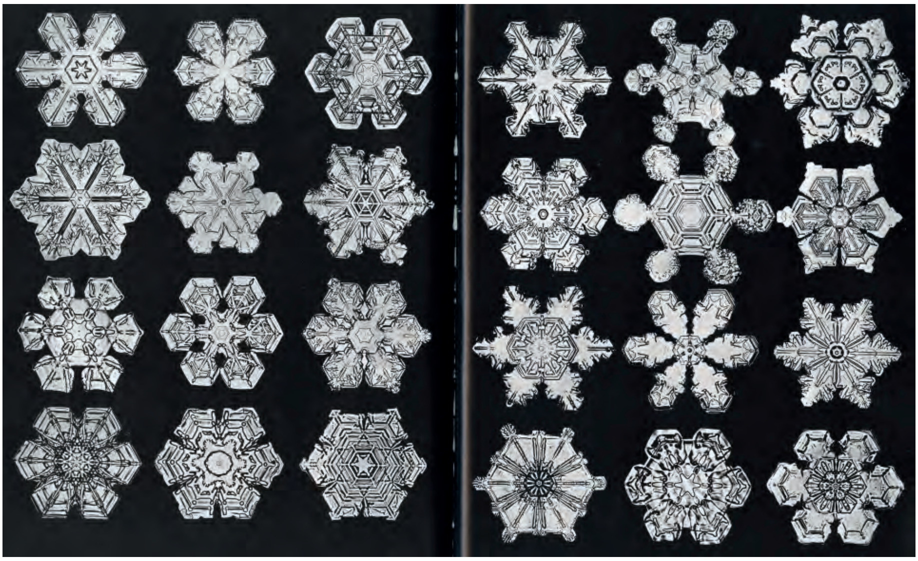

Fig. 53: Snow Crystals.

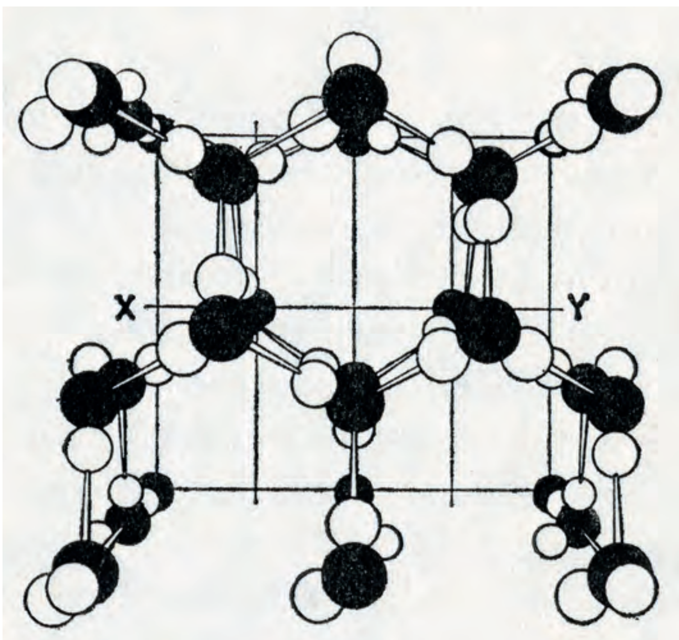

Fig. 54: Atomic Structure of Snow Crystals.

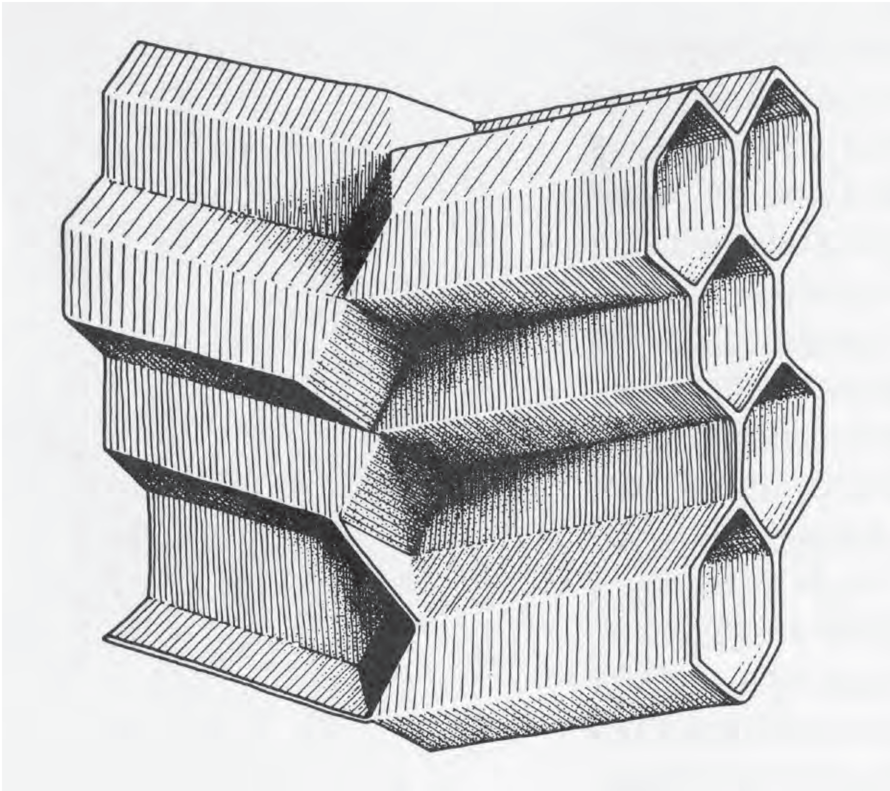

Fig. 55: Geometrical Order of a Bee's Honeycomb.

optimization: while the hexagon is the densest of all planar space-filling arrangements, the rhombic dodecahedron encloses space with a minimal extent of surface.[190]

The hexagonal structure of snow-crystals, Plateau's laws, the exceptional efficiency of the bees' constructions, and crystalline forms of minerals were discussed at length in Thompson's *On Growth and Form*. Emphasizing the frequent occurrence of hexagonal meshes in the cellular structure of organic tissues, he argued:

> [T]he conjunction, three by three, of almost any assemblage of partitions, of cracks in drying mud, of varnish on an old picture, of the various cellular systems we have described, is a general

190 Cf. Tomaso Aste and Denis Weaire, *The Pursuit of Perfect Packing* (London: The Institute of Physics Publishing, 2000) p. 58. Not surprisingly, Peter Behrens as newly appointed design consultant of the general German electricity company (AEG) in 1907, chose the honeycomb as the enterprise's new logo – clearly a visual allegory to the bees' model of economy where the individual counted nothing with respect to the collective well-being of the hive.

> tendency […] When the partitions meet three by three, the angles by which they do so may vary indefinitely, but their average will be 120°; and if all be on the *average* angles of 120°, the polygonal areas must, *on the average*, be *hexagonal*.[191]

According to his wife Esther, Kahn had become fascinated with crystallography in the early 1950s.[192] In addition, Tyng noted a decade later:

> Today a comprehension of the nature and behavior of crystals, with their geometric growth patterns and axes of symmetry, is considered essential to most branches of science, particularly mineralogy, chemistry, sold-state physics, metallurgy and electronics.

Accordingly, she proposed that

> [t]hese indications of the profound validity of all three dimensional structure suggest that architecture could gain fresh insight and release sources of form derived from fundamental principles of physical structure revealed in the consistency and beauty of the underlying unity of all form.[193]

This appreciation of nature's geometries, most notably the hexagon, was recognizable on a practical level in a number of Kahn's projects throughout the 1950s. Three larger hexagons, each with a fractal hexagonal substructure, interlocked in the ground plans of the City Tower (Figures 56, 57), while an almost identical cellular overall scheme, though slightly extruded, characterized the first version of the Bernard Shapiro House in Narberth, Pennsylvania (1959-61).[194]

Recalling Tyng's statement that the House for her Parents was being hollowed out like "in a bee's honeycomb," the clearest indication of Kahn and Tyng's interest in the bees' geometries was a small addition to the studio of the artist Wharton Esherick (Figure 58), built between 1955 and 1956 in Paoli, Pennsylvania, at a place quite fittingly called "Diamond Rock Hill."[195] Esherick, the "dean of American craftsmen," had abandoned city life intrigued by Henry David Thoreau's *Walden; or Life in the Woods* (1854). In 1926, he began to build his woodworking studio incorporating with its curvilinear shapes the outlines that also characterized his biomorphic artworks and furniture designs. Kahn and Esherick met during the 1950s through Howe, when the artist required a further addition to his studio. Kahn's *organic* proposal was quite the

191 Thompson, *On Growth and Form*, p. 515.

192 Cf. Goldhagen, *Situated Modernism*, p. 72.

193 Tyng's letter to the Ford Foundation, Fellowship Program for Studies in the Creative Arts, 30 October 1962, 225.II.A.283.15, VSBC.

194 In addition, the early schemes of the Adath Jeshurun Synagogue were outlined with a hexagon. In the Row House Studies for the City Planning Commission in Philadelphia (1951-3; in collaboration with Dan Kiley) Kahn further experimented with hexagonal arrangements, while in the design for the American Federation of Labor Building (1954-6) he made use of elongated hexagonal openings in the Vierendeel trusses to contain the mechanical services.

195 Interview by the author with Ruth and Mansfield Bascom (daughter and son-in-law of Wharton Esherick), the present owners of the estate, 12 June 2009.

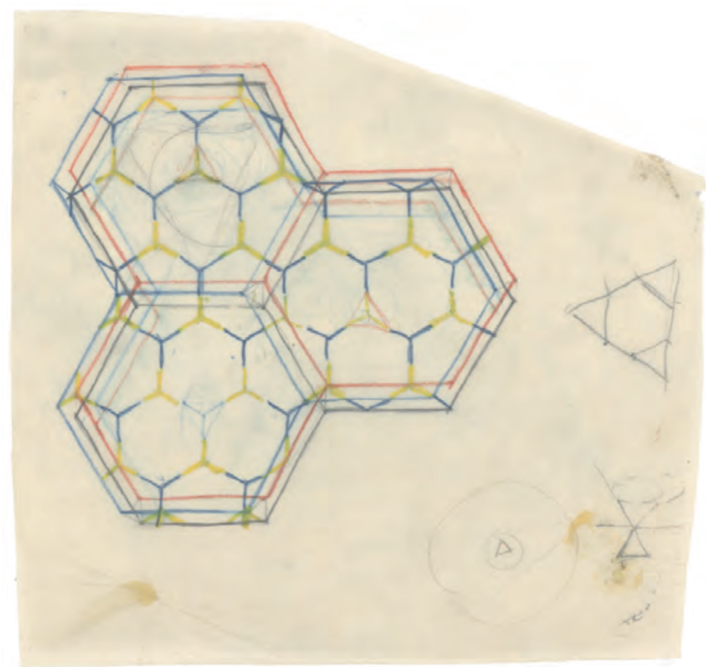

Fig. 56: Louis I. Kahn and Anne Griswold Tyng, City Tower, Philadelphia, Pennsylvania, 1952-7.

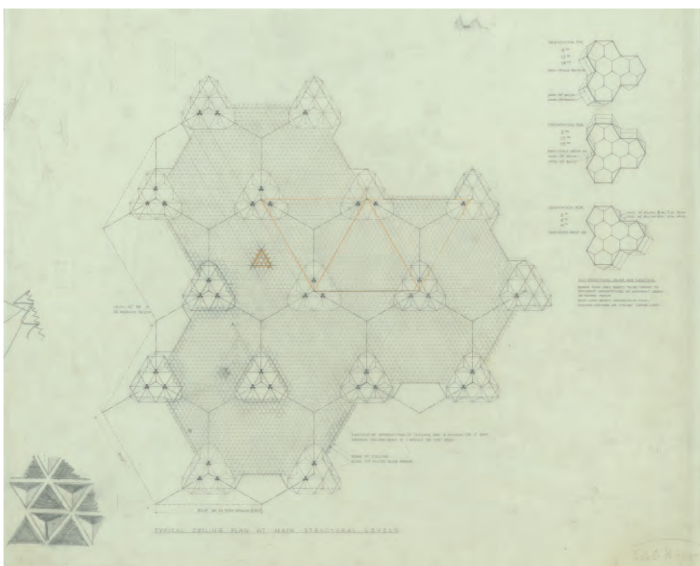

Fig. 57: Louis I. Kahn and Anne Griswold Tyng, City Tower, Philadelphia, Pennsylvania, 1952-7.

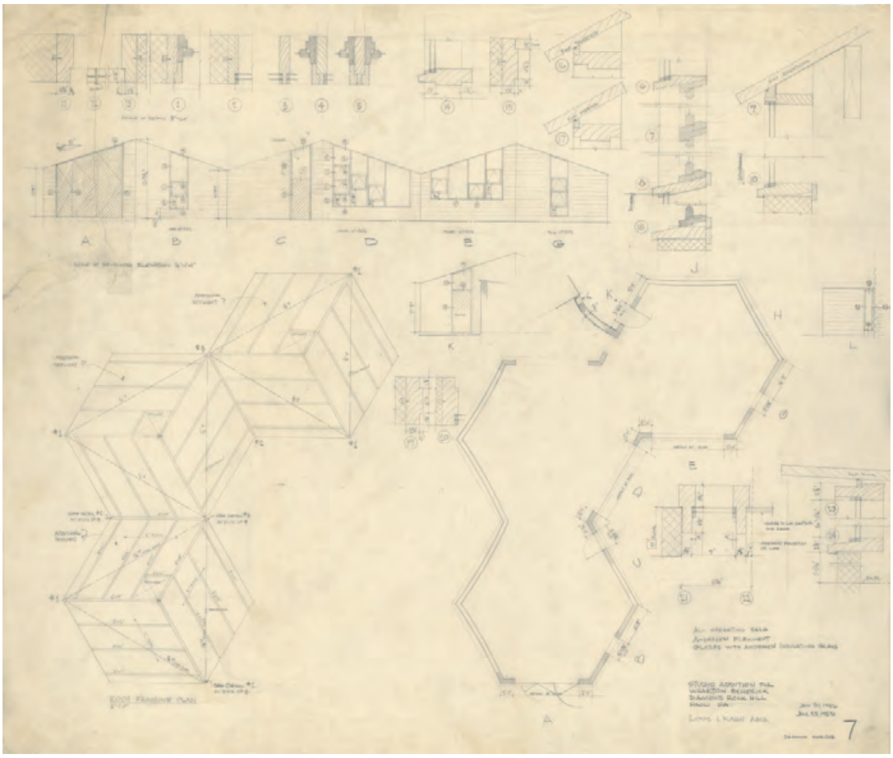

Fig. 58: Louis I. Kahn, Wharton Esherick Studio, Paoli, Pennsylvania, 1955-6.

opposite of the existing one: three prismatic hexagonal pavilions, each functionally responding to a particular stage in the woodworking process, were strung together to frame a small terrace. A regular rhomboid crowned each spatial unit, precisely as it was the case in a honeycomb.

While insects had mesmerized Kahn in general as his employee Jefferson Clark recalled, his interest in the geometrical principles of the bees was first triggered through the Israeli architect and Bauhaus student Arieh Sharon during the planning of the Palestine Emergency Housing in 1949.[196] Sharon had been a beekeeper in a young *kibbutz*,[197] and this experience would have a lasting impact on his later architecture, for example in the utilization of a hexagonal module in the design of Israel's Pavilion at the Expo in Montreal in 1967. In the Israeli architect's opinion, one could learn from

196 Cf. Susan G. Solomon, "Secular and Spiritual Humanism: Louis I. Kahn's Work for the Jewish Community in the 1950s and 1960s" (Ph.D. diss., University of Pennsylvania, 1997) pp. 74-6.
197 Cf. Arieh Sharon, *Kibbutz + Bauhaus: An Architect's Way in a New Land* (Stuttgart: Karl Krämer, 1976).

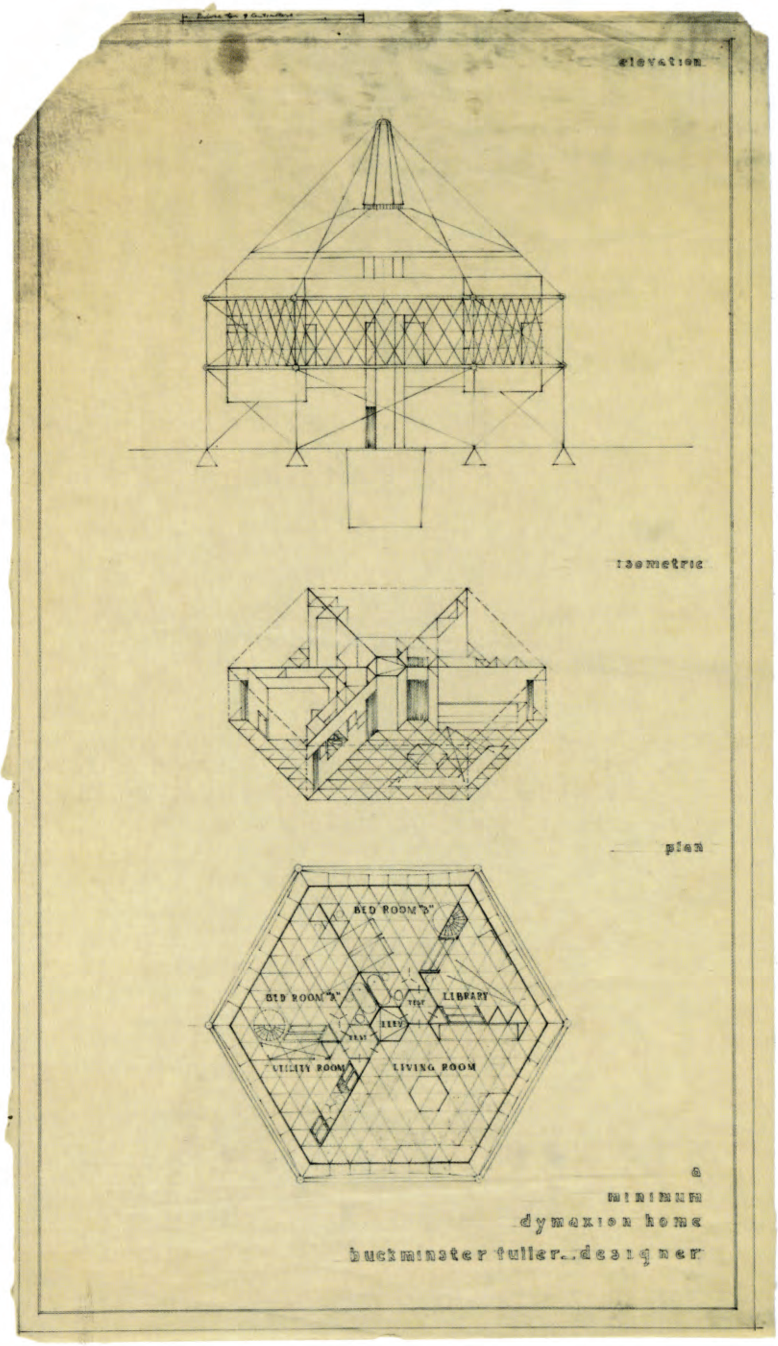

Fig. 59: Richard Buckminster Fuller, Dymaxion House, 1932.

the bees not only about modularity, but also "how to design, to organize and to build so as to combine function and form in a most economical way."[198] Altogether, Kahn was not alone in his attempts to create "spatial honeycombs:" Fuller had rigorously exploited the hexagon to structure the plan of his Dymaxion House (Figure 59); Wright had credited the bees' geometries with being more flexible than cubic arrangements;[199] and coinciding with Kahn's efforts, the Dutch architect Aldo van Eyck employed the hexagon in his unrealized design for an Open-Air School in Amsterdam (1955).

Nevertheless, Le Ricolais probably most vehemently influenced Kahn's hexagonal designs. Studying crystals, the French engineer, who taught his students that "[t]he discipline of seeing natural things is a mathematical one,"[200] was astonished by their rich combinatory possibilities. He realized that the less difference there was between standard parts, the easier it was to assemble them in spatial structures. In February and March 1953 he sent Kahn a series of letters, which included several extensive reports on hexagonal projects. In one, called "Structural Approach in Hexagonal Design," Le Ricolais referred critically to Wright's attempts as not "'structurally' focused."[201] He argued that a hexagonal arrangement had the advantage of increasing distances between supports by a third; thus, leading to a reduction of required columns. Le Ricolais also sent Kahn plans for a single-story "Hexacore 'Free Flow' Building" composed of several hexagonal cells (Figure 60), each having at its center a hexagonal column that was partly used for air-conditioning and the evacuation of rainwater. This idea to attach an ancillary use to a column, making it do more than just being a structural element, was subsequently elaborated by Kahn in his configuration of the *hollow column*. For Le Ricolais to build with "hollow stones" was "a good concept for building," since it meant "to build with holes, to use things which are hollow, things which have no weight, which have strength but no weight."[202]

However, this particular development entails issues of *spatial optimization*, including the seminal question of the "nature of the space," which diverges from the core of ideas concerning structural and geometrical efficiency. It touches upon Kahn's increasingly teleological reasoning to explain the morphological development of his

198 Ibid., p. 14.

199 Already in 1922 Wright had utilized the hexagon in the design for a Summer Colony at Lake Tahoe, while its built realization followed with the Honeycomb House for Paul and Jean Hanna in 1937. In an interpenetrating amalgam of open and closed spaces, the hexagonal geometry ordered the entire composition in a fluent manner.

200 Le Ricolais' quote stems from notes by Denise Scott Brown, in Mimi and John Lobell, "The Philadelphia School: The Bachelor of Architecture Curriculum at the University of Pennsylvania from 1960 to 1966," unprocessed file, ENBC. A shortened version of the article was published as "Postscript: Kahn, Penn and the Philadelphia School," in *Oppositions*, vol.4, October 1974, pp. 158-9.

201 The following reports were sent to Kahn by Le Ricolais: "Structural Approach in Hexagonal Design," (February 1953) "Multicore Building Frame System," (19 March 1953) and "Hexacore 'Free Flow' Industrial and Public Buildings;" (31 March 1953) Cf. 030.II.A.56.6, LIKC.

202 McCleary, *Visions and Paradoxes*, p. 43.

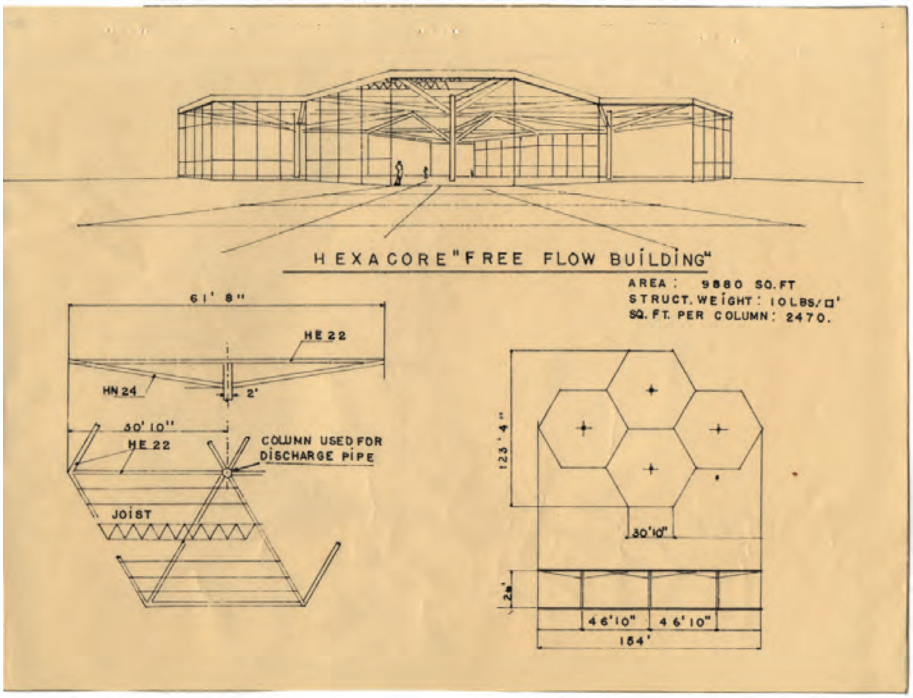

Fig. 60: Robert Le Ricolais, "Hexacore 'Free Flow' Building," 1953.

projects albeit without neglecting his fundamental belief in the prevalence of law and order in the universe. Thompson subscribed to such a distinction:

> Still, all the while, like warp and woof, mechanism and teleology are interwoven together, and we must not cleave to the one nor despise the other; for their union is rooted in the very nature of totality.[203]

While Kahn had demonstrated a fervent aspiration to employ nature's most economic geometries and optimized forms in his early works, in the future this rational appeal appeared insufficient for incorporating the holistic forces shaping the diversity of life.

203 Thompson, *On Growth and Form*, p. 7.

2 From Mechanism To Vitalism. Rethinking The Paradigm Of Organization

As Kahn's practical endeavors remained concerned with an abstract, and by implication mathematical understanding of nature, in his theory the focus shifted gradually towards issues of generation, and hence it came to increasingly incorporate questions of biology as well. Altogether, Kahn's theoretical statements first leaped the gap from the lifeless to the vital, or, as it were, from the rigid, restricted and inert world of mechanisms to the more adjustable, open and dynamic domain of organisms. Besides, via a strong influence of humanist concepts of spatial organization, the former homogenization of space was eventually replaced by a more compartmentalized approach that revealed itself through a process of individuation, i.e. the elaboration of a space's inner function. Each of the differentiated spatial elements should enforce the entirety of the built organism, like the individual parts of an animal fulfilling various functional tasks.

Kahn first presented his deliberations at a conference in Princeton, held between December 11 and 13, 1953. The weekend after the presentation he summarized his thoughts in a letter to Tyng:

> I advanced my 'order-design' thesis but added another area of design influence – 'the nature of the space' […]. External shapes must wait until the 'nature of the space' unfolds, and before 'order' can be evolved or created.[204]

In a tripartite scheme, the "nature of the space" preceded "order," from which, lastly, the "design" was derived. Half a year later, Kahn clarified the meaning of each term: The "nature of the space" was the general desire of what a building or space wanted to be; "order" as a double agent both referred to the permanent laws of nature and provided the necessary geometrical means to articulate them, while "design" underlined the influence of the changing circumstantial conditions besides making corporeal the previously defined will of what a building intended to be (Figure 61).[205] Hence, Kahn's theory progressed from the abstract towards the concrete in a linear manner.[206]

204 Tyng, *The Rome Letters*, pp. 76-7; letter 18 December 1953.

205 Ibid., p. 160; letter 10 July 1954.

206 Kahn's division between the noumenal world of the "nature of the space" and the phenomenal realm of "design" corresponded closely with the Socratic distinction between a *mundus intelligibilis* made up of essential types, and the visible, substantial strata of becoming. For Socrates, the *Good*, like Kahn's sense of "order," symbolized a general intention to change the world from a random and chaotic state into an orderly constitution through the implementation of limit, reason and number. As Ernst Cassirer described it, "this universal, eternal, inviolable order governs the world and determines all single events: the path of the sun, the moon, the stars, the growth of plants and animals, the way of winds and clouds. All this is maintained and preserved, not by mere physical forces but by the force of the Good." Cassirer, *An Essay on Man*, p. 100.

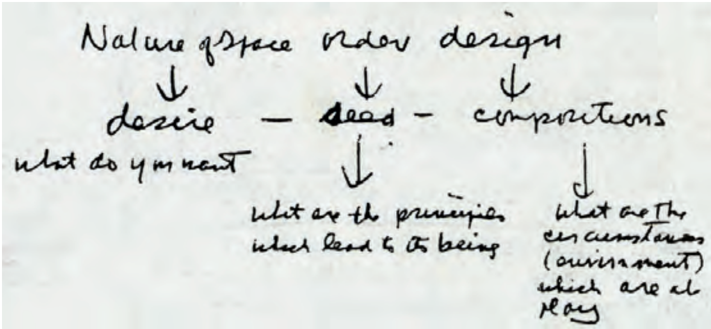

Fig. 61: Louis I. Kahn, “Nature of Space – Order – Design,” 1953.

At the origin of a design’s generative process stood the biological metaphor of the seed inherent in the question of the “nature of the space:” “I believe the concept should be equal to that of planting a seed, in which the concept, that is, the result you are going to get should be quite clear.”[207] To underline this argument, he stated years later: “It’s just as sure as when you plant an oak seed, you’re going to get an oak tree. The shape you don’t know, but it’s going to be an oak.”[208] Akin to Kahn’s observation, Paul Klee in his lectures at the Bauhaus had suggested:

> Despite its primitive smallness, a seed is an energy center charged to the highest degree. It comprises ineluctable impulses that will give rise to entirely different and highly characteristic forms. One seed will grow into a violet, another into a sunflower – not in the least fortuitously, but by its very nature – the one always a violet, the other always a sunflower.

A slumbering tendency rested in predetermined precision – “determined,” as Klee emphasized,

> with reference to the underlying idea, to the logos, or, as the translation runs: the word, which was in the beginning. The word as a premise, as the idea required for the genesis of a work.[209]

In light of the fact that Kahn had been educated under Beaux-Arts guidelines, according to which a project should develop from the initial *esquisse* or rough sketch through the *analytique* to a complete submission for the Paris Prize competition, it is apparently more than a coincidence that the jury required a student’s final *rendu*

207 Louis I. Kahn, “On the Responsibility of the Architect,” in *Perspecta*, no.2, 1953, pp. 47-50.
208 Kahn’s answers to questions at “The Invisible City – International Design Conference” in Aspen, 19 June 1972, in Wurman, *What will be has always been*, p. 163.
209 Paul Klee, “General System of Pictorial Media combined with Nature Study,” 5 November 1923, in Klee, *Notebooks: The Nature of Nature* (London: Lund Humphries, 1973; *Unendliche Naturgeschichte*, 1970) II, p. 25.

to conform to the spontaneously produced features of the preliminary sketch.[210] As Kahn remembered, "[the *esquisse*] was registered as a first impression as to how the student saw the nature of the building." Hence, the Beaux-Arts method systematically enforced the significance of the first idea, which had to be worked out in short, usually nine to twelve hours, *en loge*, meaning in isolation in a cubicle. As Kahn recalled, "the sketch depended on our intuitive powers. But the intuitive power is probably our most accurate sense." Years later he declared:

> I'm at my best when I talk about the nature of things – the nature of a library. It's not derived so much from knowledge because the examples are very ragged. It is derived because you revere the sense of beginning. You don't take anything for granted that has been done. You start as though a library had never been built. [...] The *esquisse* gave this sense of a source [...].[211]

Regarding the elusive "nature of the space," in Hellenic times the term *nature* was closely bound up with the idea of an immanent motion or inner fire animating an organism's morphological development.[212] Therefore, in contrast to today's use of the term as a synonym for the outer material world, nature called on a thing's inborn character, its animating spirit: the German *Naturell* being a remnant of this tradition. Aristotle, the *biologist* among the Greek philosophers, explained that

> the primary and proper sense of 'nature' is the essence of those things which contain in themselves as such a source of motion; for the matter is called 'nature' because it is capable of receiving the nature, and the processes of generation and growth are called 'nature' because they are motions derived from it.[213]

For Aristotle, *na-ture* was etymologically equivalent to *gene-sis*; thus, *nature* was not only a noun referring to formed matter, but a verb relating to a process.[214] Subsequently,

210 Regarding the *esquisse*'s faculty of being an immediate response to one's first ideas, Michael J. Lewis in analyzing Kahn's drawings and travel sketches remarked that he never used oil painting, which could be endlessly corrected, but "his most significant architectural drawings were invariably made with means that demanded swift execution." Lewis, "Louis Kahn's Art and his Architectural Thought," in Von Moos and Eisenbrand, *The Power of Architecture*, p. 80.

211 Louis I. Kahn, "Kahn on Beaux-Arts Training," in *The Architectural Review*, no.155, June 1974, p. 332. Cf. Richard Chafée, "The Teaching of Architecture at the Ecole des Beaux-Arts," in Arthur Drexler, *The Architecture of the Ecole des Beaux-Arts* (New York: The Museum of Modern Art, 1977).

212 For Heraclitus of Ephesus, it was a general law of nature that all things capable of nurture and growth contained within themselves a *fire*, since things alive were warm and once the heat disappeared, they were dead. Likewise, Cicero quoting Zeno defined nature as a "'craftsmanlike fire, proceeding methodically to the work of generation.'" Cicero, *De natura deorum* (Cambridge: Harvard University Press, 1933) II, § LVII.

213 Aristotle, *The Metaphysics* (London: William Heinemann, 1933) V, § IV.

214 Cf. Aristotle, *The Physics* (London: William Heinemann, 1929) II, § I. "Again, *na-ture* is etymologically equivalent to *gene-sis* and (in Greek) is actually used as a synonym for it; nature *qua* genesis proclaims itself as the path to nature *qua* goal."

nature helped the Greek philosopher to differentiate between inanimate objects and things being injected with an inner spirit of generation, since “the common feature that characterizes them all seems to be that they have within themselves a principle of movement [...].”[215] The final cause or *telos*, i.e. the sake for which something was done, Aristotle identified as the “soul,”

> for just as mind acts with some purpose in view, so too does nature, and this purpose is its end. In living creatures the soul supplies such a purpose, and this is in accordance with nature, for all natural bodies are instruments of the soul; and just as is the case with the bodies of animals, so with those of plants.[216]

To put it in more pictorial terms, a plant did not merely grow from the seed; the seed grew only because it wanted in its soul to become a plant, or as Kahn proclaimed: “[T]he psychic Existence Will calls on nature to make what it wants to be. I think a rose wants to be a rose.”[217] Similarly, when inquiring as to the “nature of the space,” Kahn attempted to grasp what a space wanted to be, respectively capture, “the spirit and the will to exist a certain way. Design must closely follow that will [...].”[218] Like Aristotle, who acknowledged that simultaneously with the soul other causes acted from without to influence an organism’s development, Kahn also recognized them, but insisted that they were unable to halt the formative power arising from the initial impetus within.[219]

In sum, for Kahn the initial task of an architect was to distinguish the particular *whatness* that made a school a school or a museum a museum. In doing so, he attempted to discern a project’s general objective, the specific semen and intangible inner nucleus from which the creative force disseminated. In 1955, in the third issue of *Perspecta*, Kahn accompanied the presentation of a few of his projects with a short, psalm-like commentary entitled “Order is.” Emphasizing that order *is*, Kahn stressed his unswerving faith in the lawfulness of the natural world that might have also derived from his personal encounter with Einstein at Princeton in the late 1930s.[220]

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215 Ibid. In a general way, one could argue that *irritability* qualifies all things living.

216 Aristotle, *On the Soul* (London: William Heinemann, 1936) II, § IV.

217 From Kahn’s recording entitled “Structure and Form” for the *Voice of America* broadcast; 19 November 1960; Cf. 030.II.55.22, LIKC.

218 Louis I. Kahn, “Order is,” in *Perspecta*, no.3, 1955, p. 59.

219 This argument had found further verification in the experiments of the German biologist Hans Driesch, who in 1895 separated the cells of a sea urchin embryo at the two-cell stage and found that each individual part developed into a smaller albeit complete sea urchin. Thus, physical laws as secondary parameters placed constraints on the development of organisms, but left the actual outcome governed by their primary genetic code undetermined.

220 According to Kahn’s wife, her husband had met with Einstein for a cup of a tea. Cf. Joseph A. Burton, “Philosophical Differences in the Thoughts of Louis I. Kahn and Martin Heidegger,” (1998) http://www.tu-cottbus.de, accessed 7 June 2008.

In relation to Einstein's well-known aphorism, "God does not play dice," "order" in Kahn's understanding did not imply beauty or ugliness, because nature unconsciously created variation after variation in following the same superior law. What differentiated their appearance was related to their specific *natures* and the influences of "design," or the "form-making in order," which incorporated the circumstantial directives:

> The same **order** created the elephant and created man
> They are different designs
> Begun from different aspirations
> Shaped from different circumstances
> **Order does not imply Beauty**
> The same order created the dwarf and Adonis[221]

2.1 The Romanticist Roots of the Existence-Will

In Kahn's earlier letter to Tyng elaborating his tripartite design philosophy, he mentioned another relevant aspect, namely the distinction between "feeling" and "thinking:" "Feeling is our great well of consciousness," he wrote, "but some people always separate feeling from thinking and build their solution around thinking only." In Kahn's opinion, "feeling" captured the "nature of the space," "order" and "design" all at once intuitively because the creative mind could not separate them. "BUT," he insisted, "the intuitive needs help to actuate and direct his field to a single objective at time (to a building)."[222] In this sense, while "feeling" was able to grasp the impervious will of what something wanted to be, "thinking" as the rational component was necessary to implement the intuitively grasped motives through a thoughtful understanding of "order."

This distinction between "feeling" and "thinking," where neither could function without the other, closely relates to basic patterns of Romanticist epistemology. On this basis, Henri Bergson in *Creative Evolution* (1907) made a similar distinction between "intelligence," which had

> the advantage of enabling us to foresee the future and of making us in some measure masters of events; in return, it retains of the moving reality only eventual immobilities, that is to say, views taken of it by our mind,[223]

221 Kahn, "Order is," p. 59.
222 Tyng, *The Rome Letters*, p. 78; letter 18 December 1953.
223 Henri Bergson, *Creative Evolution* (Lanham: University Press of America, 1983; *L'evolution créatrice*, 1907) pp. 342-3.

and “instinct,” which was “reality itself.” Therefore, Bergson, like Kahn, expounded on the dualism between an intellectual capacity, which reasoned and broke down the continuity of life into successive quantifiable states, and an intuitive capacity, which recognized, but could not intellectualize the self-creative “élan vital.”[224] Repudiating a complete rationalization of life, also for Kahn,

> [t]he elements of knowledge have been assembled by men, since knowledge did not come out of the skies; our knowledge applies only to the physical world, the biological world defies description.[225]

Bergson partially agreed, since the “intellect,” which by “mathematical treatment” attempted to think the mobile by immobile means, was incapable of embracing a living being’s essentially durative nature:

> While intelligence treats everything mechanically, instinct proceeds, so to speak, organically. If the consciousness that slumbers in it should awake, if it were wound up into knowledge instead of being wound off into action, if we could ask and it could reply, it would give up to us the most intimate secrets of life.[226]

As a consequence, unconscious “instinct” combined with self-conscious “intelligence” would lead to “intuition” – an “instinct” that had become capable of reflection and could *think* organic evolution. For Kahn, too, “intuition” was “the sum of the whole universe [b]ecause basically we know by intuition everything that is to be known.”[227] Attempting to restore a more holistic, qualitative appreciation of reality, analogous lines of Romanticist thought had also penetrated the wider architectural discourse as Mumford affirmed in 1938:

> [S]teadily, for the past generation, a transformation has been going on in every department of thought: a re-location of interest from mechanism to organism […].[228]

Also Kepes in *The New Landscape* demanded a more encompassing approach to design, which included both the rational and sensual capacities of man:

224 The congruent establishment of the electron theory of atomic matter enforced the viewpoint that matter was essentially not a rigid form, but a vital process, and in order to grasp its inner frequency one had to get in touch with *change* itself.

225 Louis I. Kahn, “Harmony between Man and Architecture,” in *Design Incorporating Indian Builder*, vol.18, no.3, March 1974, p. 24.

226 Bergson, *Creative Evolution*, p. 165.

227 Kahn, “Harmony between Man and Architecture,” p. 24.

228 Lewis Mumford, *The Culture of Cities* (New York: Harcourt, Brace & World, 1938) p. 300.

> The rationalism that has dominated our intellectual life, with its focus on abstract concept and quantitative measure, has brought us precision and breadth. These, however, have been paid for by a thinning of the richness and intensity of experience.[229]

The Hungarian called for unifying

> the scientist's brain, the poet's heart, the painter's eyes. It is an integrated vision that we need; but our awareness and understanding of the world and its realities are divided into the rational – the knowledge frozen in words and quantities – and the emotional – the knowledge vested in sensory images and feelings.[230]

Whether Kahn was aware of these developments in contemporary thought is difficult to tell, but it is verified that Romanticism played a seminal role in his upbringing. Kahn's mother Bertha Mendelowitsch, who claimed to be related to the German Romanticist composer Felix Mendelssohn and his grandfather Moses Mendelssohn, the *prophet of Jewish Enlightenment*,[231] was his tutor and guide. She had studied literature and music in her youth, and according to Kahn's wife was an "expert upon Goethe," besides considering Friedrich Schiller and Friedrich Nietzsche her favorite authors. As Esther remembered, Kahn had kept several German books as gifts from his mother in his library, which he could probably read, since only *high* German, along with some Yiddish, was spoken at his parental home.[232]

Taking a closer look at German Romanticism, one discovers a whole storehouse of ideas that correspond with Kahn's attempt to articulate an organic philosophy of design. To begin with, in close analogy to Kahn's concept of the "existence-will," Gottfried Wilhelm Leibniz had speculated in his *Monadology* (1714) that all organisms derived from *monads* with unique psychic pre-dispositions:

> [W]e see from careful research into plants, insects and animals that natural organic bodies are never the products of chaos or putrefaction, but always arise from seeds, in which they are doubtlessly somehow preformed.[233]

Subsequently, also for Goethe, a transcendent life force animated, ordered and controlled all nature, and denoting this *being* in line with Aristotelian epistemology as an intangible soul, Friedrich Wilhelm Schelling published *On the World Soul* in

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229 Kepes, *The New Landscape*, p. 259.
230 Ibid., p. 20.
231 The author could not verify that Bertha Mendelowitsch was directly related with Felix and Moses Mendelssohn. Cf. Hans-Günter Klein, *Die Familie Mendelssohn: Stammbaum von Moses Mendelssohn bis zur siebenten Generation* (Berlin: Staatsbibliothek zu Berlin, 2007).
232 Cf. Burton, "Notes from Volume Zero," p. 75, and Alexandra Tyng, *Beginnings: Louis I. Kahn's Philosophy of Architecture* (New York: Wiley, 1984).
233 Anthony Savile, *Leibniz and the Monadology* (London: Routledge, 2000; 1714) p. 237.

1798, and Gustav Theodor Fechner added *Nana, or the Soul-Life of Plants* in 1848. In the philosophy of Arthur Schopenhauer "will" stood for this inner principle of growth and unity in nature, which lay, however, outside the territory of etiological explanation. It was the vital force, formative principle, *anima-mundi*, or *archeus*, all of which denoted nothing else than an inexplicable X: "[T]he will is what is primary, the *prius* of the organism, which is conditioned by it."[234] Accordingly, one could recognize the will as

> the force that shoots and vegetates in the plant, indeed the force by which the crystal is formed, the force that turns the magnet to the North Pole, the force whose shock he encounters from the contact of metals of different kinds, the force that appears in the elective affinities of matter as repulsion and attraction, separation and union, and finally even gravitation, which acts so powerfully in all matter, pulling the stone to the earth and the earth to the sun [...].[235]

A central facet to Romanticism was also its transcendental attitude. By spiritual reconcilement or *intellection*, man's soul entered the soul of the world, by which means the self merged into union with the universal spirit. For the Romanticists it remained the peculiar task of poets and artists to communicate this experience, the viewing through the phenomena of nature into the Divine *noumenon*. The visionary poet laid claim to a superior truth of vision, since with his feelings and intuition he was capable of sensing the ultimate reality beyond the measurable realms of matter. In analogous terms, the transcendental tradition in America regarded nature in a pantheistic sense as the *body of God*, all united by the spirit of the over-soul. Ralph Waldo Emerson, the ideological head of the movement, of whose selected essays Kahn owned a copy,[236] emphasized the immanence of divinity throughout the perceivable world and the human capacity to decipher it within oneself:

> [T]hroughout nature, spirit is present; that spirit is one and not compound; that spirit does not act upon us from without, that is, in space and time, but spiritually, or through ourselves. Therefore, that spirit, that is, the Supreme Being, does not build up nature around us, but puts it forth through us. [...] Who can set bounds to the possibilities of man?[237]

234 Arthur Schopenhauer, *On the Will in Nature* (Whitefish: Kessinger Publishing's Rare Reprints, 2007; Ueber den Willen in der Natur, 1836) p. 236.
235 Arthur Schopenhauer, *The World as Will and Representation* (New York: Dover Publications, 1969; *Die Welt als Wille und Vorstellung*, 1819) pp. 109-10.
236 Cf. Joseph A. Burton, "The Aesthetic Education of Louis I. Kahn, 1912-1924," in *Perspecta*, no.28, 1997, p. 216. It is due to the pivotal analysis of Maria Bottero that the connection between Kahn's architecture and American Transcendentalism was first brought to light, as she indicated that his work oscillated "between the two opposite poles of American organicism and European rationalism." Cf. Bottero, "Organic and Rational Morphology in Louis Kahn," in *Zodiac*, no.17, 1967, pp. 47-53.
237 Ralph Waldo Emerson, *Nature* (Boston: James Munroe, 1836) p. 30.

2.2 From Transcendentalism to Form follows Function

Central to the American Transcendentalists' experience in the mid-19th century was the encounter with the continent's pristine wilderness and native culture. In *Leaves of Grass* (1855), of which Kahn likewise owned a first edition print, Emerson's contemporary Walt Whitman urged American poets to transmit the country's spirit and incarnate its geography, seasons and forms of life. Overall, for a young country challenged with defining itself, the tremendous landscape provided the most valuable source of possible identification. Besides, in a nation whose first presidents – George Washington, John Adams and Thomas Jefferson – were all farmers, a virtuous relationship with the land, personified in the figure of the self-sufficient farmer, formed the backbone of democracy.

In artistic terms this focus upon the natural domain was first articulated in the *tableaux* of the Hudson River School. With their depictions of pastoral natural settings, they helped to reveal the beauty of their own land. Gradually this contemplation developed into a philosophy in its own right, in which nature, with its awe-inspiring grandeur, evidenced the powers of God. It is crucial to point out that the Transcendentalist's almost religious reverence of nature and its harsh exploitation through industrial means occurred in parallel. For the poet Thoreau and others, certain safety measures had to be taken in order to guarantee the preservation of the country's treasures before all was spoiled by reckless destruction by profit-oriented entrepreneurs. As a first consequence, national and state parks were gradually established, and the implementation of large natural retreats within the booming cityscapes would promptly follow.[238]

In architectural terms Andrew Jackson Downing's treatises set the tone in advocating American cultural independence: having no more patience with architects who created "copies of the temple of Theseus," Downing demanded the authentic expression of a building's purpose. In his opinion this manifestation should develop "freely, as a tree expands which is not crowded by neighbors in a forest, but grows

238 The first one, Yellowstone National Park opened in 1872. The Conservation Movement would find its champion in President Theodore Roosevelt, who further popularized the idea that environmentally important areas should be set aside for the common good. Leading the way in the erection of vast metropolitan parks and parkway systems were Frederick Law Olmsted Sr. and Charles Eliot. Olmsted, a farmer by origin and deeply impressed by Joseph Paxton's Birkenhead Park in the suburbs of Liverpool, designed the exemplary Central Park in New York in 1858 together with the Englishman Calvert Vaux. Following the imperatives of the picturesque landscape tradition, as a *people's garden* it provided the citizens of the rapidly expanding metropolis with recreational and sanitary amenities that, in Europe, were only accessible to the privileged class. Olmsted and Eliot's Emerald Necklace, besides the latter's planning of the Boston Metropolitan Park System pursued these civilizing intentions through the creation of ribbons of green inlets that not unlike Kahn and Tunnard's "greenways" formed a continuous web throughout the city.

in the unrestrained liberty of the open meadow."[239] While Downing was making his claims, Thoreau, whom Kahn admired as a "wonderful man in the sense of feeling for all living things […],"[240] also sensed that it was time to create an original American architecture: "What of architectural beauty I now see, I know has gradually grown from within outward […] without ever a thought for the appearance."[241] This last quotation closely echoes the dictates of Horatio Greenough, an American sculptor who had been a classmate of Emerson's at Harvard. In 1843, in the essay "American Architecture," Greenough postulated:

> Instead of forcing the functions of every sort of building into one general form, adopting an outward shape for the sake of the eye or of association, without reference to the inner distribution, let us begin from the heart as the nucleus, and work outward.[242]

Indeed, these sentences sound very familiar when recalling Kahn's insistence on the immanent *will to be* from which a design should evolve. At the root of Greenough's writings figured also the idea of differentiation, and

> [a]s its first result, the bank would have the physiognomy of a bank, the church would be recognized as such, nor would the billiard room and the chapel wear the same uniform of columns and pediments.[243]

In the burgeoning industry Greenough recognized the first recognizable examples of his ideas, because "in all these structures character has taken the place of dilettantism."[244]

A similar striving for the truthful expression of a building's inner purpose characterized the work of Louis H. Sullivan. In 1873, he commenced his architectural career in the office of the Philadelphian architect Frank H. Furness, whose father had studied with both Greenough and Emerson, while the latter would remain a lifelong friend of the family.[245] Most acclaimed for his Pennsylvania Academy of the Fine Arts (1871-6) with its delightful enfilade of sky-lit exhibition spaces and the

239 Andrew Jackson Downing, *The Architecture of Country Houses* (New York: Appleton, 1850) p. 22.
240 Louis I. Kahn, "Interview with *Via*," 11 January 1969, in Wurman, *What will be has always been*, p. 45.
241 Henry David Thoreau, *Walden; or Life in the Woods* (New York: Dover Publications, 1995; 1854) p. 30.
242 Horatio Greenough, "American Architecture," (1843) in Greenough, *Form and Function* (Berkeley: University of California Press, 1962) pp. 61-2.
243 Ibid., p. 63.
244 Horatio Greenough, "Structure and Organization," in op.cit., p. 117.
245 At the time of Sullivan's apprenticeship, Furness collaborated with George W. Hewitt, the brother of William D. Hewitt, in whose office Kahn shortly worked between June and September 1922. Cf. "Louis I. Kahn: Draft Resume, c. 1930," 330.I.B.5, SAKC.

vigorously composed University Library (1888-91), Furness sought inspiration from nature and not the dead past: "In all cases the student must go for knowledge to the fountain-head, Nature."[246] During his stay in Philadelphia, Sullivan might have also encountered the paintings of Thomas Eakins, who, according to Whitman, was the sole artist of the time "who could resist the temptation to see what they think they ought to rather than what is."[247]

Eakins had taught at the Pennsylvania Academy of Fine Arts since 1876, and among his students was James Liberty Tadd, who in his own right would be influential in teaching Kahn at the Public Industrial Art School between 1912 and 1914.[248] In *New Methods in Education: Art, Real Manual Training, and Nature Study* (1899), the educator allowed his ideas to coalesce:

> Children love nature instinctively. Nature speaks as loud today as ever, and all should hear her voice. As Emerson says, we must 'bend to the persuasion which is flowing to us from every object in nature [...].'[249]

Through the close observation of the "Book of Nature," the apt student would be given a golden key to decipher all knowledge within the Divine script:

> If God speaks at all (and who doubts it?), He speaks through His works, 'There are tongues in trees, books in the running brook, sermons in stone, and good in everything' (Shakespeare).[250]

According to Tadd, a common spirit that the pupils immediately perceived penetrated all of nature's works:

> Bring something into the class room like a new bird form, or fish form, and all of the children follow it with their eyes, which seem to almost stick out; there is no lack of attention here, the magnetic influence is at work, the divine energy is flowing.[251]

Consequently, he inquired if the task of the teacher should not be to

> make them so familiar with things that even the mud and dirt and weeds will seem filled with beauty and mystery? [...] Make them realize the force that is in every common thing, that holds together each flower and leaf and stone; make them realize that 'matter and spirit are two sides of one fact.'[252]

246 Frank Furness, "Hints to Designer," in *Lippincott's Magazine*, no.21, May 1878, p. 613.
247 Lewis Mumford, *The Brown Decades: A Study of the Arts in America 1865-95* (New York: Dover Publications, 1955; 1931) p. 216.
248 Cf. Burton, "The Aesthetic Education of Louis I. Kahn," pp. 204-17.
249 J. Liberty Tadd, *New Methods in Education: Art, Real Manual Training, and Nature Study* (New York: Orange Judd, 1907; 1899) p. xii.
250 Ibid., p. 62.
251 Ibid., pp. 253-4.
252 Ibid., pp. 62-3.

Fig. 62: James Liberty Tadd, *New Methods in Education*, 1899.

In methodological terms, students should begin by drawing objects from nature (Figure 62) – as much as possible from living forms – and only later investigate the abstract geometries of cubes, pyramids, spheres or cones that were submerged in nature's morphological constitutions. In a last step, imaginative forms that sprang from the pupils' minds would follow. Focused upon drawing, but also encouraging plaster modeling and woodcarving, Tadd's goal was to synthesize the student's hand, eye and mind into one instrument. For that purpose, special exercises such as ambidexterity and memory drawing were invented, since drawing as a "universal tongue" should be as automatically employed as speech and writing.[253] Rice, who first encountered Kahn in the Public Industrial Art School, remembered Tadd as a "remarkable man" and recollected that his classmate "was an outstanding student in that school, renowned for his sketches of animals at the Zoo."[254] Altogether, Tadd's curriculum had a manifest effect upon Kahn, who would continue to regard drawing as one of the centers of his professional occupation.[255]

253 Ibid., p. 33.
254 Norman N. Rice, "Kahn," in *Architecture Plus*, vol.2, no.3, 1974, p. 103.
255 From early on Kahn had shown surpassing talent, for instance by receiving a first prize for "Original Free Hand Drawing" from the Academy of Fine Arts in 1919. On his later lecture tours Kahn

Fig. 63: Louis H. Sullivan, Bayard-Condict Building, New York City, New York, 1897-9.

Sullivan after working briefly for William Le Baron Jenney in Chicago began his studies at the École des beaux-arts in Paris.[256] After venturing back, the skyscraper, like the Bayard-Condict Building in New York (1897-9; Figure 63), turned in his hands into a continuous vertical object instead of several ones piled on top of each other. While the grand figure communicated with the scale of the city, the fractal patterns of its idiosyncratic decoration corresponded with the user and passer-by on the street. Studying mineralogy and plant morphology, Sullivan also kept nature at the center of his investigations:

> My conclusions have been reached not in the racket of cities, nor in the study of garrulous philosophies, nor in libraries, nor in schools, but in the bounteous open air, within the infinite peace of Nature [...].[257]

continued to parade his skills in ambidextrous drawing. Kahn's notebook entry describing a day sketching in Carcassonne is a perfect testament to how Tadd had imagined drawing to function: "From the moment I entered the gates, I began to write with drawing [...]. I began studiously to memorize in line the proportions and the living details of these great buildings [...]. At the close of the day I was inventing shapes and placing buildings in different relationships than they were." Richard Saul Wurman and Eugene Feldman, (eds.), *The Notebooks and Drawings of Louis I. Kahn* (Philadelphia: Falcon Press, 1962) n.p.

256 Cf. Louis H. Sullivan, *The Autobiography of an Idea* (New York: Dover Publications, 1956; 1924).

257 Louis H. Sullivan, *Kindergarten Chats and other Writings* (New York: George Wittenborn, 1955; 1901) p. 114. The *Kindergarten Chats*, initially written in 1901 as a series of weekly articles, were revised

Condensing Greenough's earlier dictums into the compendious formula of "form follows function," Sullivan elaborated his theory in the *Kindergarten Chats* of 1901:

> [S]peaking generally, outward appearances resemble inner purposes. For instance: the form oak-tree, resembles and expresses the purpose or function, oak; the form, pine-tree, resembles and indicates the function, pine; the form, horse, resembles and is the logical output of the function, horse; the form, spider, resembles and is the tangible evidence of the function, spider.

For Sullivan, form existed because of function, and "this something behind the form is neither more nor less than a manifestation of what you call the infinite creative spirit, and what I call God."[258] Following the Latin motto of *finis origine pendet* ("The end depends of the beginning"),[259] Sullivan was aware that function, which sounded abstract and profound, in reality referred to

> that need [...] which is seeking or finding fulfillment. If you put an acorn in the ground, that acorn, containing the function oak, will seek the form oak, and, in process of time, will become an oak-tree.[260]

This quote, almost a paraphrase of Kahn's earlier statement, underlines that the inner function was not as in its later Modernist use a rational cause, but primarily represented a telluric force enlivening all organic creation. Accordingly, Sullivan clarified:

> In seeking now a reasonably solid grasp on the value of the word, organic, we should at the beginning fix in mind the values of the correlated words, organism, structure, function, growth, development, form. All of these words imply the initiating pressure of a living force and a resultant structure [...] whereby such invisible force is made manifest and operative. The pressure, we call Function: the resultant, Form.[261]

Moreover, in his last theoretical work *A System of Architectural Ornament: According with a Philosophy of Man's Powers* (1924), Sullivan reasserted his belief that mankind in its creations should proceed just like nature from the inside out. The pamphlet opened with a drawing of a germ, a typical seed with two cotyledons containing sufficient nourishment for the initial stages of a plant's development (Figure 64):

> The Germ is the real thing; the seat of identity. Within its delicate mechanism lies the will to power: the function, which is to seek and eventually to find its full expression in form.

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collectively in 1918. In 1934, Claude Bragdon republished them, whereby the latter's *The Beautiful Necessity: Architecture as 'Frozen Music'* (Rochester: Manas Press, 1910) is noteworthy, too, in relation to Transcendentalist architectural theory.

258 Ibid., pp. 43-6.

259 Heraclitus, *Fragments* (New York: Penguin Books, 2003) Fr.70.

260 Sullivan, *Kindergarten Chats*, p. 99.

261 Ibid., p. 48.

Fig. 64: Louis H. Sullivan, *A System of Architectural Ornament*, 1924.

Wright, "the good pencil in the Lieber Meister's hand," in many ways followed Sullivan's organic doctrines.[262] In 1959, when requested by the *Architectural Forum* to contribute a testimonial on Wright's work, Kahn responded:

> Wright gives insight to learn – That nature has no style – That nature is the greatest teacher of all – The ideas of Wright are the facets of this single thought.[263]

Kahn had visited numerous of Wright's buildings including Unity Temple (1906) and further Prairie Style houses in Chicago's Oak Park area, the Robie House (1908-10), Fallingwater (1934-8) and the Johnson Wax Administration Building. Besides, Wright was a constant presence in Philadelphia during the 1950s: in 1951 the exhibition "Frank Lloyd Wright: 60 Years of Living Architecture," organized by Kahn's former partner Stonorov, commenced its global tour in the local Gimbels department store. In 1954, a large reception took place in Philadelphia on behalf of Wright's receipt of the American Institute of Architects Gold medal, and the same year, his design of the Beth Sholom Congregation in Elkins Park (1954-9) was announced.[264] To outline

262 According to Wright, Sullivan was "always active and effective in the investigation of Nature. […] In his every design a bit of Nature enters into a building." Frank Lloyd Wright, *Genius and Mobocracy* (New York: Duell, Sloan and Pearce, 1949) p. 3.

263 Telegram from Joseph Hazen, managing editor of *The Architectural Forum*, 10 April 10 1959; Kahn's answer is undated; Cf. 030.II.A.61.42, LIKC. Talisien, Wright's family retreat and workshop in northern Wisconsin was based on the principles of Unitarianism and derived its name from his Welsh ancestors referring it back to mythic heroes "born from natural elements such as grains, trees, and plants." Exemplifying the idea of self-reliance, the apprentices as part of their fellowships not only worked on architectural projects, but also as farmers and craftsmen to maintain the autonomy of the community.

264 "Frank Lloyd Wright plans Synagogue here," in *The Sunday Bulletin*, 23 May 1954; Cf. 030. II.A.66.6, LIKC.

Wright's general popularity at the time, *In the Nature of Materials: The Buildings of Frank Lloyd Wright* was according to Kahn a sort of bible among his students.[265] Deeply influenced by Emerson,[266] Wright, too, spotted in nature the principles to create a "living architecture:"

> I know with what suspicion the man is regarded who refers matters of fine art back to Nature. I know that it is usually an ill-advised return that is attempted, for Nature in external, obvious aspect is the usually accepted sense of the term and the nature that is reached. But given inherent vision there is no source so fertile, so suggestive, so helpful aesthetically for the architect as a comprehension of natural law.[267]

As indicated in these lines, Wright's study of natural forms relied on an in-depth analysis; he was like Kahn an abstractionist seeking the patterns behind nature's superficial appearance:

> What we must know in organic architecture is not found in books. It is necessary to have recourse to Nature with a capital N in order to get an education. It is necessary to learn from trees, flowers, shells – objects which contain truths of form following function. If we stopped there, then it would be merely imitation. But if we dig deep enough to read the principles upon which these are activated, we arrive at secrets of form related to purpose that would make of the tree a building and the building a tree.[268]

Nonetheless – and this is relevant in relation to Kahn's later attitude, too – Wright insisted that architecture was ultimately not nature, but in Romanticist terms "a child of the spirit of man."[269]

2.3 Spatial Differentiation and Square Compositions

What Kahn and Wright shared further in common was first a longing to constitute proportionally interrelated frameworks, in which, as Wright put it, "part is to whole as the whole is to the part;"[270] second, a concern for basic geometries; and third, a coequal

265 Cf. Carter Wiseman, *Louis I. Kahn: Beyond Time and Style* (New York: Norton, 2007) p. 86.
266 Cf. Naomi Tanabe Uechi, *Evolving Transcendentalism in Literature and Architecture: Frank Furness, Louis Sullivan, and Frank Lloyd Wright* (Newcastle: Cambridge Scholars Publishing, 2013).
267 Frank Lloyd Wright, "In the Cause of Architecture," (1908) in Bruce Brooks Pfeiffer, (ed.), *Frank Lloyd Wright: Collected Writings* (New York: Rizzoli, 1992) I, p. 87.
268 Aline B. Louchheim, "Frank Lloyd Wright talks of his Art," in *The New York Times Magazine*, 4 October 1953.
269 Wright, *Autobiograph*y, p. 147. Cf. Richard P. Adams, "From Coleridge to Wright: The Romantic Movement," in *American Quarterly*, vol.9, no.1, 1957, pp. 46-62.
270 Frank Lloyd Wright, "What's the Matter with America?" (unpublished speech delivered in Los Angeles, 1954), in Uechi, op.cit., p. 132. For Wright, most of all "Gothic architecture approached the organic in character." Wright, *Genius and Mobocracy*, p. XI.

emphasis on differentiation. Regarding the last and based on the precept that every problem contained its particular solution, Wright had indicated a longing for such individuation as early as 1908, when he demanded "In the Cause of Architecture:"

> There should be as many kinds (styles) of houses as there are kinds (styles) of people and as many differentiations as there are different individuals.[271]

Difference, for both Wright and Kahn, possessed a clue to the essence of what something wanted to be. In a congenial way, Kahn criticized his earlier design of the Yale Art Gallery, saying that he would now "give the [director] spaces that were there and had certain inherent characteristics."[272] His subsequent ideological focus on differentiation clearly contradicted the spatial homogeneity derived from the universal space: "If you can now put columns as much as 100' apart you may lose more than you gain because the sense of the enclosed space disappears."[273]

Kahn's basic awareness to differentiate the elements of his architectural composition derived from his Beaux-Arts education, where he had learnt in Guadet's *Éléments et théorie de l'architecture* (1901) to distinguish between "surfaces utiles" and "communications nécessaires." This implicated that next to *useful* spaces, "no plan should ever be reduced to those useful surfaces only," since

> there is always a need for openings, some neutral surfaces so to speak, which will link up the first ones, which will allow the accessess and the passages from one floor to the other, which will allow light and air to reach those parts that have no access to public space, and which will be, in a word, the arteries of the composition.[274]

This tendency to classify the compositional elements was further promoted in Talbot Hamlin's *Forms and Functions of Twentieth Century Architecture* (1952) that divided a building's structure into "structural elements" and five types of "use elements:" rooms for public and private utilization, service areas, passages for horizontal and vertical circulation, as well as areas for mechanical equipment:

> A knowledge of this alphabet is essential to [the architect] as a knowledge of words to the writer or of notes to the musician. No building can exist without some of them, and upon their correct arrangement and design the success of the building, both practically and aesthetically, will almost entirely be founded.[275]

271 Wright, "In the Cause of Architecture," p. 87.
272 Kahn, "Talk at the Conclusion of the Otterlo Congress," p. 213.
273 Walter McQuade, "Architect Louis I. Kahn and his Strong-Boned Structures," in *The Architectural Forum*, vol.107, no.4, October 1957, p. 136.
274 Julien Guadet, *Éléments et théorie de l'architecture* (Paris: Libraire de la construction moderne, Aulanier and Co., 1901) IV, p. 199; transl. by the author.
275 Talbot Hamlin, *Forms and Functions of Twentieth-Century Architecture* (New York: Columbia University Press, 1952) pp. 6-7.

Further evidence of Kahn's attempt to define a more compartmented approach is found in his notebooks from the mid-1950s. Positioning his own approach in relation to the architecture of Mies van der Rohe and Le Corbusier, Kahn argued, while the latter felt "[w]hat a space 'wants to be' [...]," the former did not sense it:

> Mies's order is not comprehensive enough to encompass acoustics, light, air, piping, storage, stairs, shafts, vertical and horizontal and other service spaces. His order of structure serves to frame the building but not harbor the servant space.[276]

These notes underline that the burgeoning concept of "the nature of the space" vehemently criticized the Miesian order. Contrasting its spatial continuity that permitted a large space to be divided into smaller ones, Kahn's novel approach was to foster separate albeit hierarchically interdependent spatial units. Following their distinct nature, the individually defined rooms should assemble in a rhythmically coordinated *organization* of "served" and "servant" spaces to form a "society of rooms."[277]

Tracing the origins of Kahn's concern with individuation, it is notable that in 1931, in his first published essay, "The Value and Aim in Sketching," the general ambition to recognize an object's intrinsic qualities was already present: "We must learn how a steamship is to be given its character as devotedly as how a cactus plant can be given its particular character [...]."[278] In addition, in the illustration "The Plan of a City is like the Plan of a House" for the booklet *You and Your Neighborhood* from 1944 (Figure 65), Kahn revealed an early yearning to emphasize the diversity of atmospheres within a single building, as he compared each room with a separate part of a city.[279] Likewise, Van Eyck had discovered evidence for the analogy of the house and the city during a sequence of study trips to Africa. While the chambers of a Dogon house represented separate bodily organs, the houses, in turn, were the organs of the city, and therefore, also conceived in the androgynous image of man (Figure 66).[280] It was especially in

276 Kahn, "Notebooks," 288.III.15, RSWC.

277 Cf. Heinz Ronner, Sharad Jhaveri and Alessandro Vasella, *Louis I. Kahn: Complete Work 1935-74* (Basel: Birkhäuser, 1977) p. 347.

278 Louis I. Kahn, "The Value and Aim in Sketching," in *The T-Square Club Journal of Philadelphia*, vol.1, no.6, 1931, p. 19.

279 Again in close analogy, Wright had remarked: "[E]ach room has its own individuality and its use completely recognized in the floor plan. Dining room, kitchen, and sleeping rooms thus may become small buildings in themselves. All are grouped together to form a whole [...]." Wright, *Ausgeführte Bauten und Entwürfe – Studies and executed Buildings* (Berlin: Ernst Wasmuth, 1998; 1910) p. 39.

280 Cf. Aldo van Eyck with Paul Parin and Fritz Morgenthaler, "Miracle of Moderation," in *Via*, no.1, 1968, pp. 96-124; orig. published in *Forum*, vol.20, no.7, 1967. In the spring of 1960, Van Eyck visited the Dogon, who lived in some 700 scattered communities along the Bandiagara plateau in present-day Mali. The Dogon's mud-brick houses and granaries virtually grew from the rocky cliffs, and all the products of their design, from a simple basket to the more complex granaries, were charged with extra symbolic meanings inherent in the geometries used: the circle standing for the sun and the square for the sky. Cf. Aldo van Eyck, "The Child, the City and the Artist," manuscript (1962), 109.II.E.6.1, ILMC;

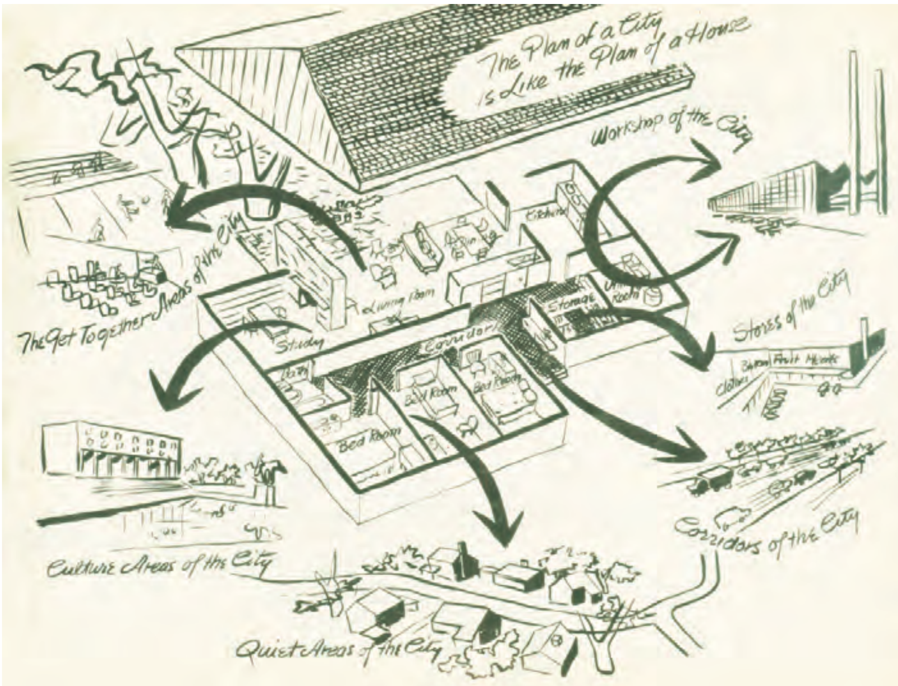

Fig. 65: Louis I. Kahn, “The Plan of a City is like the Plan of a House,” 1944.

his project for an Orphanage in Amsterdam (1955-60) that Van Eyck addressed the reciprocal notion that every house ought to be like a small city and every city like a large house.[281] The Dutch architect’s dogma to “conceive architecture urbanistically and urbanism architecturally,”[282] also stretched back to the Renaissance. In *De re aedificatoria* of 1452, Leon Battista Alberti had already wondered:

> If (as the philosophers maintain) the city is like some large house, and the house is in turn like some small city, cannot the various parts of the house – atria, xysti, dining rooms, porticoes, and so on – be considered miniature buildings?[283]

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published by Vincent Ligtelijn and Francis Strauven, (eds.), *The Child, the City and the Artist: An Essay on Architecture, the In-Between Realm* (Amsterdam: Sun Publishers, 2008).

281 ”Make of each window and each door a place, a bunch of places of each house and each city. Make also of each house a small city and of each city a large house.” Aldo van Eyck, “There is a Garden in her Face,” in *Forum*, vol.15, no.3, 1960-1, p. 121. Cf. Vincent Ligtelijn and Francis Strauven, (eds.), *Aldo van Eyck: Collected Articles and Other Writings, 1947-1998* (Amsterdam: Sun Publishers, 2008) pp. 291-2.

282 Aldo van Eyck, “The Medicine of Reciprocity,” in *Forum*, vol.15, no.6-7, 1960-1, p. 237.

283 Leon Battista Alberti, *On the Art of Building in Ten Books* (Cambridge: The MIT Press, 1988; *De re aedificatoria*, 1452) I, § IX.

Fig. 66: Dogon Village, in Aldo van Eyck, "The Child, the City and Artist," 1962.

To remain with Van Eyck, as noted already in relation to his hexagonally planned Open-Air School in Amsterdam, he shared with Kahn an interest in the application of basic geometrical patterns. As the more than 700 playgrounds in Amsterdam prove, these exercises in arranging primary forms derived from a similar education under

Beaux-Arts guidelines at ETH Zurich,[284] but also from Van Eyck's personal exploration of the basic gestures of spatial communication in tribal African communities that, due to their isolated desert location, had remained largely unchanged.[285] For him, it was the perfect place to discover the constant aspects of architectural form, since

> Modern architecture has been harping continually on what is different in our time to such an extent that even they have lost touch with what is not different, with what is always essentially the same.[286]

Much in the vein of Kahn's aphorism, "What was has always been – What is has always been – What will be has always been,"[287] the Dutch architect – quoting James Joyce, "Anna was, Livia is, Plurabell's to be"[288] – regarded contemporary man just as lost vis-à-vis the world as the earliest man had been. He faced the same inexorable natural laws that made stone just as hard and fire just as hot today as it had been thousands of years ago. Similarly, Kahn would later affirm, "[t]he man of old had the same brilliance of mind as we assume we have only now."[289]

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284 In the second year of his studies at ETH Zurich, Van Eyck took courses in the class of Alphonse Laverrière, a graduate of the École des Beaux-Arts in Paris. Cf. Robert McCarter, *Aldo van Eyck* (New Haven: Yale University Press, 2015) p. 13.

285 In 1943, just after graduation and intrigued by Marcel Griaule's ethnographic account "Mission Dakar – Djibouti – Dogon, 1931-3," Van Eyck conducted the first of his African journeys with the goal to reach the holy city of Kairouan; Medenine, the city of domes; as well as Ghadames, one of the jewels of the Sahara. Not successful on this occasion, he visited them only on later trips between 1947 and 1952. Cf. Aldo van Eyck, "Building in Southern Oases," in *Forum*, vol.8, no.1, 1953, pp. 28-38. In Zurich, the Dutch architect made the acquaintance of Carola Giedion-Welcker, who introduced him to the artistic avant-garde that had – triggered by the opening of the Musée d'Ethnographie du Trocadéro in 1882 – shown a comparable fascination for tribal art forms half a century earlier.

286 Aldo van Eyck, in Newman, *CIAM '59*, p. 27. "Our problems are also those of eternal man – of archaic man. [...] Man is always the same, in all places on earth and in all times." Van Eyck "Talk at the Otterlo Congress" (transcription of Van Eyck's lecture on 11 September 1959), in Ligtelijn and Strauven, *Collected Articles and Other Writings*, p. 199. As Eeva-Liisa Pelkonen pointed out, in his own quest to uncover the underlying essence of architectural form Kahn might have also been influenced by the publication of *The Shape of Time* (1962) by the Yale art historian George Kubler, which "put forward the idea that rather than innovation and originality, art was about reworking existing paradigms and formal problems throughout history." Pelkonen, "Toward Cognitive Architecture," p. 140. Earlier, Le Corbusier when describing the construction of the primitive hut in *Vers une architecture* had noted: "There is no primitive man; there are primitive means." Le Corbusier, *Toward an Architecture*, p. 133.

287 Louis I. Kahn interviewed by Robert Wemischner, 17 April 1971, in Wurman, *What will be has always been*, p. 116.

288 James Joyce, "Anna Livia Plurabelle," (1929) in *Finnegans Wake* (1922-39); and quoted by Van Eyck in "Kaleidoscope of the Mind," in *Via*, no.1, 1968. Kahn's quote also echoes the words in the book of Ecclesiastes (1:9): "The thing that hath been, it is that which shall be; and that which is done is that which shall be done: and there is no new thing under the sun."

289 Louis I. Kahn, "1973: Brooklyn, New York," in *Perspecta*, no.19, 1982, p. 98. In a similar vein, Van Eyck quoted Franz Boas from the book *Primitive Art* (1927): "So far as my personal experience

It is no easy step to move on from the Dogon to Kahn's urban studies for the Midtown of Philadelphia (1952-7), yet in both cases the use of simple geometric forms ordered the plan. In the early stages of the project, Kahn employed a modular triangular grid, while the most distinctive edifice was a cylindrical glass building that housed the bus station on the concourse level, a hotel in its peripheral wall and a department store in the darker middle zone. In the further development, Kahn devised several such volumes as parking garages that, like fortification towers, surrounded the city center and protected it from automobile traffic (Figure 67). Fascinated by the Martello Towers at the coast in Kent (Figure 68) as well as the cylindrical structure of Cecilia Metella's Mausoleum on Via Apia in Rome (1st century BC) – here depicted in a *veduta* of Giovanni Battista Piranesi from *Le antichità romane* (1756; Figure 69) – the American architect formalized his parking facilities as similarly powerful and autonomous elements in the cityscape.[290]

Leaving Kahn's urban studies aside, in his proposal for the Adath Jeshurun Synagogue (Figure 70), both the project's individuated plan as well as its strict formal dictum were remarkable: bound by a circular car ramp orbiting the building, a triangular floor plan hosted in its corners three triangular hollow columns with sky-lit stairs. The absolute geometries of the building harshly opposed the surrounding sloping terrain, which Kahn left undisturbed as a preserve for "the enjoyment of nature's designs."[291] Kahn's use of such archetypical forms was fueled by the publication of Emil Kaufmann's *Three Revolutionary Architects: Boullée, Ledoux and Leque* in 1952 (Figure 71). The study refocused attention on the work of this exceptional group of late 18th-century French architects,[292] who had postulated an absolute architecture of

goes and so far as I feel competent to judge ethnographical data on the basis of this experience, the mental processes of man are the same everywhere, regardless of race and culture, and regardless of the apparent absurdity of beliefs and customs." Van Eyck, "The Story of Another Idea," in *Forum*, no.7, 1959, p. 225.

290 Kahn's vision of the downtown area as an assemblage of primary geometric bodies obviously assimilated with Le Corbusier's observation that "[o]ur eyes were made for seeing forms in light; shadow and light reveal forms; cubes, cones, spheres, cylinders, and pyramids are the great primary forms that light reveals well [...]." Le Corbusier, *Toward an Architecture*, p. 102.

291 Kahn, "A Synagogue (Adath Jeshurun of Philadelphia)," p. 62. The same focus on primary geometric forms became apparent in the work of William Huff, one of his students in Yale, who in his diploma project for an Urban Church (1954) had done the reverse and inscribed a circle within a triangle. Cf. Goldhagen, *Situated Modernism*, p. 100. In 1956, Huff was awarded a Fulbright Fellowship to the Hochschule für Gestaltung in Ulm, where he became a permanent guest teacher between 1963 and 1968. In the interim period, he had worked in Kahn's office. In his own research "Symmetry: an Appreciation of its presence in Man's Consciousness" (facsimile reproductions of part five and six were published in *Oppositions*, no.6, fall 1976 and no.10, fall 1977) Huff specialized on the subject of nature and geometry.

292 In fact, the first to draw attention to the subject was Henry Lemonnier, "La megalomania dans l'architecture à la fin du XVIIIe siècle," in *L'architecte*, 1910, pp. 92-7. Kaufmann afterwards published *Von Ledoux bis Le Corbusier* (Vienna: Passer, 1933). Cf. Helen Rosenau, (ed.), *Boullée's Treatise on Architecture* (London: Alec Tiranti, 1953).

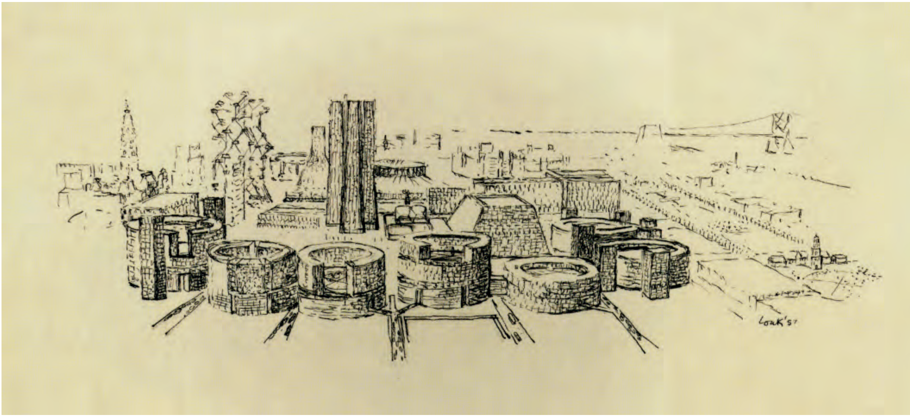


Fig. 67: Louis I. Kahn, Study for Midtown Philadelphia, Pennsylvania, 1952-7.

Fig. 68: Martello Tower, Coast of Kent, England.

Fig. 69: Giovanni Battista Piranesi's depiction (1754) of Cecilia Metella's Mausoleum, Rome, Italy, 1st century BC. Postcard from Louis I. Kahn to Anne Griswold Tyng, 1950.

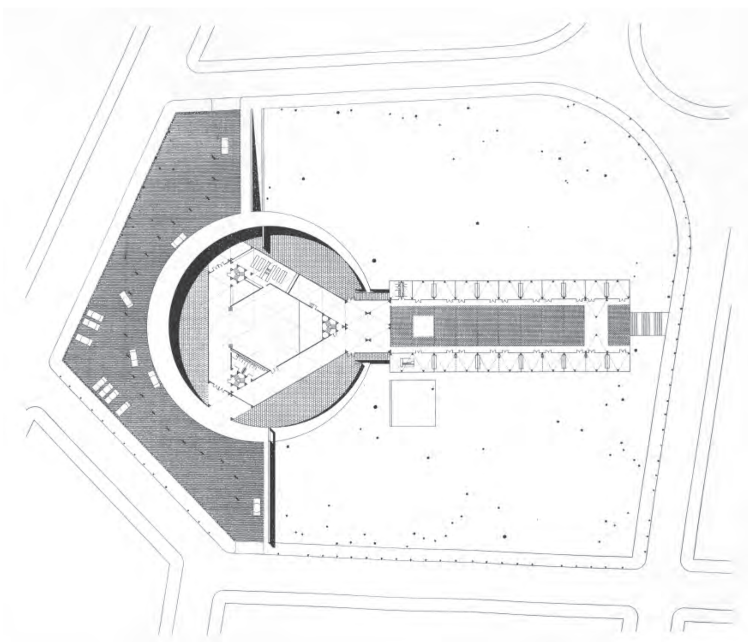
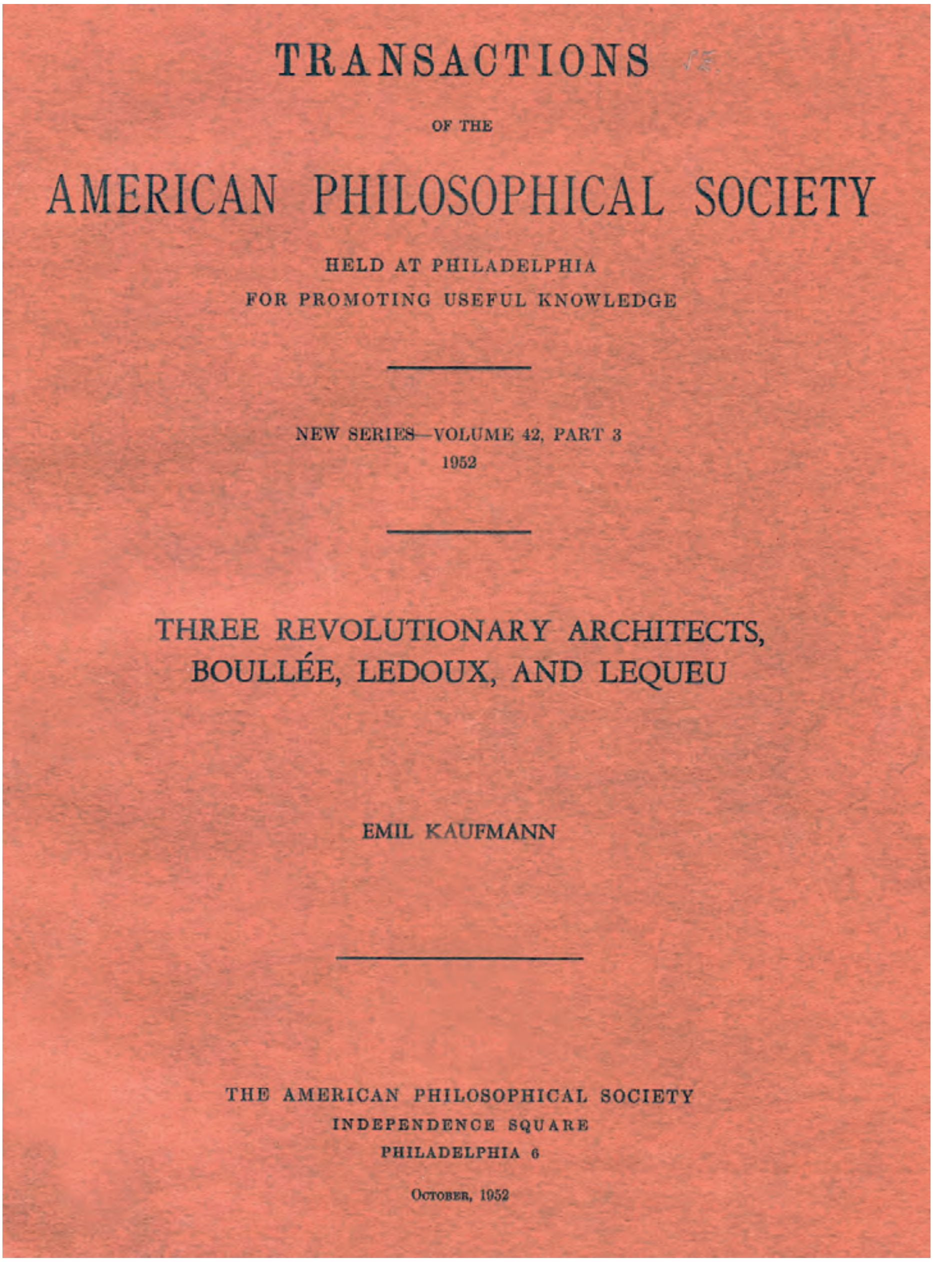


Fig. 70: Louis I. Kahn, Adath Jeshurun Synagogue, Elkins Park, Pennsylvania, 1954.



TRANSACTIONS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY

HELD AT PHILADELPHIA
FOR PROMOTING USEFUL KNOWLEDGE

NEW SERIES—VOLUME 42, PART 3
1952

THREE REVOLUTIONARY ARCHITECTS,
BOULLÉE, LEDOUX, AND LEQUEU

EMIL KAUFMANN

THE AMERICAN PHILOSOPHICAL SOCIETY
INDEPENDENCE SQUARE
PHILADELPHIA 6

October, 1952

Fig. 71: Emil Kaufmann, *Three Revolutionary Architects*, 1952.

formal restraint that contrasted the excesses of the Baroque.[293] However, Kahn seemed attracted not merely by the Revolutionary Architects' preference for simple stereometric volumes, but also by their ideological aspiration to create a communicative architecture, an *architecture parlante*, which manifested a building's capacity to enunciate the *caractère* inherent in a given task – indeed, a postulate that was akin to Kahn's spatial rhetoric of articulating a building's particular existence-will.

Their visionary proposals – in Boullée's case of colossal Egyptian-Mesopotamian scale – were omni-directionally conceived with egalitarian façades on all sides, appeared detached from their pastoral surroundings – an aspect even more encouraged by the frequent elevation of the buildings upon pedestals – and encapsulated the guiding ideas of the Enlightenment and its breakthroughs in the natural sciences. For example, their pursuit to dismantle the five classical orders in order to constitute a more elemental basis of Euclidean forms coincided with chemistry's gradual decomposition of the traditional four elements. In a way, the oxygen and hydrogen discovered by Lavoisier corresponded with the Revolutionary architects' appraisal of the sphere, cube, and cylinder as the essential members of their *arché-periodic* nomenclature. Similarly, in the *Précis des leçons* (Figure 72) Durand had systematically classified designs according to a *periodic table* of primary forms, mostly the square and circle. With his rationalizing intentions, the "disposition" of the individual spaces as an *ars combinatoria* became the discipline's main task. Turning the attention to a plan's formal syntax, architecture implied the coordination of basic, clearly defined spaces, which were according to Durand "like words in language or notes is music."[294] Of this, Kahn, a passionate piano player, was well aware: "To the musician his writing means something beyond itself – it means sound, it means organization of sound."[295]

Kahn, between 1951 and 1955, in a series of small, unrealized single-family houses, continued to elaborate his paradigm of spatial differentiation. What connected the Fruchter, Jaffe, Adler and Weber de Vore Houses besides their compartmented structure was the application of the square as a formal unit.[296] In the Fruchter House in Philadelphia (1951-4), three equally dimensioned, structurally self-contained square units – one for the living area, the bedroom, and the kitchen – surrounded a triangular courtyard. In the Jaffe House in Philadelphia (1954), the inner triangular courtyard was omitted in order to create a configuration solely made up of squares. If the arrangement of the squares surrounding the Fruchter House's interior triangle was static, the overall organization of the Jaffe House was more dynamic:

293 Among the wide range of projects presented in Kaufmann's publication, Claude-Nicolas Ledoux's Guinguette in Faubourg St. Marceau (1780) in formal terms most closely resembled Kahn's synagogue design.

294 Cf. Pérez-Gómez, *Architecture and The Crisis of Modern Science*, pp. 302 ff.

295 Kahn, "Talk at the Conclusion of the Otterlo Congress," pp. 210-1.

296 Also during the 1950s, Albers ritualized the square in his "Homage to the Square" series.

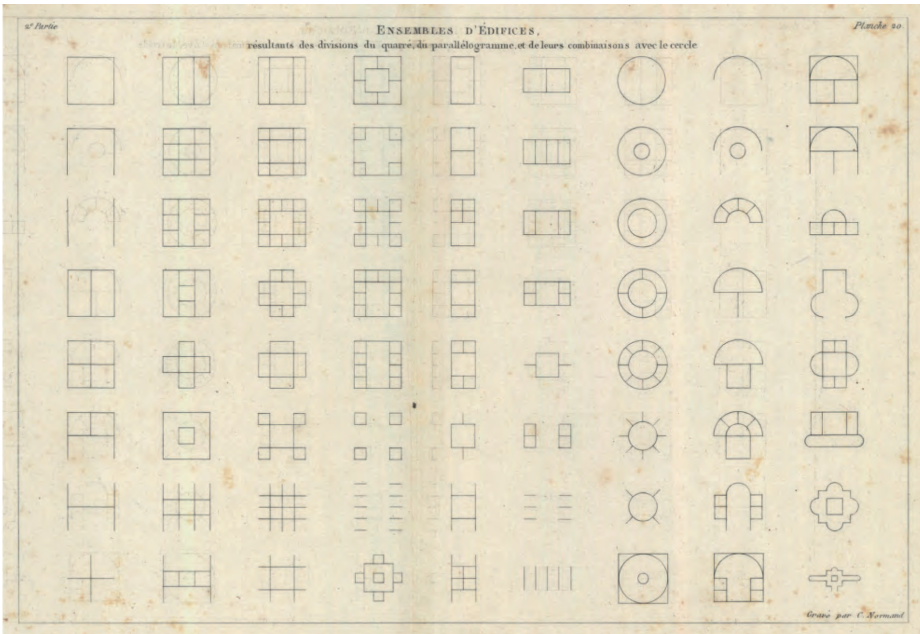


Fig. 72: Jacques-Nicolas-Louis Durand, *Précis des leçons*, 1802-5.

> The equal squares of 24 x 24 are placed as suits best the dictates of orientation view trees contours. [...] It is more adaptable and therefore more true to conditions of nature.[297]

The subsequent projects of the Adler House in Philadelphia (1954-5; Figure 73) and the Weber de Vore House in Montgomery County, Pennsylvania (1954-5; Figure 74), attempted in their asymmetric arrangement to become as versatile as the Jaffe House. In both cases, each pavilion-like sub-volume was structurally and spatially complete, while in the Adler House four hollow masonry piers defined the corners of each space to provide “the avenues to harbor today’s complex mechanical requirements including complete air conditioning.”[298] Kahn’s independent entities were of equal size, but of varied height and materials. Grouped so as to strengthen the composition in its entirety, simultaneously the autonomy of each was consolidated. Indeed, Kahn’s configurative approach conceived the individual elements in a manner such that their identity should not be lost in the process of repetition, but, on the contrary, be reinforced within the constituted whole.

297 Tyng, *The Rome Letters*, p. 117; letter 16 March 1954.
298 Louis I. Kahn, “Two Houses,” in *Perspecta*, no.3, 1955, p. 61.

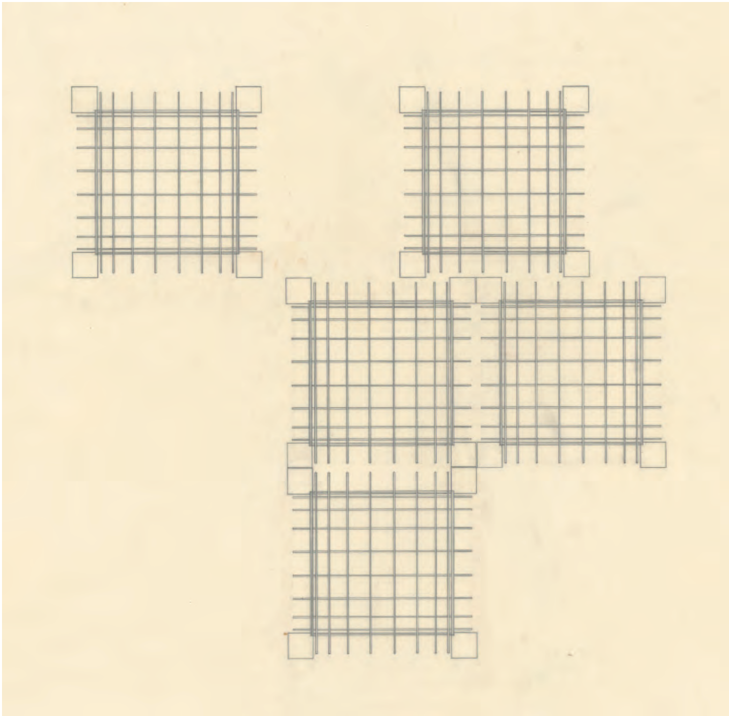


Fig. 73: Louis I. Kahn, Adler House, Philadelphia, Pennsylvania, 1954-5.

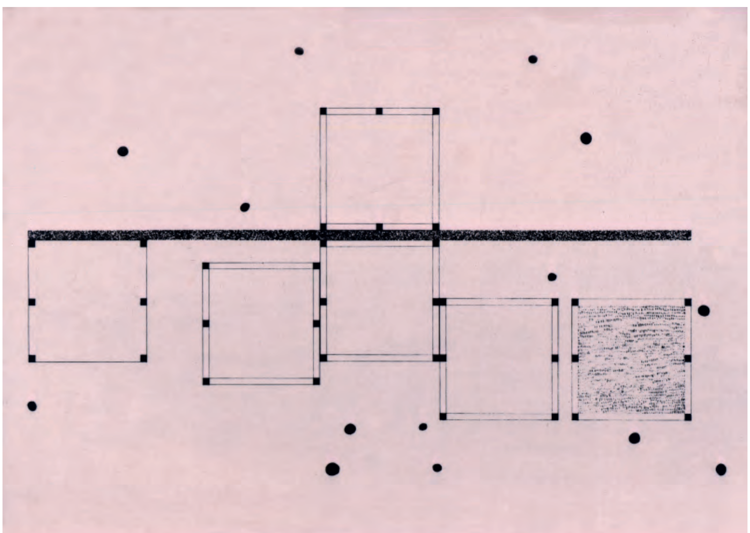


Fig. 74: Louis I. Kahn, Weber de Vore House, Montgomery County, Pennsylvania, 1954-5.

Fig. 75: Louis I. Kahn, Bath House, Trenton, New Jersey, 1955.

2.4 Humanist Principles of Organization

In 1955, Kahn's outlines on the compartmented space converged with the erection of a small Bath House in Trenton, New Jersey (Figure 75). Forming an overall cross-shape, four separate square structures, each topped with a pyramidal roof, surrounded an inner courtyard with a circular *impluvium*-like engraving on the floor. The sub-units were identical in size and each had four hollow columns in its corners that combined structural and functional tasks (Figure 76). In acknowledgment of the individual existence-will of each of the pavilions, the placement of non-bearing walls slightly differed in relation to the pavilions' varying programs.[299] In terms of geometry and contextual placement, the project again approximated the outlines of the Revolutionary Architects: its stereo-metric, omni-directional contours subjugated the natural givens,

299 As Kahn recalled, his insistence on differentiation had in fact brought him the commission: "They chose me because they felt by my submissions that I was the one man who did not repeat himself in his work and therefore they can expect a solution in keeping with their problem." Tyng, op.cit., p. 183; letter 29 October 1954.

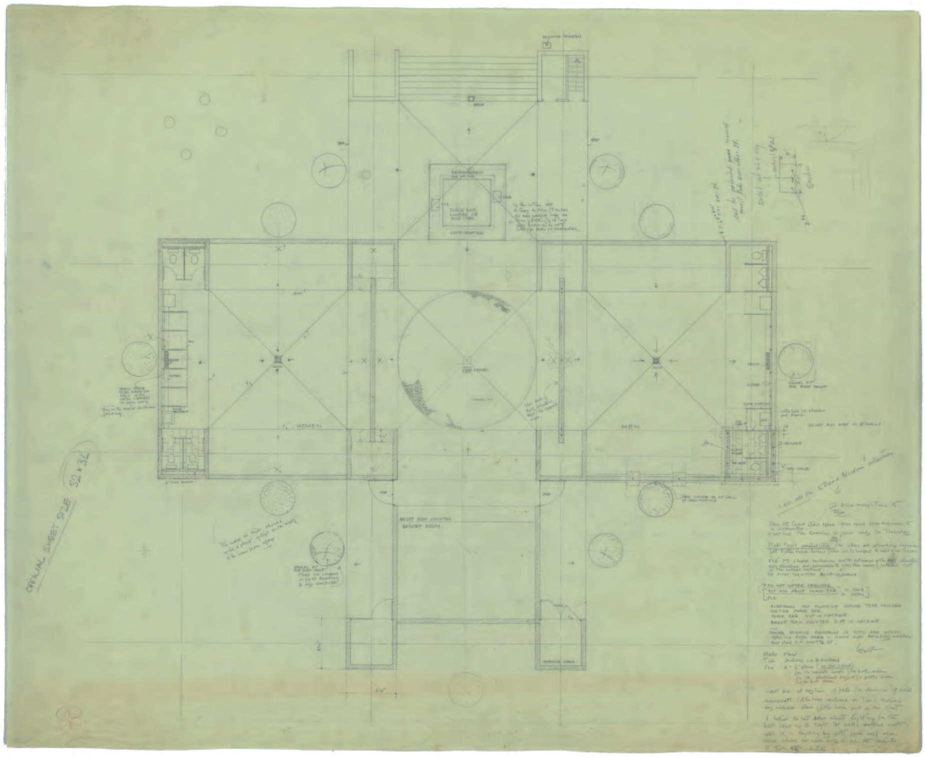


Fig. 76: Louis I. Kahn, Bath House, Trenton, New Jersey, 1955.

as Kahn had indeed designed a *perfect* building in the midst of the rough environment. Neglecting an interaction with its outer context, the design produced a static image paradigmatically developed from the inside outwards. Without windows, and therefore without a conventional façade, the self-contained composition avoided in its opaqueness a dialogue with the surroundings. Only a square shaped oculus, crowning each of the pavilion's pyramidal hip roofs, delivered light to the interiors. The use of zenithal light further emphasized the autonomy of the project, as the only outside views related to the distant sky. Like the Pantheon in Rome with its crowning *opaion*, each substructure was an "inward-focused, upward-directed" universe.[300]

300 Cf. Neil Levine, "Kahn's Edge: The Provocative Historicism of the Trenton Jewish Community Center," in Von Moos and Eisenbrand, *The Power of Architecture*, p. 106. Regarding the Pantheon, Kahn corroborated, "[i]f architecture may be expressed as a world within a world, then this building expresses it well, even refining it, by placing the oculus, the only window, in the center of the dome." Wurman and Feldman, *Notebooks and Drawings*, n.p. The Bath House, however, would be more accurately described as a doubly inverted structure, as not only the pavilions with their oculi were separate worlds in themselves, but also the inner courtyard was a detached universe. Interestingly, Kahn's application of a *quincunx* or cross-in-square plan relates the project to a wide array of possible references. Early humankind had placed a right-angled cross, inscribed either in a square or in a circle, on their settlements as a basic symbol. The Egyptian hieroglyph for a city was the cruciform, and later the Romans, in their founding of cities orthogonally crossed the *cardo* with the *decumanus* in order to transpose the *templum* of the sky to the earth (Figure 77). In "The Idea of a Town," an article published under the auspices of Van Eyck as editor of *Forum* in 1963, Joseph Rykwert noted:

> It is difficult to imagine a situation when the formal order of the universe could be reduced to a diagram of two intersecting co-ordinates in one plane. Yet this is exactly what did happen in antiquity: the Roman who walked along the *cardo* knew that his walk was the axis round which the sun turned, and that if he followed the *decumanus*, he was following the sun's course.[301]

In simple terms, the cross-shape symbolized man's aspiration to give the inaccessible and thus mentally threatening cosmos human measure and make one feel "at home in it." According to Rykwert, the templum was

> to turn the hilltop on which it was performed into the centre of the universe. [...] The augur's act in drawing his diagram on the ground changed the earth he touched from *anywhere* to *this, unique and only* place.[302]

With similar motives of cosmic reflection, cruciform shaped churches – *bodily temples* – found wide application during the spread of Christianity.[303] As a paragon served the Byzantine Church of the Holy Apostles in Constantinople (c. 536) with its far-reaching influence upon designs such as St Mark in Venice (1063-85) and St Front of Périgeux (after 1120; Figures 78, 79). Analogous to the disposition of the Trenton

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Roman patio houses usually employed a *peristyle* (a columned porch surrounding an inner courtyard containing a garden) next to a sky-lit atrium space. Kahn's use of a wooden dome instead of Roman concrete may have been triggered by E. Baldwin Smith's research on *The Dome: A Study in the History of Ideas* (1950). Smith, professor of architectural history at Princeton University, which Kahn frequently visited at the time, traced the origin of masonry domes back to wooden prototypes.

301 Joseph Rykwert (with an introduction by Aldo van Eyck), "The Idea of a Town," in *Forum*, vol.17, no.3, 1963, p. 143. As a source Rykwert mentions Hyginus Gromaticus, a surveyor and near-contemporary of Vitruvius: "Boundaries are never drawn without reference to the order of the universe, for the *decumani* are drawn in line with the course of the sun, while the *cardines* follow the axis of the sky," i.e. the *cardo* is pointing to the pole (the axis of the universe), while the *decumanus* follows the equinox of the rising and setting sun. Ibid., p. 117. Vitruvius described in detail the construction of an eight-sided wind rose to determine a city's main directions. Cf. Vitruvius, *On Architecture*, I, Ch. VI, § 6-7.

302 Rykwert, op.cit., p. 116.

303 Justinian's architects made the domed brick-vaulted central plan the rule in church building. Cf. Richard Krautheimer, *Early Christian and Byzantine Architecture* (New Haven: Yale University Press, 1986; 1965) pp. 200 ff. According to Krautheimer (p. 341), it's a type "derived from Iranian architecture, either by way of Armenia, or directly from Sassanian Fire Temples."

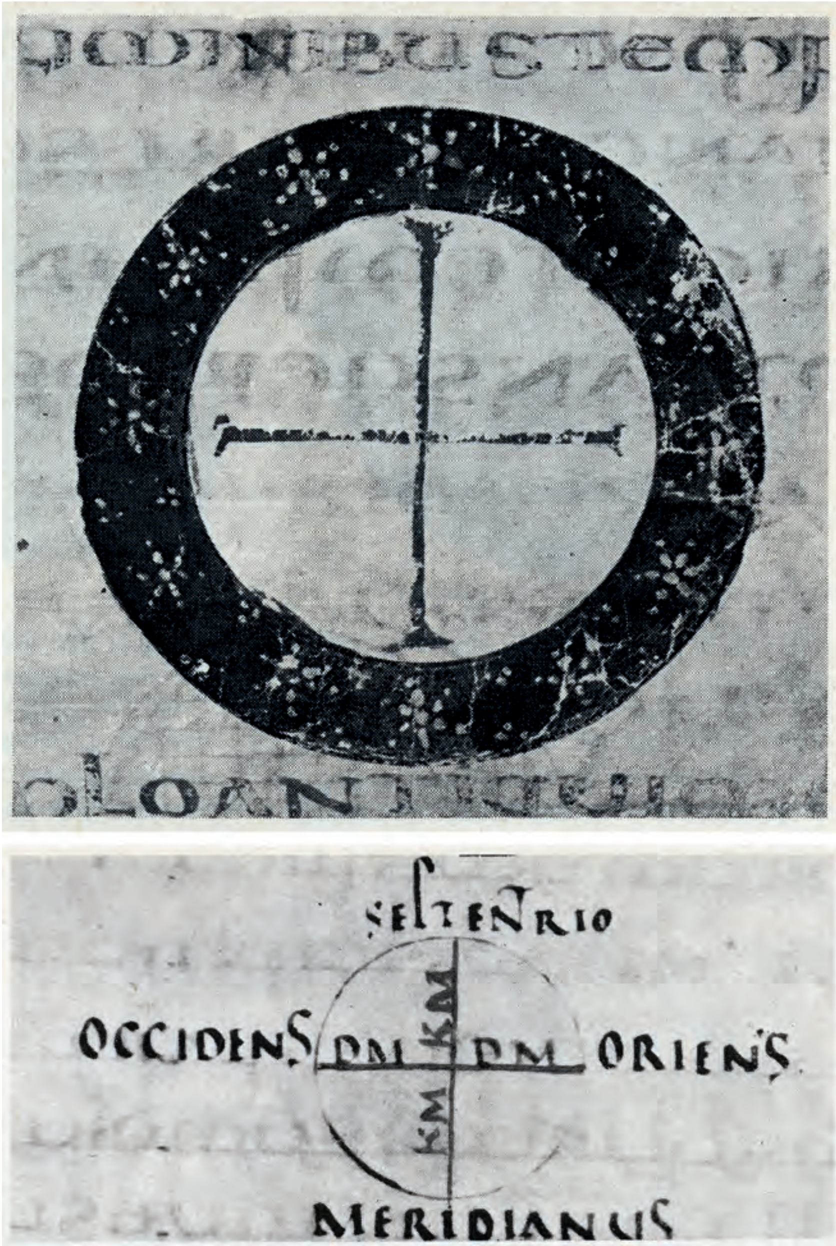

Fig. 77: Roman *Templum*, 6th century.

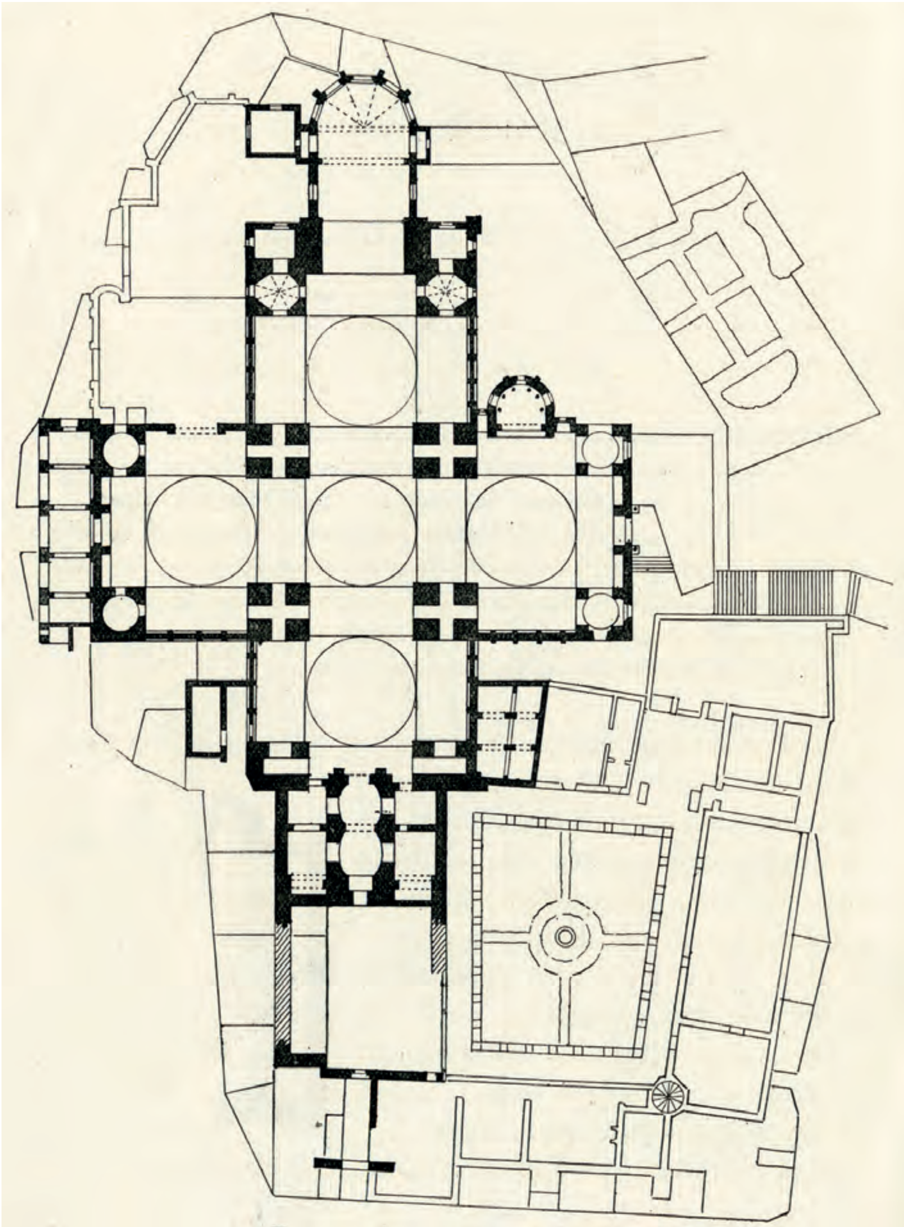

Fig. 78: St Front, Périgeux, France, after 1120.

Fig. 79: St Front, Périgeux, France, after 1120.

Bath House, all these examples employed bi-axially symmetrical Greek-cross plans, domical roofs, and hollow clusters of piers.[304] Yet, they differed markedly in terms of materialization: compared with the glittering mosaics in the interior of St Mark's, the Bath House's constructive expression was prosaic and ascetic. This "lack," to use Neil Levine's term,[305] reveals that Kahn's assimilation of historical sources went not only formally, but also in constructive terms through a process of abstraction, which in the latter case implied to unmask the naked structure.

Simultaneously, Kahn found inspiration for his hierarchical space order in Palladio's œuvre, as he stated: "A bay system is a room system – a room as an area flanked by its supports."[306] In the cruciform-shaped Villa Rotonda in Vicenza (1566; Figure 80), smaller cubicles, in which the human servants were installed, surrounded a circular master space at the core. Notably, Palladio compared the *parti* of a dwelling to a human body, whereby the noble and beautiful parts should be exposed and the ignoble but functionally essential ones hidden from sight.[307] His assumptions stemmed from Alberti, who had traced the origins of *partitio* to

> the process of dividing up the site into yet smaller elements, so that the building may be considered as being made up of close-fitting smaller buildings, joined together like the members of the whole body.[308]

In 1973, Kahn termed the areas within the structural supports *poché*-spaces, and pointed out that the Basilica of St Peter in Rome (Bramante, Michelangelo, et al.; 1506-1626) had also made use of such hollow piers containing passageways. A year later, Kahn attributed these insights to his Beaux-Arts training:

> From *poché* I learned the difference between the hollow wall and the solid wall. […] I made the wall a container instead of a solid. That came directly from my training in Beaux-Arts. So did the idea of the service spaces and the spaces served.[309]

304 Besides these similarities, also the application of *quadrature* should be indicated, which, involving a 45° rotation of nesting squares, produced like proportioned figures in a √2 sequence. Kahn would repeatedly apply this geometrical device to determine the position and size of his plan's elements.

305 Cf. Neil Levine, "The Architecture of the Unfinished and the Example of Louis Kahn," in Barry Bergdoll and Werner Oechslin, (eds.), *Fragments: Architecture and the Unfinished* (London: Thames & Hudson, 2006) pp. 323-342. According to Levine (p. 340), Kahn's goal was "not to transcend history but to make history modern."

306 Cf. 288.III.15, RSWC. Kahn owned Palladio's *The Four Books on Architecture* (1965; *I quattro libri dell'architettura*, 1570), besides a number of other treatises on Renaissance architecture: Filarete's *Trattato di architettura* (1460-4; 1972), Francesco di Giorgio Martini's *Trattati di architettura ingegneria e arte militare* (1478-81; 1967), Friedrich Peyer im Hof's *Die Renaissance-Architektur Italiens* (1870) or Léon Palustre's *L'archtictecture de la renaissance* (1892).

307 Cf. James S. Ackermann, *Palladio* (Baltimore: Penguin Books, 1966) p. 54.

308 Alberti, *On the Art of Building*, I, § II.

309 Kahn, "Kahn on Beaux-Arts Training," p. 332. In the Beaux-Arts system *poché* named the darkening of the structure in the plan.

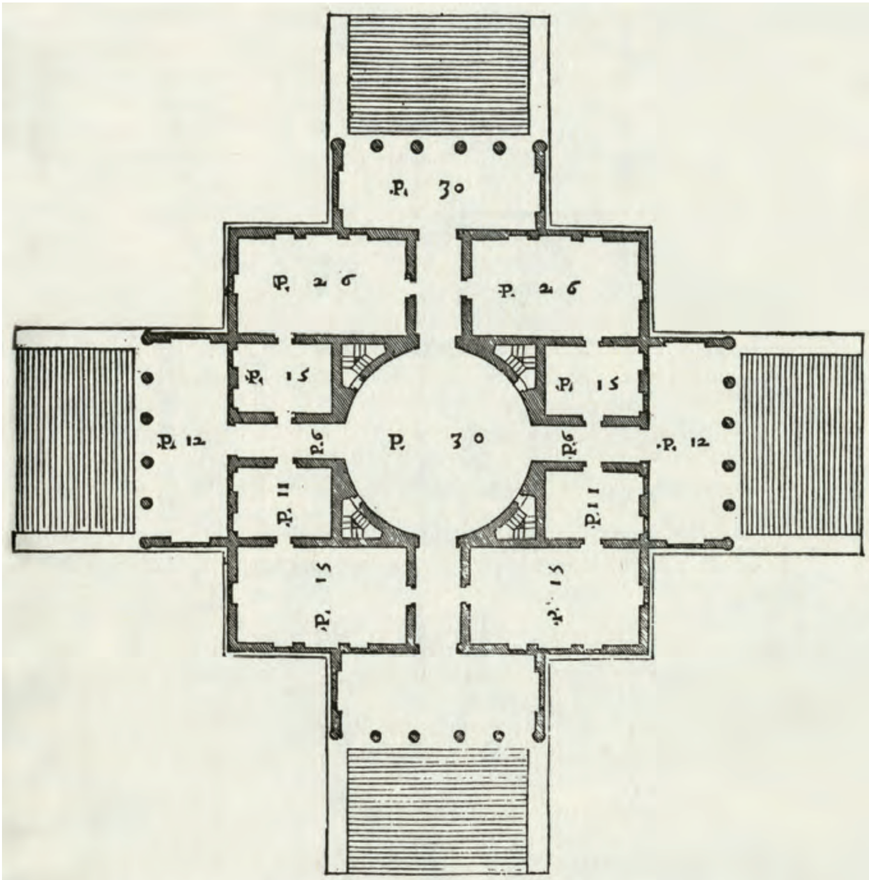

Fig. 80: Andrea Palladio, Villa Rotonda, Vicenza, Italy, 1566.

A more recent example using spatial columns was Wright's Unity Temple: its four freestanding, concrete piers housed mechanical devices and supported the cantilevered coffered ceiling with zenithal openings. Arguably, both the Unity Temple and the Bath House comprehended the structure as an organism, and this conception of the system as a whole encouraged greater cohesion, since all spaces were mutually dependent upon each other. In the Darwin D. Martin House in Buffalo, New York (1904) Wright had utilized a congenial strategy of spatial optimization to "realize the higher truth that form and function are one."[310] Consequently, mechanical devices such as lighting and radiators should find their proper place in the three-dimensional

310 Frank Lloyd Wright, *The Natural House* (New York: Horizon Press, 1954) p. 19.

composition, and Wright, just like Kahn, sought to build these into the primary spatial structure of his buildings.[311]

A couple of Kahn's following projects – the unrealized Martin Research Institute for Advanced Science in Baltimore (1956-8) and a competition entry for the Washington University Library (1956) – related directly to the Trenton Bath House. As for the first, after having initially experimented with a hexagonal scheme, the project's final stage consisted of a couple of one-story high structures placed on a precise east-west axis. On the western side were the entrance, library, dining hall and other communal spaces; all located within a square divided into nine equal parts. Once again employing multifunctional hollow columns in the corner of each individual square, the gable-shaped ceiling of the outer and middle units extended above the flat connection zones to generate an undulating roof structure. On the eastern side, the laboratory building had as an outline a stepped cross-figure and included four courtyards. Each separate ceiling was supported by a tree-like pillar made up of two rectangular shafts containing the functional devices, while the central part of each larger cross-module was raised above the outer ones in order to establish clerestory windows that allowed light to enter into the darker middle zones.

In the Washington University Library Kahn also employed a basic cruciform shape. The Library's pyramidal massing, reminiscent with its stepped section of a Babylonian ziggurat, clearly followed the Revolutionary Architect's doctrine of establishing autarchic masses that were activated by the simple play of light and shadow. Indeed, Claude Nicolas Ledoux's description of his cross-shaped House of Education (1773-90) could just as well be used to characterize the elevations Kahn drew of his intervention:

> What diversity when the rising sun spreads its shadow over the earth! What flickering effects when the moon traces labyrinths of light on the building![312]

While remaining detached from the context through its absolute shape, at least Kahn's projected façades acknowledged the different intensities of light across the sun's diurnal course as he applied varying sunscreens – horizontal *brise-soleils* towards the southern sides and V-shaped metal elements towards the west – to prevent the interiors from becoming too gloomy.

311 It should be supplemented that a basic cruciform disposition characterized many of Wright's Prairie Style houses, which enabled the separate wings to take a better hold of the terrain and permit light to enter on all sides.

312 Claude Nicolas Ledoux, *L'architecture considérée sous le rapport de l'art, des moeurs et de la legislation* (Paris: Hermann, 1997; 1804) p. 348; transl. by the author.

2.5 Tartan Grids and Formal Gardens

Altogether, no other project exemplifies the transformation that occurred in Kahn's architecture during the mid-1950s better than the unexecuted Jewish Community Center (1954-9) in Trenton. While the preliminary schemes articulated a cellular structure that related to an atomic comprehension of nature, the later bay system referred to Renaissance directives of spatial organization with interstitial rooms for services and circulation. The initial project was based upon the repetition of two interlocking polygonal figures: a small servant square and a larger served octagon (Figure 81). This basic configuration created a modular structure that could be extended horizontally, as well as vertically *close-packed*, although leaving some intervals. The vertical structure approached the tessellated configuration of a rhombicuboctahedron (Figure 82), which derives its name from the fact that twelve of the square faces lie in the same planes as the twelve faces of the rhombic dodecahedron, the bee's polyhedron.

Since the invention of the microscope – and notably Kahn possessed one, too[313] – scientists had immersed themselves in the study of organic tissues. Lord Kelvin's suggestion of the 14-faced tetrakaidecahedron (Figure 83 top), which was also illustrated by Thompson in *On Growth and Form* and would be used by Tyng in her proposal for the General Motors Exhibit at New York's World Fair in 1964 (1960-1),[314] added a new polyhedron to the analysis. As Thompson verified, extensive quantitative studies of vegetable parenchymas were undertaken in the first half of the 20th century, which revealed that polyhedral shapes approaching the tetrakeidecahedral form, with an average of 13.96 faces were the typical form cells approximated (Figure 83 bottom).[315] Kahn, or one should rather say, Tyng, pursued such strategies of close-packing in the design of the Erdmann Hall Dormitory in Bryn Mawr, Pennsylvania (1960-5; Figure 84). Her approach was pointedly dubbed the "molecular plan" by the college's president,[316] and according to Kahn

> a brilliant exercise of how one with a tremendous mind for geometry [...] how far with that knowledge it can come to almost the nonconscious ways of nature, that you can come very close to it as though you were just an agent of nature.[317]

His own proposal refuted this complete subordination to nature and reinforced an attitude of "man emerging out of nature," since "without the help of man, nature would not have been able to serve man as man."[318]

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313 Interview by the author with Harriet Pattison, 11 June 2009.

314 According to Tyng, "[i]t is a shape formed by close-packed bubbles and provides maximum volume with minimum surface. All its joints are in the tetrahedral carbon bond." Tyng, *The Rome Letters*, p. 198.

315 Cf. Thompson, *On Growth and Form*, pp. 551-5.

316 Cf. Tyng, op.cit., p. 205.

317 Prown and Denavit, *Kahn in Conversation*, p. 186. Concerning Tyng's proposal, Kahn enclosed that it was "more true to geometry, which Anne Tyng knew much more about than I did [...]."

318 Ibid.

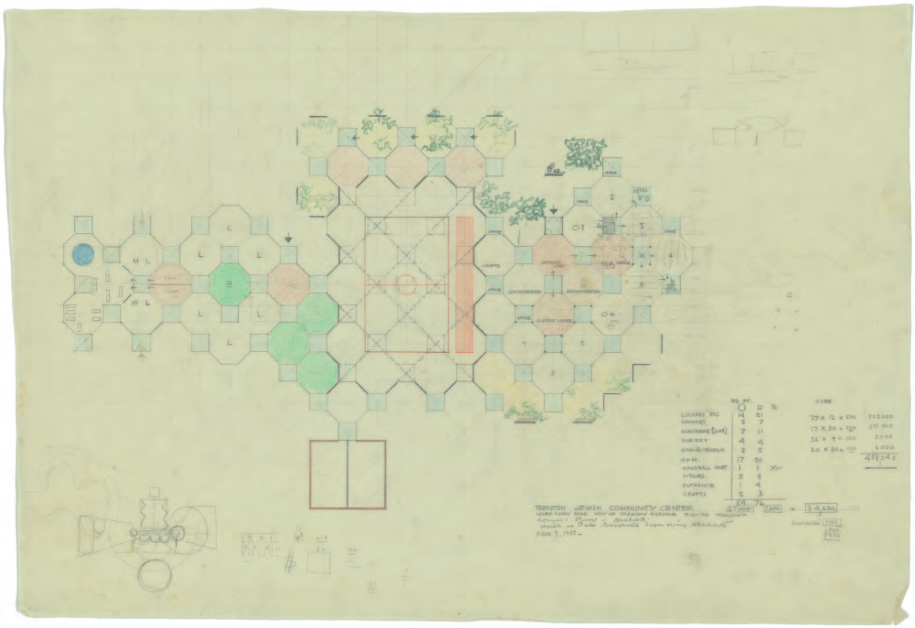

Fig. 81 : Louis I. Kahn, Jewish Community Center, Trenton, New Jersey, 1954-9.

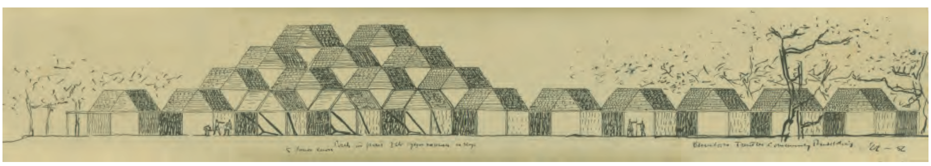

Fig. 82: Louis I. Kahn, Jewish Community Center, Trenton, New Jersey, 1954-9.

Returning to the Jewish Community Center, in late 1956 Kahn abandoned the close-packed scheme, since the rather small-scale cellular aggregate did not offer a solution for integrating the more public spaces of greater size as separate structural and spatial entities. Hence, a bay system was now introduced with hollow columns assuming both structural and functional tasks (Figures 85, 86). This proposition displayed a greater appreciation for the spaces' particular existence-will: a higher gymnasium and an intermediate-height social hall surmounted the entire composition, while the remainder of the structure was serially arranged with lower, Bath House-like pavilions. An even lower and narrower circulation zone, the actual bays interconnected all the parts of varying height and size. The project's clustered arrangement with consistently repeated domes crowned by oculi conformed with Van Eyck's contemporaneously

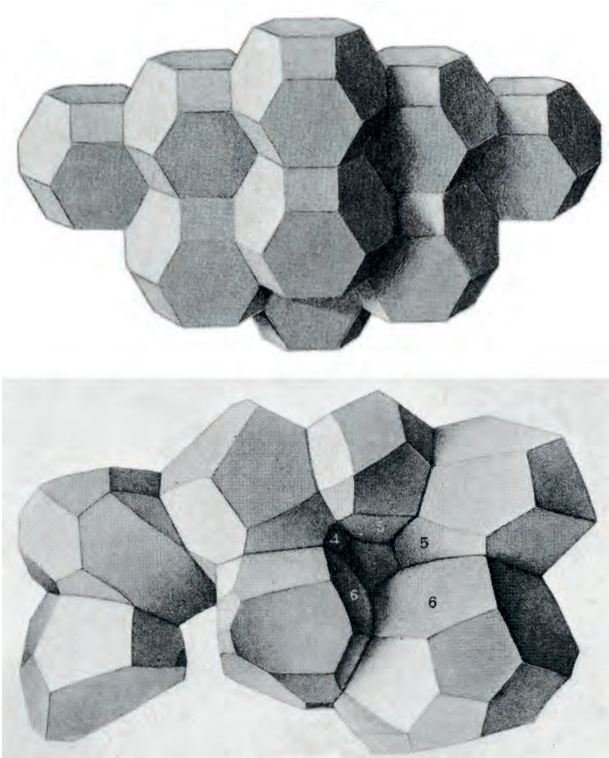

Fig. 83: Tetrakaidecahedron (top) and Vegetable Parenchymas (bottom).

designed orphanage in Amsterdam (Figure 87), this "casbah organisée" based on the configurative principles of Structuralism, but also classical references like the Roman imperial baths with their juxtaposition of clearly defined spaces within a superior tartan-gridded order. In the same breath, it recalled Vitruvius' technique of linking the modulated parts of a building to the whole in order to attain a concord of correlation called *symmetry*:

> For without symmetry and proportion no temple can have a regular plan; that is, it must have an exact proportion worked out after the fashion of the members of a finely-shaped human body.[319]

Kahn, having earlier rebelled against the doctrines of the Beaux-Arts system while attempting to be a thoroughly Modern architect, now returned to certain of its innermost

319 Vitruvius, *On Architecture*, III, Ch. I, § 1. When correctly applied, symmetry should generate recurrences of the same theme throughout the entire edifice and result in *eurhythmy*.

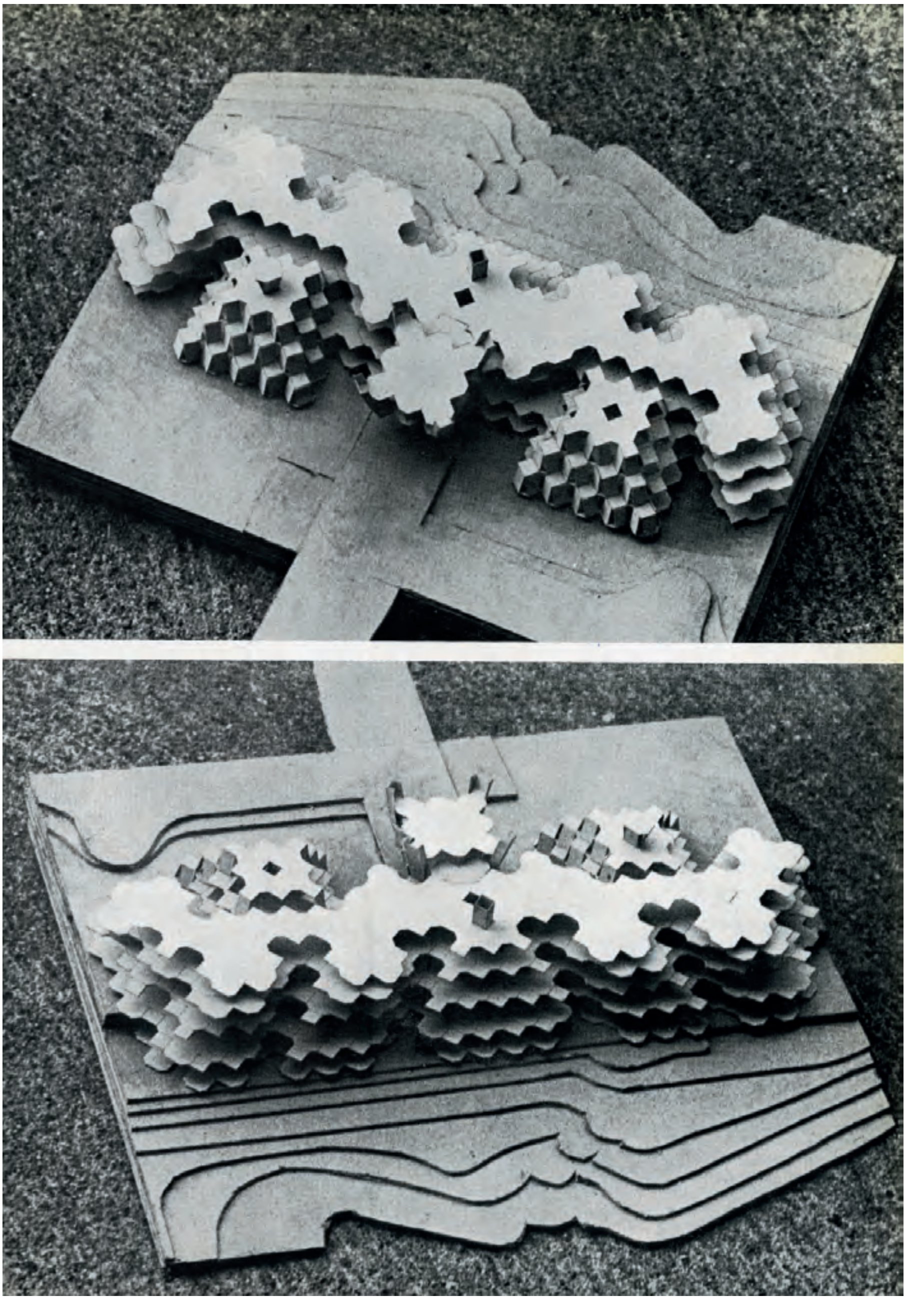

Fig. 84: Anne Griswold Tyng, “Molecular Plan,” Erdmann Hall Dormitory, Bryn Mawr, Pennsylvania, 1960-5.

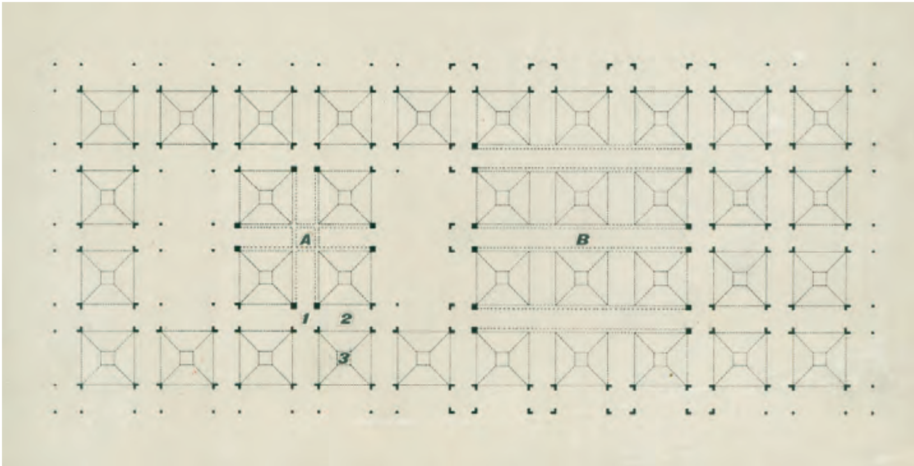

Fig. 85: Louis I. Kahn, Jewish Community Center, Trenton, New Jersey, 1954-9.

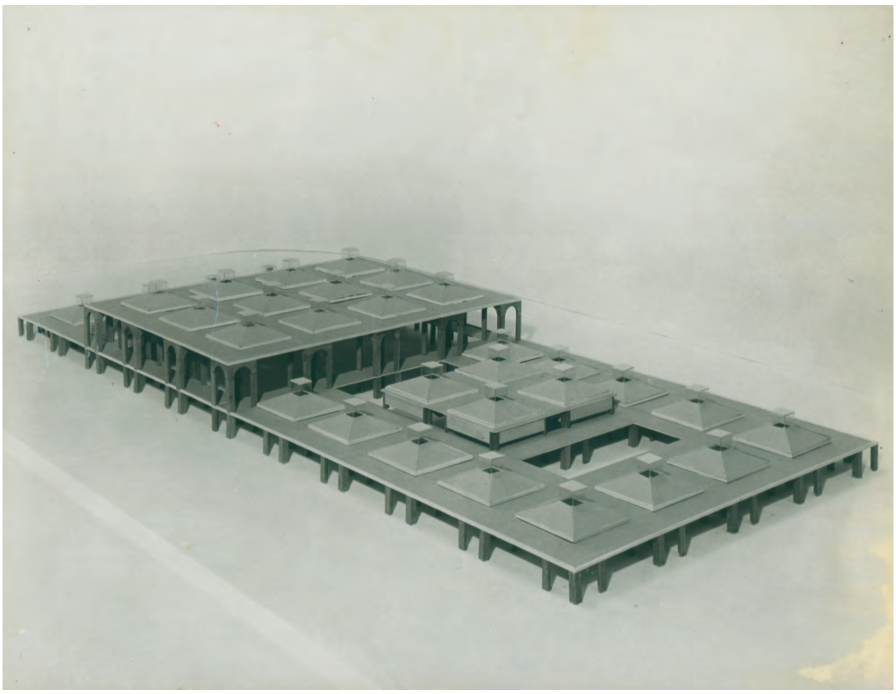

Fig. 86: Louis I. Kahn, Jewish Community Center, Trenton, New Jersey, 1954-9.

Fig. 87: Aldo van Eyck, Orphanage, Amsterdam, The Netherlands, 1955-60.

principles of composition: formal stringency, harmonic proportion, hierarchical organization, spatial individuation, and volumetric composition. This return to classical precepts was extended to the planning of the larger environs as well, as the appended site plan from 1957 shows (Figure 88). In collaboration with the Philadelphian landscape architect Edward A. Maurer, Kahn made extensive use of trees, which planted in gridded, regular masses enclosed and defined the exterior spaces of the pool area, parking space and community green.[320] The formal landscaping extended the building's inner logic into the wider terrain just as it had done in countless Renaissance gardens like the Villa d'Este in Tivoli by Pirro Ligorio (1559-80; Figure 89) or the Villa Lante in Bagnaia by Giacomo Barozzi da Vignola (1564 onwards; Figure 90).

George Patton, a landscape architect who was a fellow while Kahn stayed at the American Academy as an architect-in-residence,[321] and with whom he would collaborate

320 Nevertheless, wild vegetation should surround the Trenton Day camp – the "little acropolis" in the southwest corner of the parcel that was also antithetic with regard to its trabeated construction methods and loose compositional arrangement within a peripheral circle. Cf. Sarah Williams Ksiazek (Goldhagen), "Changing Symbols of Public Life: Louis Kahn's Civic and Religious Architecture" (Ph.D. diss., Columbia University, 1995) p. 254.

321 In 1943, Patton commenced his studies in landscape architecture at the North Carolina University in Raleigh. Interrupted were these by the Second World War, during which he served in China and Okinawa. Afterwards, Patton worked as a stage designer in Hollywood and in 1948 completed his degree. Between 1949 and 1951, he spent as a *Prix de Rome* fellow in Europe and in 1954 opened his own office in Philadelphia.

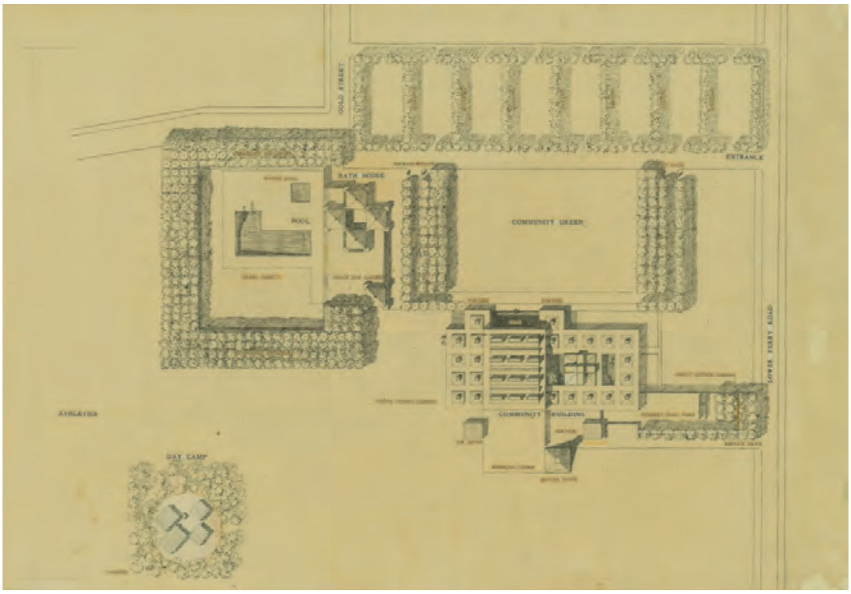

Fig. 88: Louis I. Kahn, Jewish Community Center, Trenton, New Jersey, 1954-9; Landscape Design by Edward A. Maurer.

extensively throughout the rest of his career, had analyzed and photographed numerous of these villas during his studies.[322] What these revealed was an integrative approach to landscape design, in which buildings and surroundings merged into a unit of analogous formal articulation. Following the example of the Roman Sanctuary of Fortuna Primigenia in Praeneste (1st century BC) with its spectacularly terraced landscape and other Roman palazzos like the one photographed by Patton (Figure 91), Renaissance villas – just like Kahn's intervention – sought an obvious connection between the buildings and their surroundings, at times making the ground floor patterns almost unrecognizable within the larger garden dispositions. Whether in Donato Bramante's Belvedere Courtyard in the Vatican (1506 onwards) or the Boboli Gardens laid out in Florence by Niccolo Tribolo (1550 onwards), these landscapes generated a suite of outdoor reception rooms flooded with unlimited light and air. Their geometrical rigor asserted an attitude of dominance over the natural

322 Kahn might have visited a number of these gardens during his stay at the American Academy in Rome. George Patton traveled extensively with Kahn (also to Greece and Egypt), and in his slide-collection images of the mentioned gardens, besides numerous others, can be found. Cf. 033.III.C (Roman slides in metal retainers), GEPC.

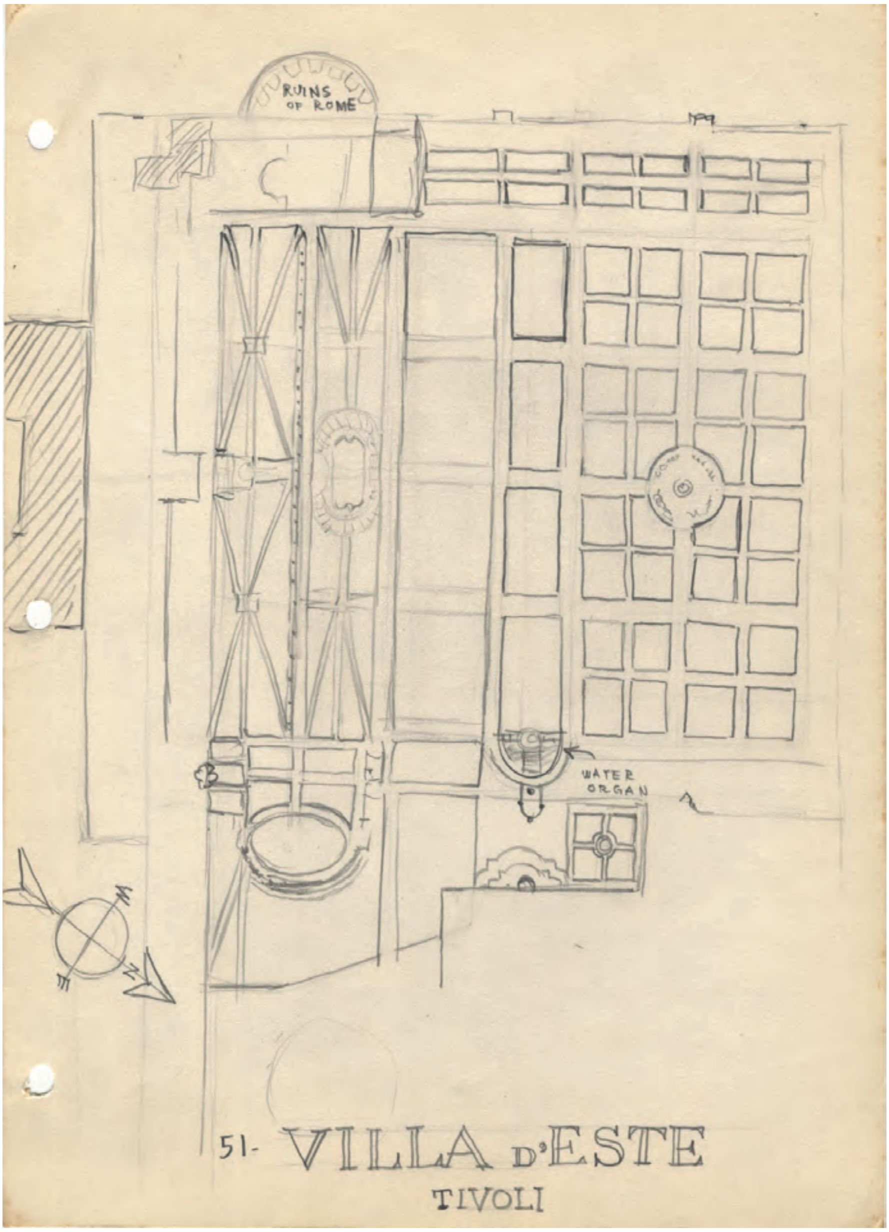

Fig. 89: George Patton's Student-Drawing of Pirro Ligorio, Villa d'Este, Tivoli, Italy, 1559-80.

Fig. 90: Giacomo Barozzi da Vignola, Villa Lante, Bagnaia, Italy, 1564 onwards .

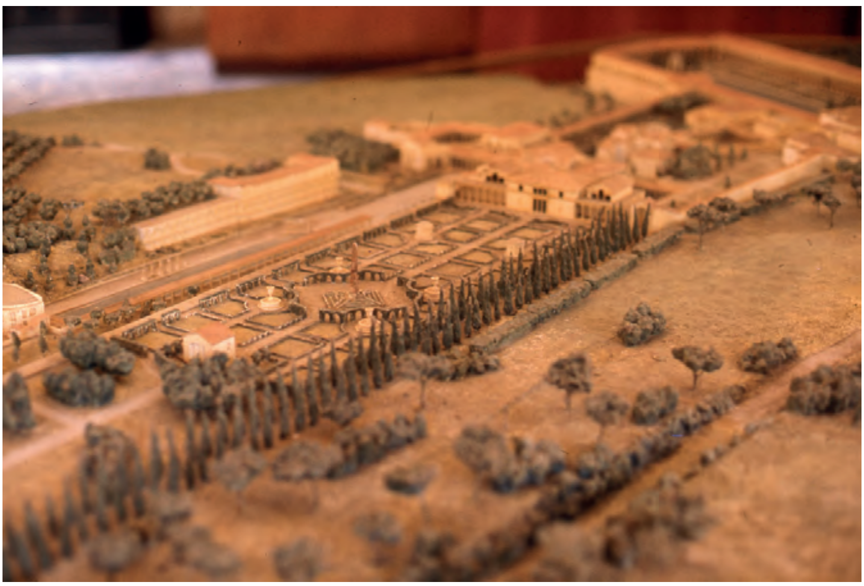

Fig. 91: Roman Palazzo and Garden.

domain; indeed, nature played a subordinate, almost extraneous part. This treatment of nature as a human commodity found its legitimization in *Genesis* (1:26):

> Let us make man in our image, after our likeness: and let them have dominion over [...] all the earth, and over every creeping thing that creepeth upon the earth.[323]

It is probable that Kahn was at the time of the planning of the Jewish Community Center still in contact with Kiley, who in the contemporaneous garden layout for the Miller House in Columbus, Indiana (1955-8; Figure 92) showed very similar formal interests.[324] Saarinen, who acted as the house's architect, considered "architecture not as building alone, but the building in relation to its surroundings, whether nature or man-made surroundings."[325] Kiley extended this idea of unity between architecture and the land to encompass the entire relationship between man and nature:

> Man is nature. Is that not exciting to realize? It's not man *and* nature. It's not man *with* nature. Man *is* nature, just like the trees. Both live and grow.[326]

The ordered arrangement of this "Contemporary Palladian Villa," as the *Architectural Forum* termed the Miller House in September 1958, was complimented in its geometrical outlines by Kiley's design of the environs: "So I took this same geometry and made rooms outside using trees in groves and allées. And the whole thing becomes a geometry."[327] One of the *rebels* of the Modern landscape movement, Kiley, when serving during the Second World War in Europe, had come under the spell of the Baroque gardens of André Le Nôtre at Vaux-le-Vicomte (1656-61; Figure 93) – here again depicted by an image of Patton – Versailles (begun 1661) and Chantilly (1670-88):

323 Dismissed from the abundant Garden of Eden into a world of disdain and torment, humanist landscapists in their ordered arrangements attempted to offer short moments of retreat from the secular disarray.

324 Kiley was a visiting critic at the department of landscape architecture at the University of Pennsylvania in the fall of 1957. The problem stated by Kiley was to develop a complete landscape design for the Miller House. Kiley was also looking forward to "seeing some of my old friends in the area;" letter Kiley to McHarg, 6 October 1957, 109.II.A.1.121, ILMC. Apparently, Kahn had introduced Kiley to Saarinen. Cf. Gregg Bleam, "Modern and Classical Themes in the Work of Dan Kiley," in Reuben M. Rainey and Marc Treib, (eds.), *Dan Kiley Landscapes: The Poetry of Space* (Richmond, CA: William Stout Publishers, 2009) p. 81.

325 Eero Saarinen, *Eero Saarinen on his Work* (New Haven: Yale University Press, 1962) p. 6.

326 Dan Kiley, "Lecture," in Rainey and Treib, op.cit., p. 23; derived from a lecture held at the University of Virginia's School of Architecture in 1982, and first published in Warren T. Byrd, Jr. and Reuben M. Rainey, (eds.), *The Work of Dan Kiley: A Dialogue on Design Theory* (Charlotteville: The University of Virginia, 1983).

327 Rainey and Treib, op.cit., p. 26.

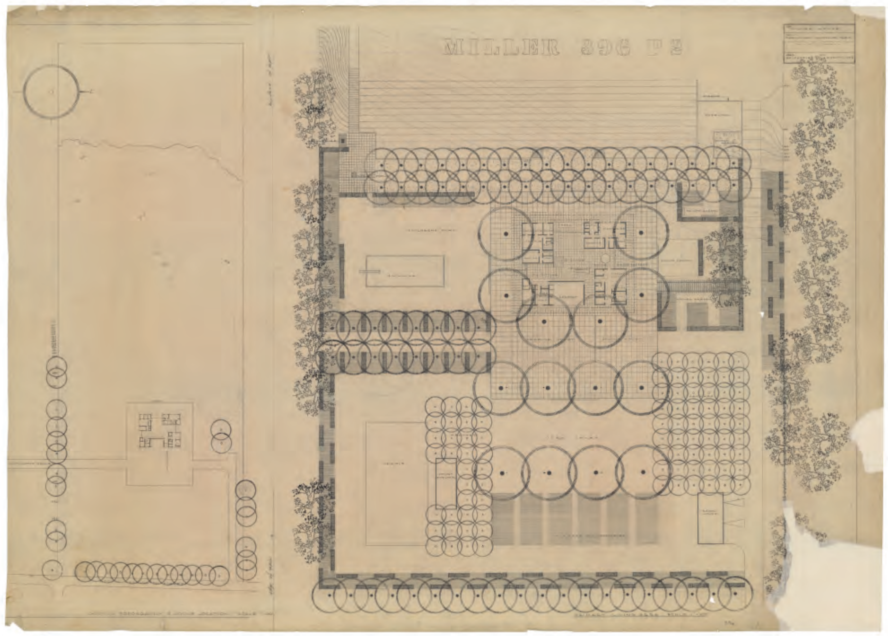

Fig. 92: Eero Saarinen, Miller House, Columbus, Indiana, 1955-8; Landscape Design by Daniel Urban Kiley.

Fig. 93: André Le Nôtre, Vaux-le-Vicomte, France, 1656-61.

> THIS was what I had been searching for – a language with which to vocalize the dynamic hand of human order on the land – a way to reveal nature's power and create spaces of structural integrity.[328]

Overall, Nicolas Fouquet's château of Vaux-le-Vicomte with its axial layout had been the experimental ground that under Louis XIV evolved into the ordering principle of the entire French nation.[329] Laid out upon the flat parterres was a basilica-like plan: three star-like avenues fanned out from the *choir* into the distance. At its summit was placed a statue of the ancient demigod Hercules, who as a champion of the Olympian order served as an appropriate symbol for the implementation of human order in the natural world.[330]

Next to Kahn and Saarinen's shift towards classical strategies of spatial organization an entire movement toward modular design was noticeable in America at the time. At odds with the more dynamic *plan libre*, the classical overtones in Mies van der Rohe's work provided the main incentive to the redirection, and in his wake a vast number of classically ordered structures were erected on American soil. In the General Motors campus, termed the "Industrial Versailles" by the *Architectural Forum* in November 1954, Saarinen with the help of the Californian landscape architect Thomas Church re-applied formal methods in the neo-classical landscaping as well.[331] Besides, both Johnson in the design of the Lucas House in Nantucket (1953) with its interpenetrating circular rooms, and Saarinen in the enigmatic MIT Chapel in Boston (1950-5), employed the circle – the Renaissance's most precious shape.[332]

Summarizing the general situation, Nowicki – certainly in defense of his own tenets of structural optimization – pointedly stated in 1951: "We have to realize that in the overwhelming majority of modern design form follows form and not function." Drawing a comparison between his times and the Renaissance, he pointed out that the

328 Kiley and Amidon, *In his Own Words*, p. 13. Kahn was definitely not aware of Le Nôtre at the time, since Harriet Pattison only in the early 1960s introduced him to his work. Interview by the author with Pattison, 13 June 2009.

329 Le Nôtre's attempts to order vast environments with long diagonals would not only be the model for Louis XIV sunbeam-like state system, but also had a decisive urban impact, since Pierre L'Enfant in Washington (1791), Georges-Éugene Hausmann in Paris (1853-69) or Edwin Lutyens in New Delhi (1912-29) relied on it.

330 French garden treatises of the 17th century referred to the process by which geometric shapes were transferred to the garden's ground as *pourtraiture*. However, unlike in Italian gardens, the evergreens were not treated sculpturally, but instead the *broderie* was all cut down to the ground to allow views into the far distance. In the same way, water was not treated as a stage-like event, but found application in flat *bassins* allowing reflections of both buildings and sky. Cf. Vincent Scully, *Architecture: The Natural and the Manmade* (New York: St. Martin's Press, 1991) pp. 221 ff.

331 Initially, Saarinen intended to work with Kiley, yet the latter was still in active service and recommended Thomas Church. Cf. Gregg Bleam, op.cit., p. 82. Saarinen's approach differed from Mies van der Rohe's at the IIT campus, where Alfred Caldwell had contrasted the modular buildings with picturesque plantings.

332 Alberti had demonstrated that all polygonal figures derive from the circle through simple geometrical operations. Cf. Alberti, *On the Art of Building*, VII, Ch. IV.

buildings of the Renaissance were crude when compared with the more structurally refined buildings of the Gothic period. For Nowicki, "[p]roblems of structure and materials became secondary in a period preoccupied with the aesthetics of form," and somewhat describing Kahn's development during these years, he added: "The discovery of [a] formal symbol of the unchanging laws of the universe seems to replace the invention of the form without precedent."[333]

2.6 From the Vitruvian Man to the Divine Proportion

In the beginning of 1956, Colin Rowe,[334] who taught at the University of Texas at the time, sent Kahn a lengthy letter enclosed with a copy of *Architectural Principles in the Age of Humanism* (1949), written by his former teacher Rudolf Wittkower. Inquiring if Kahn had seen the recent *Architectural Review*, in which Banham had published "a deplorable article on the 'New Brutalism'," Rowe pointed out in regard to a discussion they had had in Philadelphia:

> You wanted to GROW a building, and I, I think, suggested that I wanted to COMPOSE it. [...] For me, your cubes, your hexagonal cells, are objective data with a life of their own in which one can't intervene. [...] At the same time, although they are independent, they are in fact the acts of your volition.[335]

In other words, while Kahn seems to have insisted on a natural outgrowth of a building's order from its inner will to be, Rowe had alluded to the human powers to decisively articulate a design's ordinance. The latter's analysis broached a central topic, however,

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333 Matthew Nowicki, "Function and Form," in Lewis Mumford, *Roots of Contemporary American Architecture* (New York: Grove Press, 1959) pp. 411-7; orig. published as "Origins and Trends in Modern Architecture," in *Magazine of Art*, vol.44, November 1951, pp. 273-9. The arguments brought forth by Nowicki continued Geoffrey Scott's lines of reasoning in *The Architecture of Humanism: A Study in the History of Taste* (1914).

334 In 1947, Rowe had published "The Mathematics of the Ideal Villa." Making an analytical comparison of Palladio's Malcontenta (1550-60) and Le Corbusier's Villa Stein-de Monzie (1927), the English critic deduced with the help of several diagrams the compositional principle of the tartan grid in both projects. In Le Corbusier's case, once the primary *piloti* structure was positioned, a secondary wall system adapted itself freely to the programmatic needs. Cf. Colin Rowe, "The Mathematics of the Ideal Villa," in *The Architectural Review*, vol.CI, no.603, 1947, pp. 101-5. This differed from Palladio and Kahn's orchestration of spaces, where a similar bay system was made up of structurally and simultaneously space defining elements. Van Eyck's design for his own unrealized Four Tower House in Baambrugge (1958-60) also employed an A-B-A-B-A ordering in an overall cross-in-square plan. Additionally, in the axes of the bays it employed four hollow columns, which contained the service rooms and supported the roof.

335 Rowe's letter to Kahn, 7 February 1956. Also Rowe's colleague Robert Slutzky met with Kahn, and described him as a person of "inner 'knowingness' [...] at all times I felt that I was conversing with a painter as well as an architect." Slutzky's letter to Kahn, 28 January 1956, 030.II.65.22, LIKC.

that is to say the question of the deliberate human versus the quasi-natural expression, for which Kahn only towards the end of the decade would find more elaborate answers.

As Wittkower pointed out in his study, Renaissance cosmology relied heavily on nature as a model to be studied, and indeed, the architect; seeing the world in terms of patterns, lines and geometry, should mirror its Divine laws. Consequently, architecture should not imitate nature in its passively produced and phenomenal aspects, its *natura naturans*, but adopt its active principles of generation, the *natura naturata* that Kahn identified with "order."[336] Mathematics was perceived as the abstract link between the measureless macrocosm of nature and the human-scaled microcosm of architecture as it made the natura naturata comprehensible and operable. The supreme example of this tendency, "by which the human race in its marvelous and various works seems to create a second nature in this world,"[337] was Leonardo da Vinci, whose *Notebooks* edited by Jean Paul Richter (1883) Kahn often browsed.[338]

Referring to a description from Marcus Vitruvius Pollio's *De architectura libri decem* (c. 33 BC), the human body circumscribed within a circle and a square was visualized numerous times during the Renaissance, among others by Da Vinci (Figure 94).[339] The *homo quadratus* (c. 1490) demonstrated the underlying geometrical rigor of the human figure, while its architectural application – masterfully brought to expression in the House of Andrea Mantegna in Mantua (1476-1502; Figure 95) and the dominant formal theme of Kahn's architecture at the time – pointed towards a more *human* architecture, since these abstract forms related a building's geometry both to the larger cosmos and to that of a well-proportioned man.[340] Underlining this argument, Alberti also referred the mathematical harmony (*concinnitas*) of a building to the human body:

336 According to Kahn, "[o]rder is based on the nature of nature. [...] In physical order, every grain of sand is the right size, the right color, the right place. [...] There is nothing you can refute in the way of physical order. There's no such thing as chaos in physical order. [...] Even an explosion is a manifestation of order." Prown and Denavit, *Kahn in Conversation*, p. 25.

337 Irma A. Richter, (ed.), *The Notebooks of Leonardo da Vinci* (Oxford: Oxford University Press, 1998) p. 61. Cicero had already postulated that "by means of our hands we essay to create as it were a second world within the world of nature." Cicero, *De natura deorum*, II, § LX.

338 Interview by the author with Harriet Pattison, 12 June 2009.

339 Cf. Vitruvius, *On Architecture*, III, Ch. I, § 3. In Giorgio Martini's *Trattati di architettura* (Milano: Edizioni Il Polifilo, 1967) Kahn could discern further examples of the human figure inscribed in the cross-floor plan of a church (I, f.11V Tav.18 and II, f.42V Tav.236) or in the shaft (body) and capital (face) of a column (I, f.14V Tav.24 and II, f.32 Tav.217).

340 In general terms, prehistoric mythology by worshipping chthonic spirits was earth-bound, while the beginning of the historic era with the evolving God concept placed its beliefs in a transcendental otherworldly sphere. Consequently, in both the Sumerian and Egyptian civilizations, the focus shifted towards the infinitude of the stars, while earthly events seemed predestined by cosmic ones. The attack upon the telluric spirits in nature and the fostering of mankind as a god-like race was the central theme of Greek mythology.

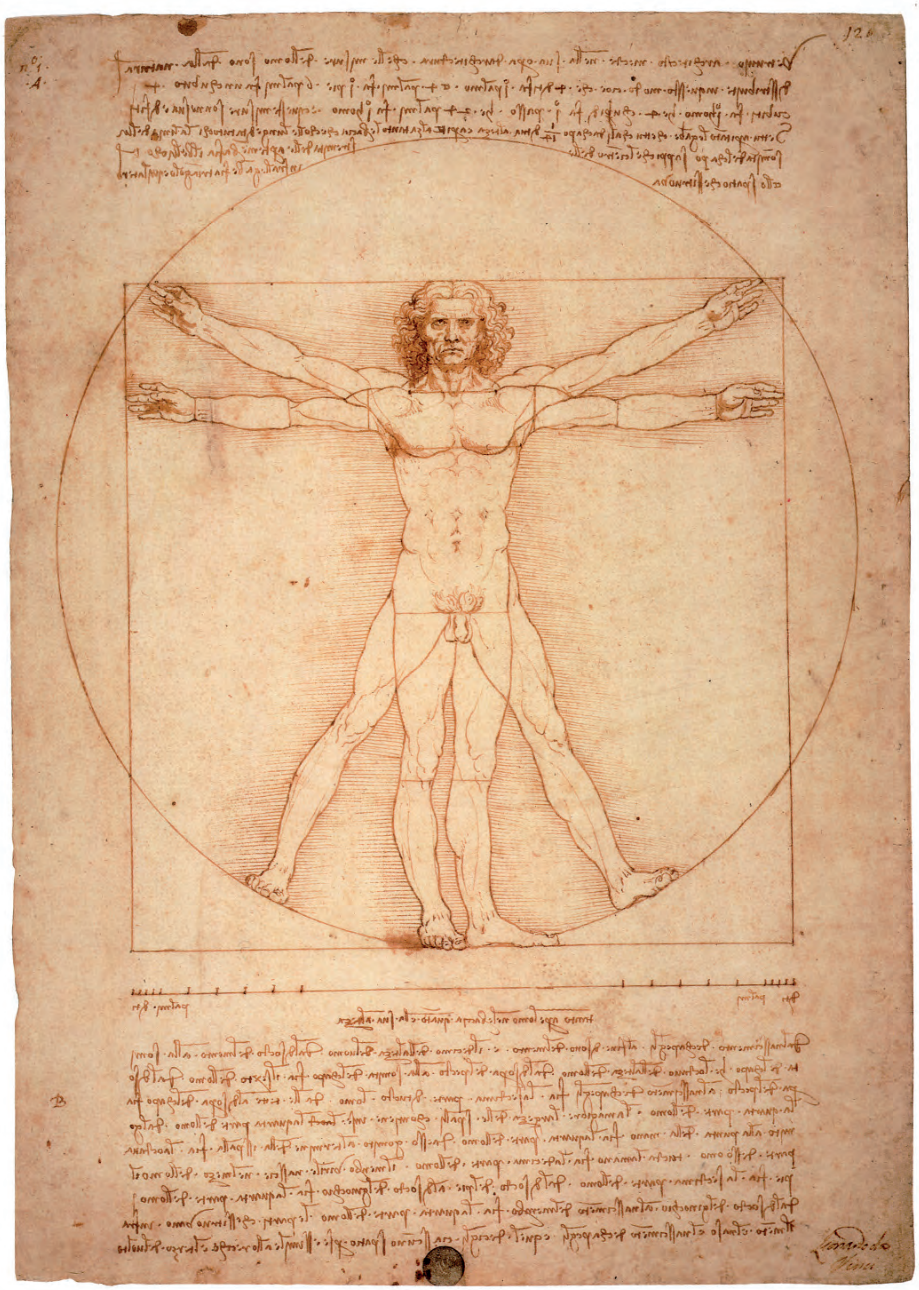

Fig. 94: Leonardo da Vinci, *Homo quadratus*, c. 1490.

Fig. 95: Casa Mantegna, Mantua, Italy, 1476-1502.

> Beauty consists in a rational integration of the proportions of all the parts of a building in such a way that every part has its absolutely fixed size and shape and nothing could be added or taken away without destroying the harmony of the whole. [...] Without that organic geometrical equilibrium where all parts are harmonically related like the members of a body, divinity cannot reveal itself.[341]

Besides its focus on the human body, a second interrelated pillar upon which Renaissance architecture theory rested was music. Accordingly, Alberti declared:

> The numbers by means of which the agreement of sounds affects our ears with delight, are the very same which please our eyes and our minds. [...] We shall therefore borrow all our rules for harmonic relations (*finito*) from the musicians to whom this kind of number is extremely well known, and from those particular things wherein Nature shows herself most excellent and complete.[342]

This transfer from the audible to the visible called upon doctrines first enumerated by Pythagoras.[343] His investigations revealed that harmonious chords corresponded to

341 Rudolf Wittkower, *Architectural Principles in the Age of Humanism* (London: Academy Editions, 1973; 1949) p. 7.
342 Wittkower, *Architectural Principles*, pp. 110-1.
343 Since Pythagoras' times, music had been part of the educational syllabus, alongside arithmetic, plane and solid geometry, physics and astronomy. Music was regarded as the counterpart to astronomy:

exact divisions of a given string by a progression of whole numbers. This discovery led the Hellenistic philosopher and his disciples to extensive speculations that all things consisted of an underlying orphic harmony arising out of simple numeric relations.

In terms of proportion, Kahn, and above all Tyng, who would be intensely preoccupied with this subject in the following years, relied only partially on commensurable ratios as also utilized in the Renaissance,[344] while focusing upon incommensurable ones that originated in organic patterns of growth. Discussed in detail by Thompson, the peculiar property of such generative sequences, perceivable for instance in the shells of the *Nautilus pompilius* or the *Triton tritonis* (Figure 96), was its accretion in successive steps of unvarying proportions, whereby the shapes increasing in magnitude showed continuous similarity of form.[345] One example of such a logarithmic series was the *Divine Proportion*,[346] which reappeared in the Fibonacci series,[347] and was noticeable in *phyllotaxis*, i.e. the arrangement of leaves and florets on a stem. In horizontal phyllotaxis, observable in the rosette of a sunflower, for example, left- and right-handed spirals intersected, whereas the number of spirals in each direction added up to adjacent numbers of the Fibonacci series. The enclosed illustration (Figure 97), derived from Arthur Harry Church's study on the *Relation of Phyllotaxis to Mechanical Laws* (1901) and used by Tyng in "Geometric Extensions of Consciousness," shows four possible examples of such a horizontal arrangement.[348]

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the one apprehending the motions in the universe through vision, the other through audition. Continuing Pythagoras' investigations to uncover the "music of the spheres," Plato constituted the entire cosmos to rest upon the geometrical series of the double and triple interval sequence 1-2-4-8 and 1-3-9-27. Cf. Plato, *Timeaus*, p. 20.

344 Palladio, attempting to impart a symphonic quality to his projects, envisioned three-dimensional fugues in a triadic system based upon geometrical, arithmetic and harmonic progressions. Cf. Rudolf Wittkower, "Systems of Proportion," in *Architect's Yearbook*, no.5, 1953. The argument to transfer proportional laws discovered in nature to architecture would be continued during the Enlightenment; e.g. François Blondel entitled a chapter in his *Cours d'architecture* (1675-83) with "Proofs That Proportions Are the Cause of Architectural Beauty and That This Beauty Is Founded in Nature, Like That Produced by Musical Accords."

345 Cf. Thompson, *On Growth and Form*, p. 757.

346 Admittedly, Renaissance theoreticians were aware of the *Divine Proportion* and, in fact, the Italian mathematician Fra Luca Pacioli coined its name with his treatise *Divina proportione* (1509). Following the Renaissance's anthropomorphic tradition, Pacioli deduced it from the analysis of the human body, because "in it is to be found all and every ratio and proportion by which God reveals the innermost secrets of nature." Fra Luca Pacioli, *Divina Proportione: Die Lehre vom Goldenen Schnitt* (Vienna: Carl Graeser, 1896; 1509) pp. 193-4; transl. by the author.

347 Each number is equal to the sum of the two preceding ones and the fraction of the two last terms asymptotically approaches the numerical equivalent of the Divine Proportion. Leonardo of Pisa (c. 1180-1250), nicknamed *Fi Bonacci*, elaborated this series in the *Liber abbaci*.

348 *Quinqueloculina seminulum* with 2 and 3, *Sempervivum calcaratum* with 3 and 5, *Pinus pinea* with 5 and 8, and lastly *Euphorbia wulfenii* with 8 left and 13 right-handed spirals. *Phyllotaxis* is also observable in vertical direction, particularly in monocotyledonous plants, which are characterized by growth from a terminal bud, parallel-veined leaves and usually a tripartite arrangement of flowers.

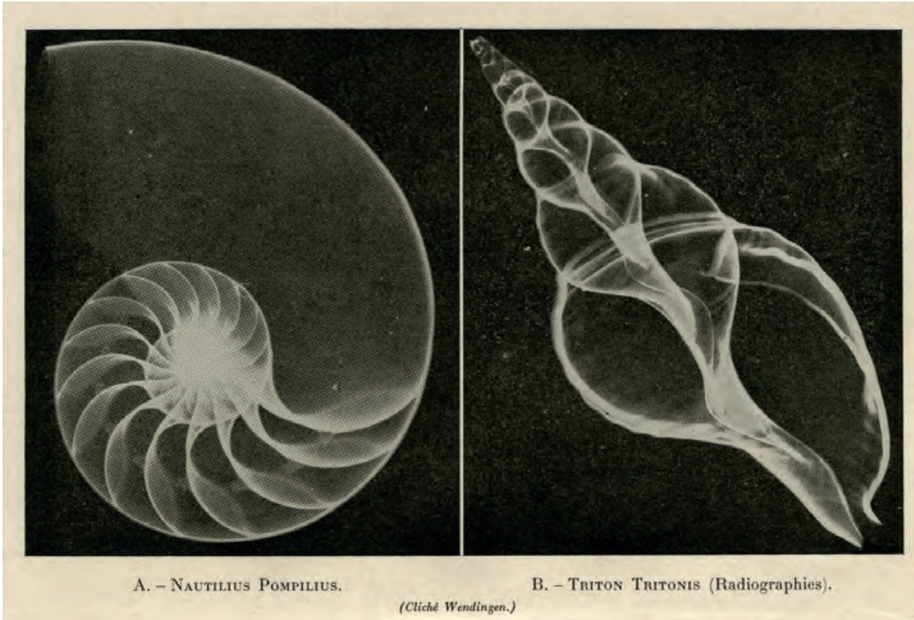

Fig. 96: *Nautilus pompilius* (left) and *Triton tritonis* (right).

Botanists had long recognized the uniqueness of these arrangements, and Thompson, too, insisted that

> the old Greek and Egyptian geometers are not likely to have left unstudied or unobserved the spiral traces of the leaves upon a palm-stem, or the spiral order of the petals of a lotus or the florets in a sunflower.[349]

Nonetheless, it was essentially up to Goethe to comprise one “spiral tendency” of vegetation – shown here in a number of examples from a double page in Tyng’s “Anatomy of Form / Atom to Urban” from 1965 (Figure 98).

As a sort of geometrical equivalent to the *anima mundi*, the equally irrational Golden Mean was thought to propel organic creation in well-proportioned cadences. In the

Cf. Asa Gray, *School and Field Book of Botany* (New York: Ivison, Phinney, Blakeman & Co., 1869) p. 183 and Hubert Airy, “On Leaf-Arrangement,” in *Nature*, Mar.6, 1873, pp. 343-4. In the case of a 3-ranked arrangement, a virtual line passes once around the stem until reaching after three leaves the one situated directly above the first one. In the 5-ranked two and in the 8-ranked three turns were needed to accomplish the same disposition. Cf. Arthur Harry Church, *On the Relation of Phyllotaxis to Mechanical Laws* (London: Williams & Norgate, 1904).

349 Thompson, *On Growth and Form*, p. 912.

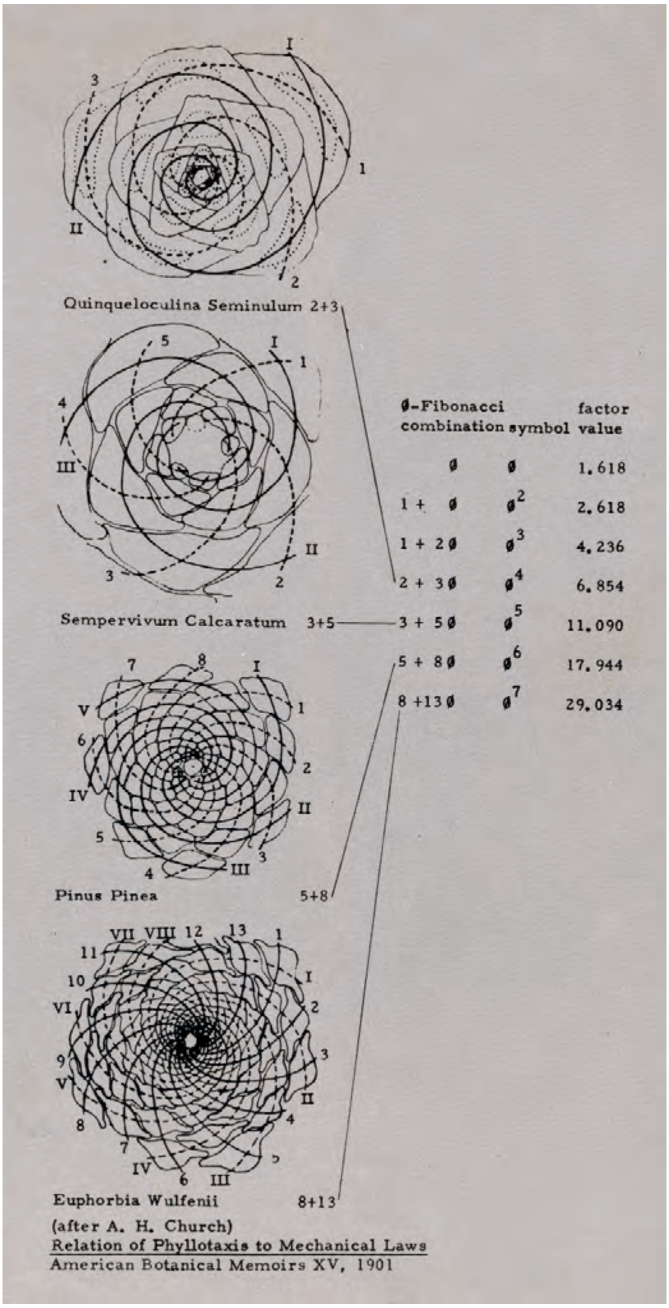

Fig. 97: Arthur Harry Church's *Relation of Phyllotaxis to Mechanical Laws*, 1901, in Anne Griswold Tyng, "Geometric Extensions of Consciousness," 1969.

of man - especially in architecture and the forms of cities - and in the astronomical forms of the universe which pre-existed man.

In studying the five Platonic Solids and the relation between them, I have established a progression from simplicity to complexity of symmetric forms linked by asymmetric process and discovered a common proportional principle in the progression toward complexity and in the process of increase in scale.

I have found that the mathematical values of the Divine Proportion function in this asymmetric process acting as a link between the increase in scale and the increase in complexity.

An example of the creation of symmetric forms from asymmetric process can be found in an article on River Meanders, which illustrates the production of 'regular forms from random processes'. In pointing out that irregularities in the bounding medium are not necessarily a reason for rivers not being straight, the authors say, "For one thing, such irregularities cannot account for the rather consistent geometry of meanders. Moreover, laboratory studies indicate that streams meander even in 'ideal' or highly regular mediums."(1) The operation of chance is shown as the explanation of the formation of regular meanders. "It is a paradox of nature that such random processes can produce regular forms and that regular processes produce random forms."(1)

The basis of geometric ordering of regular three dimensional form at all levels can be seen in Pauling's "Close-Packed-Spheron" theory for the nuclei of atoms and in the constants of atomic spacing and the consistent bonding angles of molecular structure. The time span of evolution seems relatively short if considered in terms of the time needed for random or asymmetric processes to achieve the building up of regular or symmetric forms in configurations of lowest energy state, the hierarchies of form and the hierarchies of force evolving from the interplay of polarity and rotation.

Not only does there appear to be a progress in the life forms corresponding to the geometric progression toward complexity and toward increase in scale, but this progression can be seen as a repeating one with each new beginning of simplicity containing and integrating the end result of complexity.

Geometrically, this repeating cycle began with the simpler bilateral three dimensional forms of the five solids - the tetrahedron, cube and octahedron. In these simpler solids, the corners of the cube and octahedron can be established by different positions of the tetrahedron, the simplest solid - in each case two positions of the tetrahedron which express a polarity. I found that from these simpler forms, the more complex rotational forms of the two higher solids - the dodecahedron and icosahedron - can be derived through rotation. The extension of these rotational forms in time, or fourth dimension, produces a helical form and the extension of the helical

Fig. 98: Anne Griswold Tyng, "Anatomy of Form / Atom to Urban," 1965.

20th century, among others, Prince Matila Ghyka, a Romanian diplomat, novelist and mathematician living in Paris and London in the interwar period, further elaborated this correlation between the arts and nature based on the principal invariant of the *sectio aurea*. Analyzing the proportion's peculiar properties in *Le nombre d'or* (1931) and *The Geometry of Art and Life* (1946), he argued that the Golden Section manifested a constant pulsating force, which paralleled the adaptive physical-chemical morphogenesis that obeyed the "principle of least action." Ghyka related this "type of homothetic growth by intussusception or imbibition (from inside outwards)" with living organisms, whereas in crystals the growth was by "agglutination," or simple addition of identical elements from the outside.[350] Prior to this, Kepler had already hinted at the Divine Proportion's quintessential role in the morphology of organisms:

> 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.[351]

350 Cf. Matila Ghyka, *The Geometry of Art and Life* (New York: Dover Publications, 1977; 1946) pp. 89-90.

351 Kepler, *The Six-Cornered Snowflake*, p. 21. The Golden Section appears in the ratio between the pentagon's side and diagonal. It occurs with great frequency in the flowers of dicotyledonous or exogenous plants (characterized by growth in concentric annual layers around a central pith, netted-veined leaves, and parts of the flower mostly in fives or fours), but also amongst marine animals

Having as many sides as diagonals, the pentagonal form suggested enhanced flexibility during periods of accretion, as it could easily switch between planar and stellate, that is pentagram, configurations. Among the school of Pythagoras and the masons of the Middle Ages, the pentagram was handed down with oaths of secrecy from one generation to the next.[352] At the beginning of the 20th century, the German Ernst Mössel analyzed Gothic cathedrals with the aid of "controlling circles," and concluded that the Gothic Master diagram universally applied the decagon, whose side was in Divine Proportion to the radius of its circumscribed circle.[353] Tyng, in "Geometric Extensions of Consciousness," besides alluding to the work of Mössel also referred to Otto von Simson's classic work *Gothic Cathedral* (1956), from which she quoted:

> 'In Chartres, proportion is experienced as the harmonious whole; it determines the ground plan as well as the elevation; and it 'chains' by the single ratio of the Golden Section the individual parts not only to one another but also to the whole that encompasses them all.'[354]

Simultaneously with Mössel's research, the American Jay Hambidge demonstrated that the Greeks had relied on "dynamic symmetry" suggestive of organic growth. Just like Mössel using graphic methods of analysis, Hambidge applied "root rectangles," which asserted the Greeks' ability to measure irrational √-numbers graphically in the square, and questioned Vitruvius' assumption that Greek architecture had employed solely commensurable modules.[355] Fundamental to Hambidge's analysis – as well as being key dimensions in Kahn's plans – were firstly the square with its diagonal, which when ablated horizontally yielded the longitudinal side of a √2 rectangle; and secondly, the square and the diagonal of its half, which in a similar procedure generated a "Whirling Square Rectangle" with Golden Mean ratios.[356]

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such as star- and jellyfishes. Besides, as diagrams by Ghyka demonstrated, it relates to the human silhouette with its five outstretched bodily axes.

352 In his architectural sketchbook from the 13th century, Villard de Honnecourt frequently sketched quincuncial delineations upon animals and the human figure.

353 Cf. Ernst Mössel, *Die Proportion in Antike und Mittelalter* (Munich: Beck'sche Verlagsbuchhandlung, 1926).

354 Tyng, "Geometric Extensions of Consciousness," pp. 155-6. Tyng also called attention to the Golden Section's appliance in the Cheops Pyramid (c. 2550 BC), as "[e]ach of its faces is formed by two half Golden Rectangles [...]." With reference to the shafts extending from the King's chamber to the Pyramid's outer surface, Tyng noted (p. 153): "The 31 degree angle is very close to the 31° 43' angle of the diagonal in the Golden Rectangle [...]." Cf. Alicia Imperiale, "Dynamic Symmetries," in Schaffner, *Inhabiting Geometry*, pp. 86-91.

355 Cf. Jay Hambidge, "The Diagonal," in *The Diagonal*, vol.1, no.1, 1919.

356 The unique property of the √2 rectangle is the fostering of another self-developing series: infinitely halved or doubled, it always maintains the same proportion. Inscribing a new diagonal into the √2 rectangle and repeating the geometrical process from before, the √3 rectangle is generated. This process can be reiterated until it yields the √5 rectangle, which corresponds to a square with the

Equally intrigued by the Divine Proportion was Le Corbusier. In his youth he had learned to appreciate nature's inner workings through his teacher Charles L'Eplattenier, who forced him to "draw from nature – not landscapes, but elements of plants. He would push us towards an understanding of how things go together."[357] The lesson learnt was simple: mathematics was the "key to the door of miracles," since "the masterpieces of art are in consonance with nature; they express the laws of nature and themselves proceed from those laws."[358] For Le Corbusier, at the heart of the universe stood in Romanticist terms the "axis" – an intangible "sounding board that is set vibrating" once one sensed something to be in harmonious proportion and

> along which man is organized in perfect accord with nature and, probably, with the universe: an axis of organization that must be the same as the one along which all phenomena and all objects of nature align. […] If we stop in front of the Parthenon, that is because the sight of it makes the inner chord sound; the axis is touched.[359]

Le Corbusier's geometrical investigations to unite man, nature and technology culminated in the development of the *Modulor* during the Second World War. Assessing that all great architectural periods had built according to an anthropomorphic codex of dimensions, the Swiss-French architect intended with his proportional system to transcend the "inhuman" metric regime. The basis for the Modulor's humanization of space was a prototypical person six feet tall – in the appended sketch, like the Vitruvian Man, delineated within a circle and square (Figure 99) – subdivided at its navel according to the Golden Section, "the most stringent of all laws, but also the most impalpable, the most inward that existed."[360]

In 1972, Tyng severely criticized the Modulor in a lecture called "Adam and Eve: Symmetry and Asymmetry." She argued that Le Corbusier had put too much emphasis on a series relying on the specific height of one person, "rather than on a forming principle

diagonal of its half ablated on both sides – a form of special prominence, since it again related to the Golden Section and was according to Hambidge's analysis employed in the Parthenon (447-32 BC) by Ictinos and Callicrates. Cf. Jay Hambidge, *The Elements of Dynamic Symmetry* (New York: Brentano's, 1926) p. 90. As Thompson indicated, the Greeks were also familiar with the number series 2:3:5:7:12:17 etc., which similar to the Fibonacci series, though starting with two, converged to a √2 value. Cf. Thompson, *On Growth and Form*, p. 923.

357 Ivan Zaknic, *The Final Testament of Père Corbu* (New Haven: Yale University Press, 1997) p. 105.

358 Le Corbusier, *The Modulor* (Cambridge: Harvard University Press, 1954; 1948) pp. 29-30.

359 Le Corbusier, *Toward an Architecture*, pp. 233-9.

360 Le Corbusier, *Modulor 2* (Stuttgart: Deutsche Verlags-Anstalt, 2003; 1955) p. 26; transl. by the author. This Golden Division was repeated in the deduced parts to generate a fractal matrix of numbers that was additionally subjoined by a second series, double the first one. A hundred years earlier Adolf Zeising had measured numerous Greek statues and human bodies concluding that the Divine Proportion defined every facet of their constitution. Cf. Adolf Zeising, *Neue Lehre von den Proportionen des menschlichen Körpers* (Leipzig: Weigel, 1854).

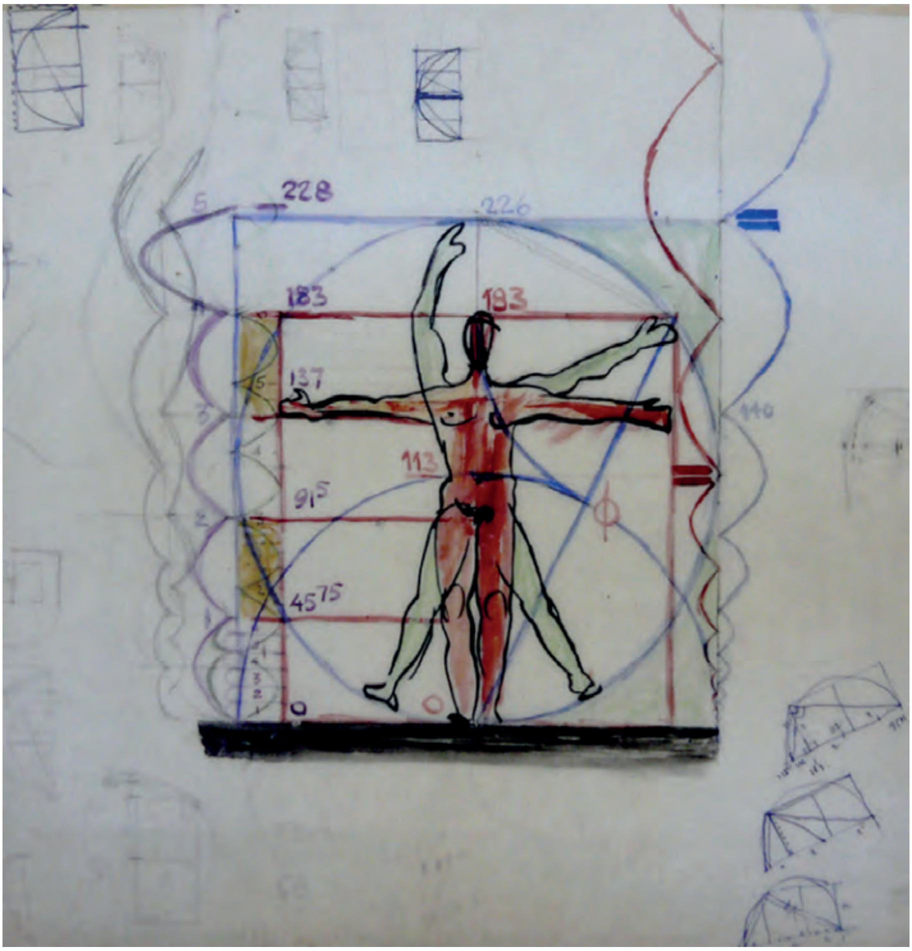

Fig. 99: Le Corbusier, Vitruvian Man and the Scales of *Modulor*, 1945.

of proportional progressions which could be applied to any series of dimensions." During the preceding decade, she had become a true expert regarding its properties:

> In spite of the fact that scientists have often treated it with amused indulgence, I believe that the so-called Divine Proportion will be recognized as a universal forming principle – a basic link between atomic structure, molecular structure, biological structure, psychic structure, and human creativity.

Tyng alluded to DNA as another indication of the ratio's relevance:

> If you think of the DNA molecule as a twisted ladder, the rungs of the ladder turn around its center one tenth of a circle with each turn. This ten-sided figure, or decagon, has the property of its sides being in Divine Proportion to its radius [...].[361]

Tyng addressed a wider public with her studies about the Golden Section in the exhibition "The Divine Proportion in the Platonic Solids," held at the University of Pennsylvania in 1964. Explaining the exhibition's intentions, she wrote to Whyte:

> Motivated by a dissatisfaction with the static 'pure' forms developed by Buckminster Fuller, I undertook a search for underlying principles ordering the relationships between the five regular three dimensional solids as the basis for meaningful asymmetry and transitions in scale-principles which might be the basis for the creation of more humanized forms.[362]

In other words, Tyng had begun to search for a connection between the "symmetric" Platonic forms and the "asymmetric" ratio of the Divine Proportion. While preparing a subsequent exhibition catalogue called "Anatomy of Form / Atom to Urban" (1965, unpublished), she verified her results in a letter to John D. Entenza:

> The principles which I have discovered (or rediscovered) bring together both 'geometric' and 'organic' forms – the first as static form and the latter as form-in-process. It seems that the Platonic Solids express geometric principles and the Divine Proportion expresses the organic principle [...].[363]

The proposed sequence (Figure 100), which Tyng liked to compare with Kepler's planetary model,[364] acknowledged the following building up of the regular solids:

> [T]he tetrahedron edges form the diagonals of the cube; the corners of the cube are centered on the faces of the octahedron; the 8 corners of the cube coincide with 8 of the corners of the dodecahedron; all of the corners of the dodecahedron are centered on the faces of the icosahedron.[365]

361 Anne G. Tyng, "Adam and Eve: Symmetry and Asymmetry;" lecture held at the Franklin Institute in Philadelphia, 20 October 1972, 030.II.45.64, LIKC.

362 Tyng's letter to Whyte, 4 August 1964, 074.II.A.6, AGTC.

363 Tyng's draft of a letter to John D. Entenza, 28 February 1965, 074.II.A.6, AGTC. Tyng was well aware of having only "rediscovered" a geometrical link between the Platonic Solids. Plato had mentioned that the perfect bodies were "capable in part of being produced out of one another by means of dissolution [...]." Plato, *Timaeus*, § 53 C – 55 D. As Tyng noted in "Anatomy of Form / Atom to Urban," her analysis also referred to the work of Campanus of Novara, a 13th century Italian mathematician, who had considered the Golden Section to orchestrate the five Platonic Bodies in an *irrationali symphonia*.

364 Cf. Anne G. Tyng, "What is the Divine Proportion?;" introductory notes for the exhibition "The Divine Proportion in the Platonic Solids," n.d., 074.II.A.39.1, AGTC.

365 Tyng, "Anatomy of Form / Atom to Urban," n.p.

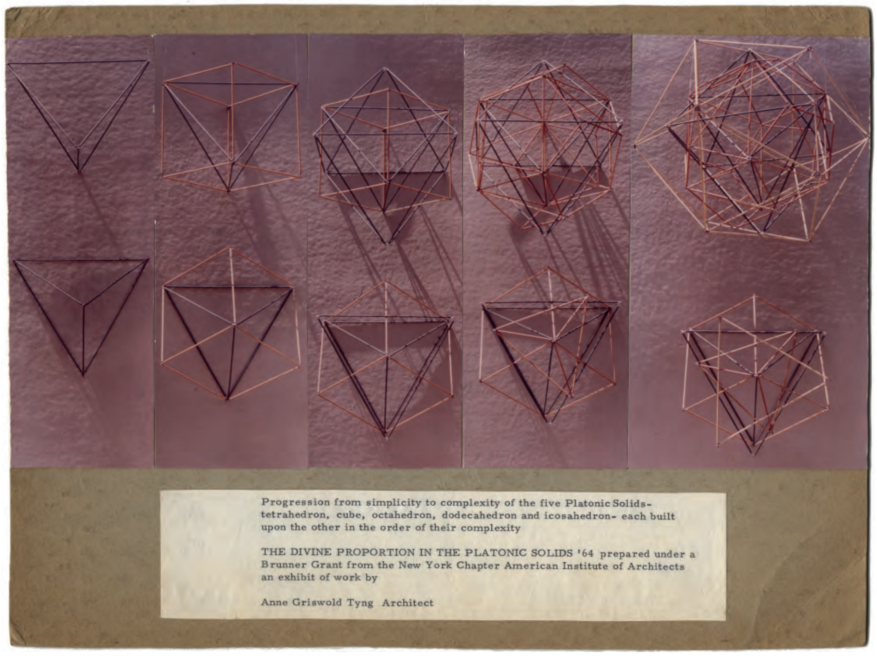

Fig. 100: Anne Griswold Tyng, Exhibition "The Divine Proportion in the Platonic Solids," University of Pennsylvania, Philadelphia, 1964.

The central protagonists in this transformation were the dodecahedron, one of the "higher solids" with its reflexive, the icosahedron (both contained the Golden Section: the dodecahedron having 12 pentagonal faces and the icosahedron having its vertices on three centrally, orthogonally crossed Golden Rectangles), and the cube, one of the "simpler solids," with its dual the octahedron and the tetrahedron.[366] Remarkably, the sides of the dodecahedron and cube stood in Divine Proportion to each other, since the cube side was a diagonal of a pentagonal face. This was for Tyng the key to connecting the higher and simpler bodies. She verified her theory with several other examples of "sacred cut" divisions in the Platonic Solids, while for her a particularly impressive one was the division of every edge of the simple octahedron with the "subtle asymmetric proportion" to produce the higher icosahedron: "A most fascinating fact – the asymmetric division of a regular solid produces another complete regular solid."[367] Altogether, Tyng, in contrast to Ghyka, sought to accentuate

366 All simpler solids related to a √2 progression: the side of the tetrahedron being the diagonal of the cube, while the octahedron side was half the one of the tetrahedron.
367 Tyng, op.cit., n.p.

> the continuity between the living and non-living forms, and the fact that living forms themselves have evolved from systems or arrangements of matter which are not considered alive.

Hence, she recognized no absolute dualism between the inorganic and organic, as the all-encompassing Golden Ratio unified both:

> Unity of form found in a spiraling atom, the spiral of the nautilus shell, of leaves around a stem and of the spiraling galaxy *Ursa Major* nine million light years away is convincing evidence for the existence of underlying principles for all natural forms in the universe.[368]

In her dissertation "Simultaneous Randomness and Order: The Fibonacci-Divine Proportion as a Universal Forming Principle" (1975, advised by Fuller), she summed up her studies and also used *Pascal's Triangle* – a numerical scheme to register the accumulation of repeated tosses for heads or tails – as further proof. Noticing that the sums of its diagonals yielded the Fibonacci numbers, she concluded: "It is probable that all physical form through the evolutionary process of probabilities in time and space include these ratios."[369] Ultimately, it was a

> safety net to catch chaos – it is really a process that builds up randomness, and out of that randomness you have a spontaneous simple order again.[370]

2.7 The Building as Organism

In the Alfred Newton Richards Medical Research and David Goddard Laboratories Buildings (1957-65), situated on the campus of the University of Pennsylvania in Philadelphia, culminated Kahn's concerns for the individuation of spatial functions. Teaching studio courses at his *alma mater* since 1954,[371] under the auspices of its new dean G. Holmes Perkins the school transformed from a historicist Beaux-Arts institution into a Modernist interdisciplinary one.[372] With twenty-two new faculty

368 Ibid.

369 Tyng, "Simultaneous Randomness and Order: The Fibonacci-Divine Proportion as a Universal Forming Principle," pp. 29–30, 074.I.B.14, AGTC.

370 Anne G. Tyng interviewed by Robert Kirkbride, "Number is Form and Form is Number," in *Nexus Network Journal*, vol.7, no.1, 2005, p. 137.

371 For all dates concerning people's tenures at the University of Pennsylvania, the author relies on the *University of Pennsylvania Bulletin – School of Fine Arts*, AAUP.

372 As G. Holmes Perkins remembered and probably referring to the A.R.G., his "own contacts with Kahn began in the mid-1930s with the founding of a secessionist group of architects (headed by Hudnut, then dean at Harvard) dedicated to research on housing, architecture and urban design. Kahn became president and I secretary just before the outbreak of war which spelled the death-knell of our fledgling Society." Perkins, "Louis I. Kahn: Conception and Meaning," in *Architecture and Urbanism*, extra edition, November 1983, p. 221.

appointments throughout the first two years of his tenure, Holmes Perkins initiated a *Golden Age* in Philadelphia. Within the novel regime, Kahn together with Rice and Le Ricolais taught a master course in a loft space underneath the roof of Furness' Library Building.

By the time of the first project presentation in June 1958, Kahn had conceived a basic scheme of three interconnected, seven-story high towers distributed in a swastika-like formation around a central, eight-story high utility tower. During the same summer, the commission expanded to include laboratory facilities for biology, which Kahn integrated in two additional towers placed towards the property's western end. The rotating pinwheel formation indicated that Kahn was not satisfied with a purely static order, as it added a dynamic spiral impetus to the configuration, which contrasted with the inner restfulness of the squares.[373] Once again, the general disposition was antagonistic with respect to its site that featured the "Bio Pond," officially known as the James G. Kaskey Memorial Garden – a remnant of a once five-acre grand botanical garden designed by John M. MacFarlane – in its back (Figure 101). Even though the façades had windows and the towers' fluctuating clustering allowed natural light – in fact, too much – to enter on all sides, the basic scheme derived predominantly from inner, compositional considerations.

In contrast with the formal landscaping that had characterized the Jewish Community Center's later stages of planning, this time an informal landscape surrounded, or rather *confronted*, the clear geometry of Kahn's composition (Figure 102). On this occasion, Ian L. McHarg in collaboration with Patton (unexecuted design for the plaza) was the landscape architect.[374] A central passageway connected the irregularly planted front lawn with the botanical garden in the back. In short, two dramatically different perceptions of nature collided: one promoting a geometric understanding of natural growth, the other emphasizing the beauty of unbridled nature. While the mutual benefit remained questionable, one should not discount McHarg's overall influence in heightening Kahn's ecological awareness. A Scottish Presbyterian by origin, McHarg had come to the United States after the Second World War in order to study landscape architecture and city planning at Harvard.[375] After his studies, he returned to

373 The two later biological towers, again square-shaped, were added in such a way that a virtual Golden Rectangle outlined the perimeter's intervention. With the aid of such reference frames Kahn introduced a novel mathematical exactitude to his design. Cf. Klaus-Peter Gast (foreword by Anne G. Tyng), *Louis I. Kahn: The Idea of Order* (Basel: Birkhäuser Verlag, 2001). Le Corbusier employed comparable "tracés régulateurs" as "a guarantee against arbitrariness," while Alberti had suggested to verify compositional harmony with similar *lineamenta*.

374 Kahn and McHarg had already collaborated on the Martin Research Institute, whereas the latter's influence was especially noticeable in the four courtyard designs of the Laboratory Building, because this was a major research area of his at the time. Cf. Ian L. McHarg, "The Court House Concept," in *Architectural Record*, vol.122, no.9, 1957, pp. 193-200.

375 Since classicism was still being preached, McHarg would not be introduced in Harvard to the ideas and personalities that would later influence his work – Olmsted, Eliot, the Prairie Style

Fig. 101: Louis I. Kahn, Alfred Newton Richards Medical Research and David Goddard Laboratories Buildings, University of Pennsylvania, Philadelphia, 1957-65.

Scotland, and in 1954 asked Holmes Perkins, his former professor, if he saw any academic opportunities worth pursuing. Well, the latter did: McHarg became assistant professor of city planning in Philadelphia with the responsibility of developing a department of landscape architecture that should rival Harvard's, the only one at the time.

Yet, returning to the project, not only was each of the studio towers a separate spatial entity (Figure 103), each steeple had additionally attached at its periphery smaller and even higher rising service sub-towers (Figure 104) that housed either the escape stairways or mechanical facilities such as air-ventilation ducts and the means to carry water, gas and vacuum tubes.[376] Kahn, in collaboration with the mechanical engineer Fred S. Dubin, had recognized that the researchers often infected animals with germs and worked with poisonous isotopes as well as noxious gases. Hence, taking into account the necessity of clean air, the service tower had at its base four external *nostrils* for the intake of fresh air, which was then drawn up to an engine

landscape architect Jens Jensen, or some of the younger rebels on the East and West coast. The English landscape approach, which McHarg had learnt to appreciate in his youth, was bypassed as well, as were the natural sciences and ecology.

376 Distinguished were the escape towers by two parallel walls leading higher up at top.

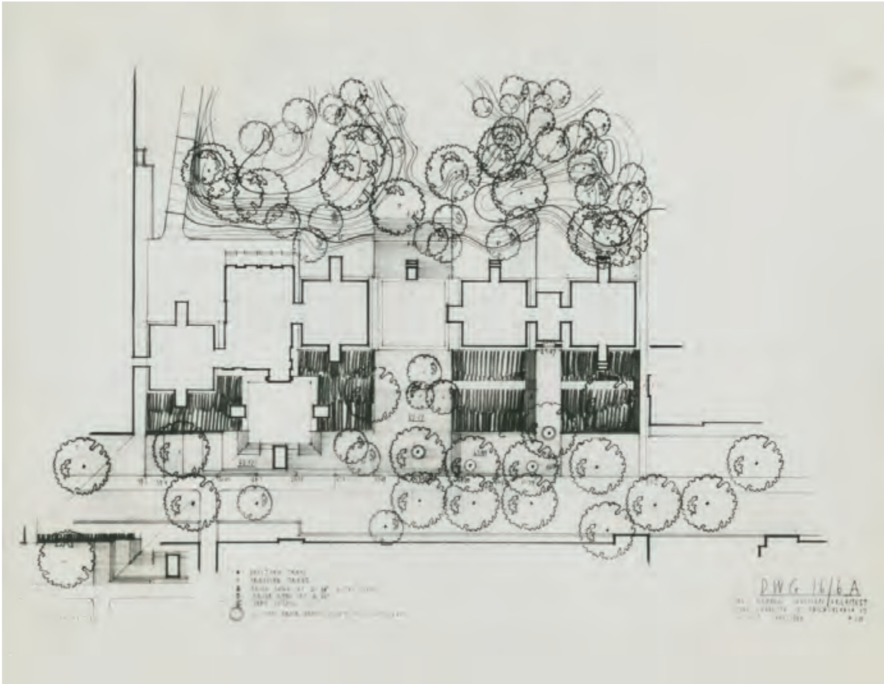

Fig. 102 Landscape Design by Ian L. McHarg, 1960.

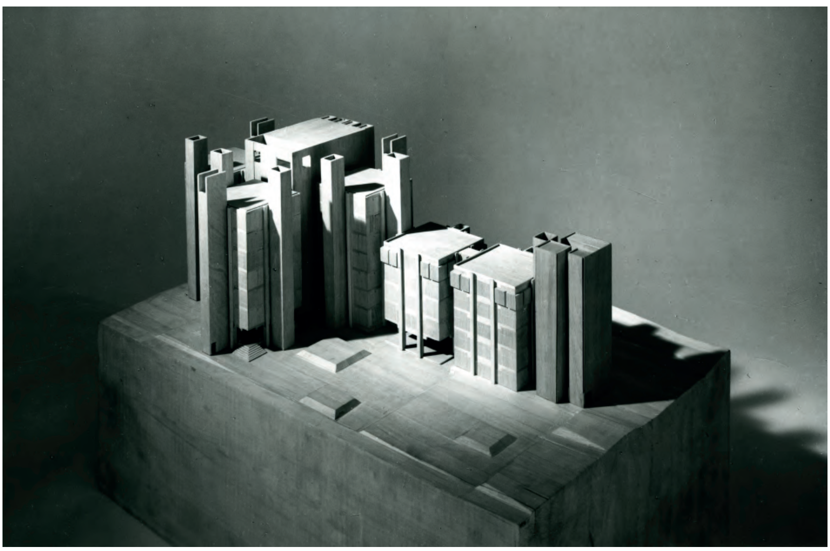

Fig. 103: Louis I. Kahn, Alfred Newton Richards Medical Research and David Goddard Laboratories Buildings, University of Pennsylvania, Philadelphia, 1957-65.

Fig. 104: Louis I. Kahn, Alfred Newton Richards Medical Research and David Goddard Laboratories Buildings, University of Pennsylvania, Philadelphia, 1957-65.

room on top. The conditioned air was blown down in two distribution shafts – notably hidden from sight in the central tower – to be *breathed* into the studios. The vitiated air was finally dispersed through the exhaust sub-towers with their stacks high above the roof. The concealment of the distribution and the simultaneous dramatization of the exhaust- and intake shafts, giving "them a monumental dignity they barely deserve," yet, which "the profession at large has persistently underdone," prompted Banham in his critical examination of the project to conclude that a "curious mixture of the obscure and the over-explicit" characterized the building.[377]

Notably, the Smithsons in a competition entry for the extension of Sheffield University (1953) had applied comparable exhaust-stacks to express the building's mechanical intestines. Peter Smithson visited the United States between September and October 1957, and encountered Kahn in Philadelphia.[378] Most noteworthy for Kahn were Smithson's remarks on how he had entered the country through Hoboken in New York:

> We were all shocked, because it was such an unsightly way of coming to the United States. [...] Then Smithson said, *No, I disagree with you all. I think that's a reality.*[379]

To remain in England, Denys Lasdun's Cluster-Block in Bethnal Green, built between 1957 and 1960, in its arrangement of four apartment towers around a central service shaft was akin to Kahn's basic constellation, while Michael Webb, a founding member of the London-based group Archigram, with his student project for the Furniture Manufacturers Association Headquarters in High Wycombe from 1958 provoked the emergence of a new *high-tech* architecture. Promoting the sculptural expressionism of an edifice's mechanical and structural entrails, this tendency culminated in the building of the Centre Pompidou in Paris (1971-6) by Kahn's later employee Renzo Piano in collaboration with Richard Rogers.[380] Likewise in Kahn's case, the entire spatial structure was treated as a hollow system, since an exposed three-foot-deep omni-directional concrete web of Vierendeel-elements supported the floor

377 Reyner Banham, "On Trial 2: The Buttery-Hatch Aesthetic," in *The Architectural Review*, vol. CXXXI, no.781, March 1962, pp. 204-5.

378 Cf. Airletter from Peter Smithson to Kahn, 27 November 1957; 030.II.A.58.56, LIKC. Smithson also inquired whether Kahn could forward publication material for *Architectural Design* that was preparing a special issue on American architecture. Eventually the English architect published an article about Kahn's work in *Architect's Yearbook* (no.9, 1960, pp. 102-18) that ended with the prophetic words: "Louis Kahn will soon be a very great architect." In October 1959 the Graduate School of Fine Arts of the University of Pennsylvania exhibited the "Work of Three English Architects," including the Smithsons, James Sterling and William Howell.

379 Kahn, "The Invisible City," p. 165.

380 The Centre Pompidou deliberately exposed all its services, and by designating to each function a separate color (yellow for electricity, red for circulation, blue for water, green for air, white for the structure) an intricate superstructure of pipes and tubes resulted.

slabs. This open truss system, just like the hollow ceiling in the Yale Art Gallery, contained the mechanical devices such as pipes, conduits, ducts and exhaust hoods (Figure 105).[381] For the first time Kahn had managed, thus, to integrate both the horizontal and vertical utilities in hollow spaces, and consequently liberated the studio areas from any mechanical obstructions. Again, Banham recognized a “schizoid tendency,” tough, since Kahn had frankly exposed only the horizontal services, while vertically he felt “impelled to clothe them in pseudo-monoliths of positively Ledolcian monumentality.”[382]

Writing for *The Guardian* on the occasion of a special exhibition devoted to the building at the Museum of Modern Art in New York in 1961, Peter Collins in “The Will to Form” approved the project’s organic quality, describing it as “not a building of beauty, but one of character.” In its acceptance of heating, lighting, ventilating and other mechanical equipment as architectural determinants, he noticed a “complete lack of formal allusions.” Not obliterating the structural fabric and the other services, they co-existed in harmony just like “the natural forms of organic life, where physiological and anatomical elements are intertwined.”[383] Kahn himself would have subscribed to this description, as he liked to compare the mechanicals in the building with different parts of the human body – the air system being the lungs, the plumbing the blood vessels, the electrical network the nervous system, and the skeleton the structure:

> Integration is the way of nature. We can learn from nature. How a space is served with light, air and quiet must be embodied in the space order concept which provides for the harboring of these services.[384]

Considering these imperatives, Kahn’s daughter, Alexandra Tyng, also noted:

> From his understanding of how the trunk and branches of a tree carry nourishment to the leaves and how the heart pumps a life-sustaining supply of oxygen through the arteries to every cell in the body, Kahn conceived the idea that a building should have separate spaces for the mechanical system that provides ventilation, electricity, and plumbing to every room. His perception of the order inherent in living forms inspired his idea of the order of servant and served spaces.[385]

In this sense, Kahn’s following statement from 1973 is revealing, too:

> I see a building in an anthropomorphic way, as a body. I don’t want to be conscious of how my body functions. I always expect it to be tremendously resourceful.[386]

381 Later, parts of the open structure had to be covered up with false ceilings, though, since dust interfering with the scientists’ experiments could easily settle on the beams.
382 Banham, op.cit., p. 206.
383 Peter Collins, “The Will to Form,” in *The Guardian*, July 6, 1961, 030.II.66.10, LIKC.
384 Louis I. Kahn, “Architecture is the thoughtful making of Spaces,” in *Perspecta*, no.4, 1957, p. 1.
385 Tyng, *Beginnings*, p. 31.
386 John W. Cook and Heinrich Klotz, *Conversations with Architects* (London: Lund Humphries, 1973) p. 204.

Fig. 105: Louis I. Kahn, Alfred Newton Richards Medical Research and David Goddard Laboratories Buildings, University of Pennsylvania, Philadelphia, 1957-65.

Thus, answering the demands of spatial optimization, the Richards Laboratories also reapplied the dictums of structural proficiency. Kahn employed poured-in-place concrete for the independent service sub-towers, later covered with brick, and the central utility tower. Released from supporting the studio towers that relied on their own structural system, these shafts, nevertheless, visually anchored the buildings to the ground. The studio towers' structural members – always two H-shaped stanchions moved to the third points of the square on every side – supported the ceiling's Vierendeel structure. Its concrete members were precast, pre-stressed, and later portions of the horizontal framing were post-tensioned. By means of the pre-stressing process, the columns and girders decreased in size and their internal reinforcement turned them factually into a continuous structure. Besides, the Vierendeel girders cantilevered to leave the corners open, whereas its outmost vertical members were omitted in order to reduce the load.[387]

387 Cf. Robert M. Price, "Report on Inspection of Medical Research Building," 30 July 1959, 030. II.25.19, LIKC; and "Logic and Art in Precast Concrete," in *Architectural Record*, vol.126, September

Altogether, the towers closely resembled the Wright-inspired Open-Air School in Amsterdam by Johannes Duiker and Bernard Bijvoet, planned and erected between 1927 and 1930 (Figure 106). This comes as no surprise, since during his first visit to Europe in 1928, Kahn was enamored with Dutch architecture and had received from Jan Federic Staal, another exponent of the Amsterdam School and member of the *Wendingen* editorial board, a letter of introduction to his colleague and director of Public Works in Hilversum, Willem M. Dudok, with the request that the latter would show the young American Duiker's local Zonnestraal Sanatorium (1926-9).[388]

Like fine cabinet works, Kahn's structural elements were assembled on site. Watching a crane move the 25-ton members around like "matchsticks," Kahn realized the gross amplification of man's naturally given powers through technological aids. Collaborating with Kahn on the structural design were the local engineers Sheldon A. Keast and Raymond A. Hood. They recommended as a consultant the Estonian-born and German-educated August E. Komendant, who after his immigration to the United States in 1950 had established a pre-casting and pre-stressing plant in Lakewood, New Jersey (Figures 107, 108). Kahn visited the plant with his students in the fall of 1956 and went "into ecstasy seeing all these new possibilities."[389] He immediately recognized the opportunity to continue his rational investigations into prefabricated construction that had commenced a decade earlier.[390] Besides, with Komendant, Kahn had now recourse to another remarkable engineer: while Le Ricolais remained an authority in speculative-theoretical issues, his compatriot, who also joined the faculty in 1960, would advice him in more pragmatic-practical tasks. With regard to his own structural doctrines, Komendant maintained that there could be

> only one rational structural solution: the solution which carries out the purpose of the project and satisfies all conditions with maximum efficiency.

In his opinion, a system, where no single element could be omitted without the carrying function losing its wholeness, was by its very nature aesthetically satisfying:

> The appearance of a structure should express all its embodied qualities and, without any mystery, should make the observer directly aware of what the structure is or is expected to be.[391]

1959, pp. 233-8, 027.II.254, AEKC.

388 Cf. "Letter of Intro, Staal to Dudok," 19 June 1929, 330.I.B.3 SAKC.

389 August E. Komendant, *18 Years with Architect Louis I. Kahn* (Englewood: Aloray, 1975) p. 4.

390 In pre-fabricated structures, and in pre-stressing in particular, Komendant recognized the advantage of a more homogenous state of stress distribution, a better control of cracking in the tensional zones, a reduction of costs, and lastly an elongation of the structure's lifespan.

391 August E. Komendant, *Contemporary Concrete Structures* (London: McGraw Hill, 1972) pp. 8-12.

Fig. 106: Johannes Duiker and Bernard Bijvoet, Open Air School, Amsterdam, The Netherlands, 1927-30.

Having studied at the Technical University in Dresden (graduating with a doctorate in 1938), Komendant then returned to Estonia and erected a number of concrete structures such as grain silos (Figure 109), hyperbolic cooling towers, bridges and stadium roofs in the Baltic countries (Figure 110). In 1944, he escaped from the arriving troops and found employment in the American Army Headquarters in Heidelberg, mainly rebuilding damaged bridges and studying the German highway system.[392] After the end of the war, Komendant was assigned to studying German submarine shelters on the French

392 Cf. Authorization to study damaged reinforced concrete bridges and other structures from the Office of the Chief Engineer, 19 September 1945, U.S. Army Headquarters European Command, 027.II.263, AEKC.

Fig. 107: August E. Komendant, Concrete Pre-Casting and Pre-Stressing Plant, Lakewood, New Jersey, 1950 onwards.

coast in order to explain their almost unharmed survival of the allied air attacks.[393] Komendant's collaboration on the Silvenstein Dam with Franz Dischinger, a pioneer in concrete shell construction, during the end of his stay, was most remarkable. Intended to help overcome Bavaria's energy shortage, the dam, if executed, would have been the second largest in the world after the Hoover Dam in Colorado.[394]

393 Once in America, the state authorities immediately contacted Komendant, since he owned "extensive documents pertaining to protective shelters and their effectiveness." Cf. Letter from L. Wilkinson, director of New York State Civil Defense Commission, to Komendant, 22 August 1950; 027.II.263, AEKC.

394 Not only the sheer magnitude was remarkable, but also the dam's novel construction method. The structural principle, for which both received a patent in 1950 and which Dischinger considered "probably the most relevant invention in this area in this century," was based on the idea of using instead of a massive wall – 42 meters thick at the valley bottom – four separate cylindrical concrete shells, which together totaled not more than 15 meters. Cf. "Grosse Pläne für die Sylvenstein-Talsperre," in *Süddeutsche Zeitung*, no.88, 17 April 1950, 027.II.263, AEKC; and Telegram from Dischinger to the board of the German Concrete Society, 16 March 1950, 027.II.11, AEKC.

Fig. 108: August E. Komendant, Concrete Pre-Casting and Pre-Stressing Plant, Lakewood, New Jersey, 1950 onwards.

Fig. 109: August E. Komendant, Grain Silo, Tartu, Estonia, 1941.

Fig. 110: August E. Komendant, Tribune Kadrioru Stadium, Tallin, Estonia, 1936-7.

2.8 Trees, Plants and the Design from the Inside Out

Looking for references for Kahn's project, one inevitably comes across the many sketches of towers he had made during his journeys. From the early drawings of Caesar's Tower at Warwick Castle, the *cortile* of Villa Rufolo in Ravello or San Gimignano's mighty steeples, to the later depictions of lighthouses along the shores of New England or the bulwark-like shafts of St Cécile Cathedral in Albi – all these examples share in common an emphasis on verticality and multi-functional hollowness. Furthermore, Kahn was deeply fascinated by castles, which despite their pure volumetric outlines, appeared to emerge naturally from the terrain. Owning books on the subject such as David MacGibbon and Thomas Ross' *Castellated and Domesticated Architecture of Scotland* (1887-92), he also had a number of photographs and illustrations of such defense edifices in his slide-collection – for instance the appended Orford Castle on the Suffolk coast in England (12th century; Figure 111).[395]

395 Kahn visited this castle and others during his stay on the British Isles for a lecture at the Royal Institute of British Architects in London, 14 March 1962. Cf. Susan Braudy, "The Architectural

Fig. 111: Orford Castle, Coast of Suffolk, England, 12th century.

Kahn used the plans of Comlongon Castle near Dumfries in southern Scotland (15th century) in his article "Remarks," published in *Perspecta* in 1965 (Figure 112), wherein he noticed that these fortification buildings demonstrated a *poché*-strategy of spatial optimization: a hollowed out exterior wall harbored auxiliary spaces that adjusted their form to the varying functional and strategic needs.[396]

In addition to these architectural sources, Kahn's intervention correlated with different natural configurations. For instance, his proposed air cycle was similar to the ventilation principles employed by termites in their tower-like constructions to maintain a steady temperature and degree of moisture. Perforated like a sponge in order to soak cool air into an underground cellar, the heated air is dispatched through chimney-like tops (Figure 113).[397] Furthermore, as owner of Louis Figuier's *Vegetable World: Being a History of Plants, with their Structure and peculiar Properties* (1867), Kahn had ample opportunity to discover in it the basic constituents of an organic design ideology that focused upon the plant as a model of operation. Already in 1954, in a letter to Tyng, Kahn had drawn a hollow stem and stated next to it:

Metaphysics of Louis Kahn," in *The New York Times Magazine*, 15 November 1970.

396 A similar scheme of spatial organization characterized Kahn's Bryn Mawr Dormitories (1960-5), where smaller-scale student apartments surrounded three obliquely connected introvert community spaces.

397 Cf. Maurice Maeterlinck, *The Life of the White Ant* (New York: Dodd, Mead & Company, 1927).

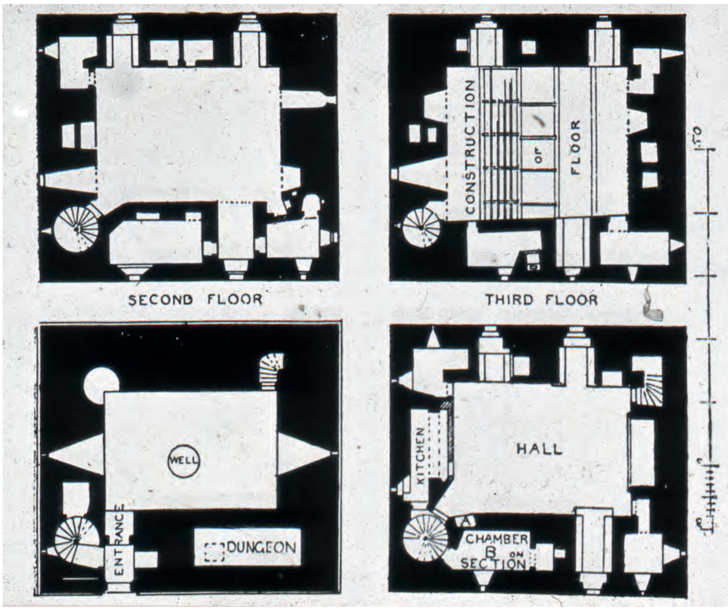

Fig. 112: Comlongon Castle, near Dumfries, Scotland, 15th century.

Fig. 113: Termitary, Avash National Park, Ethiopia.

"Now the column must be hollow like the stem of a leaf or the trunk of a tree." [398] (Figure 114) Possibly, Kahn was referring to *On Growth and Form*, in which Thompson alluded to the increased mechanical efficiency of tubular structures as exemplified by "the quill of the bird's feather, the hollow shaft of a reed, the thin tube of the wheat-straw [...]."[399] Calling attention to the work of the Swiss botanist Simon Schwendener, who had "elaborately investigated the factor of strength in the cylindrical stem, which Galileo was the first to call attention to,"[400] Thompson remarked

> that the resistance to bending was at least twenty-five times as great as it would have been had the six main bundles been brought close together in a solid core.[401]

Admittedly, in the Richards Laboratories the vertical cores were not placed like natural stems in the center and, in fact, except for stiffening they did not structurally support the studios. But the comparison still holds true in functional terms: a multi-purpose hollowness characterizes plants, exemplified here in a section of *Equisetum hyemale* (Figure 115), through which every vein of the leaf remains in continuous interaction with the imbibing roots.

Beforehand, Wright had excessively relied on plant analogies as well, while employing hollow columns in the Larkin Building in Buffalo as early as 1904 (Figure 116). Placed at the building's peripheral corners, hollow pylons of equally monumental scale as Kahn's housed the stairways and utility ducts, and next to these, three even higher shafts contained the building's air-conditioning system.[402] In the Unity Temple the centrally placed cores virtually carried the cantilevering roof like the crown of a tree.[403] "Breaking-up the box" as a reply to his general distaste of the *Chicago Frame* – this "hideous efflorescent boxing in of humanity"[404] – Wright postulated:

> Conceive now that an entire building might grow up out of conditions as a plant grows up out of soil and yet be free to be itself, to 'live its own life according to man's Nature.'[405]

Further incorporating these principles in his high-rise projects, in St Mark's-in-the-Bouwerie in New York (1929) a central arrangement of hexagonal cores supported the

398 Reproduction of Kahn's letter to Tyng, 25 April 1954, in Tyng, *Beginnings*, p. 65.
399 Thompson, *On Growth and Form*, p. 971.
400 Ibid., pp. 972-3.
401 Ibid., p. 974.
402 Fresh air was taken in at the top of the outer shafts and drawn to an air-conditioning plant in the basement (the reverse of Kahn's scheme). Then the tempered and cleaned air was distributed through the middle shaft to outlet grilles underneath the balconies of each floor.
403 Wright's interest in cantileverage had commenced during his employment as a draftsman in the office of the engineer Alan Conover. Cf. Bruce Brooks Pfeiffer, (ed.), *Frank Lloyd Wright: Letters to Architects* (Fresno: California State University, 1984) p. 2.
404 Frank Lloyd Wright, "Frank Lloyd Wright," in *The Architectural Forum*, vol.94, no.1, 1951, p. 101.
405 Wright, *Autobiography*, pp. 146-7.

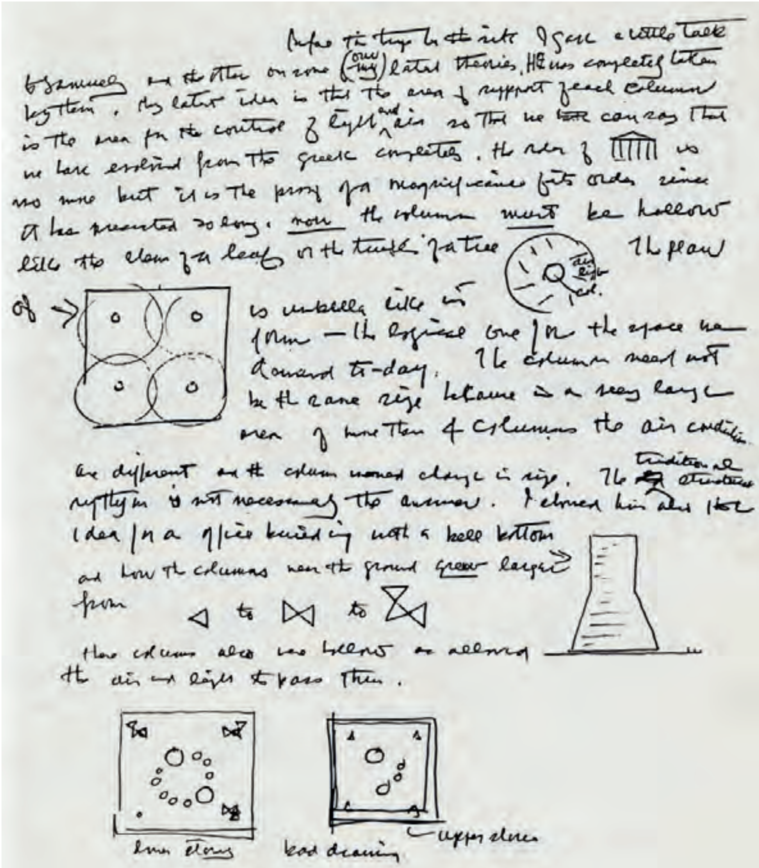

Fig. 114: Louis I. Kahn, "<u>Now</u> the column <u>must</u> be hollow like the stem of a leaf or the trunk of a tree." Letter to Anne Griswold Tyng, 1954.

overhanging apartments. While this concept later found execution in the Price Tower in Bartlesville (1952-6), Wright had earlier used it in the Johnson Wax Administration Building:

> Cantilevered from the giant stack, the floor slabs spread out like tree branches, providing sufficient segregation of departments vertically. Elevator and stairway channels up the central stack link these departments to each other. All utilities and the many intake and exhaust pipes run in their own central utility grooves, arranged like the cellular pattern of the tree trunk.[406]

406 Wright, "Frank Lloyd Wright," p. 77. A similar indivisible fusion of structure and space had unveiled itself in Kiesler's project for a Department Store in 1925. His "Tensionist Skyscraper" was also anchored to the ground by only one central hollow column, which included elevator shafts, heating and cooling systems, besides supporting a continuous floor-succession that rotated spirally upwards.

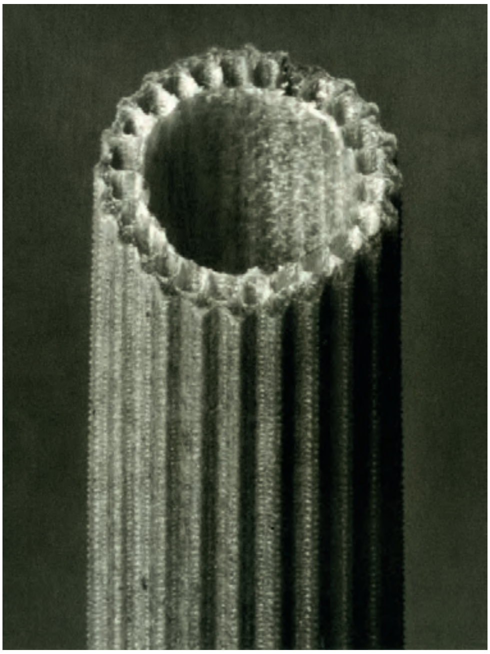

Fig. 115: *Equisetum hyemale*.

In Racine, not only the tower-structure, but also the horizontally extending working hall appeared like a forest of columns: numerous freestanding dendriform piers supported circular ceiling trays, i.e. the foliage. Nervi used a similar strategy of tree-like construction, although magnified to giant proportions, in the Palazzo del Lavoro in Turin (1959-61), whereas Kahn, as mentioned earlier, had appropriated such a scheme in his designs of the Parasol House, the Martin Research Institute, and would later re-apply it in the Olivetti-Underwood Factory in Harrisburg (1966-70) and the Hurva Synagogue in Jerusalem (1968-74).[407] In this context, Fuller's description of the Dymaxion House, which Kahn kept in his files, is of interest, too:

> The structural character suggests the tree form, with a central stem containing what might be termed the elements which give life to the rest of the house, which spreads out from the stem as limbs do from the trunk of a tree.[408]

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407 In the Olivetti Factory a series of freestanding umbrella-shaped piers of cast-in-place concrete defined the primary structure with fiberglass-reinforced pyramidal plastic skylights in-between.
408 Fuller added: "The central tower, composed of inflated duralumin tubes in flexible-jointed triangulation, contains all the required utilities, a triangular elevator, equipment for air conditioning, light and heat generation and distribution, water pipes and facilities for sewage disposal." Clipping of Fuller's "Dymaxion House," in *The Architectural Forum*, vol.56, no.3, March 1932; Cf. 030.II.63.22, LIKC.

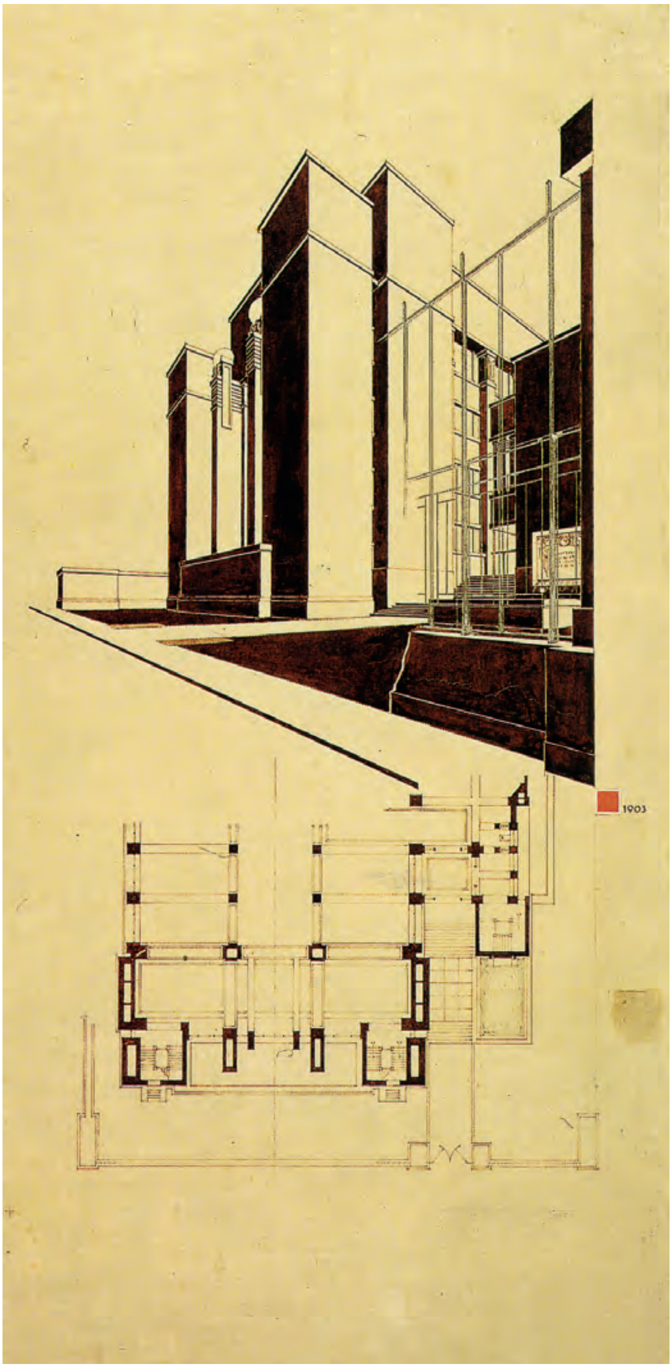

Fig. 116: Frank Lloyd Wright, Larkin Building, Buffalo, New York, 1903-6.

A common parameter among all these tree-projects was their insistence on developing the compositional structure from the inside outwards. In Kahn's case, a method of organic organization emerged that widely ignored, at least at this point, the outer circumstantial factors. From the contemplation of the inner purposefulness was deduced a functional and compositional interdependence of the plan's constituent elements, or as Wright had clarified many years before:

> Organic building is natural building: construction proceeding harmoniously from the nature of a planned or organized inside outward to a consistent outside.[409]

Kahn, too, considered his buildings to be living entities, in which each discrete spatial unit had its particular hierarchical role to perform in the built organism. Accordingly, in 1957 he stated: "A building is like a human, an architect has the opportunity of creating life."[410] Only from a mutual cooperation of the serving and served components did the vigor of the whole fabric arise, and in a reciprocally interactive manner certain spatial *organs* were subordinated to others, since they possessed a different functional role. Likewise, Cuvier had testified:

> It is in this mutual dependence of the functions and the aid which they reciprocally lend one another that are founded the laws which determine the relations of their organs and which possess a necessity equal to that of metaphysical or mathematical laws, since it is evident that the seemly harmony between organs which interact is a necessary condition of existence of the creature to which they belong and that if one of these functions were modified in a manner incompatible with the modifications of the others the creature could no longer continue to exist.[411]

Similarly, for Kahn a building's inner disposition occupied a fragile state of organic-geometrical equipoise – no member could be removed without destroying the whole.

Kahn's increased attention to fostering a project from the inside out was further demonstrated in a couple of unexecuted private house designs. The Morris House in Mount Kisco, New York (1955-8) again used the square as a basic formal unit, but on this occasion the entire constellation was fiercely heaped together and dynamically arranged. An overall geometrical form no longer determined the building's appearance. Instead, an internal vital impulse had seemingly erupted that ascribed to each space an appropriate position and form. A more didactic albeit not less dynamic order concretized in the Goldenberg House in Rydal, Pennsylvania (1959; Figure 117). Its basic configuration rested upon a triple-layer structure: in the center a square court was surrounded by a corridor, which itself was embraced by a series of servant spaces with dormer windows, while the served rooms radiated around the periphery. The distinctiveness of each zone was stressed by their changing light conditions: the

409 Wright, *Genius and Mobocracy*, p. XIII.
410 Ronner, Jhaveri and Vasella, *Complete Work*, p. 116.
411 William Coleman, *Georges Cuvier: Zoologist* (Cambridge: Harvard University, 1964) pp. 67-8.

Fig. 117: Louis I. Kahn, Goldenberg House, Rydal, Pennsylvania, 1959.

sky-lit servant zone was distinguished from the introvert corridor, while the outer chambers were side-lit and through large windows interacted with the landscape. This time the vividness of the volumetric composition was not obtained through the dispersed assemblage of individual spatial elements, but by means of 45° diagonals and fluctuating room dimensions.

With their extreme sensitivity towards internal needs, both houses were paradigmatic examples for Kahn's current design approach: starting from the seed "house" the intervention gradually assimilated with the more informal conditions to become "a house."[412] Conveying a sense of expansion in his sketches (Figure 118), the Goldenberg House extended into a living entity like a blossoming flower. Its spaces rather than being constrained into a *Procrustean bed* extended freely with respect to their different natures, since "there was an existence will for this house not to be disciplined within a geometric shape."[413] In sum, Kahn's assumptions – from the

412 Cf. Kahn, "Talk at the Conclusion of the Otterlo Congress," p. 208. In a last step, no longer influenced by the architect, the house became "a home," which is the building as used by its occupants.

413 Louis I. Kahn, "A Discussion recorded in Mr. Kahn's Philadelphia Office in February 1961," in *Perspecta*, no.7, 1961, p. 13. A similar *broken* geometry characterized the work of the Finnish architect Alvar Aalto, as illustrated for example in his Säynätsalo Town Hall (1949-52) and his own Summer House in Muuratsalo (1953). Fracturing an initial, preconceived geometrical order, a grouping of programmatically and contextually well-adjusted volumes resulted. Kahn had met Aalto, the son of land surveyor, on the occasion of different juries and symposiums during the 1950s. Since 1940, Aalto had been teaching at MIT, where also Kahn was a visiting professor between February and June 1956. Moreover, Kahn owned Nils Erik Wickberg's book *Finnish Architecture* (1959) with a personal dedication by Aalto.

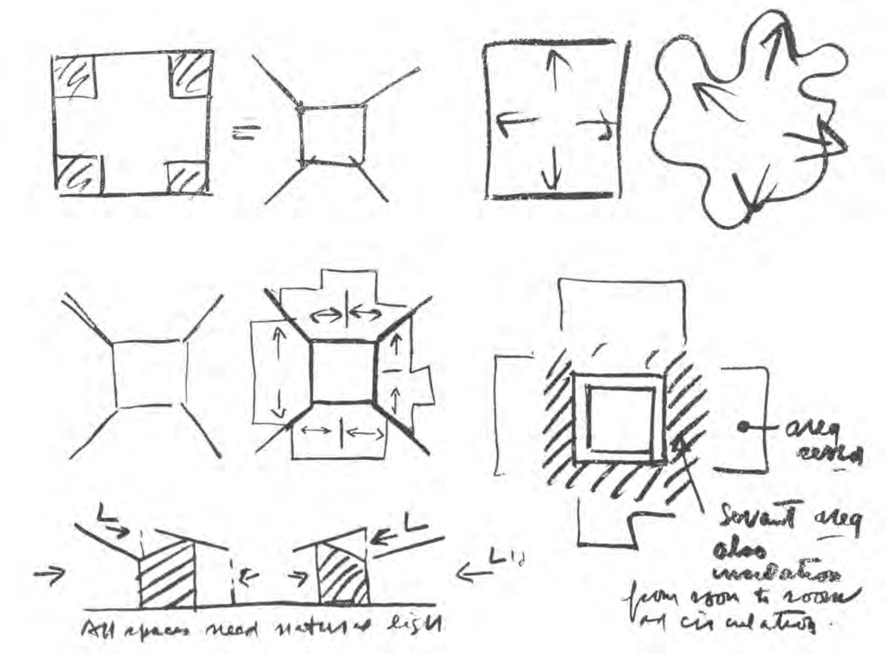

Fig. 118: Louis I. Kahn, Goldenberg House, Rydal, Pennsylvania, 1959.

anti-Cartesian diagonals that broke with the grid-order to the appreciation of every spatial unit as a singularity, thus, exaggerating rather than eliding differences – fundamentally opposed the International Style's basic tenet of homogeneity. Speaking at the University of California in Berkeley in 1960, Kahn agreed:

> Our buildings have a tendency to look completely insensitive to an activity. They tend to look alike. Office buildings look like apartment buildings, maybe with a few balconies that differentiate one from the other; actually they appear alike, the same kind of building.[414]

Kahn's criticism was mainly directed at late Modernism's obsession with modularity and universal spaces, but did not confront its orthodox roots. This is no surprise since the emancipation of the outer shape from the interior needs had been one of the main imperatives of early functionalist doctrine with its origins in the writings of Greenough, Sullivan and Wright. Once the American doctrines had spread to Europe, mainly through the publication of Wright's *Wasmuth Portfolio* and the exhibition of

414 Louis I. Kahn, "On Form and Design;" speech held at the 46th meeting of the Association of Collegiate Schools of Architecture, University of California in Berkeley, 22-3 April 1960, in Latour, *Writings, Lectures, Interviews*, p. 107.

his early work in Berlin (1910), a whole generation of European architects – initially mostly German and Dutch, but after the Second World War also many Italians influenced by Bruno Zevi's Wright-inflected *Verso un'architettura organica* (1945) – became determined to develop the architectural project through a closer inspection of the inner functions.

As summarized by Le Corbusier, "*from the inside, work outwards*. This rule, I think is equally a law of nature and of architecture,"[415] the ambition was no longer to constrain a building from the outside into a prescribed corset, but instead await its unfolding from the inner premises. This search for the natural form had found its most incisive expressions in the Concrete and Brick Country Houses of Mies van der Rohe. Simultaneously, Hugo Häring, who was sharing the studio with him in Berlin, built a Farm in Garkau (1922-3) that achieved an exemplary melding of its formal and functional features.[416] During the following years, Häring elaborated his ideas of an organic architecture:

> The given task is clear: it is to draw up the house from the interior, from the vibrant processes of living and also to compose according to this principle. The exterior is no more *à priori* given, it only reveals itself like all the outer forms in nature reveal themselves.[417]

While sharing this longing for an enunciation of the inner programmatic pressures, Häring's formal vocabulary differed decisively from that of Mies van der Rohe, but also that of Kahn, Wright, and Le Corbusier. Attempting to avoid any abstract notions of geometry, the German architect emphasized a freer, more fluid volumetric articulation.[418] While Häring in Romanticist terms regarded man as an unconscious outlet of nature's continuous plastic force, the others stressed a more hybrid juxtaposition that allowed man to rise above nature through the intelligible recourse to geometry.

2.9 Man is and is not Nature

Regarding the question of what distinguished man from nature, Kahn gave a more definite answer in his keynote lecture at the 11th C.I.A.M. meeting in Otterlo in September 1959, by stating:

415 Le Corbusier, *Talks with Students* (New York: Princeton Architectural Press, 1999; 1961) p. 32.

416 A couple of years later, Häring explained: "We search to make our demands for expression applicable in the direction of the vital, in the tendency of the becoming, in the line of the agitated, in the course of an organic conformation, because the way of designing in accordance with the fulfillment of the purpose is also the way nature designs." Hugo Häring, "Wege zur Form," in *Die Form*, vol.1, no.1, 1925, pp. 3-5; transl. by the author.

417 Hugo Häring, "Arbeit am Grundriss," in *Baukunst und Werkform*, no.5, 1952, pp. 20-2; transl. by the author.

418 Cf. Peter Blundell Jones, *Hugo Häring: The Organic versus the Geometric* (Stuttgart: Menges, 1999).

> **Nature is not concerned with form, only man is concerned with form.** It makes it according to circumstances. If it meets the order of things in the nature of things, it will make any form that answers to the very nature of things. That is why we have what we call such peculiar-looking animals. Because there is a certain existence-will in this kind of thing which produces itself into this kind of animal and nature is not concerned about form – but we are.[419]

Quite explicitly, Kahn positioned man apart from nature, giving him powers of formal choice, while nature was a sort of unconscious automaton. Van Eyck, who helped organize the congress, responded with similar ideas in his final talk called "The Moment of Realization:"

> **It is in the nature of art that it should be different from nature.** [...] Art has its own kind of logic. It looks illogical beside nature's logic, but so does nature's logic look illogical beside that of art – beside that of man. [...] The moment of realization is what is crucial [...] The art is the jumping: how you take off, when, and where.[420]

To stay with Kahn, what had formerly been split into the three parts of "Nature of the Space," "Order" and "Design," at the end of 1959 coalesced into the novel terminology of "Form and Design." "Form" replaced the elusive "Nature of the Space" in terms of designation, but remained identical in terms of content: through "Form" one ought to grasp the intrinsic characteristics of a program, space or material by asking what is the essential difference between one thing and another, what constitutes its essence, "its nature against any other nature."[421] "Design" still referred to the tangible parameters of the changing circumstances and was but a simile of the original idea; while "Order," nature's universal lawfulness discernable through geometry, linked the two domains:

> Form has no existence in material, shape or dimension.
> A design is but a single spark out of form;
> It is of material and has shape and dimension. [...]
> I recall the beginning as Belief.
> It is the time of realization of Form. [...]
> And then I recall the adventure of design when dream-inspired
> Form must answer to the laws of order so as to be.[422]

Kahn elucidated these thoughts in the lecture "The Scope of Architecture" held at the Cooper Union on 20 January 1960, which provided the basis of a recording for the *Voice of America* broadcast on the 19th of November the same year.[423] Its revised

419 Kahn, "Talk at the Conclusion of the Otterlo Congress," p. 206.
420 Aldo van Eyck, "Talk at the Conclusion of the Otterlo Congress," in Newman, *CIAM '59*, pp. 216-7.
421 Prown and Denavit, *Kahn in Conversation*, p. 42.
422 Wurman and Feldman, *Notebooks and Drawings*, n.p.
423 Kahn, "Voice of America." Kahn had received from Henry-Russell Hitchcock the invitation to be part of the *Voice of America* program by the United States Information Agency with the general title

transcript was subsequently reissued in a number of publications with the appended diagrams (Figures 119, 120). Most importantly, Kahn distinguished physical nature that he regarded as the measurable "order" and "maker of all existence," and which was graspable through "thought," from the immeasurable invocation of what something wanted to be that he detected in "feeling." Accordingly, he wrote:

> Realization is the merging of Thought and Feeling in the closest rapport of the mind with the Psyche, the source of what a thing wants to be. It is the beginning of Form. Form encompasses a harmony of systems, a sense of order and that which characterizes one existence from another. Form is what, design is how.[424]

As a result, a building should not become a mere victim of circumstantial decisions, but instead always evoke its original inspiration:

> A great building, in my opinion, must begin with the unmeasurable, go through measurable means when it is being designed, and in the end must be unmeasurable. The design, the making of things, is a measurable act. At that point, you are like physical nature itself, because in physical nature everything is measurable [...]. But what is unmeasurable is the psychic spirit.[425]

With regard to Kahn's stringent separation between the measurable and immeasurable, the following statement from his notebooks further clarifies his intentions:

> Nature is the maker of all things, the psyche desires things and challenges nature to make that which expresses the inexpressible, that which cannot be defined, that which has no measure, that which has no substance ... love, hate, nobility.[426]

In this sense, nature was in Kahn's epistemological system simply a necessary instrument that raised his intelligible visions from the ineffable grounds of the imagination to the palpable properties of reality. Nature did not know "how beautiful the sunset is,"[427] and therefore was regarded by Kahn as a principally dull affair, producing infinite variations in a symphony of laws without any awareness of the beauty of its actions. Just as Kahn claimed nature was unconscious of its own activities, so Plotinus stated (in Emerson's borrowing): "Nature is but an image or imitation of wisdom, the last thing of the soul; nature being a thing which doth only do, but not know."[428] In contrast, mankind existed consciously, but in order to give

"Forum – The Arts and Sciences in Mid-Century America" on 13 March 1960, 030.II.A.55.22, LIKC. Cf. Louis I. Kahn, "Form and Design," in Scully, *Louis I. Kahn*, pp. 114-21.
424 Ibid.
425 Ibid.
426 Wurman and Feldman, op.cit., n.p.
427 Ibid.
428 Emerson, *Nature*, p. 1.

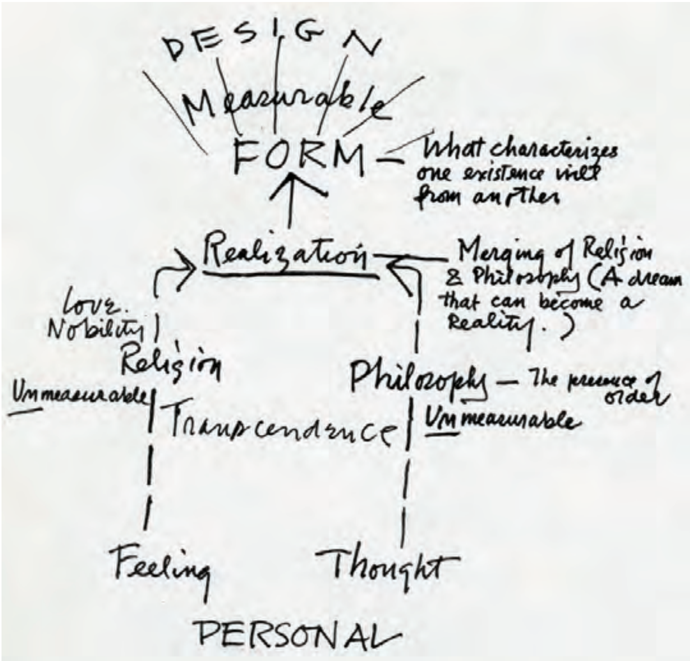

Fig. 119: Louis I. Kahn, "Form and Design," 1960.

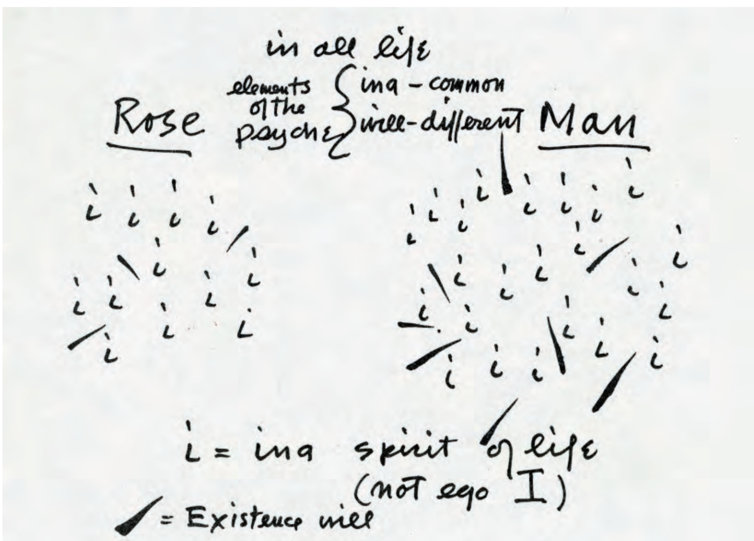

Fig. 120: Louis I. Kahn, "INA – Spirit of Life," 1960.

its psychic longings presence, it needed to consult nature. A few years later, in 1967, Kahn summarized: “We need Nature, but Nature doesn’t need us.”[429]

Yet, and this may sound paradoxical, in nature too there was a psyche and a consciousness, since in Kahn’s opinion a tulip or an ant had an individual “existence-will,” too, which demanded and gave life. In support of this hylozoistic hypothesis, Kahn stated in 1969:

> I would say the desire to be, to express, exists in the flowers, in the tree, in the microbe, in the crocodile, in man. Only we don’t know how to fathom the consciousness of a rose. Maybe the consciousness of a tree is its feeling of its bending before the wind. I don’t know. But I have definite trust that everything that’s living has a consciousness of some kind, be it as primitive.[430]

Therefore, Kahn ultimately regarded nature in a twofold way: first, as an unconscious tool that he termed the “workshop of God” in 1962;[431] and second, as a living thing that was pervaded by an inscrutable vital spirit just like man. In an ambiguous way Kahn could remain both dominant over nature and simultaneously acknowledge that a unitary, unfathomable “will to be” guided both human and organic development. Hence, bridging the opposition between confronting and participating in nature, Kahn believed in a holistic interconnectedness of all life, while always acknowledging mankind’s superior “will to express.“ By implication, man in Kahn’s epistemology was in a dipolar way both an immanent part of nature and simultaneously transcending it:

> The whole motivation of presence is to express. And what nature gives us is the instrument of expression which we all know as ourselves, which is like giving the instrument upon which the song of the soul can be played.[432]

Kahn envisioned the “soul”

> as being a kind of prevalence – not a single soul in each of us – but rather a prevalence from which each one of us always borrows a part. This applies to every living thing, be it a flower, be it a microbe, or be it a man or an animal. Every living thing. And I feel that this psyche is made of immeasurable aura, and that physical nature is made of that which lends itself to the measurement. I think that the psyche prevails over the entire universe.[433]

429 Louis I. Kahn, “Space and the Inspirations,” in *L’architecture d’aujourd’hui*, vol.40, no.142, February-March, 1969, p. 14. From a lecture originally delivered at the symposium “The Conservatory Redefined” at the New England Conservatory in Boston, 14 November 1967.

430 Louis I. Kahn, “Silence and Light;” lecture at ETH Zurich, 12 February 1969, in Ronner, Jhaveri and Vasella, *Complete Work*, p. 447.

431 Cf. Louis I. Kahn, “A Statement by Louis I. Kahn,” in *Arts and Architecture*, vol.81, no.5, 1964, p. 8; from a speech delivered at the *International Design Conference* in Aspen in 1962.

432 Kahn, “Silence and Light,” p. 447.

433 Kahn, “A Statement,” p. 18. In quite similar terms, Klee affirmed: “Creative power is ineffable. […] We are ourselves charged with this power, down to our subtlest parts. We may not be able to utter its essence, but we can move towards its source, insofar as at all possible. In any event, it is up to us to manifest this

What Kahn called here "psyche," he had in late 1959 termed "INA":

> So I invented INA. Now the reason is that there can be consciousness without will but there can be no will without consciousness. So INA is pure consciousness without will. [...] INA is the same for all living things – The character of will is different – This makes a rose different from a man.[434]

Consequently, the different "existence-wills" emerging from the INA were certain tendencies (Figure 120), which moved in one direction or another to make one *nature* different from another. Likewise, Schopenhauer had insisted that every particular thing manifested a certain aspect of the "universal will," so that various grades of will existed in relation to varying causality: While "causes" operated in the realm of physics and chemistry, "stimuli" were active in vegetal life, and "motives" stirred the life of animals including man. In Kahn's case, the INA laid the basis for a trans-subjective philosophy, which regarded the entire universe as being interlinked by a unitary force from which all life emerged. Such a hylozoistic cosmology had indeed been the basis upon which *primitive* mentality rested, and as Cassirer noted, "a fundamental and indelible *solidarity of life*" characterized its existence,[435] resulting in a deep conviction that man had to cooperate with nature's powers.

As stated, Kahn would have subscribed to such an attitude, yet he posited a similar strong belief in the uniqueness of man. Altogether, Kahn's philosophy at this point entered a new sub-level, since he was analyzing the hitherto only marginally touched workings of the intangible. As noted by Alexandra Tyng,[436] Kahn's theory of "realization" was not unlike fecundation, in which the complementary gametes of egg and sperm fused through *meiosis* into one cell, the *zygote*, to initiate a new life. Likewise, Kahn's antithetical notions of "feeling" and "thought" merged in a flash of "realization" to spark a new existence-will in "Form." A few years later, in 1966, when lecturing at Berkeley, he acknowledged:

> The fetus is a perfect record, a complete record, of how we were made – right from the very start. I believe it to be one of the most occupying of studies – [that] of human existence.[437]

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power in its function, just as it becomes manifest within ourselves. In all likelihood, it is itself a form of matter, although it cannot be perceived with the same senses as the more familiar kinds of matter. Yet it is in these familiar kinds that it must reveal itself. It must function in union with matter. Permeated with matter, it must take on living, actual form." Klee, *The Nature of Nature*, p. 63; notes dated 27 November 1923.

434 Kahn's letter to Harriet Pattison, 29 December 1959; reprinted in Tyng, *Beginnings*, pp. 159-60. Comparably in Plotinus' philosophy, in a triad system the One (*hén*), the source of all being, informed the Divine Mind (*noûs*) that represented reason and knowledge (Kahn's "order"). Beneath, the Cosmic Soul (*psyché*) as the vital principle (*physis*) consisted of a Higher or Celestial Soul (comparable to Kahn's "INA" or "psyche"), and a Lower Soul or *logos* (Kahn's "existence-will"), which penetrated all matter. Cf. Plotinus, *The Enneads* (London: Penguin Books, 1991).

435 Cf. Cassirer, *An Essay on Man*, p. 82.

436 Cf. Tyng, *Beginnings*, p. 31.

437 Louis I. Kahn, "Lecture at the University of California, Berkeley, 1966," in *Perspecta*, no.28, 1997, p. 7.

During the planning of the Richards Laboratories, Kahn had been in contact with David Goddard – namesake of the Biological Towers, director of the division of biology and chairman of the department of botany at the University of Pennsylvania.[438] Goddard was a specialist in cell theory and was quite aware that a cell's nucleus contained as a blueprint all the necessary information to construct and maintain a new organism.[439] The genetic code, just like Kahn's "Form," offered a potentiality, since "**in the start lies the seed for all things that must follow.** A thing is unable to start unless it can contain all that ever can come from it."[440]

Besides, in an organism the multitude of cells with their specialized functions are bound together by a perplexing quality that maintains perfect coordination of its members and functions, i.e. every part is constantly permeated by a self-contained higher principle that controls the entire development. A similar analogy can be made with regard to a hive or formicary where in a concerted action presupposing a transcendent mind all ants and bees perform different interrelated tasks to constitute one super-organism.[441] From a biological standpoint, a principle of unity within multiplicity, a mysterious inner center baffling all analysis, monitors an organism's different cell activities. Besides this binding concept within an organism, the DNA and its decoding processes are interchangeable: the *codons* as the genes that encode the proteins, *amino acids* as the basic letters of the DNA, and the molecular unit *ATP* (Adenosine-5'-triphosphate) as the universal currency of intracellular energy transfer are nearly identical among all living beings. Consequently, bio-chemical analysis essentially verified Kahn's hylozoistic concept of the INA. Even more, since all life forms rest on continuous cell divisions that range from one generation to the next, they must have descended from one common ancestor cell into which the spark of life once emanated.[442] Kahn acknowledged, too, that man through his intuition was

438 Cf. Kahn's correspondence with Goddard concerning the green- and growth-houses, 030. II.A.23.11, LIKC.

439 Cf. Transcript of an interview with David Goddard in McHarg's TV-series "The House We Live In," 23 October 1960, 109.II.B.2.5, ILMC. Thompson had alluded to the internal form and structure of the cell as well, besides giving a historical account of cell theory. Cf. Thompson, *On Growth and Form*, p. 19.

440 Kahn, "Talk at the Conclusion of the Otterlo Congress," p. 207. During the process of growth, the zygote's gene information is duplicated through *mitosis* each time a cell divides. As a consequence, in every cell the entire coded information is present, and thus presumably each cell is capable of producing the whole individual under appropriate conditions. However, to sustain different cell functions, their specific *protein* (deriving from the versatile Greek sea-god *Proteus*) activities change. Hence, the initial zygote's DNA – which is most versatile as it contains the potentiality of all properties of all cells – is translated through a process of differentiation into a diverse range of less versatile cells performing more specialized tasks. Cf. Carl P. Swanson, *The Cell* (New Jersey: Prentice-Hall, 1960).

441 Cf. Maurice Maeterlink's triptych on the social insects: *The Life of the Bee* (1901), *The Life of the White Ant* (1926) and *The Life of the Ant* (1930).

442 Charles Darwin suggested that "probably all the organic beings which have ever lived on this earth have descended from some one primordial form, into which life was first breathed." Darwin, *The Origin of the Species* (New York: Gramercy Books, 1979; 1859) p. 455. Bergson, too, expounded most lucidly upon in contact with this “odyssey of our making through the billions […] Recorded in your intuitive are all the great steps and momentous decisions of the making.”[443]

this unitary life basis: “All organized beings, from the humblest to the highest, from the first origins of life to the time in which we are, and in all places as in all times, do but evidence a single impulsion […].” Bergson, *Creative Evolution*, pp. 270-1. Using the analogy of a gush of wind at a street corner dividing into diverging currents, each individual only retained, however, a certain degree, a particular “existence-will” in Kahn’s terms, of the universal stimulus.

443 Kahn, “1973: Brooklyn, New York,” p. 91.

3 Engaging Sun, Wind, Earth And Water. Adaptation In A Climate Of Change

Although with the separation of "Design" from "Form" Kahn recognized the influence of circumstantial factors in theoretical terms, his actual buildings only marginally related to external impulses. This rejection became an explicit problem in the Richards Laboratories, where scientists were obliged to cover up windows with aluminum foil in order to shield their sensitive experiments from the incoming glare. Thus, just as in the Yale Art Gallery, where the emerging problems had prompted Kahn to rethink the directives of the universal space, this time the criticism incited him to increasingly acknowledge the presence of the outer environmental forces.

More generally speaking, no living organism exists without some kind of interaction with the larger environment. The specific form of plants or animals is not solely determined by hereditary traits – the internal order passed on from one cell and one generation to the next – but just as much by the interaction of this given genetic constitution with the unique situation in which it is destined to perform. In a reciprocal interaction, external energies like light, gravity, temperature, water or wind decisively affect the material manifestation of an organism. Living beings inherit a kind of reactivity to the habitat they belong to and any organic configuration is a product of the dual relationship between its native constitution and a diverse range of contextual factors, through which, in a feedback process, the eventual form takes shape.

In *The Next Development in Man* (1944), a book Kahn was well aware of,[444] Whyte described this oscillating equilibrium between organisms and the environment they inhabit as "'adaptation' to, or 'mastery' of the environment by the organism."[445] For Whyte, as the result of this ever-changing symbiosis, form changed with changing conditions and natural organisms met the alternating external requirements with convertibility. As a logical result, even members of the same species, which had a similar internal code or "will to be," articulated themselves differently if they lived in different environments. To illustrate this tendency of convertibility, a diagram by the two Hungarian architects Victor and Aladar Olgyay might be used to show the environmental impact on the morphological development of leaves (Figure 121). In cooler zones, compact shapes like pine needles withstand cold, drought and other unfavorable conditions. In temperate zones, the leaves open up considerably to fetch more incoming light. In hot-arid regions a reduced surface area with bulky sections is common in order to protect the plants from extreme heat, while in hot-humid zones the leaves' size markedly increases and freer shapes develop.

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444 Kahn mentions this book, besides Whyte's *Aspects of Form*, as "a topic of particular value to architects" in a letter to G. Holmes Perkins, 23 September 1965, 030.II.A.57.107, LIKC.

445 Lancelot Law Whyte, *The Next Development in Man* (New York: Mentor Books, 1950; 1944) p. 22.

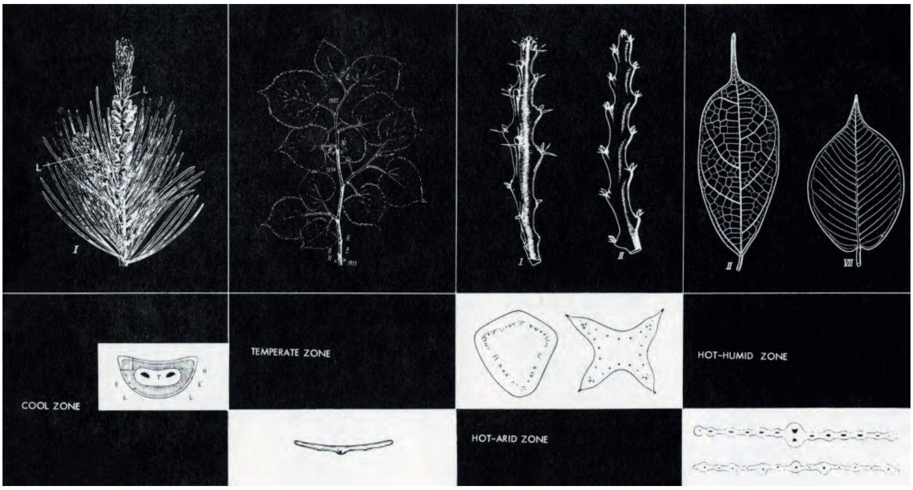

Fig. 121: Leaves in Relation to Different Climate Zones, in Victor Olgyay, *Design with Climate*, 1963.

Such a display of morphological modifications is discernible in both plants and animals, although animals have an extended range of possible interactions due to their locomotive capacities – however, no parrots are present in the Arctic and no polar bears in the deserts of Africa, unless of course the immediate local conditions – the *microclimate* influenced by the altitude, exposure to solar and night-sky radiation, prevailing winds, the presence or absence of water bodies, topography, soil structure and vegetation[446] – diverge substantially from the common *macroclimate* deduced mainly from the place's latitude (distance from equator determining the amount of solar energy received). Nonetheless, at least for short periods, due to acclimatization animals possess a certain flexibility of constitution, which for instance allows a mammal to endure more temperate climates during the summer months by shedding of its heavy winter fur. Inevitably, adaptation leads to morphological specialization, since each organic entity adhering to the causality of its place develops into an expert in its unique field of environmental interaction; for instance, a camel being especially well suited for the desert.

The first scientist asserting the significance of adaptation was the French naturalist Jean-Baptiste Lamarck in the late 18th century. Working as a zoology professor in the newly founded Muséum national d'histoire naturelle in Paris, Lamarck, together with his assistant Cuvier, had the possibility to compare and order a large quantity of

446 Notably, at ground level a multitude of microclimates exist side-by-side and different communities of the same plant might grow on the opposite sides of a hill. For animals, just like for the architect, plants are sensitive indicators of more favorable circumstances.

specimens and fossils that had been gathered during colonial expeditions.[447] On the one hand, their research brought to light that the entire organic development had to be older and more continuous than indicated in *Genesis*; on the other, in comparison to their predecessor, the Swedish biologist Carl Linnaeus with his *Systema Naturae* (1735), the Frenchmen no longer simply attempted to categorize the natural creation in a typological inventory of plant, animal and mineral forms, but tried to relate the morphological traits to a higher law explaining their variances. In the same vein, Alexander von Humboldt, a contemporary of Lamarck, on his voyages to West India together with the botanist Aimé Bonpland established a system of plant geography, which demonstrated that the effects of different climates determined vegetal growth.[448] Comparing plants at similar altitudes but diverse regions, the German naturalist concluded that there existed a direct relationship between the physical-climatic constraints and the plants' morphology.[449] Goethe, Humboldt's friend, also took notice of the influence of high altitude on plant growth during his Italian journey:

> In the low-lying regions, branches and stems were strong and fleshy and leaves broad, but up here in the mountains, branches and stems became more delicate, buds were spaced at wider intervals and the leaves were lanceolate in shape. I observed this in a willow and in a gentian, which convinced me that it was not a question of different species.[450]

All these investigations culminated in Charles Darwin's *Origin of the Species* (1859) and Alfred Russel Wallace's "On the Tendency of Varieties to Depart Indefinitely from the Original Type" (1858), which simultaneously laid the cornerstones of the *theory of evolution*. Darwin, who had circumnavigated the globe as a naturalist on board the "Beagle" between 1831 and 1836, recognized that the

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447 Likewise the rapid consolidation of the Islamic world from Andalusia and Morocco to the Middle East and India during the 7th and 8th century had been crucial for the development of a general theory of adaptability. Travelers such as Ibn Battuta in the 14th century had the opportunity to cross from the Atlantic to the Ganges and China, acquiring along the way knowledge of the changing flora and fauna.

448 Cf. Alexander von Humboldt, *Views of Nature: or Contemplations on the Sublime Phenomena of Creation* (London: Henry G. Bohn, 1850; *Ansichten der Natur*, 1808-26).

449 As a general rule, plants' vertical distribution on a mountain close to the equator, for instance the Chimborazo in the Andes, resembled their horizontal spread from the equator towards the poles. Comparably, Louis Figuier in *The Vegetable World* paid tribute to Joseph Pitton de Tournefort's account of the distribution of plants on the slopes of Mount Ararat: "At the foot of this mountain he saw the plants of Armenia; higher up he found the plants resembling those of Italy; higher up still he found representatives of those of the environs of Paris; above these were allies of the plants of Sweden; finally, on the borders of eternal snow, near the summit of the mountain, he found plants which recalled those of Lapland." Cf. Figuier, *The Vegetable World: Being a History of Plants, with their Structure and peculiar Properties* (New York: D. Appleton, 1872) p. 510.

450 Johann Wolfgang von Goethe, *Italian Journey* (London: Penguin Books, 1970; *Italienische Reise*, 1816-7), p. 33; from an entry written on the Brenner, 8 September 1786.

> seedlings from the same fruit, and the young of the same litter, sometimes differ considerably from each other [...] and this shows how important the direct effects of the conditions of life are in comparison with the law of reproduction [...].[451]

Having read Thomas Malthus' *An Essay on the Principle of Population* (1798), which stated that population increased faster than obtainable food sources,[452] both Darwin and Wallace concluded that if more individuals were produced than could possibly survive, they had to compete for their existence. Nature, just like the agriculturist in improving his stocks, acted as a selective force exterminating the weak by *natural selection* and ensuring "the survival of the fittest." Alongside this *gravitational* law of biology, every organic structure gradually mutated in order to better adapt to present circumstances and, thus, increase its chance of survival.[453]

In time, however, a number of scientists questioned Darwin's assumption that organic forms were in a constant flux of modification. For example, in his article "Observations on the Occurrence and Attributes of Pentagonal Symmetry" (1955), Charles M. Breder pointed out that five-dividedness in organic structures "is held to with great rigidity, even when extensive evolutionary change has taken place."[454] In the same vein, Thompson in his analysis of equiangular spirals noted:

> [W]e find the same forms, or forms which (save for external ornament) are mathematically identical, repeating themselves in all periods of the world's geological history; and we see them mixed up, one with another, irrespective of climate or local conditions, in the depths and on the shores of every sea. It is hard indeed (in my mind) to see in such a case as this where Natural Selection necessarily enters in, or to admit that it has any share whatsoever in the production of these varied conformations.[455]

Thompson acknowledged that natural selection might modify these spiral forms, but the basic concept of growth remained unaltered. Darwin was well aware of the immutability of certain organisms and termed such anomalous forms "living fossils," as they had "endured to the present day, from having inhabited a confined area, and from having thus been exposed to less severe competition."[456] Yet, Darwin's

451 Darwin, *Origin of the Species*, p. 73.

452 Malthus stated that population growth increases by geometrical progression (1:2:4:8 etc.), while its means of subsistence tended to grow by an arithmetical succession (1:2:3:4 etc.).

453 Transferring such principles of evolution to architecture, Kiesler with his theory of *correalism* also insisted that just as no biological organism could exist on its own, no tool, and by implication no architecture existed in isolation: "Every technological device is *co-real*: its existence is conditioned by the flux of man's struggle, hence by its relation to his *total environment*." Consequently, the morphology of man-made objects was linked directly to man's needs for survival, and their primary aim was to sustain life, i.e. health. Kiesler, "On Correalism and Biotechnique," p. 63.

454 Charles M. Breder, "Observations on the Occurrence and Attributes of Pentagonal Symmetry," in *Bulletin of the American Museum of Natural History*, vol.106, 1955, p. 216.

455 Thompson, *On Growth and Form*, p. 849.

456 Darwin, op.cit., p. 151.

argument solely considered organisms as a whole, while leaving out the more stable mathematical and compositional principles affecting their growth.

For Darwin, man adhered to the same laws of mutability, which called into question the anthropocentric doctrines of the preceding centuries regarding man as the Divine exception and center of the universe. But mankind still had its special virtues, since it could survive unassisted by technological aids in almost every kind of habitat.[457] Primeval man as a nomad had moved from one place to another; he was adaptive to and dependent on the rhythms of nature. Through the domestication of fire he could beat the cold and transform the material world around him. Once settled in permanent dwellings, he turned from a gatherer into a collector and predator storing nutrition, which released him from the full dependence upon the moods of nature. In a further step, the farmer emerged, who, by providing a controlled environment for the domestication of animals and plants, took permanent possession of the land. The agricultural order promoting stability and cooperation established the basis for the emergent higher civilizations during the Neolithic period, and in a dichotomous way, it both fostered mankind's technological dominance over nature and underlined its dependence on soil and weather.

Henceforth, *homo habilis*, the toolmaker, possessed the means to adapt the environment to his own wants, i.e. utilize the environmental forces to produce more favorable microclimates.[458] In the beginning, fire added warmth, enabled the easier digestion of food, kept predatory animals off with its flames, permitted the smith to craft more powerful tools, and, as Vitruvius suggested, acted as a civilizing force at the origin of man's ceremonial coming together.[459] At the same time, human

457 In general, warm-blooded animals, including man, can survive wider variations of external temperature fluctuation than cold-blooded ones.

458 Karl von Frisch's pivotal work *Animal Architecture* (1974) evidenced that not only man but also animals made their environments more fit. For instance, in Australia the Meridian termites' cathedral-like *concrete* slabs faced with their broad side precisely in east-west direction to receive the warm morning sun, but restrict the impact of the hot midday radiation. Cf. Peter M. Jacklyn, "'Magnetic' Termite Mound Surfaces are oriented to suit Wind and Shade Conditions," in *Oecologia*, vol.91, no.3, 1992, pp. 385-95. Lisa Heschong made the interesting observation that "[n]est building is, in a way, a more advanced version of choosing the best microclimate." Heschong, *Thermal Delight in Architecture* (Cambridge: The MIT Press, 1993; 1979) p. 7.

459 Cf. Vitruvius, *On Architecture*, II, Ch. I, § 2. Steen Eiler Rasmussen beautifully described this idea of meeting around a fire: "A campfire on a dark night forms a cave of light circumscribed by a wall of darkness. Those who are within the circle of light have the secure feeling of being together in the same room." Rasmussen, *Experiencing Architecture* (Cambridge: The MIT Press, 1964; 1959) pp. 208-9. As Luis Fernándes-Galiano critically examined, "the Greek Hephaestus – an later the Roman Vulcan – represented the *ignis elementatus*, the civilizing physical fire that counters the symbolical fire of knowledge in Prometheus; and starting with Homer, the God of Fire is acknowledged as Arch-artisan and Master of Humanity, who teaches the crafts to men who had lived 'in caves like wild beasts.'" Fernández-Galiano, *Fire and Memory: On Architecture and Energy* (Cambridge: The MIT Press, 2000) p. 9. Expanding on Vitruvius' notion, Gaston Bachelard asserted, "fire is more a *social reality* than a *natural reality*." Bachelard, *The Psychoanalysis of Fire* (Boston: Beacon Press, 1964) p. 10.

inventiveness led to defying the rigors of the external conditions by the provision of protective means like clothing and shelter. Thus, before the advent of the industrial era, man appropriated natural sources of energy and available local materials in order to shape his habitat. Thereby, passing knowledge from one generation to the next, the interaction with the climatic constraints continually improved. Conceived to include external factors, vernacular dwellings were adjusted to their biome just as a bird to the air or a fish to the sea. Mud-brick-towers in the Hadhramaut (Figure 122) virtually grew from the ground as Adam emerged from the dust (*Adamah* is Hebrew for "earth"). For the indigenous builder existential needs necessitated a co-operation with the pre-existing equilibrium of natural forces.[460] Likewise, Vitruvius recommended that architects should respect the geographically changing parameters,

> since, in the sun's course through the inclination of the zodiac the relation of the heavens to the earth is arranged by nature with varying effects, it appears that in like manner the arrangement of buildings should be guided by the kind of locality and the changes of climate.[461]

Arguing like a first architectural climatologist, he added:

> [The architect] must know the art of medicine in its relation to the regions of the earth (which the Greeks call *climata*); and to the characters of the atmosphere, of localities (wholesome or pestilential), of water supply. For apart from these considerations, no dwelling can be regarded as healthy.[462]

Transgressing cultural barriers, in the vernacular tradition similar solutions answered similar problems in similar environments.[463] For instance, in Egypt, the Middle East and Pakistan complex ventilation schemes (Figure 123) evolved that used wind-scoops on rooftops to capture the prevailing breezes that drawn into damp cellars cooled the buildings with chilled air. Many more examples of such forms revealing climate

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460 For instance, just like the angles of gabled roofs decreased as the amount of precipitation declined, also the ratio of window to wall area became less as one approached the warmer zones near the equator.

461 Vitruvius, *On Architecture*, VI, Ch. I, § 1.

462 Ibid., I, Ch. 1, § 10.

463 As possible responses, in hot-humid climates, vernacular builders traditionally employed elevated floors to detach their buildings from the moist earth, besides large floor-to-ceiling openings to offer a maximum exposure to prevailing breezes. Constructed of thatch, reed or grass – all loosely woven together to permit the slightest breeze to pass through – continuous porches underneath pitched roofs shielded the walls against heavy rainfall and offered shade against the slanting sun. In hot-arid zones, massive adobe buildings of cubic volume with small openings blocked the heat and glare during the day, while radiating the stored warmth to the interiors during the cold nights. The packing together of individual buildings into a communal group-form reduced the amount of exposed surface area, and their careful positioning on a west-east axis minimized summer surpluses and winter deficiencies.

Fig. 122: Shibam, Yemen.

Fig. 123: Hyderabad, Pakistan.

by pre-industrial people could be added, ranging from the igloo in the cold north to the harmoniously embedded farmhouse in the countryside; altogether, compelling strategies developed through centuries of struggle and amity with nature.[464] “Alertly responsive,” and working under the restrictions of “an economy of scarcity,” for James Marston Fitch, archaic building techniques reflected

> a precise and detailed knowledge of local climate conditions on the one hand, and on the other a remarkable understanding of the performance characteristics of the building materials locally available.[465]

3.1 Regionalist Premises and the Modern Vernacular

The interest in indigenous architecture, this aggregate of human constructive effort, grew rapidly in the 1950s. Erwin A. Gutkind’s taxonomical survey *Our World from the Air: An International Survey of Man and his Environment* (1952), the research of Sibyl Moholy-Nagy compiled in *Native Genius in Anonymous Architecture* (1957) and Bernard Rudofsky’s *Architecture without Architects* (1964) are of especial relevance in Kahn’s context. In addition, in 1969 Kahn wrote the foreword to Myron Goldfinger’s *Villages in the Sun* that mined the timeless lessons of traditional Mediterranean architecture, and a year earlier he had written the prologue to Clovis Heimsath’s *Pioneer Texas Buildings*:

> The simple structures of shelter seem like the markers of a dominating desire to establish a claim out of the vastness of the land […]. The stone and wood, not bought but found, are used true to the rights one dares to take in gratitude for the gifts of nature.[466]

Summarizing his impressions, Kahn concluded, “[t]his indigenous architecture is, I think, the great excitement of architecture.”[467]

Gutkind, a German architect who had been teaching urbanism at the University of Pennsylvania since 1958, observed in his meticulous study, which Kahn kept in his library:

464 Discussing igloos, James Marston Fitch noted: “From a purely theoretical point of view, it would be difficult to formulate a better scheme for protection against Arctic winters. Its performance is excellent: with no mechanical equipment […].” Fitch, *American Building: The Environmental Forces that Shape It* (Boston: Houghton Mifflin Company, 1972) p. 266.

465 Fitch added: “Limited to what for us would be a pitifully meager choice of materials, the primitive architect often employs them so skillfully as to make them seem ideal.” Fitch and Daniel P. Branch, “Primitive Architecture and Climate,” in *Scientific American*, vol.203, no.6, December 1960, pp. 134-44.

466 Louis I. Kahn, “Forward,” in Clovis Heimsath, *Pioneer Texas Building: A Geometry Lesson* (Austin: University of Texas Press, 1968) n.p.

467 Kahn, “A Statement,” p. 33.

> We are witnessing to-day the first beginnings of a new stage in the changing attitude of Man towards his environments; a stage characterized by growing responsibility towards natural resources and by a scientific appreciation of their use in the service of mankind.[468]

Moholy-Nagy, with whom Kahn corresponded several times throughout the early 1960s,[469] argued similarly in "Environment and Anonymous Architecture," published in *Perspecta* in 1955, and two years later in the book mentioned above. She, too, recognized that the 1950s were a period of change in man's perception of the environment, and the age-old vernacular methods should be reappraised: "The speculator lines up bulldozers and cement mixers and then poses the challenge: 'What can I do to the land?'," whereas the "settler asked: 'What can the land do for me?'"[470] Most important, though, in informing a wider public about the "unfamiliar world of non-pedigreed architecture" was Rudofsky's investigation, which accompanied an exhibition at the Museum of Modern Art in New York in 1964. Rudofsky, whom Kahn possibly encountered while teaching at MIT between February and June 1956, noted: "Instead of trying to 'conquer' nature, as we do, [the untutored builders] welcome the vagaries of climate and the challenge of topography."[471] Having travelled extensively, his central concern was that

> [m]an's chances for biological survival have always rested in his ability to adapt himself to the natural environment. The best he can make of life is to behave like a perfect guest on earth, not as a parasite.[472]

Besides Rudofsky and the aforementioned theorists, who mostly studied anonymous architecture from an aesthetic and ethical point of view, others like Fitch in *American Building: The Forces that Shape It* (1948; extended in 1966 with *The Historical Forces,* and in 1972 with *The Environmental Forces that Shape It*) Jeffrey E. Aronin in *Climate and Architecture* (1953; Figure 124), Maxwell Fry and Jane Drew in *Tropical Architecture in the Humid Zone* (1956; extended in *Tropical Architecture in the Dry and Humid Zones*, 1964) and Victor Olgyay in *Design with Climate: Bioclimatic Approach to Architectural Regionalism* (1963) targeted pre-industrial practice from a climatological perspective. They recognized in traditional and folk architecture a repository of native wisdom

468 Erwin A. Gutkind, "Man and Environment," in Gutkind, *Our World from the Air: An International Survey of Man and his Environment* (London: Chatto and Windus, 1952) n.p.

469 Cf. 030.II.A.55.36, LIKC.

470 Sibyl Moholy-Nagy, *Native Genius in Anonymous Architecture* (New York: Horizon Press, 1957) p. 51.

471 Bernard Rudofsky, *Architecture without Architects* (Albuquerque: University of New Mexico Press, 2002; 1964) preface.

472 Bernard Rudofsky, "The Human Side of Architecture;" lecture held at the *Annual Northwestern Regional Conference* of the American Institute of Architects in Seattle, 1966. Cf. Felicity Scott, "Bernard Rudofsky: Allegories of Nomadism and Dwelling," in Goldhagen and Legault, *Anxious Modernisms*, p. 228.

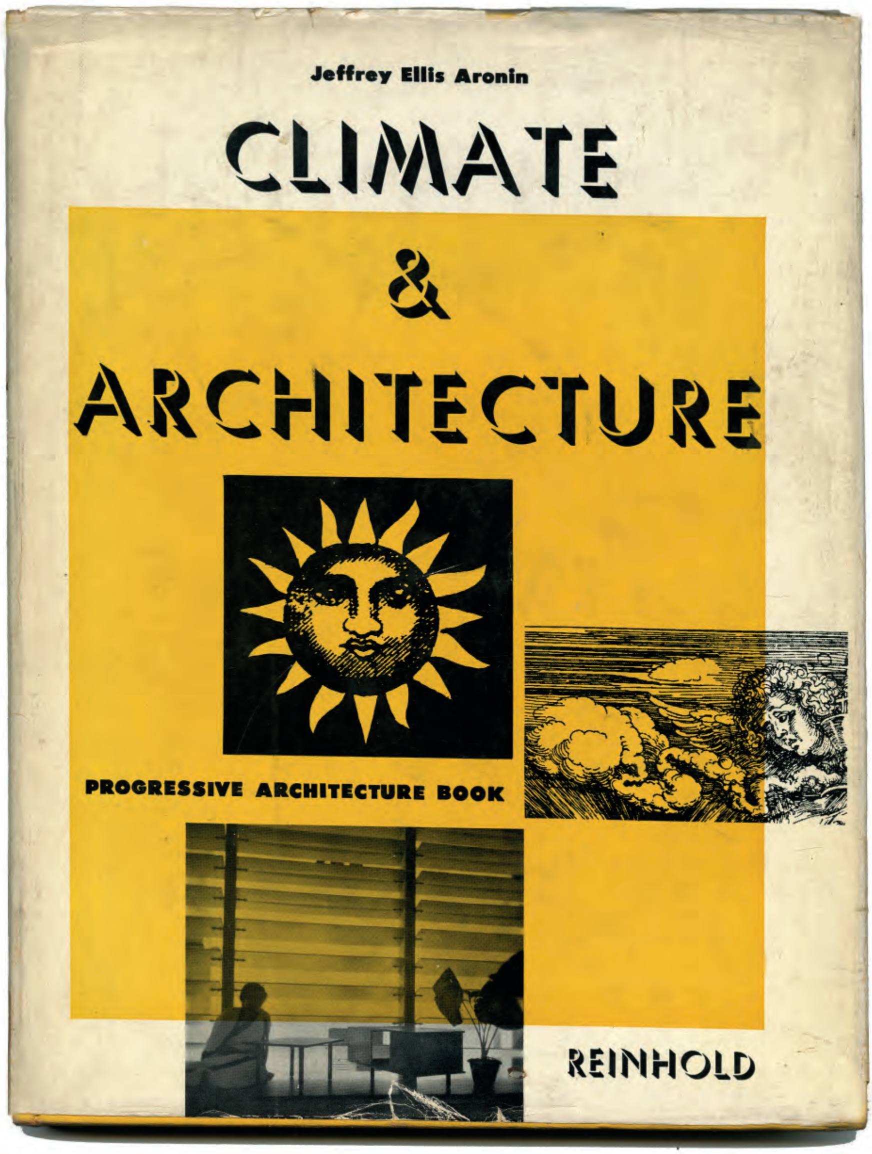


Fig. 124: Jeffrey Ellis Aronin, *Climate and Architecture*, 1953.

that could in contemporary times, due to its environmentally appropriate *passive strategies* – i.e. climatic effectiveness in the absence of active mechanical systems – help economize energy consumption, and by implication operation costs. For Fitch, primitive practice rested upon highly sophisticated methods, "not only within its own terms but even when analyzed in the light of modern scientific knowledge."[473] Answering to the pressing demand that the all-glass buildings posed with their high energy consumption, the vernacular edifice with its sensitivity to daily and seasonal temperature variations, adaptation of form to wind and rain, passive cooling through cross-ventilation, orientation in accordance with the path of the sun, direct relation to the topography and terrain, and employment of on-site materials indicated more integrative solutions.

Thus, Regionalism, as the emerging movement was soon coined, valued the uniqueness of a site and insisted that there were as many *dialects* of the International Style as there were different regions. Turning its back on the simplistic treatment of buildings as technologically self-sufficient entities, the Regionalist approach intended to do justice to the locally changing and subordinate technology to a more humanistic set of values defined by man's harmonious relationship with nature. In 1954, Giedion in "The New Regionalism" canonized these premises and concluded:

> Now that we no longer adhere to a creed of production for production's sake, the civilization that is now in the making draws closer to the mental outlook that is shared by primitive man and Eastern man.[474]

Reconciling Western Modernity with local customs, Giedion did not call for blind adoption, but an adaptation questioning the traditional forms through the lens of progress. In the same vein James Stirling in "Regionalism and Modern Architecture" (1957) emphasized that the new approach was about

> a re-assessment of indigenous and usually anonymous building and a revaluation of the experience embodied in the use of traditional methods and materials.[475]

473 Fitch, *American Building: The Environmental Forces that Shape It*, p. 265.
474 Sigfried Giedion, "The New Regionalism," in *Architectural Record*, vol.115, no.1, 1954, p. 135.
475 James Stirling, "Regionalism and Modern Architecture," in *Architects' Year Book*, no.8, 1957, p. 62. The English architect considered Le Corbusier and Aalto, the only major architects not resident in North America at the time, as the innovators of the movement. Kahn, who got acquainted with Stirling during the exhibition "Work of Three English Architects" at the University of Pennsylvania in 1959, seems to have been very intrigued by the article, since some of its illustrations showing traditionally constructed masonry buildings like a late-19th-century warehouse in Liverpool, the Oast House in Kent or the Martello Tower near Kent would resurface in a slightly differently photographed way in Kahn's personal slide collection. Cf. Sarah Williams Ksiazek (Goldhagen), "Architectural Culture in the Fifties: Louis Kahn and the National Assembly Complex in Dhaka," in *Journal of the Society of Architectural Historians*, vol.52, no.4, December 1993, pp. 416-435.

In the same year, Rudolph in "Regionalism in Architecture" critically examined Mies van der Rohe's Lake Shore Drive Apartment Towers in Chicago (1948-51): "Why did he treat all façades of his building identically regardless of orientation, even though the building is not air conditioned?"[476] As counter-examples Rudolph presented his own designs for the Healy Guest House in Siesta Key (1948-9) and the Walker Guest House in Sanibal Island (1952), which both acknowledged their southern contexts by being raised on a platform above the damp ground and used a dog trot to obtain a maximum amount of ventilation besides adjustable window-blinds to soften the glare. Altogether, instead of solely copying vernacular methods, the accomplishments of modern technology should be integrated as a *critical* ingredient to establish a more wholesome synthesis. It was precisely such a *Modern Vernacular*, which required global thinking and local actions that Mumford also called for. Between 1952 and 1962 professor of city planning at the University of Pennsylvania, Mumford recognized on the one hand

> that which adapts itself to special human capacities and circumstances, that belongs to a particular people and a particular soil and a particular set of economic and political institutions,

and on the other a transnational standard, which

> passes over boundaries and frontiers; it unites in a common bond people of the most diverse races and temperaments; it transcends the local, the limited, the partial.[477]

Based on the assumption that "[t]o maintain its life-shape the organism must constantly alter it and renew itself by entering into active relations with the rest of the environment,"[478] Mumford realized the immense impact of external forces on the morphology of organic constitutions, and questioned why architecture did not react in an analogous way:

> As our knowledge of the organism has grown, the importance of the environment as a cooperative factor in its development has become clearer; and its bearing upon the development of human societies has become plainer, too. If there are favorable habitats and favorable forms of association for animals and plants, as ecology demonstrates, why not for men?[479]

Throughout extended periods of his life, Mumford stood in close contact with Wright, and both had reached mutual consensus regarding the International Style's failure to incorporate local specifications.[480] As early as 1932, Wright had criticized that

476 Paul Rudolph, "Regionalism in Architecture," in *Perspecta*, no.4, 1957, p. 14.
477 Lewis Mumford, *The South in Architecture* (New York: Harcourt Brace, 1941), pp. 51-2.
478 Mumford, *Culture of Cities*, p. 301.
479 Ibid., p. 302.
480 Cf. Bruce Brooks Pfeiffer and Robert Wojtowicz, (eds.), *Frank Lloyd Wright and Lewis Mumford: Thirty Years of Correspondence* (New York: Princeton Architectural Press, 2001).

> regardless of native characteristics and fitness to climate or environment, we may see the formula in Miami, Minneapolis, Alaska, Arizona, the Philippines, and Texas.[481]

Attempting to embrace the surroundings, Wright's architecture should be *of* the landscape, and not on it. Also at the root of his approach stood a deepened interest in vernacular architecture:

> In the aggregate of these simple buildings lie traits, which make them characteristically Italian, French, Dutch, German, Spanish, or English as the case may be. The traits of these structures are national, of the soil; and, though, often slight, their virtue is intimately interrelated with environment and with the habits of life of the people.[482]

The consequence of Wright's reflections was a principal recognition of the varying contextual circumstances: In the prairie, in long parallel lines his houses extended the horizontality of the flat meadows' contours, while his buildings in the Arizonian desert took the *Sajuaro* cactus as a formal model. Comparable to primitive adobe dwellings, the houses Wright built in Los Angeles used concrete textile blocks to cope with the distinct Californian setting. Fallingwater of 1938 (Figure 125) projected spectacularly over a small creek's water cascade like the stone ledges near-by. In a true celebration of the place, this house in the Pennsylvanian backcountry magnified the contextual traits to such a degree that it could hardly exist anywhere else.

Through Zevi's publication of *Verso un'architettura organica* in 1945, and his founding of the Associazone per l'architettura organica the same year, Wright's organic doctrines spread to Italy (additionally, in 1951 the large Wright exhibition "60 Years of Living Architecture" was shown in the Palazzo Strozzi in Florence). These efforts decisively informed the advent of Neo-Realism in the Italian post-war debate,[483] which similarly sought to assimilate with the polyphony of vernacular and historical substrates.[484] To remain in Europe, Le Corbusier, too, during his voyage to the East in

481 Frank Lloyd Wright, "For all may Raise the Flowers Now – For all have got the Seed," in *T-Square*, vol.2, no.2, 1932, p. 8.

482 Wright, *Ausgeführte Bauten und Entwürfe*, p. 32. This organic tenet of coupling architecture with the natural and cultural context had already been pre-formulated by Downing applying the term "rural adaptation:" "Architectural beauty must be considered conjointly with the beauty of the landscape or situation [...] not only as architectural objects of greater or less merit, but as component parts of the general scene [...]." Downing, *A Treatise on the Theory and Practice of Landscape Gardening, adapted to North America* (Ann Arbor: University of Michigan Reprint Series, 2006; 1859) p. 320.

483 Zevi, since 1945 editor of *Metron* and since 1954 of *L'Architettura*, also intended to publish an article on Kahn, whom he considered "to be one of the most excellent architects living today." Letter Zevi to Richard Neville, associate editor of *Perspecta*, 27 August 1957; Cf. 030.II.A.62.44, LIKC. Kahn and Zevi would meet during several juries in Israel throughout the 1960s.

484 Carlo Aymomino, one of the architects of the settlements in the Tiburtino Quarter in Rome (1950-5), postulated: "We therefore recommend a careful consideration of habits, local traditions, climate, latitude and altitude, local construction materials, crafts, workmen, and building systems

Fig. 125: Bear Run (left) and Frank Lloyd Wright, Fallingwater, Stewart Township, Pennsylvania, 1934-9 (right).

1911 had recognized the "law of the land" and the "law of the sun," and summarized: "*I discovered architecture related to its natural site*. More than that, the architecture expressed its site."[485] These statements were substantiated during the 1930s when his architecture detached itself from the bare whiteness of its former stucco façades and became more raw and archaic like nature itself.[486] Le Corbusier realized his buildings should engage with the varying situations and express the "typical" essence of each:

> I have travelled a great deal and I have taken note of the diversity which is the very essence of things – different characteristics: climates, races, costume, history, topography, degrees of culture. Spontaneity is the very essence of human nature. Life is multiform.[487]

[...] bearing in mind the spiritual and material needs of man, of a real man and not an abstract being, a man, that is, who does not love and does not understand the endless and monotonous repetition of the same type of dwelling, in which he cannot distinguish his own house except by its number." Maristella Casciato, "Neorealism in Italian Architecture," in Goldhagen and Legault, *Anxious Modernisms*, p. 34.

485 Le Corbusier, *Talks with Students*, pp. 40-1.

486 During his first visit to South America in 1929, Le Corbusier came to admire the hut of the savage, recognizing that these "organisms" were "created with the authenticity that nature itself places in its works [...]." Le Corbusier, *Precisions*, p. 161.

487 Le Corbusier, *"L'avion acusse ..." Aircraft: The New Vision* (London: The Studio, 1935) p. 95.

As a built axiom the Maison de week-end in La Celle-Saint Cloud (1935) displayed this more realistic approach, expressing in a proto-Brutalist fashion its rustic materials and paying tribute with its Catalan vaulted structure to traditional buildings techniques. Brick vaults and material blatantness again characterized the Maisons Jaoul in Neuilly-sur-Seine (1952), as well as the Sarabhai House in Ahmedabad, India (1955). The latter especially was a perfect example of Le Corbusier's adaptive aims: partly without thermal barriers, the surrounding garden literally became a part of the interior landscape, while the sod roof – covered with grass, plants and a network of water channels to insulate and cool the spaces beneath – made the building practically disappear amidst the ardent vegetation.[488] Le Corbusier summarized in *New World of Space* (1948):

> Realizing how much our world was convulsed by the birth pains of the machine age, it seemed to me that to achieve harmony ought to be the only goal. Nature, man, cosmos: these are the given elements, these are the forces facing each other.[489]

3.2 Light leading the Path

Kahn's involvement with vernacular structures is not merely discernible in the books he owned on the subject, but also in many of his travel sketches. For instance, in his drawing of Positano on the Amalfi coast from 1929 (Figure 126), the village's houses merged with the surrounding hillside so that the landscape almost appeared to empower the *natural* irregularity of the architecture. As analyzed by Michael J. Lewis, "the real subject" of these drawings was "the way that light, nature, and architecture interact to create a poignant sense of place."[490] Besides his apparent interest in

488 With a similar objective, Antonin Raymond, a Wright disciple, in his Dormitory for the Disciples of Sri Aurobindo Ghose in Pondichéery, India (1935-42), sought to collect rainwater on vaulted roofs and cool them by evaporation. The "Golconde," but also Raymond's earlier Karuizawa Summer House in Japan's countryside with its heavy grass roof (1933) or the Readers' Digest Offices in Tokyo (1951) with its delicate balustrades to block the sun, were fine examples of an architecture addressing the pragmatic in order to mitigate the changing climatic conditions.

489 Le Corbusier, *New World of Space* (New York: Reynal & Hitchcock, 1948) p. 11. Two years later in Bogotá, Le Corbusier "had the feeling that a page was turning [...] an important page in human history, the history of the life of men before the machine and which the machine has shattered, ground up, pulverized." Zaknic, *The Final Testament of Père Corbu*, p. 87.

490 Lewis, "Louis Kahn's Art and his Architectural Thought," pp. 72-3. Kahn would continue this examination of age-old building patterns during his later visits to Mediterranean countries like Israel, Greece and Egypt, as well as on his subsequent journeys to Africa, the Middle East and India. Having just mentioned Egypt, Kahn during his visit in 1951 might have also inspected or at least passed by the construction site of Hassan Fathy's exemplary housing project in New Gourna. The Egyptian architect with the help of *moallem* (master mason) Boghdadi Ahmed Ali regarded a self-aid approach using indigenous mud-brick techniques as the sole option for his country. Noticing the beauty of the domes,

Fig. 126: Louis I. Kahn, *Positano*, Italy, 1929.

vaults and *claustra*-work, all provided from the mud the Nile carried along, Fathy "realized that I was looking at the living survivor of traditional Egyptian architecture, at a way of building that was a natural growth in the landscape, as much a part of it as the dom-palm tree of the district. It was like a vision of architecture before the Fall: before money, industry, greed, and snobbery had severed architecture from its true roots in nature." Fathy, *Architecture for the Poor*, p. 7. Holding on to his belief in the viability of traditional practice, Fathy's later works accommodated the highly opportune thermodynamic behavior of Egypt's historical Islamic architecture. These investigations coalesced in Hassan Fathy, *Natural Energy and Vernacular Architecture: Principles and Examples with Reference to Hot-Arid Climates* (Chicago: University Press, 1986).

vernacular architecture, during his first stay in Europe, Kahn also made countless studies of trees, for example in the Borghese Gardens in Rome or Gabled Manor in England (Figure 127). Later, during his summer holidays in the 1930s and '40s – usually spent at the coast in upstate New York, New England or Canada – Kahn made numerous drawings of ordinary country scenes.[491] These depictions of the everyday landscape revealed a more sensitive side in Kahn's perception of nature and of reality *per se*. Needless to say, Tadd's educational focus had at an early age instilled in him a desire to approximate nature in more realistic terms. Highlighting this empathetic tendency was Kahn's appreciation of natural light as a constituent factor both in his renderings and from early on as a substantial element of his architecture. Just as the sun was the prime mover of the entire terrestrial system, it would also be the engine to propel Kahn's attempts in conceiving a more adaptive architecture; quite logically, since in the *cut off* realm of architecture an isolated segment of light could suggest the entire world. Towards the end of his life, Kahn asserted that it was light, which "makes a room have its nature, its characteristic, its mood."[492]

Recognizing light as the progenitor of all presence in architecture, Kahn drew an important distinction, however: "Artificial light is the light of night expressed in positioned chandeliers not to be compared with the unpredictable play of natural light."[493] Kahn's emphasis that natural light could express different temperaments was a clear critique of the static, all-bright light condition devoid of spatial sentiment that Modernism had produced. Thus, the most miraculous of the sun's powers was its capacity to change, and Kahn intended through this quality to inject vividness into his buildings:

> The structure is a design in light. The vault, the dome, the arch, the column are structures related to the character of light. Natural light gives mood to space by the nuances of light in the time of the day and the seasons of the year as it enters and modifies the space.[494]

The architectural project that initially indicated Kahn's awareness of the significance of natural light was the design of the unexecuted Pennsylvania Solar House, conceived together with Stonorov between 1945 and 1947 (Figure 128). Sponsored by the Libbey-Owens-Ford glass company to investigate the feasibility of thermopane glass, the architects designed a prototypical building of trapezoidal shape, which would optimize the sun's impact by admitting a minimum amount of direct sunrays in summer and a maximum during the winter. Verifying mathematically the advantage of the house's conical shape in comparison to an oblong, circular, triangular and square one, the project was accompanied by several light control elements. A cantilevering roof in addition to horizontally projecting sun-breakers above the ground floor was

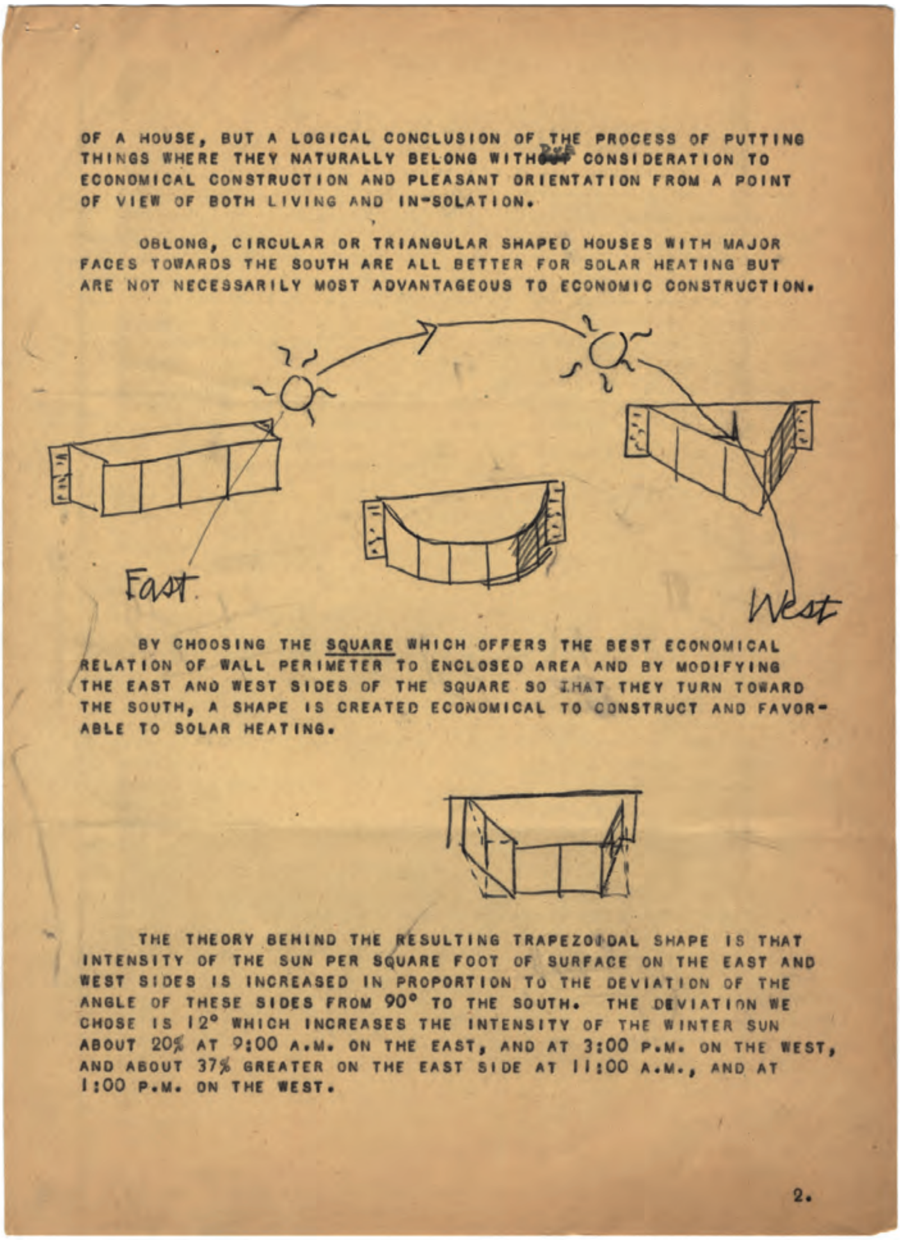
491 Cf. Jan Hochstim, *The Paintings and Sketches of Louis I. Kahn* (New York: Rizzoli, 1991).
492 Cook and Klotz, *Conversations with Architects*, p. 212.
493 Wurman and Feldman, *Notebooks and Drawings*, n.p.
494 Ibid.

Fig. 127: Louis I. Kahn, *Gabled Manor*, England, 1928.

planned to protect the façades from the vertical rays of the high midday and summer sun, while allowing lower inclined morning, evening and winter radiation to enter. A foldable sunscreen on the west and laterally sliding wood panels on the east and south side would make additional adjustments possible. The architects' description of the project was also informative, as they emphasized their house would continue Pennsylvania's vernacular tradition,

> full of original architectural forms – functional in their way. [...] The 'Modern structure' can be as much a part of the Pennsylvania landscape as the old houses.[495]

495 Louis I. Kahn and Oscar Stonorov, "A Solar for Pennsylvania," manuscript dated 19 September 1946, 030.II.A.54.56, LIKC.



OF A HOUSE, BUT A LOGICAL CONCLUSION OF THE PROCESS OF PUTTING THINGS WHERE THEY NATURALLY BELONG WITHOUT CONSIDERATION TO ECONOMICAL CONSTRUCTION AND PLEASANT ORIENTATION FROM A POINT OF VIEW OF BOTH LIVING AND IN-SOLATION.

OBLONG, CIRCULAR OR TRIANGULAR SHAPED HOUSES WITH MAJOR FACES TOWARDS THE SOUTH ARE ALL BETTER FOR SOLAR HEATING BUT ARE NOT NECESSARILY MOST ADVANTAGEOUS TO ECONOMIC CONSTRUCTION.

East

West

BY CHOOSING THE <u>SQUARE</u> WHICH OFFERS THE BEST ECONOMICAL RELATION OF WALL PERIMETER TO ENCLOSED AREA AND BY MODIFYING THE EAST AND WEST SIDES OF THE SQUARE SO THAT THEY TURN TOWARD THE SOUTH, A SHAPE IS CREATED ECONOMICAL TO CONSTRUCT AND FAVORABLE TO SOLAR HEATING.

THE THEORY BEHIND THE RESULTING TRAPEZOIDAL SHAPE IS THAT INTENSITY OF THE SUN PER SQUARE FOOT OF SURFACE ON THE EAST AND WEST SIDES IS INCREASED IN PROPORTION TO THE DEVIATION OF THE ANGLE OF THESE SIDES FROM 90° TO THE SOUTH. THE DEVIATION WE CHOSE IS 12° WHICH INCREASES THE INTENSITY OF THE WINTER SUN ABOUT 20% AT 9:00 A.M. ON THE EAST, AND AT 3:00 P.M. ON THE WEST, AND ABOUT 37% GREATER ON THE EAST SIDE AT 11:00 A.M., AND AT 1:00 P.M. ON THE WEST.

2.

Fig. 128: Louis I. Kahn and Oscar Stonorov, Solar House, 1945-7.

Altogether, Kahn and Stonorov's project attempted to reveal the local light conditions, and in this objective it was not unlike a plant, whose growth and physiognomy are immediate consequences of the sun's radiance.[496]

Three of the elements used in the Solar House would become standard tools in Kahn's early repertoire to cope with the sun: first the horizontal shades, second the application of projecting roofs, and third the employment of flexible shutter panels. The two projects to first combine these elements were the Morton Weiss House in East Norristown, Pennsylvania (1947-59) and the Philadelphia Psychiatric Hospital (1948-54). In the Weiss House, especially noteworthy are the wooden louvers Kahn applied on the southeastern side, which allowed adjustments to the fluctuating weather, besides enabling different views of the landscape and sky. The same system, involving a complicated double-hung construction with a pull and cable control system, was employed on the west façade of the occupational therapy center – the Pincus Building – of the Psychiatric Hospital. The Radbill Building, a later addition to the hospital, used horizontal *eyebrows* as sun shades on the southern and south-western façades, which increasing in size from top to bottom supported hollow wooden cubes as light filters that enabled intricate light and shade patterns on the façades.

Notably, Kahn's sun blockers were also featured in the compilation *Solar Control and Shading Devices* (1957; Figure 129). Its authors, the Hungarian twin brothers Victor and Aladar Olgyay had established a unique environmental laboratory in Princeton during the 1950s, working for instance with a sun-machine – the "Thermoheliodon"[497] –

496 Sensitive light detectors in the leaf stalks respond to the incoming light and direct the leaves' upper surface to absorb the sun's energy. F. G. Gregory in "Form in Plants," published in Whyte's *Aspects of Form*, made it clear that when growing in complete darkness, the physical constitution of plants dramatically changes: while monocotyledonous plants are still apt to expand their leaves, dicotyledonous ones completely arrest their expansion. Besides, Figuier referenced *Mimosa pudica* that closes its leaflets once darkness sets in. Cf. Figuier, *The Vegetable World*, pp. 106-7; and Harold Wager, "Behaviour of Plants in Response to the Light," in *Nature*, vol.96, no.2408, 1915, pp. 468-72. Many plants besides the commonly known sunflowers or marigolds are *phototropic*, and according to Victor Olgay the leaves of *Convolvulus sepium* may turn as much as 270° to follow the sun's path in the sky. Cf. Olgyay, *Design with Climate: Bioclimatic Approach to Architectural Regionalism* (Princeton: Princeton University Press, 1963) p. 53.

497 The earliest report indicating the use of a heliodon was published in *Journal of the Royal Institute of British Architects* in 1931 ("Orientation of Buildings: Sun Planning by Means of Models – The Dufton-Beckett Heliodon," vol.XXXVIII, no.14, 16 May 1931, pp. 509-10). A. F. Dufton and H. E. Beckett of the Building Research Station of the United Kingdom had constructed a simple *heliodon*: a model on a tilted surface (angle of latitude) was rotated on a vertical axis to indicate the daytime, while the sun in form of a lamp was mounted adjustably on a nearby vertical bar to indicate the declination, i.e. the time of the year. In America, Henry Wright designed at Columbia University a heliodon based on the English prototype in 1936. A total of 18 sun-machines were in use or under construction in schools in the United States, Canada and England in 1953. In addition to the *Thermoheliodon,* the Olgyays also developed a "shade-dial:" This useful tool could be placed on a model, while it cast on its semicircular reference frame a shadow indicating the month and the hour of the day.

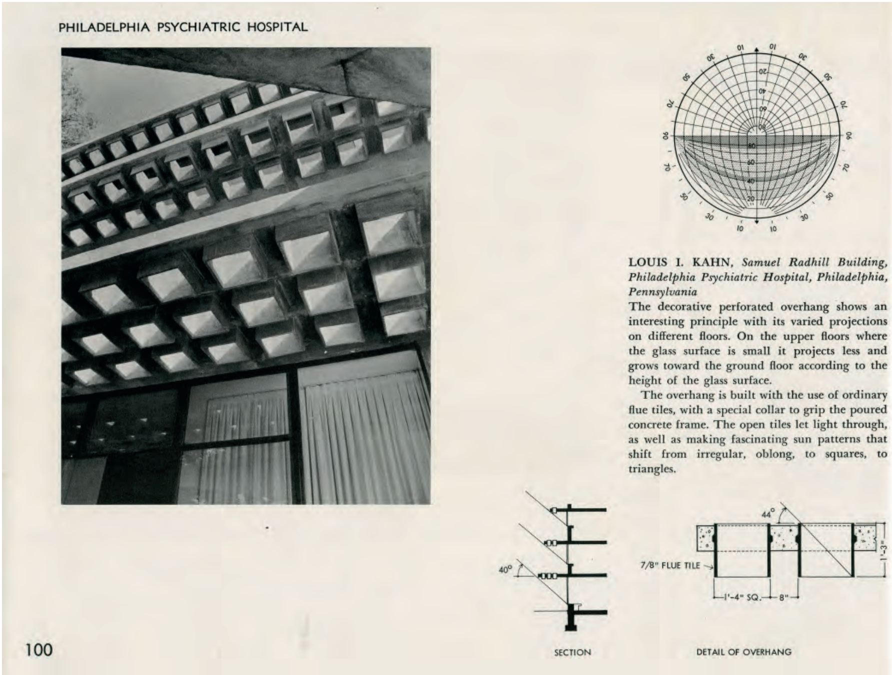


Fig. 129: Louis I. Kahn, Samuel Radbill Building, Psychiatric Hospital, Philadelphia, Pennsylvania, 1950-3, in Victor and Aladar Olgyay, *Solar Control & Shading Devices*, 1957.

that should more accurately predict the influence of sunlight on architectural designs. Propagating increased energy-consciousness, the brothers proposed that upon an initial survey of the climatic elements – temperature, relative humidity, radiation and wind effects – a biological "diagnosis" of the region should be conducted. Resulting in "timetables of climatic needs," these should be overlaid on sun-path projections that were provided by the Libbey-Owens-Ford glass company as part of an easy usable *Sun Angle Calculator* (Figure 130) – evidently the same company for which Kahn had developed the Solar House – to determine the type and position of shading devices.[498] Altogether, as Henry Wright had shown earlier, proper sun-control could reduce heat gain in summer as much as nine times, while improving the situation in winter by four times.[499]

498 *Sun Angle Calculator* (Washington D.C.: Aeronautical Services Inc., 1951): Each latitude has a particular sun-path diagram that indicates the sun's altitude and bearing angle (azimuth) at any time of the year. Cf. Jeffrey Ellis Aronin, *Climate and Architecture* (New York: Reinhold Publishing, 1953) p. 36.
499 Cf. James Marston Fitch, *American Building: The Forces that Shape It* (Boston: Houghton Mifflin Company, 1948) p. 301. The general appeal, which also Kahn and Stonorov incorporated in their Solar

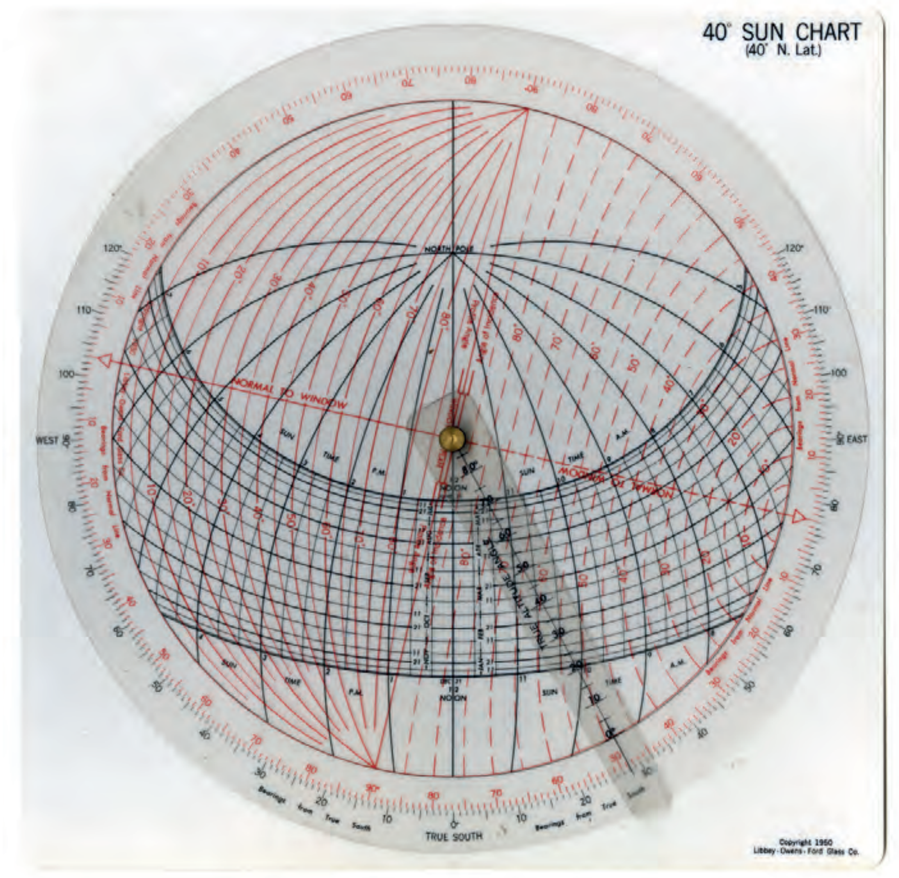


Fig. 130: Libbey-Owens-Ford, *Sun Angle Calculator*, 1951.

Kahn, not until the end of the 1950s, and clearly as a response to the problems occurring in the Richards Medical Research Building, invented various new solutions for handling the intrusion of natural light. More than just a coincidence, this increasing awareness of light as a determining architectural factor became noticeable at a time when Kahn was first offered the opportunity to build in different parts of the United States, and shortly thereafter, all over the globe. Instead of neglecting the changing contexts, his future work attempted to articulate the varying situations and to magnify

House, was to place houses with their broadside to south or southwest. This, because on the southern façade the high-standing sun could be intercepted using relatively small overhangs, while in winter, when most desirable, the sun's rays penetrated the interior.

the natural preconditions. The first project in this line of contextual adaptation was the Tribune Review Building in Greensburg, Pennsylvania (1958-62). In a tour-de-force of expressive construction and hierarchical organization a serving middle zone divided the composition into two oblong halves that were bridged by prefabricated and pre-stressed concrete beams resting on masonry piers. The filled in walls – detached from the masonry supports and made up of rough concrete blocks – were not load bearing and housed T-shaped *keyhole* windows that changed in shape according to their orientation. Differentiating the functions of a window, the vertical slits enabled outward views, while the horizontal ones on top washed the ceilings in light.

This experimentation with keyhole openings, which moderated the glare without blocking the view, was continued in the design of the Fleisher House in Elkins Park (1958) and the Goldenberg House.[500] However, it was especially in the subsequent design for the Margaret Esherick House, the niece of Wharton, in Chestnut Hill, Pennsylvania (1959-61; Figure 131) that Kahn further clarified the versatile roles a window could perform. This time, the multifunctional apertures did not merely facilitate visual prospects (view) and illumination (light), but additional ventilation (air) shutters were included, too. Thus, next to the fixed glass parts, slightly recessed wooden panels could be opened to let breezes enter the house.[501] A keyhole aperture in the living room illuminated the ceiling allowing shimmering light reflections to enter the double-height space. Overall, Kahn conceived the façade no longer as a thin, passive, dividing membrane, but rather as an active element of depth, which like the human skin heightened the junction between the inside and outside.[502] He realized that external walls were mediums of connection rather than separation and through the openings one ought to establish fine-tunable relations between the indoors and the outdoors both visually and thermodynamically.

Kahn continued to elaborate these potentials in the Unitarian Church in Rochester, New York (1959-64; with a later addition of an office part, 1964-7). As an answer to the starkness of the light, he placed the windows in deep masonry reveals (Figure 132): "There, again, light, light, light [...]. All these undulations are, in a way, to modify

500 In the Fleisher House, which again was outlined by a square and made use of four centrally placed hollow columns, the upper part of the keyhole openings formed a half circle akin to a *lunette*, while the lower square windows could be opened.

501 Comparable to Kahn's flexible and multifunctional window-system, traditional Dutch houses also employed four-framed apertures with a shutter to each frame in order to regulate the intrusion of natural light. As Rasmussen observed, "shutting the lower halves only," it produced "a more even light over the entire room" but prohibited visual contact with the outside, while "by darkening the upper halves and leaving the lower unshuttered, the light was concentrated near the windows." Rasmussen, *Experiencing Architecture*, p. 205.

502 In addition, the walls' depth cultivated an effect of lively shades and shadows. In the interior, the resulting hollowed-out areas were usable as storage areas accommodating bookcases, radiators and the like.

Fig. 131: Louis I. Kahn, Margaret Esherick House, Chestnut Hill, Pennsylvania, 1959-61.

Fig. 132: Louis I. Kahn, Unitarian Church, Rochester, New York, 1959-67.

Fig. 133: Louis I. Kahn, Unitarian Church, Rochester, New York, 1959-67.

light [...]."[503] With respect to the façades-of-depth, it had been one of the Beaux-Arts exercises to make use of shades and shadows to enhance in gradients the relief of an elevation, or as Kahn remembered and exemplified in his drawings (Figure 133): "They gave us an unquestionable feeling of the inseparability of light and building, and the fact that we could construct light."[504] Remaining under the spell of such implications, during his stay at the American Academy, Kahn had displayed his apparent enthusiasm for relief features in numerous sketches (Figure 134). Joseph Amisano, another fellow, remembered that

> the effects of light preoccupied Louis and fascinated him; the deliberateness of the detailed forms; some carved like deep wounds with shadows deepening into reaches.[505]

Asked what he had done during his stay, Kahn answered pointedly: "I watched the light."[506] Especially memorable must have been his visit of Zoser's Mortuary Complex in Saqqara (planned by Imhotep, c. 2650-2600 BC; Figure 135), where delicately recessed layers of stone gave rhythm and depth to the enclosing wall.

503 Kahn, "Berkeley Lecture, 1966," p. 32.
504 Kahn, "Kahn on Beaux-Arts Training," p. 332.
505 Goldhagen, *Situated Modernism*, p. 72.
506 Robert McCarter, *Louis I. Kahn* (London: Phaidon, 2005) p. 57.

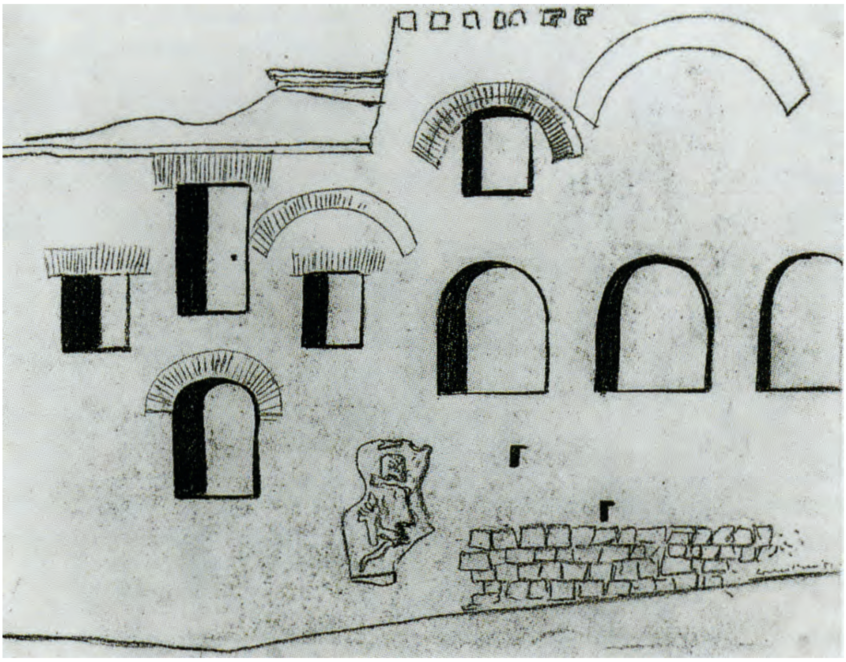


Fig. 134: Louis I. Kahn, *Roman Ruins*, Italy, 1950-1.

To further the impact of natural light, in the Unitarian Church's congregational hall – covered by a folded, concrete plate roof – four clerestory light hoods placed in the corners of the sanctuary admitted indirect light into the otherwise windowless space. As a container lending itself to the activation of light, the corner lanterns were reminiscent of Le Corbusier's chapels in the church of Notre Dame du Haut in Ronchamp (1950-4). The reference to this building is telling, since in an intermediate scheme Kahn had proposed four cross-shaped, zenithally lit concrete umbrellas resting on central columns – once again an application of a dendriform structure – which on their fringes were removed from the rest of the edifice by a continuous slit of light (Figure 136). In Ronchamp, Le Corbusier had utilized a similar device to make the ceiling appear as if magically suspended in the air.[507] (Figure 137) The Swiss-French architect proclaimed that "[t]he sun, which governs all growth, should penetrate the interior of every dwelling, there to diffuse its rays, without which life withers and

507 In Kahn's case, too, when the eye of the beholder was close to the boundary walls of the congregational space, the full-length slash of light would become apparent and make the canopy seem to levitate. It had been common practice in Renaissance and Baroque churches that vaults and domes were *raised* by the light entering through windows along the perimeter of their drums. This highly symbolic gesture isolated the domes as the image of heaven from the worldly domain.

Fig. 135: Imhotep, Zoser's Mortuary Complex, Saqqara, Egypt, c. 2650-2600 BC.

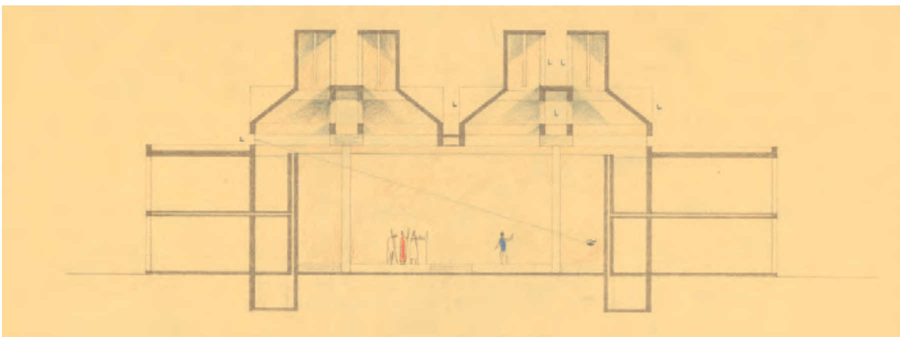


Fig. 136: Louis I. Kahn, Unitarian Church, Rochester, New York, 1959-67.

Fig. 137: Le Corbusier, Notre Dame du Haut, Ronchamp, France, 1950-4.

fades."[508] In *Le poème de l'angle droit* (1955) he signed in aphoristic terms "a pact of solidarity with nature" and regarded the sun in prophetic terms as the "master of our lives," "an overlord" who enters our house.[509] Just as Le Corbusier intended to "*compose with light*,"[510] Kahn also had arrived at the conclusion that "a plan of a building should read like a harmony of spaces in light."[511]

3.3 Entering the Realm of the In-Between

It was no coincidence that Kahn referred to Le Corbusier's Notre Dame du Haut. In January 1959, he had received an invitation from Alison Smithson, in which she asked if he would join and be a "like mind" in a group "called the new 'CIAM'." The same year in May, she concretized her inquiry, "pleading" for him to "come to the Congress in Otterlo in Holland, between September 7 to 15 this year." Kahn replied by cablegram on June 4: "Agree heartily with new group."[512] Consequently, he went to Europe at the end of 1959, and before and after going to Otterlo visited a number of places in France, among others the Cathedral in Albi, the medieval walled city of Carcassonne, besides a few works of Le Corbusier including Ronchamp. However, before discussing the events in Otterlo in more detail, the crucial role of the English architect Blanche Lemco in bringing Kahn to the 11th C.I.A.M. congress should be briefly emphasized.

Lemco, like Alison Smithson a pioneering woman in the field of architecture, had worked in Le Corbusier's studio in 1948, and a year earlier attended her first C.I.A.M. meeting in Bridgewater. Afterwards, she obtained a degree in city planning from Harvard (1950), where she studied under Holmes Perkins who would invite her to join the University of Pennsylvania in 1951. Teaching as an instructor in city planning until 1957, she first entered into contact with Kahn in 1953. While in Philadelphia, Lemco continued to participate in the European dominated postwar C.I.A.M. debate, and together with her fellow faculty-members Robert Geddes, George Qualls and Romaldo Giurgola contributed projects to the congresses in Aix-en-Provence (1953) and Dubrovnik (1956).[513] During the meeting in Aix-en-Provence, Lemco met her later husband H. P. Daniel (Sandy) van Ginkel, who had traveled with Van Eyck through

508 Le Corbusier, *The Athens Charta* (New York: Grossman, 1973; 1942) p. 55.
509 Le Corbusier, *Le poème de l'angle droit* (Milano: Electa, 2007; 1955) A.1 and A.3 Milieu.
510 Le Corbusier, *Precisions*, p. 132.
511 Kahn, "Voice of America."
512 Alison Smithson's letters to Kahn, 6 January and 8 May 1959; Kahn's cablegram, 4 June 1959, 030. II.A.58.56, LIKC.
513 Geddes, Qualls and Giurgola together with Kahn and Venturi would be termed "The Philadelphia School" by Jan Rowan in 1961. Cf. Rowan, "Wanting to Be: The Philadelphia School," in *Progressive Architecture*, vol.42, no.4, 1961, pp. 150-4.

Northern Africa in 1952 and collaborated with him on several occasions, for example, the design of the Nagele School (1954-6). According to Lemco, "it was Sandy and I who introduced Lou to the Team X crowd, suggesting that he be invited to the Otterlo meeting in 1959."[514]

The C.I.A.M. congress held at the Kröller-Müller Museum in Otterlo, organized by an *ad hoc* group consisting of the Dutch architect Jacob Bakema, the Independent Group member John Voelcker, and the Italian Ernesto Nathan Rogers,[515] as well as Le Corbusier's former employees Georges Candilis, Alfred Roth and André Wogenscky, was the last of its sort, and afterwards a younger generation of architects commonly termed *Team X* took over. Forty-three participants from twenty countries, among them the three Americans Shadrach Woods, Wendell H. Lovett and Kahn, declared in basic terms the existing reality with all its complexities as the paradigm of the architectural project. "In this sense," as could be read on an invitation to an Otterlo II meeting in 1961, which Kahn received as well, "Team X is Utopian, but Utopian about the present."[516]

While the assembled members agreed unanimously on this central concern, the keenest controversies arose between a group led by the Smithsons, which rejected all historical precedents, and a group of Italians, foremost Rogers and Giancarlo de Carlo, who sought to continue the historical growth of the urban fabric. In Roger's opinion the Smithsons' strategy was just another sort of *tabula rasa* approach that ignored "the biology and the morphology of the city [...]."[517] Besides, the Japanese architect Kenzo Tange, traumatized by the atomic bombing of Hiroshima where he had designed the Peace Museum and Memorial Cenotaph (1949-55), foregrounded in his lecture the expense of basic human rights following the fanatical efforts of the technological revolution. In his opinion, a "re-establishment of the leadership of human beings over technology" was inevitable.[518] Nevertheless, Kahn was most intrigued by Van Eyck's presentation:

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514 Interview by the author with Blanche Lemco van Ginkel, June 2008.

515 On the occasion of Kahn's first presentation of his general design theory at Princeton in 1953, amongst the other lecturers figured the Italian Enrico Peressutti, one of the school's visiting professors during the 1950s. Kahn's friendly relationship with him was presumably a convenient link for staying informed about recent discussions in European architecture. Peressutti worked as a partner in the Milanese architectural office BBPR with Lodovico Barbiano di Belgiojoso, Gian Luigi Banfi, and Ernesto Nathan Rogers – the last being a pivotal figure in the post-war C.I.A.M. discussions as the editor of the magazines *Domus* (1946-7) and *Casabella-Continuità* (1953-65). Rogers and Kahn remained in close contact throughout the 1960s, since the latter on his journeys to India and Bangladesh usually flew by way of Rome. Cf. Correspondence between Kahn and Rogers, 030.II.A.55.8, LIKC.

516 Report of the Team X meeting in London, 2-5 July 1961, written by the Smithsons, Candilis, Woods, Alexis Josic, Ralph Erskine, Bakema and Van Eyck; 030.II.A.64.41, LIKC.

517 Newman, *CIAM '59*, p. 77. In terms of indigenously grown structures, the Dutch architect Herman Haan presented his insights attained during a journey to Africa, while the Swedish architect Ralph Erskine contributed his schemes of a "Sub-Arctic Habitat."

518 Ibid., p. 170.

> I heard him speak one time when Le Corbusier disbanded the CIAM, and a new team called Team X grew and had their first meeting. Aldo van Eyck made a speech about the meaning of a threshold just before you enter a room. It was magnificent, because through this he could build a whole architecture.[519]

In the following years, Kahn and Van Eyck would have ample opportunities to meet and exchange ideas. In the spring of 1960, right after their encounter in Otterlo, Kahn invited the Dutch architect to teach as a visiting critic in Philadelphia. Subsequently, until 1965 he worked among McHarg's research staff at the University of Pennsylvania, where he finished with a grant obtained from the Rockefeller Foundation the manuscript *The Child, the City and the Artist: An Essay on Architecture, the In-Between Realm* (published posthumously, 2008) that collected in book form his observations of the preceding years.[520] As indicated, in Otterlo Van Eyck had discussed a "doorstep" – illustrated here with an example from the architect's visit to Djenne, Mali, in the spring of 1960 (Figure 138) – that he regarded as an "in-between" zone, a moment of transition from the inside to the outside where the conflicting polarities or "dual-" and later "twin-phenomena" of the private and collective were reconciled. Rejecting the analytical determinism of the International Style, Van Eyck argued that reality was more poly-dimensional than

> just geometry and the pretty shadows sunlight casts – not just abstract space theory and demonstrative construction – nor just concrete, steel, glass, bricks and whatever the catalogue suggests … but rain, storm, snow, spring, stars, winter, sun, clouds, ice, moon, child and the aged: these and the greater rest are the 'materials of architecture' – come to terms with them, architects, take hold of them.[521]

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519 Kahn interviewed by Wemischner, *What will be has always been*, p. 113.

520 Cf. McCarter, *Aldo van Eyck*, p. 116. In first introducing Van Eyck to the University of Pennsylvania, again Lemco van Ginkel and her husband played a significant role. Van Ginkel, who had visited Philadelphia in December 1956, met on the 21st with McHarg. As a result of their encounter, Van Ginkel proposed on the 3rd of January 1957 to make a joint-study with Van Eyck, "who could contribute a chapter on his own playgrounds in Amsterdam and an article called 'The Child, the City and the Artist,' which he wrote for UNESCO some time ago, but which was never published." Cf. 109.II.A.1.92, ILMC. As this proposal diluted, two years later when the Van Ginkel's met Van Eyck again, the latter expressed dissatisfaction with his professional life and Lemco then suggested Holmes Perkins "that he might be an interesting visitor at Penn." Interview by the author with Blanche Lemco van Ginkel, June 2008.

521 Aldo van Eyck, *The Child, the City and the Artist*, manuscript p. 11.8, 109.II.E.6.1, ILMC. Cf Aldo van Eyck, "Image of Ourselves," in *Via*, no.1, 1968, p. 127. Shifting his focus away from the rationally pure that resulted only in the menace of monotony, Van Eyck's thoughts crystallized in the "door and window" issue of *Forum* from 1960: "Whatever space and time mean, place and occasion mean more. For space in the image of man is place and time in the image of man is occasion." Van Eyck, "There is a Garden in her Face," p. 121.

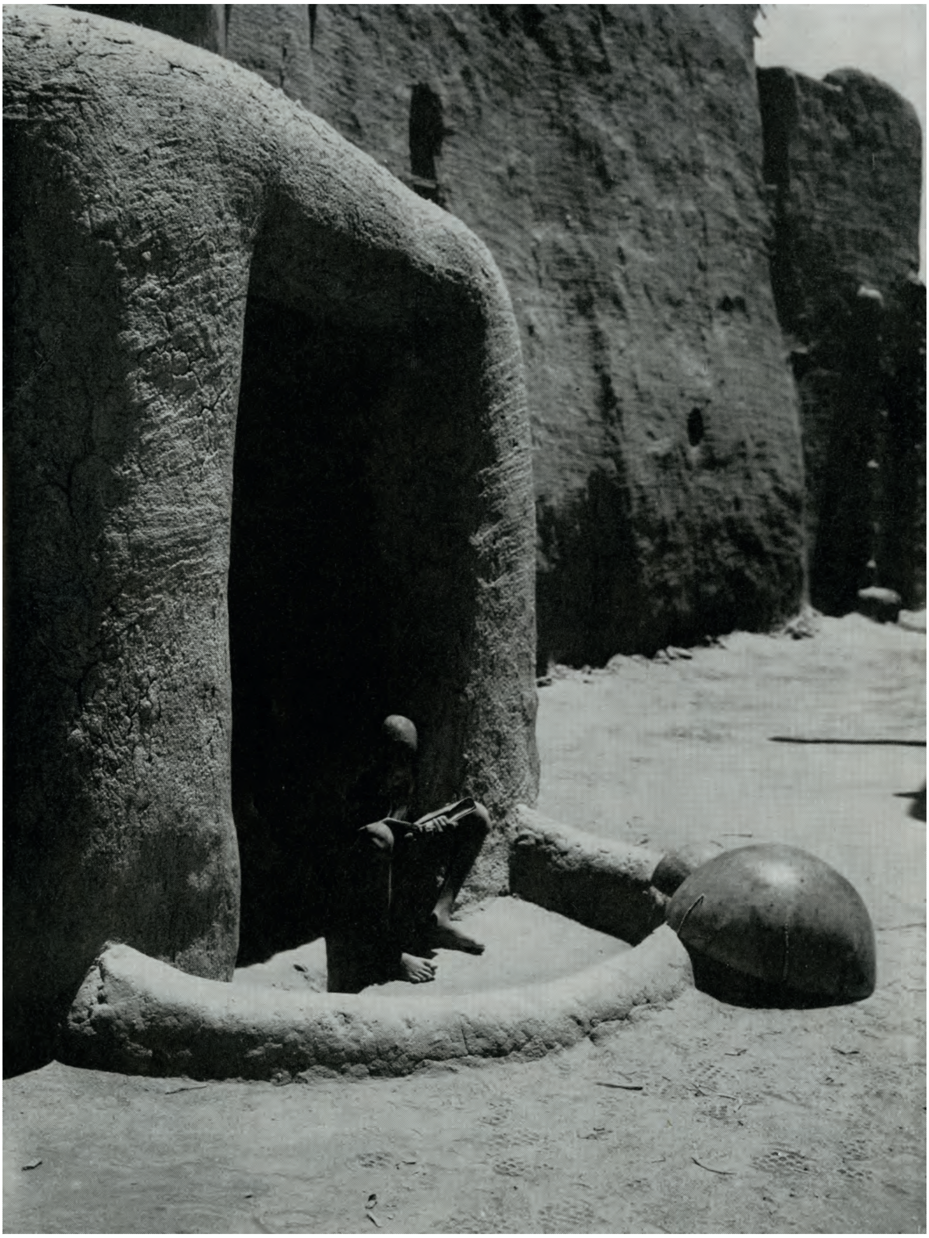

Fig. 138: Djenne, Mali, in Aldo van Eyck, “Deur en Raam,” 1960-1.

It was precisely this concept of the "in-between" that Kahn felt attracted to, and which found immediate expression in his mediating walls-of-depth. To underline the dual-phenomena's reciprocal relationship and dependence upon one another, Van Eyck used the impossibility of one-directional breathing to illustrate his point: "Man still breathes in and out. When is architecture going to do the same?"[522] In environmental terms, instead of annihilating all the alleged climatic disadvantages by technological means, the Dutch architect attempted to embrace the existing natural forces to overcome the limitations of the "air-conditioned nightmare." On his journeys studying primitive culture, or as he called it in less disparaging terms, "the Vernacular of the Heart,"[523] he had recognized:

> In former ages (though also in those parts of the world today where the impact of our 20th century technology is still negligible and psycho-physical affinity to a cosmic order still immediate), the natural cycles, the elements and environmental phenomena challenged man's spiritual and physical adaptability – there was no question of desiring supremacy, it was a struggle for physical survival.[524]

Regarding it as a "far cry indeed from the way the Dogon tend the natural morphology of their environment," contemporary society behaved in his opinion "with insanity instead of grace, like a half-wit with two left hands."[525] Van Eyck's orphanage in Amsterdam, which Kahn visited during his stay as well, was in a dual sense a tiny city and a large house, whereby a meandering interior street with several plazas created the in-between zone. The configuration followed a cellular logic yet accentuated the different spatial functions, since it intended to

> break away from the contemporary concept (call it sickness) of spatial continuity and the tendency to erase every articulation between spaces, i.e. between outside and inside, between one space and another.[526]

At the climax of Van Eyck's tendency "to interiorize the exterior" figured his Sonsbeek Sculpture Pavilion in Arnhem (1966; Figure 139), where he created a sequence of labyrinthine interstitial spaces resulting from the layered assemblage of six parallel, partly fragmented walls with different circular recesses.

522 Ibid.

523 Van Eyck visited the Dogon half a year after the meeting in Otterlo, whereas during his time teaching in the United States, he took a profound interest in the settlements of the Pueblos in New Mexico. Cf. Aldo van Eyck, "The Pueblos," in *Forum*, vol.16, no.3, 1962, pp. 95-113.

524 Van Eyck, *The Child, the City, and the Artist*, p. 11.3.

525 Van Eyck, "Miracle of Moderation," p. 125.

526 Van Eyck, "The Medicine of Reciprocity," p. 238.

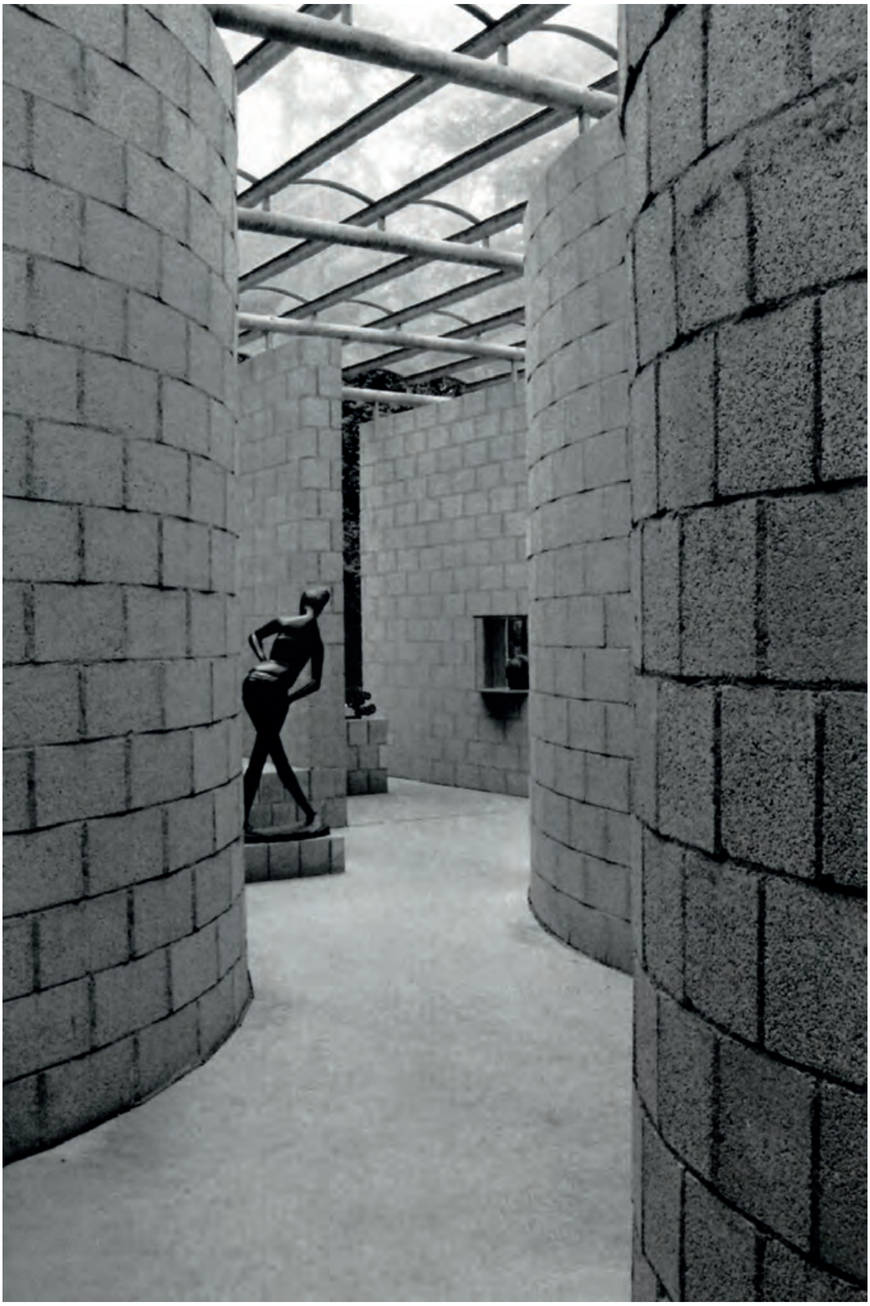

Fig. 139: Aldo van Eyck, Sonsbeek Sculpture Pavilion, Arnhem, The Netherlands, 1966.

Generally speaking, the Team X members continued many thoughts that had already appeared earlier on the intellectual horizon. Lemco's statement is of exceptional significance in this regard:

> Notwithstanding the polemic, I do not think that Team X was a revolutionary movement, but rather evolutionary. My husband has told me about the meeting of the Team X founders with Le Corbusier in his apartment. According to Sandy, Le Corbusier blessed the enterprise – which does not surprise me since in my own experience he encouraged the young not to emulate the old.[527]

To confirm, the initial voices triggering a fundamental change in outlook were already perceivable at the first post-war C.I.A.M. meeting in Bridgewater (1947). The congress in Hoddesdon (1951) with the telling title "The Heart of the City: Towards the Humanisation of Urban Life" clearly questioned the omnipotence of rationalism in its capacity to insert a "civic core." Anticipating much of the later Team X-rhetoric, Giedion wrote in summary of the meeting:

> At the present time, despite all appearances and amid all destructive tendencies, a humanizing process is evident; an uprising of the human spirit against the oppression of those close brothers – mechanization and bureaucracy.

In his opinion, "a longing for '*Ganzheit*' – wholeness – a desire for the integration of the different facets of human experience" would characterize the new era.[528] Openly criticizing the "C.I.A.M. Grid" at the 9th meeting in Aix-en-Provence, the younger generation opposed its simplistic categorization (Dwelling-Working-Recreation-Circulation) through which passed "most of what goes to make life,"[529] and presented with the Smithsons' "Urban Re-Identification" scheme an alternative that utilized the more encompassing "clusters" of house, street, district and city to describe the human "habitat." Consequently, architecture was to become a built counter-form, an "active socio-plastics," of the hybrid forces shaping reality:

> We must evolve an architecture from the fabric of life itself, an equivalent of the complexity of our way of thought, of our passion for the natural world and our belief in the nobility of man.[530]

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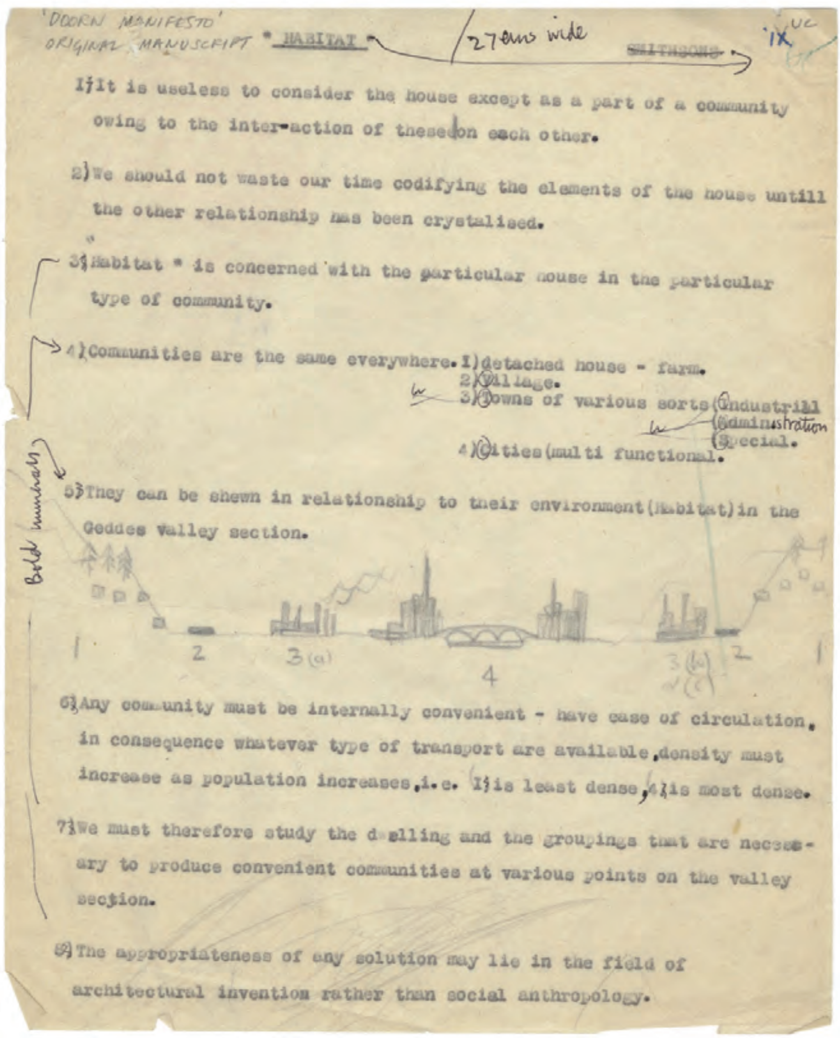
527 Interview by the author with Blanche Lemco van Ginkel, June 2008. Present at the meeting in Le Corbusier's apartment on 14 September 1954 were Le Corbusier, Giedion, Bakema, Candilis, Van Eyck, Van Ginkel, the Smithsons, and William with Jill Howell.
528 Sigfried Giedion, "The Heart of the City: A Summing-Up," in Jacqueline Tyrwhitt, José Luis Sert and Ernesto N. Rogers, (eds.), *The Heart of the City: Towards the Humanisation of Urban Life* (New York: Pellegrini and Cudahy, 1952) p. 159.
529 Van Eyck's letter to the Smithsons on the guideline for the 10th C.I.A.M. meeting; n.d., in Ligtelijn and Strauven, *Collected Articles and Other Writings*, p. 187. In 1959, Van Eyck presented the development of this *different* Modern architecture in "The Story of Another Idea," published in the first number of *Forum* with him being part of the editorial team (no.7, special issue).
530 Smithson, *Team 10 Primer*, p. 86.



'DOORN MANIFESTO'
ORIGINAL MANUSCRIPT * HABITAT 27 ems wide ~~SMITHSONS~~ 'IX' UC

1) It is useless to consider the house except as a part of a community owing to the inter-action of these on each other.

2) We should not waste our time codifying the elements of the house untill the other relationship has been crystalised.

3) Habitat * is concerned with the particular house in the particular type of community.

4) Communities are the same everywhere. 1) detached house - farm.
2) Village.
3) Towns of various sorts (Industrial / Administration / Special.
4) Cities (multi functional.

5) They can be shown in relationship to their environment (Habitat) in the Geddes Valley section.

Bold numerals

1 2 3(a) 4 3(b) 3(c) 2 1

6) Any community must be internally convenient - have ease of circulation, in consequence whatever type of transport are available, density must increase as population increases, i.e. 1) is least dense, 4) is most dense.

7) We must therefore study the dwelling and the groupings that are necessary to produce convenient communities at various points on the valley section.

8) The appropriateness of any solution may lie in the field of architectural invention rather than social anthropology.

Fig. 140: Jacob Bakema, Aldo van Eyck, H. P. Daniel van Ginkel, Peter Smithson, John Voelcker, and Hans Hovens Greve, "Doorn Manifesto," 1954.

Regarded as the foundational document of Team X, the "Doorn Manifesto" or "Statement on Habitat" (Figure 140) – drawn up by Bakema, Van Eyck, Van Ginkel, Peter Smithson, Voelcker and the Dutch social economist Hans Hovens Greve in Doorn between January 29th and 31st, 1954 – elaborated the "Urban Re-Identification" scheme into the "Scale of Association" diagram. A sectional drawing through the four clusters evoked different forms of habitation in relation to changing ecological fields. Making explicit reference to Patrick Geddes' "Valley Section" from 1909

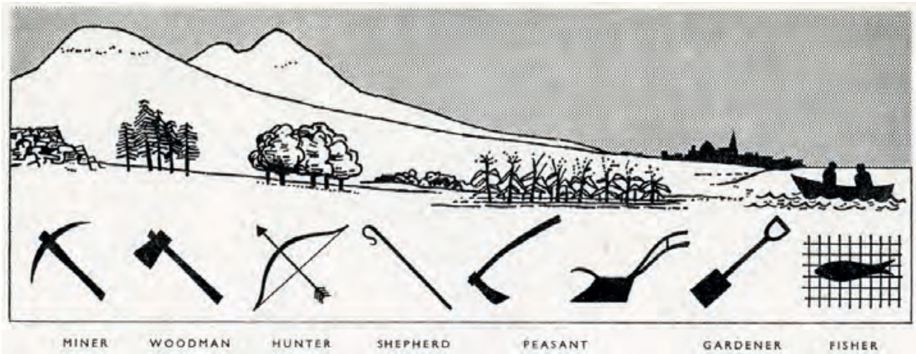


Fig. 141: Patrick Geddes, "Valley Section," 1909.

(Figure 141), which had indicated that human tools were directly related to varying contexts, i.e. the pick to the mine or the axe to the woods, the "Scale of Association" diagram similarly suggested that architectural form had to adapt to the particular context it functioned in.[531]

Shortly after the C.I.A.M. meeting in Otterlo, between the 11th and 16th of May, 1960, the *World Design Conference* took place in Tokyo under the telling title "The Total Image: What Designers can contribute to the Human Environment of the Coming Age." Once again, Kahn participated and noticed a general dissatisfaction with the technological homogenization of the previous decades. The basic tenor of the meeting was to define a new outlook that respected the universal traits of a global culture albeit without spoiling local characteristics. Presenting their ideas of future domestication, a young generation of Japanese architects including Fumihiko Maki, Kiyonori Kikutake, Arata Isozaki and Noriaki Kurokawa – gathered under the name Metabolism – demanded a general reorientation from the "Age of the Machine" to the "Age of Life." In accordance with the biological implications of the term *metabolism*, i.e. the set of chemical reactions occurring in living organisms to maintain life by exchanging matter and energy with their surroundings, either through *catabolism* (the breaking down of organic matter) or *anabolism* (the construction of cells), the group insisted that life was only possible because all organisms, in contrast to machines, were open systems and thus related to and dependent on their environment. What's more, a living system was never in a static equilibrium, but instead in a constant state of mutation.

531 Jacqueline Tyrwhitt, a trained horticulturist before studying architecture, was particularly influential in propagating Geddes' ideas in C.I.A.M. circles. She published *Patrick Geddes in India* in 1947, along with a new edition of his *Cities in Evolution* in 1949. Kahn had the opportunity to see the practical results of Geddes' ideas during his visit to Tel Aviv in the late 1940s.

Tange, the mentor of a number of the Metabolists at the University of Tokyo in the late 1950s, disclosed certain features of their approach in his lecture "Technology and Man." As perfectly exemplified in his Yamanashi Broadcasting Center in Kofu (1961-6), a building, just like a city, should in his opinion possess two basics structures: first, a functional substructure that secured long-term stability, and second, a more flexible "cell-structure" that continually renewed the system's "biometabolism." Just as recent studies in cytology had indicated that the human body constantly replaced its cells, a factor of transmutability should also be injected into architecture, since "[o]ur family life, our daily life rapidly changes its forms every five or ten years."[532] For Kahn, hearing Tange's lecture and seeing the other Metabolists' proposals, such as Isozaki's Clusters in the Air (1960-2), Kikutake's Oceanic City (1958), or Kurokawa's Helix City (1961), was arguably both a revelation and honor, since they incorporated a number of tenets drawn from his earlier work.[533]

During his stay, Kahn came into closer contact with Kikutake and visited his Sky House in Tokyo (1956-8; Figure 142),[534] which was a paradigmatic example of the Metabolists' approach: within a concrete frame cantilevering from four central posts, the short-cyclic elements of bath and kitchen termed "move-nettes" were set apart. In 1961, Kurokawa sent Kahn a draft of "'Metabolism:' Proposed Method for Creation" to review,[535] which overtly paid tribute to the latter's "master space and servant space." Furthermore, the Japanese architect clarified in a historical synopsis:

> The main idea of the Classical Greek Ages was 'existence;' that of the Middle Ages was 'God;' and 'nature' was the dominating thought in the Renaissance; 'natural law' in 17th century; 'individual' in 18th century, and in the present age the concept of 'life' […].[536]

Besides becoming familiar with Metabolist thought, Kahn visited a number of historic sites in Japan, as he had already indicated before his departure that he regarded the journey as "an opportunity to see another part of the world, especially to see the Gardens

532 Kenzo Tange, "Technology and Man," in World Design Conference Organization, (ed.), *World Design Conference 1960 in Tokyo* (Tokyo: Bijutsu Shuppan-sha, 1961) p. 183.

533 First, the Metabolists made extensive use of the tree-metaphor, whereby from vertical trunks the clustered cells branched away. Second, the helix form that Kahn had utilized in the City Tower found re-application. Third, the Metabolists' theoretical outlines uniformly followed Kahn's served and servant concept. What differed was their insistence on cellular "capsules," which allowed – at any rate in theoretical terms – for greater freedom in the adaptation to changing needs.

534 Kikutake's letter to Kahn, 12 August 1960: "I express my heartful thanks for you to call at my house and to tell us the philosophy of architecture until midnight when the World Design Conference was held in Japan." Response from Kahn, 25 August 1960: "When I returned from Japan I kept talking about meeting in your house which was a highlight of my stay. It was a wonderful experience for me being in a beautiful conceived house and in the company of people eager to learn as I am." Cf. 030.II.A.64.32, LIKC.

535 Kurokawa's letter to Kahn, 30 August 1961, 030.II.A.66.9, LIKC. Besides, both Kikutake and Kurokawa visited Philadelphia on 16 and 17 December 1961. Cf. 030.II.A.66.14, LIKC.

536 Kisho Kurokawa, "'Metabolism': Proposed Method for Creation," 030.II.A.66.9, LIKC.

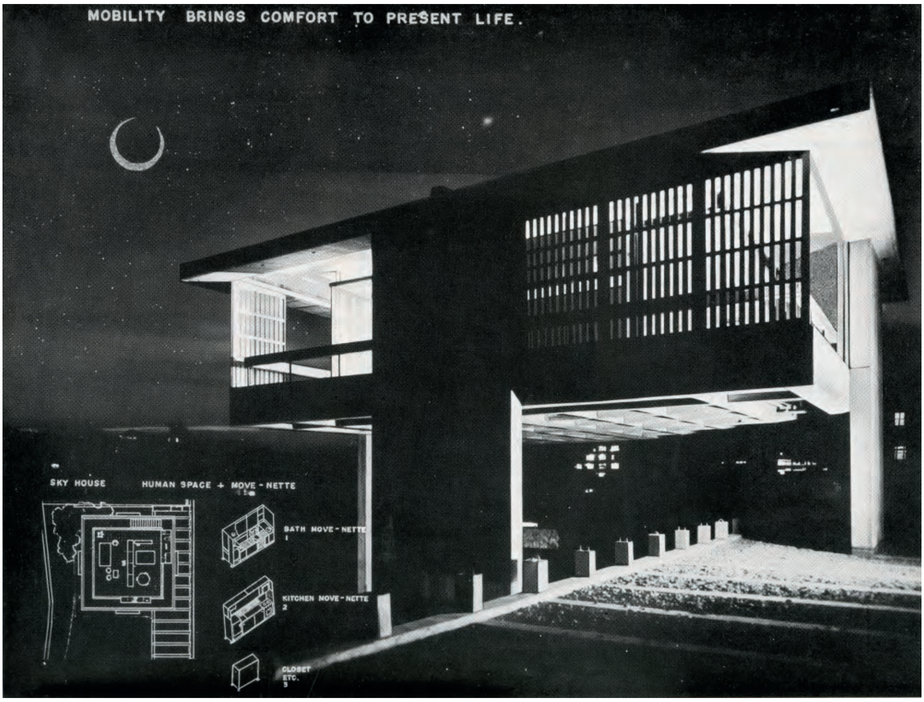


Fig. 142: Kiyonori Kikutake, Sky House, Tokyo, Japan, 1956-8.

of Japan."[537] Based on the principle of *shakkei* or "borrowed landscape" that sought to incorporate features of the real landscape in abstracted form, the main function of Zen Buddhist dry-rock gardens like Ryōan-ji in Kyoto (c. 1500) was to invoke a state of *sartori*, i.e. an atmosphere to contemplate the here and now in its continuous unfolding. In these *gardens of the mind*, man was not regarded as set apart from nature, but rather as submerged within the cycles of *Tao*. Thus, both Zen and Metabolism rested upon concepts of transformation and impermanence, or as Kakuzo Okakura in *The Book of Tea* (1906) had written, "[i]t was the completing, not the completion, which was really vital."[538]

Furthermore, as expressed most explicitly in the principle of *Ying* and *Yang*, a non-dualistic relativism was also at the very basis of the Zen mindset. This concept of reconciling polarities was arguably of particular interest to Kahn, who at the

537 Kahn's letter to Thomas W. Mackesey, dean of the College of Architecture at Cornell University, 14 April 1960, 030.II.A.9.22, LIKC. The symposium's participants visited historical sites in the Kansai region including Kyoto and Nara between 17 and 19 May 1960.
538 Kakuzo Okakura, *The Book of Tea* (New York: Dover Publications, 1964; 1916) p. 15. Kahn noted that he "was very taken" by Okakura's book. Tyng, *The Rome Letters*, pp. 88-9; letter 8 January 1954.

time so heartily attempted to heighten the correspondence between the inside and outside. Besides, it permeated traditional Japanese architecture, too, for instance the Katsura Imperial Villa in Kyoto (c. 1615 onwards), where the porch or *engawa* as a sort of neutral Van Eyckian intermediary space conflated the interior with the exterior. Again, Kahn owned a book on the subject, *The Lesson of Japanese Architecture* by Jiro Harada (1936; 1954), which in a concise manner outlined the major principles of traditional Japanese architecture. While paying particular tribute to the edifices' relation to their bounteous gardens with splendid illustrations, in the preface C. Geoffrey Holme pointed out that

> we have much to learn from the tradition of Japan where nature comes first: and the architect does not set out to dominate or destroy the surroundings of the house, but to render homage to them.[539]

In general terms, while in the West a building's outer walls were regarded as a dividing barrier between the inside and outside, so that the landscape was viewed like a detached painting through the frame of a window, the East *ipso facto* did not recognize the wall as such and emphasized continuity in order to exteriorize the interior. According to Harada, there were several devices used by the traditional Japanese builder to make this happen: first, the outer walls partly made up of sliding panels or *shoji* could be pushed to one side or removed altogether in order to open views (Figure 143). Second, subtly placed stepping-stones and detached fences reached out from the houses to the gardens. Third, projecting eaves protected the houses against heat and rain, while, fourth, the opaque paper screens captured in silhouettes the shadows of the surrounding trees, and therefore, as Harada remarked: "Nature herself appears to enter into the room."[540] Lastly, the use of *tokonoma* posts – natural timber columns placed at the center of the houses – in their crudeness contrasted with the otherwise sober, *almost* perfect orthogonal order.

3.4 Urban Sprawl versus the Rise of Ecological Awareness

This Eastern model to achieve harmony between man and nature was especially illuminating for all those who since the early 1950s had been increasingly alarmed by the negative repercussions of man's technological development. The dramatic population explosion, the exploitation of geological resources, the depletion of the soil, the destruction of forests, the extinction of plant and animal species, the pollution of the atmosphere and waters, the advancing deserts, the increase of natural disasters like earthquakes, hurricanes or floods, and the nuclear threat made

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539 Jiro Harada, *The Lesson of Japanese Architecture* (London: The Studio Limited, 1954; 1936) p. 10.
540 Ibid., p. 138.

Fig. 143: *Shoji* Panels, in Jiro Harada, *The Lesson of Japanese Architecture*, 1936.

a growing number of people aware that humankind had to find new strategies in its dealings with nature. While the production of energy became more efficient, its dispersion was equally wasteful. Ecological issues, however, only garnered public attention once the correspondence between health problems and pollution became more apparent during the mid 1960s.[541]

While many Americans in a time characterized by a general can-do attitude asked why they should bother about such disturbing issues, others realized that because of the country's advanced industrial status it also faced the most immediate setbacks. The forces unleashed by economic determinism led to the shaping of sterilized environments, and urban sprawl impelled the ceaseless replacement of fields, forests and wetlands by endless rows of identical single-family homes. Based on an exchange economy, the land turned into a commodity that was tradable like any other good.[542]

541 Coined by Ernst Haeckel, the term *ecology*, the "household of nature" stems from Greek *oiko*s, the "house" or "place to live in."

542 Jean-Jacques Rousseau had written in the *Discourse on the Origin and Foundations of Inequality Among Men* (1755): "The first man who, having fenced in a piece of land, said 'This is mine,' and found people naive enough to believe him, that man was the true founder of civil society. From how many crimes, wars, and murders, from how many horrors and misfortunes might not any one have saved mankind, by pulling up the stakes, or filling up the ditch, and crying to his fellows: Beware of listening to this impostor; you are undone if you once forget that the fruits of the earth belong to us all, and the earth itself to nobody." Cf. Alan Ritter and Julia Conaway Bondanella, (eds.), *Rousseau's Political Writings* (New York: W. W. Norton, 1988) p. 34.

In *The Human Use of the Earth* (1960), the American geographer Philip L. Wagner described the situation incisively:

> The modern inhabitant of a commercial country does not make his world; he buys it. The material circumstances of his life are not the outcome of his individual encounter with the natural order, but arise out of his relations with the social order.[543]

One of the most critical voices, Peter Blake in *God's own Junkyard: The planned Deterioration of America's Landscape* (1964) attacked all those who "befouled" large portions of the country, turning the nation's "beautiful inheritance into the biggest slum on the face of the earth."[544] Recognizing a flood of systematic "uglification," he especially blamed single-minded private enterprises for the resulting monotony.[545] Supporting Blake's argument, as early as 1950 the *Architectural Review* had set out to "investigate the mess that is man-made America."[546] Its authors, including Tunnard, prophesied that present development was threatening the survival of man, and proposed that value itself should no longer be measured by money, but rather by the ability to sustain life. The same year, Eckbo noted in *Landscape for Living* that a "sharp contradiction between the interests of ordinary citizens and of those free enterprise elements who see no values beyond their own private profit" had become obvious.[547] Arguing against a plundering of the planet, he pointed out: "The growing dominance of man over nature is graphically clear," yet, "[h]is sense of responsibility for the general landscape has not grown as rapidly […]."[548] Thus, man's power to change the face of the earth had increased faster than his understanding of the manipulations' profound effects, or as Aldo Leopold critically inquired: "The gadgets of industry bring us more comforts than the pigeons did, but do they add as much to the glory of the spring?"[549]

It was a fatal illusion that humanity believed to have constructed a technological environment that released it from dependence upon nature. The truth was tragically different and the proper use of technology implied not the conquering, but the better appropriating of natural resources. In the environmentalists' opinion the animist spirits, which saw man as a tolerant partner of nature, had to be reawakened. If these effects continued to be neglected, many scientists and activists agreed in apocalyptic terms that a complete abasement of the biological

543 Philip L. Wagner, *The Human Use of the Earth* (Glencoe: Free Press, 1960) p. 225.
544 Peter Blake, *God's own Junkyard: The Planned Deterioration of America's Landscape* (New York: Holt, Rinehart and Winston, 1964) p. 8.
545 Furthermore, highways planned on spurious cost-benefit formulas crisscrossed the country, although the most direct route was not necessarily the ecologically most appropriate one.
546 Cf. "Man Made America," in *The Architectural Review*, special number, December 1950, p. 339.
547 Garrett Eckbo, *Landscape for Living* (New York: F.W. Dodge, 1950) p. 27.
548 Ibid., p. 38.
549 Aldo Leopold, *A Sand County Almanac* (London: Oxford University Press, 1949) p. 109.

environment, including the extinction of man, was inescapable.[550] To take a glimpse back in history, environmentalism had reached an early peak in George Perkins Marsh's *Man and Nature* from 1864. The long-term American ambassador to Italy believed that the civilizations along the Mediterranean had brought about their own land's devastation by inflicting abuses of the landscape.[551] In addition, Lawrence J. Henderson argued in his seminal study *The Fitness of the Environment* from 1913 that not only were organisms adapted to their environments in the most suitable way, but that the environment should likewise be thought of as an organism. Through a careful exchange of matter and energy the atmosphere affected organisms, but conversely organisms affected the atmosphere, too – an argument leading to the simple conclusion that the earth's inhabitants also had to take care of their surrounding world, since it sustained their life.

It would be farfetched to argue that Kahn was aware of all these arguments and studies. Nonetheless, a first demonstration of his interest in the discussed issues was a letter he sent to the American sociologist William H. Whyte, who in 1957 had presented excerpts from his book *The Exploding Metropolis* in *Fortune* magazine. Kahn seemed especially fascinated by the article "Urban Sprawl," as he acknowledged:

> It arouses a spirit of home beyond that of one's own. [...] Planning of the land and building on it must be made an understandable part of everyone's life just as it was when cities began; only now it must be understood through the powerful forces of the bulldozer, the automobile, and free enterprise.[552]

Whyte, whom Kahn met personally at a conference on city planning in 1960,[553] had addressed in his article the problems of massive suburbanization:

550 Crucial in drawing wider attention to the problem was the publication of Rachel Carson's *Silent Spring* in 1962. The American marine biologist concluded that man, through irresponsibly poisoning with chemicals, had entered a crusade against nature to create a sterile, insect-free world. For Carson, it was difficult to fathom how intelligent beings could "seek to control a few unwanted species by a method that contaminated the entire environment." Carson, *Silent Spring* (Cambridge: The Riverside Press, 1962) p. 8.

551 Citing large-scale deforestation along with exhaustive agriculture as the prime destructive forces, Marsh observed that in the depleted soil the rain or water from snowmelt was no longer absorbed by plants, but now filled ravines with large torrents that left the terrain arid in summer and inundated in spring and autumn. According to him, there were "parts of Asia Minor, of Northern Africa, of Greece, and even of Alpine Europe, where the operation of causes set in action by man has brought the face of the earth to a desolation almost as complete as that of the moon [...]." Marsh, *Man and Nature* (Seattle: University of Washington Press, 2003; 1864) p. 42.

552 Kahn's letter to William H. Whyte Jr., 27 December 1957, 030.II.A.68.23, LIKC.

553 On 15 September 1960, Kahn received from U.S. Senator John F. Kennedy an invitation to take part in a conference on urban issues held in Pittsburgh on 10 October the same year; Cf. 030.II.A.61.44, LIKC.

> Already huge patches of once green countryside have been turned into vast, smog-filled deserts that are neither city, suburb, nor country, and each day – at a rate of 3000 acres a day – more countryside is being bulldozed under. You can't stop progress, they say, yet much more of this kind of progress and we shall have the paradox of prosperity lowering our real standard of living.

When flying from Los Angeles to San Bernardino, he recognized "an unnerving lesson in man's infinite capacity to mess up his environment:" only the ocean seemed able to stop the speculative builders from "irretrievably" fouling the countryside (Figure 144).[554]

Alongside this recognition of the failures brought about by the growth of American metropolises, Kahn participated in several congresses concerning issues of landscape architecture in general. On these occasions, he not only met with some of the discipline's most distinguished practitioners, but also with some eminent ecologists like Paul B. Sears at the *National Conference on Instruction in Landscape Architecture* (1960) with its expressive heading "Landscapes for Survival."[555] Besides Sears, a number of Kahn's colleagues at the University of Pennsylvania including McHarg and Gutkind spoke at Amherst, too. Additional time was reserved for reading an address written by Mumford, the self-proclaimed "patron-saint" of the ecological movement:[556]

> [T]he last sixteen years I have found myself wryly sympathizing with the Biblical prophet Jonah, who fled from his unpleasant duty of announcing to the people of Nineveh that, unless they altered their conduct, they were headed for destruction.[557]

In his archival notes, Kahn also kept Mumford's address "The New World Promise," delivered at the *American Institute of Architects Annual Convention* in 1965,[558] in which the American historian cautioned:

> In the act of conquering nature, our ancestors treated the land as contemptuously and brutally as they treated its original inhabitants, wiping out great animal species like the bison and the passenger pigeon, mining the soils instead of replenishing them, cutting down the primeval forests,

554 William H. Whyte Jr. "Urban Sprawl," in *Fortune*, vol.57, no.1, 1958, p. 103. Cf. 030.II.A.68.23, LIKC. For Whyte the major problem was the lack of control of the patterns of growth. Only through a regional approach could the country be rescued from its state of jeopardy.

555 Kahn received the invitation to take part in the three day conference in Amherst, Massachusetts, 23-5 June 1960, from Karl Linn on 29 March 1960; Cf. 030.II.A.64.31, LIKC.

556 Cf. Lewis Mumford, "The Social Function of Open Spaces," in *Landscape*, vol.10, no.2, Winter 1960-1, pp. 1-7. The address had initially been delivered at the *Congress of the International Federation of Landscape Architects* in Amsterdam in 1960.

557 Lewis Mumford, "The Human Way Out;" address given at the University of California in Berkeley on 28 September 1961, republished in *Royal Institute of British Architects Journal*, December 1961, pp. 548-9. Cf. 109.II.C.87.2, ILMC.

558 Cf. 030.II.A.68.22, LIKC.

Fig. 144: Puente Area of Los Angeles, in William H. Whyte Jr., “Urban Sprawl,” 1958.

> even the great sequoias, and breaking open the prairie instead of setting part of this primeval landscape aside as a special New World gift that could never be replaced.

Unfortunately, however, later generations had not learned their lesson, and contemporary “machine-worshippers” showed

> their hatred of nature by turning every landscape into an urbanoid wasteland paved with multi-laned motorways, parking lots and clover-leaves, with rubbish dumps and motor car cemeteries, in which buildings, low and high, are thrown almost at random without respect to any human purpose except to absorb the products of an expanding economy, whose affluence so largely takes the form of organized waste.

In the same vein, the *International Design Conference* with the topic “Environment” (Figure 145) was held in Aspen, Colorado in 1962 and again included Kahn as a participant. It announced in its official brochure:

> Man is and always has been affected by environment. [...] It modifies us and we modify it. With short-sightedness and stupidity, we sometimes have changed it for the worse, witness our ugly, congested cities and denuded, erosion-scarred landscapes.

Regarding the environment as a complex aggregate of physical, biological and social factors, the conference advised, “[s]ince we cannot remove it, we must learn to

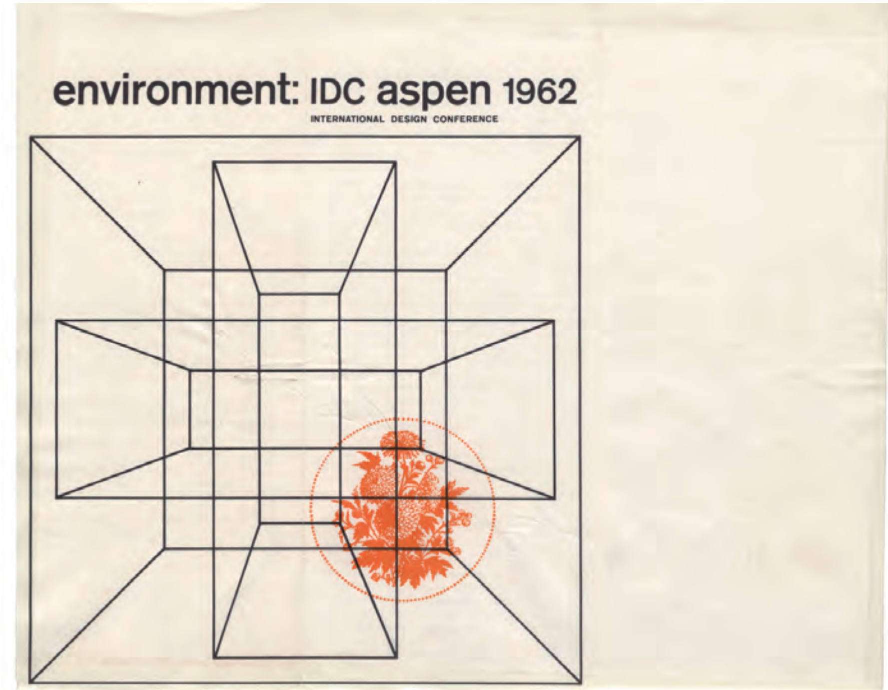

Fig. 145: "Environment," International Design Conference, Aspen, Colorado, 1962.

improve it."[559] In Aspen John Brinckerhoff Jackson also lectured, who was the editor of the journal *Landscape* from 1951 to 1968. Offering a platform for discussion on environmental issues, the respect between Jackson and Kahn was mutual: when the latter was requested to contribute an article to the journal's ten years anniversary issue, he replied: "For J. B. Jackson's sake I would do anything."[560] In 1961, Jackson returned the compliment: "A few figures like Louis Kahn in this country and Zevi in

559 "Environment," pamphlet of the *International Design Conference* in Aspen, 24 to 30 June 1962, 030.II.A.59.31, LIKC.

560 Kahn's letter to Sylvia Loomis, an editorial associate of Jackson, 15 July 1960, 030.II.A.9.7, LIKC. Loomis's inquiry of 9 June 1960 made apparent the magazine's objectives: "We want to show that there is a widespread interest in the ideas of our contributors on the importance of architects, planners, geographers, conservationists, agriculturists, and students of landscape all recognizing their common concern for a harmonious relationship between man and his natural environment; and on the necessity for fresh thinking about this relationship." Cf. 030.II.A.64.34, LIKC. Kahn kept in his files also Jackson's outline for the *60th Annual Meeting of the American Society of Landscape Architects* with the topic "Landscape … A Vanishing Resource" held in Chicago between 28 June and 1 July 1959.

Italy have pioneered in the direction of a new architecture […] but their disciples are few."[561]

Influenced by Carl Sauer's broad distinction between culture as the *agent*, nature as the *medium* and the cultural landscape as the *result*, Jackson sought to give *Landscape* a holistic focus, covering all aspects shaping the environment. Hence, the journal's title clearly related to the original meaning of the word *landscape*, derived from the old English *landskipe* or *landscaet*, the "shaping of the earth", in contrast to latter derivations from the Dutch *landshap*, which primarily denoted the painting of rural settings. Weaving together a diverse network of contributors from such diverse fields as geography, history, architecture, landscape architecture, urban planning, sociology and anthropology, the periodical's objective was to install a more conscious comprehension of the different forces shaping the land. The ten-year anniversary issue from the fall of 1960 – with contributions by the landscape architects Eckbo, McHarg, and Tunnard, a statement by Mumford, and notes from the ecologists Sauer, Sears and Wagner, amongst others – indicated the central position the magazine had obtained. Kahn, the only architect, acknowledged the journal's "thoughtful selection of subjects," which "stimulates dedication in the professions concerned about environment."[562] Jackson, in his opening statement declared:

> All that the magazine wanted to do […] was to revive in another form the kinship men had once felt for the living world, the sense of belonging to it; to remind our readers that the natural environment can satisfy our spiritual as well as our material wants.

He attributed the present confusion to one grand mistake, "the error which proclaims that nature is something outside of us […]."[563] Man should not return to a completely unharnessed state of nature, but at least acknowledge nature as an omnipresent actor on the stage of an increasingly artificial life.

3.5 Man and Environment

One of the most direct influences on Kahn's increasing ecological consciousness was the formation of one of the nation's leading landscape departments under the aegis of McHarg at the University of Pennsylvania. The core group of teachers comprising its faculty was McHarg, Patton, the botanist John M. Fogg, the communal planner Karl Linn, the Wright disciple George Bishop Tatum, and the English landscape architect

561 John Brinckerhoff Jackson, "Essential Architecture," in *Landscape*, vol.10, no.3, spring 1961, p. 30.
562 Louis I. Kahn, "10th Anniversary Letters," in *Landscape*, vol.10, no.1, fall 1960, p. 4.
563 John Brinckerhoff Jackson, "Notes and Comments," in *Landscape*, spring 1961, pp. 1-2.

Peter Shepheard.[564] The central objective of the department, as one can read in the official course description for the 1959-60 academic year, was to oppose the further despoilment of the environment:

> One of the most conspicuous failures of 20th century Western society has been the environment created. Squalor and anarchy are more accurately descriptive than are efficiency and delight.

The same year, McHarg announced a new course called "Man and Environment," which, by inviting guest speakers from a wide array of disciplines sought in an interdisciplinary fashion to obtain a better understanding of the human relationship with the natural world. The program, in which Kahn also lectured, was immensely popular and in the following years developed into a television program called "The House We Live In," a series of 26 half-hour interviews conducted by McHarg.[565] What differentiated the latter's analysis of the ecological situation from that of other environmental advocates, who mainly blamed the selfish greed of the speculators as the source of the dilemma, was his exceptional historical and religious comprehension of the problem. According to McHarg,

> [f]rom its origin in Judaism, extension in Classicism, reinforcement in Christianity, inflation in the Renaissance and absorption into the 19th and 20th centuries, the anthropomorphic-anthropocentric view has become the tacit view of man versus nature.[566]

Thus, the emergence of monotheism had as its corollary the rejection of nature, and the *Genesis*, licensing man to subdue the earth, was in McHarg's opinion the initial "declaration of war on nature."[567] He recognized the devastating repercussions of it most of all in the excesses of Renaissance and Baroque gardens, but also in the present actions of the

> atomic demolition expert, clear feller of forests, careless miner, he who fouls the air and the water, destroys whole species of wildlife: the gratified driver of bulldozers, the uglifier.[568]

564 Furthermore, an illustrious group of visiting critics joined the department each term, among them the landscape architects Eckbo, Kiley, Halprin, and between 1962 and 1965 the Brazilian Roberto Burle Marx. Supplementing these academic activities was a research branch, which would enable Van Eyck to conclude his work on *The Child, the City, and the Artist*, and the English urban planners Ian Nairn and Gorden Cullen to conduct a study on the man-made American environment. Cullen's publication *Townscape* (1961) served as the template for their investigation that was published as *The American Landscape: A Critical View* in 1965.

565 For a list of participants of "Man and Environment" and the "The House We Live In," amongst others the biologist Julian Huxley, the astronomer Harlow Sharply or the psychologist Erich Fromm; Cf. 109.II.B.2.2, ILMC.

566 Ian L. McHarg, "Man and Environment," in Leonard J. Duhl and John Powell, (eds.), *The Urban Condition* (New York: Basic Books, 1963) p. 47.

567 Ian L. McHarg, *Design with Nature* (New York: John Wiley & Sons, 1992; 1969) p. 26.

568 Ibid., p. 76.

According to the Scottish landscape architect, mankind had essentially refused to acknowledge that its privilege of participating in the Divine creation also implied a responsibility for the care of it. Whether Kahn subscribed to McHarg's religious viewpoint is doubtful, since on the one hand the former's conception of "order" was so closely assimilated with the lawfulness of God's creation, and on the other he applied precisely those modes of landscape composition that McHarg most harshly criticized. To contextualize McHarg's statements, however, it ought to be pointed out that the Holy Scripture also contained more beneficent expositions of man's relation with nature; for example, Noah's construction of the ark protected and ensured the survival of all species.[569]

A further alternative, as McHarg acknowledged, was the different reading of *Genesis* in Islam, which focused on its second chapter, where "the LORD God took the man, and put him in the garden of Eden to dress it and to keep it" (2:15); and the third, which stated that after Adam ate from the tree of knowledge and before he attempted to take hold of the tree of life, "the LORD God sent him forth from the garden of Eden, to till the ground from whence he was taken." (3:23) These injunctions, which regarded Adam as the steward of the garden, and after his dismissal from Eden of the world, were for McHarg much preferable *leitmotifs*.[570] Besides these Islamic imperatives, he regarded the English landscape tradition as a further alternative, which in his opinion had accomplished a rehabilitation of the environment albeit without confronting the industrial urban centers. Furthermore, McHarg valued all forms of primitivism with its animist tendency to deify every aspect of the natural creation. In prehistoric times, people lived in constant fear of offending the indwelling nature spirits, which if pleased through sacrifices and elaborate festivals would stabilize the ecological equilibrium. Lastly, he supported Hinduism, Zen Buddhism and Transcendentalism, in which in one panentheist scope all nature was respected as a medium of Divine revelation.[571]

In 1965, McHarg founded the Institute of Environmental Studies, which made possible the recruitment of a faculty of natural scientists within the department of landscape architecture. On this basis, he developed an interdisciplinary ecological planning (survey) and design method (implementation), which he published as *Design with Nature* in 1969. The proposed planning sequence included the full suite of natural

569 Also the frequent use of the shepherd as a role model of a solicitous ruler demonstrates that besides a definite favoritism for man, the Old and New Testament also contained the idea of a bond of brotherhood that unified all creatures.

570 Many early treatises dealing with environmentalism stem from Islam's Golden Age: Avicenna, for instance, demanded the selection of housing sites in accordance with health parameters, while Abdallatif al-Baghdadi urged the use of wind-catchers, sewage channels and wider streets to make medieval Cairo one ecological entity. Cf. Lutfallah Gari, "Arabic Treatises on Environmental Pollution up to the End of the Thirteenth Century," in *Environment and History*, no.8, 2002, pp. 475-88.

571 Cf. McHarg's rough draft "Religious Attitudes to Man and Environment," n.d., 109.II.C.87.2, ILMC.

sciences – geology, meteorology, geomorphology, hydrology, geography, soil studies, vegetation and wildlife – which were brought together in a "land use analysis." In a next step, this data was overlaid on a map in a "layer-cake" representation of different color intensities (Figure 146) that in a descriptive but also diagnostic manner presented the biophysical status of a region. Thus, McHarg in a first step distilled the intrinsic values certain areas possessed, and in a second, assigned these to possible conservational, recreational or urban uses. Following an evolutionary logic the Scottish landscape architect sought to accomplish "creative fitting,"[572] i.e. the identification of those environments that were best suited for a particular kind of application.[573]

Mumford, who kept a close eye on the development of *Design with Nature*, recognized in McHarg's theories a consummation of the work he had commenced in the 1920s, yet questioned the "unfortunate part religions:"[574]

> When you look at the Myth of the Machine [...] you will find that I trace it back to a much older injury done by the cult of Divine Kingship, of which Judaism and Christian religions are only a late derivative; and even at the point of origin, the destructive side of this cult was counterbalanced by all the fertile, life-giving practices of Neolithic culture, centered in Osiris [...] the animus behind the bulldozing, highway robbery and desert makers derives, not from Jehovah, but from Mammon and Moloch: the gods of money, war, and power.[575]

To add a final note, the growth of the ecological movement in the 1960s occurred in parallel with man's push into outer space. In November 1967, the first full-disk color photographs of the earth were transmitted from NASA's ATS-3 satellite; one of them was also featured on the back cover of *Design with Nature* (Figure 147). Kahn remembered, in speaking of Apollo 8, the first human spaceflight mission to escape

572 Cf. McHarg, *Design with Nature*, p. 121.

573 McHarg was well aware that he was not the first to propose such a method. Olmsted and Eliot's ecological planning study for the Boston Metropolitan Area had inaugurated such an approach. Later, also Mumford's concept of "regional planning" encouraged communities to zone the public landscape according to different "place possibilities." Cf. Mumford, *Culture of Cities*, p. 335.

574 Mumford also confirmed in a letter to McHarg the compliance of the younger fellow's approach with Geddes': "Though you didn't know Patrick Geddes in the flesh, you are in fact his best disciple, and I am only the link that binds you two Scots together [...]." Mumford's letter to McHarg, 27 May 1969, 109.II.A.2.65, ILMC. In *Cities of Evolution* (1915) Geddes had postulated the idea of an interdisciplinary "regional survey" to detect the "health" status of a region. Invited to India between 1915 and 1919, the former lecturer in biology harshly opposed British town planning methods that cut enormous boulevards through the congested cities. In contrast Geddes proposed patient diagnosis before actual treatment: "Happily there is another school of planning, of building and of gardening that investigates and considers the whole set of existing conditions; that studies the whole place as it stands, seeking out how it has grown to be what it is, and recognizing alike its advantages, its difficulties and its defects." Jacqueline Tyrwhitt, (ed.), *Patrick Geddes in India* (London: Lund Humphries, 1947) p. 25. Because of Geddes' more conservative *surgery*, roads were only slightly enlarged, some patios added through the removal of dilapidated houses, and more greenery was introduced.

575 Mumford's letter to McHarg, 31 January 1967, 109.II.A.2.65, ILMC.

Fig. 146: Ian L. McHarg, *Design with Nature*, 1969.

the gravitational field in December 1968, that he "went with them every single mile of it, and I saw this great marble, blue and green in space […].[576] McHarg, too, envisioned man in outer space looking back on the verdant celestial fruit, yet noticing certain blemishes, the astronaut was prompted to ask: "Is man but a planetary disease?"[577] The basic lesson to be learnt from man's interstellar voyages was that the globe itself was a self-sustaining capsule – an analogy first coined by Fuller in *Operating Manual*

576 Louis I. Kahn, "Lecture at the Architectural Society of Drexel University," 5 November 1968, in Wurman, *What will be has always been*, p. 30. In 1968 Kahn recalled in front of his students that he "was asked by NASA to come to Washington to meet with Werner von Braun and some scientists to explore what living in space might be like." Charles E. Dagit Jr., *Louis I. Kahn – Architect* (New Brunswick and London: Transaction Publishers, 2013) p. 60.
577 McHarg, "Man and Environment," p. 44.

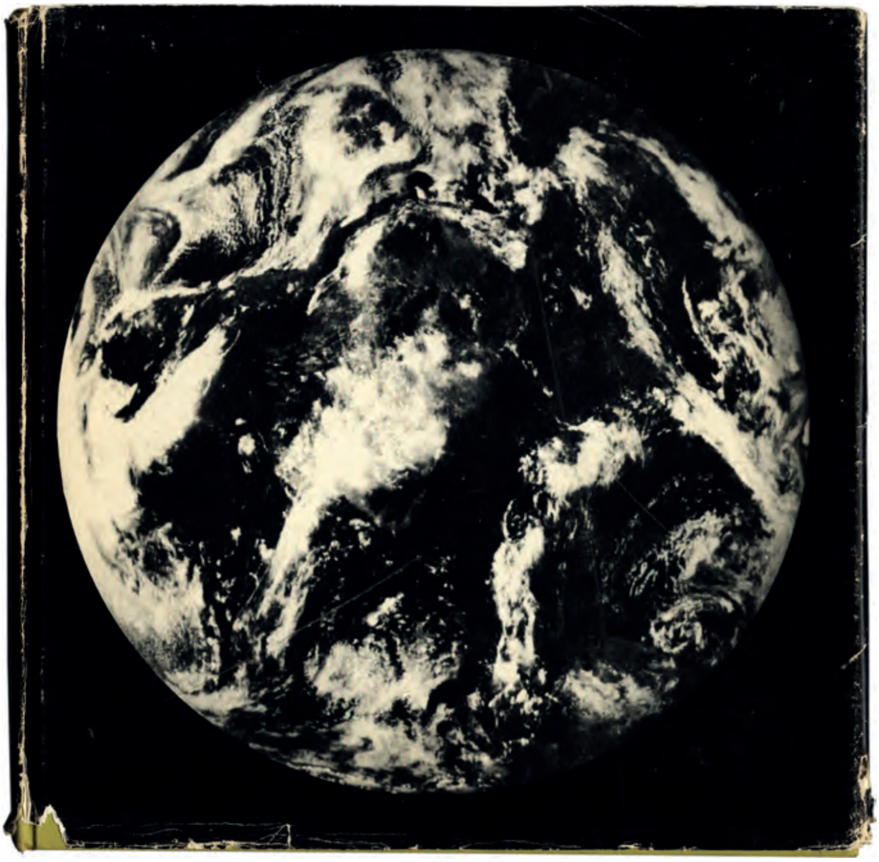

Fig. 147: First Full-Disk Color Photograph of the Earth (1967) as Back-Cover of Ian L. McHarg, *Design with Nature*, 1969.

for Spaceship Earth (1963).[578] Consequently, one of the central demands of the first nationwide *Earth Day* initiated by McHarg on April 22, 1970 was to insure that in the future laws and regulations would protect against environmental crimes. From this apex of environmental sensibility a series of political actions like the Clean Air and Clean Water Act followed alongside the formation of the Environmental Protection Agency.[579] President Richard Nixon turned environmentalism into one of the key issues of his administration, as he noted in his State of the Union address in 1970:

578 Cf. John McHale, "Global Ecology: Toward the Planetary Society," in *Zodiac*, no.19, 1969, p. 177.
579 Beforehand, the Wilderness Act (1964), the Land and Water Conservation Act (1965), and the Wild and Scenic River Act (1968) had passed American legislation.

> The great question of the 1970s is, shall we surrender to our surroundings, or shall we make our peace with nature and begin to make reparations for the damage we have done to our air, to our land, and to our water?

In 1972, the year the first United Nations Conference on the Human Environment was held in Stockholm, the related publication *The Limits to Growth*, of which Kahn owned a copy, indicated that definitive measures had to be taken, since the world's resources would in a short time not be able to sustain the present rates of industrial acceleration. Summing up their intentions by using a phrase of the pioneering American conservationist John Muir, the authors' appeal was "not blind opposition to progress, but opposition to blind progress."[580]

3.6 Bringing the Elements to Presence

Kahn's architectural proceedings took on a global dimension once he received the commission for the United States Consulate Chancellery and Residence in Luanda, Angola – a project that would preoccupy him from 1959 to 1962. Although the project was never carried out, it would be decisive in further defining the adaptive potential of the wall as an in-between zone and in clarifying his efforts to attune with the natural forces. In January 1960, Kahn returned from his first site visit intrigued by the local architecture and the efforts of its anonymous builders: "I came back with multiple impressions of how clever was the man who solved the problems of sun, rain and wind".[581] He eventually drew the conclusion that a good design should "tell the people on the street the way of life in Angola."[582] Kahn clearly recognized that in its engagement with the world, architecture was one of the last activities that could aspire to give meaning to the archaically obvious. This primarily meant enhancing man's sensitivity to the events of the world and his sense of belonging to the cosmos.

Kahn had acquired the commission through Pietro Belluschi, with whom he had taught at Yale. In 1954, the Italian-American architect became director of the Architecture Advisory Committee of the Foreign Building Operations (F.B.O.), a state department responsible for the construction of federal government projects abroad.[583] Belluschi instantly clarified the agency's objectives:

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580 Donella H. Meadows, Dennis L. Meadows, Jorgen Randers and William W. Behrens III, *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind* (London: Earth Potomac Associates, 1972) p. 154.
581 Kahn, "Voice of America."
582 Ibid.
583 The same year that Belluschi was appointed, the F.B.O. informed Kahn that his name had been suggested for possible cooperation. Cf. Henry J. Lawrence's letter, F.B.O., 6 April 1954, 030.II.A.34.27, LIKC.

> To the sensitive and imaginative designer it will be an invitation to give serious study to local conditions of climate and site, to understand and sympathize with local customs and people, and to grasp the historical meaning of the particular environment in which the new building must be set.[584]

Accordingly, he was searching for an architecture that would stand up

> against the very drab and standardized background of the straight, no-nonsense type of architecture which is being built with appalling sameness from Baghdad to Rovaniemi.[585]

Kahn's design, which certainly kept track of Belluschi's resolutions, began with a thorough analysis of the geographic and cultural restraints of the region. On his first visit he made several sketches of the country's landscape features (Figure 148) and took precise notes on the availability of local building materials. Furthermore, he received from the Department of State detailed reports concerning Angola's climatic conditions, which indicated a humidity average of 83 percent a year, an extreme heat peak between December and March, as well as tempering sea breezes caused by an Antarctic current flowing along the coast.[586]

Answering the Department of State's request to deliver a building that in a Modern Vernacular's sense "should reflect the culture of the United States but should be in harmony with local influences,"[587] too, in August 1961, Kahn handed in a first submission. In his opinion, it both reflected "the culture of this country and is sympathetic to that of Angola and the local climate."[588] Altogether, Kahn applied a whole repertory of novel climatic devices for the two separated volumes of the chancellery and the residence, which were connected through a shared entrance courtyard in east-west orientation (Figure 149). Both volumes were divided into three parts, leaving the central circulation area open to the prevailing winds from the north. Placed on a paved platform, the chancellery was surrounded by three flanking pools emptying into each other,[589] which were supposed to moderate the heat through

584 Vincent B. Canizaro, (ed.), *Architectural Regionalism: Collected Writings on Place, Identity, Modernity, and Tradition* (New York: Princeton Architectural Press, 2007) p. 320.

585 Pietro Belluschi, "The Meaning of Regionalism in Architecture," in *Architectural Record*, vol.118, December 1955, p. 131.

586 Cf. Kahn's notes and the "Post Report" about Angola (issued 3 November 1956) by the Department of State, 030.II.A.34.28, LIKC. Additionally, Kahn kept in his files an undated report from *The Institute for the Study of Man* in Africa by Edward W. N. Mallows, a professor of architecture at the University of Witwatersrand in South Africa, entitled "Pre-European Settlement Patterns in Africa South of the Sahara." Mallows, "Pre-European Settlement Patterns in Africa South of the Sahara," n.d., 030.II.A.56.80, LIKC.

587 "Program for the Development of a proposed Office Building and Consul's Residence Luanda, Angola," 030.II.A.34.28, LIKC.

588 Kahn's letter to D. Merle Walker, F.B.O., 30 August 1961, 030.II.A.34.35, LIKC.

589 Keeping the pools in motion prevented the possible breeding of insects.

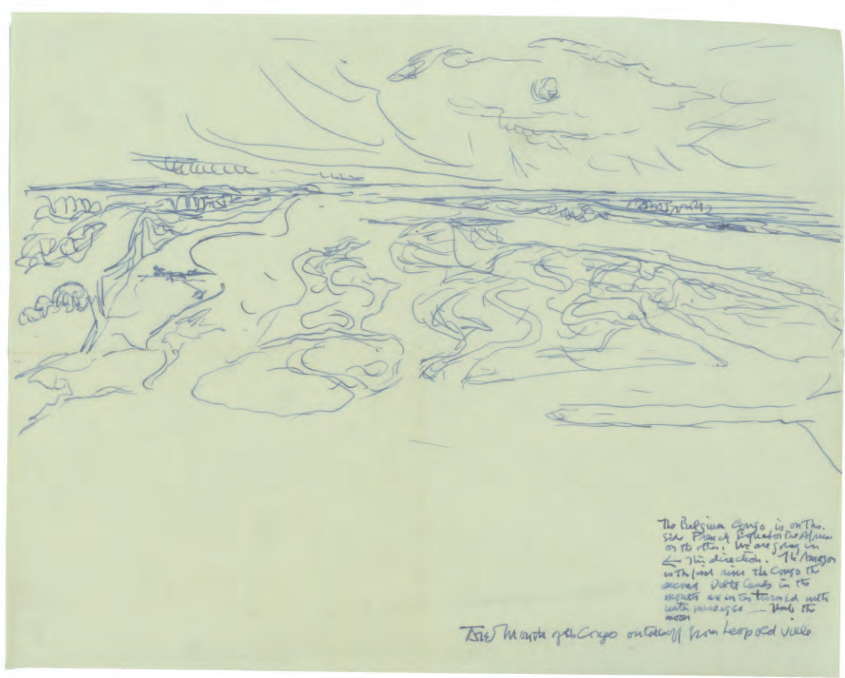

Fig. 148: Louis I. Kahn, United States Consulate Chancellery and Residence, Luanda, Angola, 1959-62.

cooling by evaporation.[590] Meanwhile, an “environment of green” – a lawn and a number of trees to offer shade and reduce the glare – surrounded the residences.[591]

As a further climatic tool, Kahn proposed the construction of an envelope of freestanding “glare screening walls,” which were designed to protect the buildings from the relentless sun and simultaneously create a space for breezes to carry away

590 Water bodies, having a greater heat-retaining capacity than landmasses, help to stabilize a climate. Cooling by evaporation is best known from sweating, whereas Heschong explained: “In hot, dry climates people have long taken advantage of evaporation as a way to cool the air. Systems of fountains, plants, and even permeable clay pots filled with water were used to both cool and humidify the air. But in humid climates, evaporation is greatly inhibited and radiational cooling to the night sky is also reduced. This made it nearly impossible to cool a place in hot, humid weather until the advent of air-conditioning technology.” Heschong, *Thermal Delight in Architecture*, p. 15.

591 Cf. Kahn, “A Discussion recorded in Mr. Kahn’s Philadelphia Office in February 1961,” p. 11. In bloom trees provide shade in summer, but bare of foliage let the sunrays pass in winter when most needed. In general terms, vegetation has a cooling effect, since the plants’ transpiration acts similar to human sweating. Besides this reduction of temperature, ground covers like lawns filter the air, reduce noise, and absorb dust.

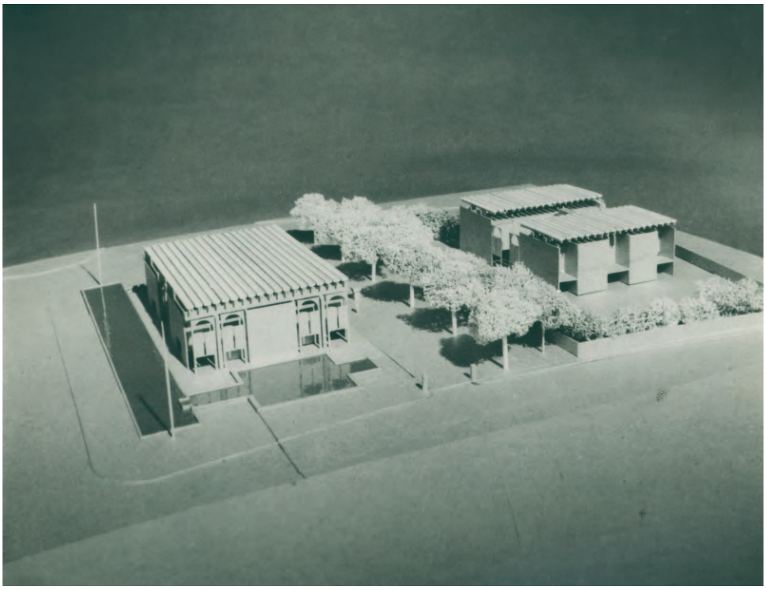

Fig. 149: Louis I. Kahn, United States Consulate Chancellery and Residence, Luanda, Angola, 1959-62.

the accumulated warm air (Figure 150). Consequently, these *second walls* tackled two immanent problems: first, protection from solar radiation, and second, increase of cross-ventilation through the activation of natural droughts. Realizing that light was needed, but in its incandescent luminosity rather an adversary in this subtropical hot steppe climate, Kahn noticed that

> the native population people – when they worked [...] they would turn their chair toward the wall and do whatever they were doing by getting the light indirectly from the wall to their work. That gave me the thought of a wall a small distance in front of every window as a kind of indigenous architectural sense.[592]

The "rain roof" was also engulfed by a second, detached and semi-transparent "leaf-like sun roof," so that again the separating airspace would allow air-currents to cool the surfaces below. Having noticed similar devices among the local population, Kahn felt

592 Ibid., p. 9.

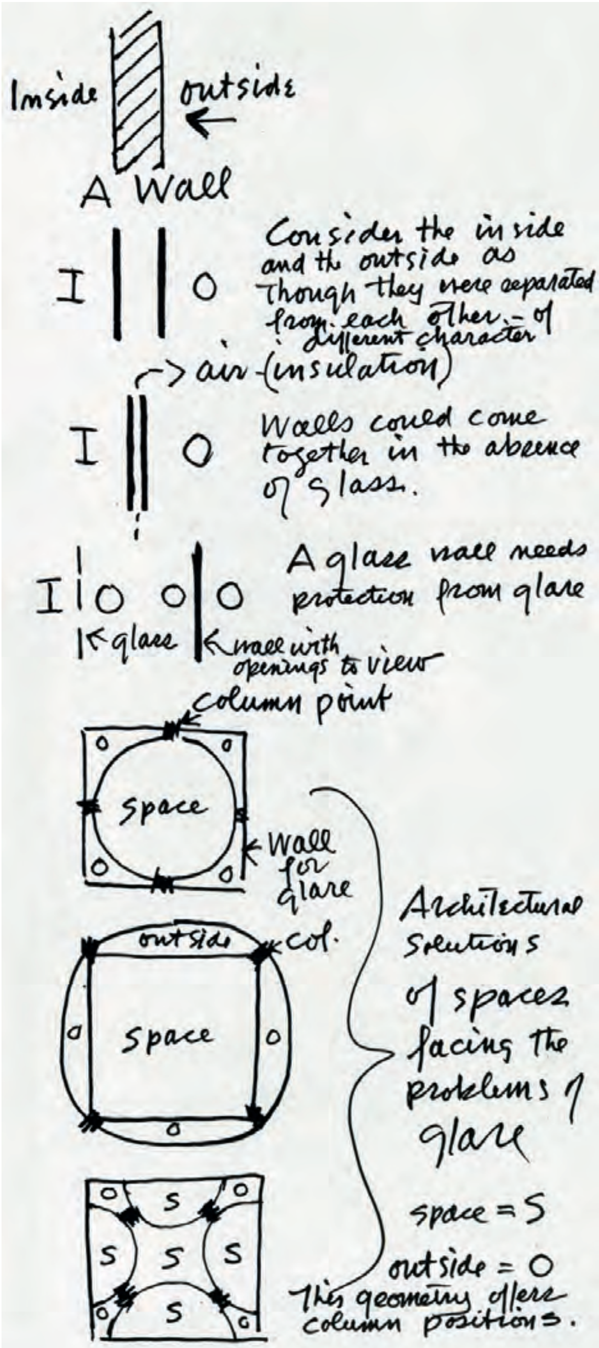

Fig. 150: Louis I. Kahn, "Glare Screening Walls," 1960.

> in bringing the rain roof and the sun roof away from each other I was telling the man on the street his way of life. I was explaining the atmospheric conditions of wind, the conditions of light, the conditions of sun and glare to him.[593]

The Consulate's double-walled strategy of placing a *building within a building*, whereby the outer layer adapted to contextual pressures and the inner one to programmatic needs, derived not solely from anonymous sources, however, but also from Kahn's more general concept of "wrapping ruins around buildings."[594] This terminology immediately brings to mind the ruins Kahn had seen in Rome, but also as Stanislaus von Moos pointed out, the devastating ruination caused by the war, which "architects almost inevitably saw [m]ore as an opportunity than a disgrace."[595] Leaving the mnemonic imagery of bombed city cores aside, in Roman architecture buildings had commonly been surrounded by arcades and occasionally even been wrapped into several-story-high galleries like the Colosseum (72-80 AD; Figure 151). Continuing this practice during the Renaissance, the two-story loggia Palladio erected around the Palazzo della Ragione in Vicenza (1549-1614; Figure 152) similarly enveloped the original Gothic town hall. In analogy with these examples, Kahn's second walls also afforded usable outdoor rooms, which, like the Japanese *engawa* spaces provided a buffer zone to mediate between the inside and outside.

Nonetheless, the Romans with all their constructive inventiveness borrowed from Hellenic architecture the enveloping colonnade or *ptera*, and thus, Greece should be considered the true birthplace of the in-between space. For Kahn, it was evident: "Archaic Paestum [550-460 BC] is the beginning. It is the time when the walls parted and the columns became [...]."[596] Splendidly rhythmized columns set up a four-sided portico or *peristasis* – visible here in a photograph of the Acropolis by Patton during his joint visit with Kahn (Figure 153) – that as a "mid-space element," as Scully termed it in *The Earth, the Temple and the Gods* (1962), interlocked the temples with their sites.[597] That Kahn, like Le Corbusier who considered the temples as "the cause of this landscape,"[598] was well aware of the reciprocal relationship between building and

593 Ibid., p. 11. With the conception of these double membranes, Kahn put into practice a strategy Mumford had already forethought 20 years earlier: "In the future, instead of conceiving of a building as built of permanent walls, broken by permanent windows, our architects will use the resources of modern fabrication to create houses with double or perhaps triple walls: one to control light, one to control heat, and one to control the entrance of living creatures, from insects to people." Mumford, *South in Architecture*, p. 26.

594 Kahn, "A Discussion recorded in Mr. Kahn's Philadelphia Office in February 1961," p. 9.

595 Stanislaus von Moos, "Ruin Count: Le Corbusier and European Reconstruction," in *Perspecta*, no.48, 2015, p. 145.

596 Wurman and Feldman, *Notebooks and Drawings*, n.p.

597 Vincent Scully, *The Earth, the Temple and the Gods* (New Haven: Yale University Press, 1962) p. 50.

598 Ivan Zaknic, (ed.), *Le Corbusier: Journey to the East* (Cambridge: The MIT Press, 2007; 1966) p. 209.

Fig. 151: Colosseum, Rome, Italy, 72-80 AD.

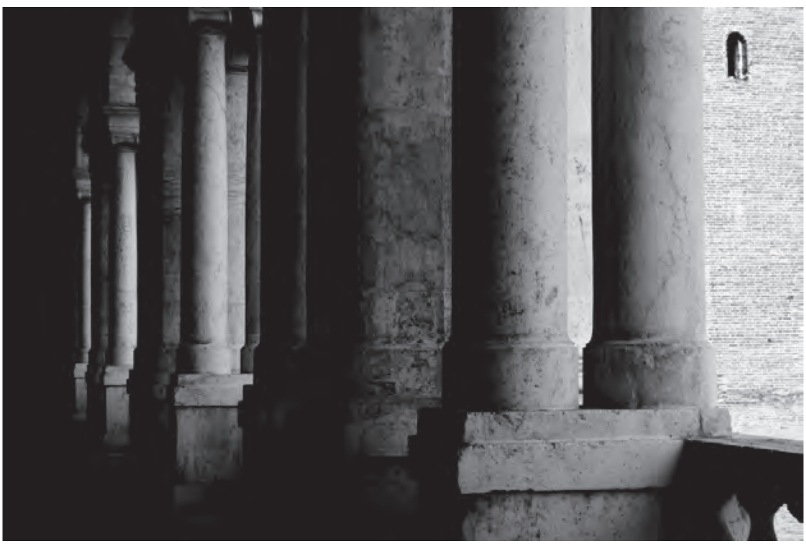

Fig. 152: Andrea Palladio, Palazzo della Ragione, Vicenza, Italy, 1549-1614.

Fig. 153: Ictinos and Callicrates, Parthenon, Athens, Greece, 447-32 BC.

landscape in Greek architecture can be deduced from the sketches he made during his visit in 1951. In these, the man-made interventions, as visible for example in the view of the Propylaea past the sharp colonnade of the Parthenon (Figure 154), were usually subordinated and framing the grandeur of the overall setting. Obviously fascinated by the ancient scenery, Kahn made numerous drawings of it, including several ones of the pyramidal peak of Arachova and an elaborate pastel rendering of the view from Delphi towards the Gulf of Corinth (Figure 155). In *Drawn from the Source*, a compilation of Kahn's travel sketches, Eugene J. Johnson and Michael J. Lewis confirmed:

> If one theme runs through almost all of the drawings Kahn made in Greece, it is the relationship between structures made by humans and the nature in which they placed those structures.[599]

A particularly beautiful example stems again from Delphi (Figure 156), where Kahn appears to have been especially intrigued by a circular plunge pool in the lower sanctuary. Surrounded by the soft silhouette of the mountains in the background and the vague outlines of several olive trees in front, the modest but concise human gesture marked a powerful moment of human presence in the mighty natural setting.

Overall, Greek sacred architecture had centered on the emerging cult of man represented by the anthropocentric pantheon of Olympian gods that opposed, or

599 Johnson and Lewis, *Drawn from the Source*, p. 87.

Fig. 154: Louis I. Kahn, *Propylaea*, Athens, Greece, 1951.

Fig. 155: Louis I. Kahn, *View from Delphi towards the Gulf of Corinth*, Greece, 1951.

Fig. 156: Louis I. Kahn, *Delphi*, Greece, 1951.

rather *humanized* the cataclysmic forces operating in nature.[600] Besides, as Scully in his study on Greek architecture made abundantly clear, from roughly 2000 BC onward, and thus taking its beginnings in the Minoan culture on Crete, a repeating pattern of the temples' placement in relation to sacred mountain features was discernible: aligned on axis, the temples first faced a conical hill and in the further distance a double-peaked mountain resembling a pair of horns.[601] This principle of orientation was most vividly recognizable on the Acropolis, where the mounded Lycabettos Hill preceded the horns of Hymettos containing the sanctuary of Zeus. Placed between the Parthenon and Erechthion (406 BC), the altar with its own sacrificial horns echoed the far-away peaks (Figure 157). The temples' arcades framed this view in a forced perspective, while the most sacred precinct in-between them remained an untouched hollow.

It should also be emphasized that in addition to Kahn's endeavors in Angola, a whole series of American embassies were planned and erected. José Luis Sert in Baghdad (1955-60; Figure 158), for instance, had employed a number of environmental devices that Kahn reapplied: first of all water, which in the Spanish architect's case

600 Greek temples monumentalized the presence of a god at a particular place – earth-bound sites like Paestum were dedicated to goddesses related to *mother-earth* like Hera or Demeter, while on hilltops that controlled the countryside they were associated with the sky-god Zeus or his daughter Pallas Athene.

601 Cf. Scully, *The Natural and the Manmade*, p. 36.

Fig. 157: Acropolis with the Horns of Hymettos, Athens, Greece.

united the entire campus through a network of tributaries; and second, double-roof constructions in both the ambassador's residence, where tree-like posts carried a folded concrete structure to create a shaded pergola, and the office building, where, as in Kahn's case, a thin air-membrane separated the rain- and sunroof. However, instead of a double-layered façade construction, Sert implemented *grilles*, i.e. porous walls, which just like the water devices and the parasol roof (*chattri*) referred to a common Islamic heritage. Similarly, Edward Durell Stone in his United States Embassy in New Delhi (1954-8) used *jalis* – intricate wooden or marble lattices as depicted here in the Tomb of Shaykh Salim Chisti in Fatehpur Sikri (1571-86; Figure 159).[602] The American architect, whose project involved a large interior water garden, not only regarded these arabesque grilles as an indigenous device to moderate the sun's glare, but also as a possible solution to break away from the monotony of the Modern glass façade. It therefore comes as no surprise that he employed similar screens in his Manhattan Residence (1956; Figure 160), although in this case to afford more privacy.

In defense of his own sun-shields that created thermal *aediculae*, Kahn dismissed these light-filtering screens as pure decoration, arguing that they merely produced

602 In Arab countries these oriel windows with latticework are called *mashrabiya*. They have five functions: control the passage of light and air, reduce temperature, increase humidity, and ensure privacy. Cf. Fathy, *Natural Energy and Vernacular Architecture*, pp. 46–9.

Fig. 158: José Luis Sert, American Embassy, Baghdad, Iraq, 1955-60.

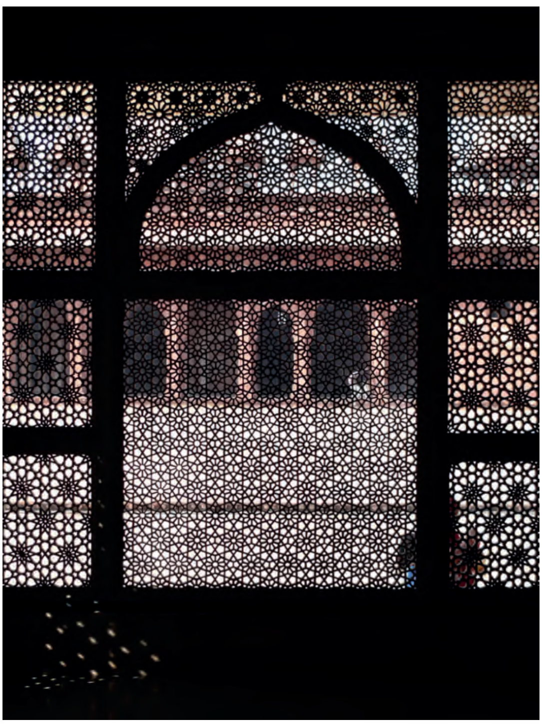

Fig. 159: Tomb of Shaykh Salim Chisti, Fatehpur Sikri, India, 1571-86.

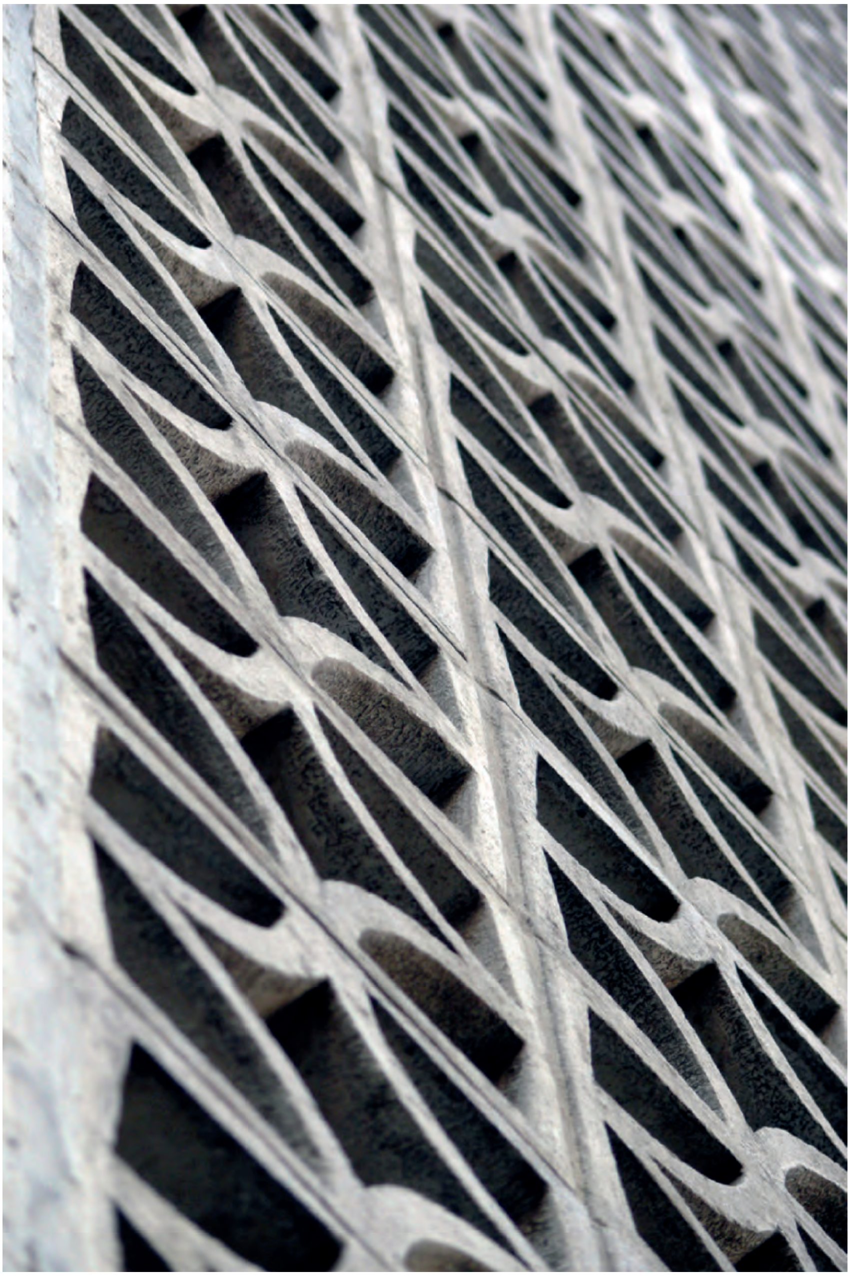

Fig. 160: Edward Durell Stone, Manhattan Residence, New York City, New York, 1956.

little pinpoints of glare, spoiled the views and did not solve the heat problem. Similarly harsh was his reaction against the *brise-soleil*:

> A *brise-soleil*, for me, is a *correction*. Actually, *the porch* is the answer, because a porch has cool air in it, and a *brise-soleil* only translates the warm air into the building.[603]

In criticizing the *brise-soleil*, Kahn explicitly targeted the work of Le Corbusier, who had frequently employed sun-breakers of spatial depth to intercept the sun's rays.[604] Since 1951, he was charged with the planning of Punjab and Haryana's new capital in Chandigarh. Both the edifices for the government complex – the Palace of Justice (finished in 1955), the Secretariat (finished in 1958), the Palace of Assembly (finished in 1963), besides the unrealized Governor's Palace (1951-3) – and the dwellings of the inner city made use of a wide scope of adaptive wall features to deal with the scorching heat, while the "Tower of Shadows" remains as visible debris of these environmental investigations. Altogether, these methods ranged from single layered grilles to the commonly employed *brise-soleil* like in the Palace of Justice (Figure 161); most often alternating configurations were employed in the same building depending on the elevations' orientation. Le Corbusier also applied solitary sun-shields – as visible in the appended depiction of an annexed structure to the Parliament (1951-66; Figure 162) – which, like the *Grecian* galleries of the inner city buildings (Figure 163) afforded corridor spaces and, thus, stood in direct proximity to Kahn's space-providing layer-strategy.[605] In Ahmedabad, too, Le Corbusier valued the climatic constraints as sources for design innovations.[606] Upon visiting the nearby Sarkhej Roza complex (1446-51; Figure 164), he reassured his Indian associate Balkrishna V. Doshi: "[Y]ou do not need to go to the Acropolis, you have all that we seek from architecture."[607]

To conclude, the Department of State ultimately declined Kahn's project as being "wasteful in respect to usable space," but also as too "fortress-like" in appearance,

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603 Kahn, "Lecture at the University of California, Berkeley, 1966," p. 20. Superior to a *venetian blind* that reflected the sun only after it had passed through a window, a *brise-soleil* reduced heat gain by one-third. Nevertheless, it obstructed the view with dark stripes, thus, contradicting the original purpose for using glass at all.

604 In the Swiss-French architect's œuvre such devices had initially appeared in the design of an Apartment House in Algiers in 1933 and found their first implementation in the Palace of Ministry of National Education and Public Health in Rio de Janeiro (1936-43; Le Corbusier acted as consultant to the local architects Lucio Costa and Niemeyer). *Brise-soleils* would find further application in the Unité d'Habitation and the House Currutchet in La Plata, Argentina (1948-9).

605 Both the Palace of Justice and the Governor's Palace made use of a parasol roof – a spatial element Le Corbusier had first experimented with in his design of the Villa Baizeau in Carthage (1928).

606 In both the Shodan House (1951-6) with its parasol roof and the Textile Mill Owner's Association (1951-4) differentiated grille- and sun-breaker-patterns corresponded with the changing light conditions.

607 Balkrishna Doshi, *Architectural Legacies of Ahmedabad: Canvas of Modern Masters* (Ahmedabad: Vastu-Shilpa Foundation for Studies and Research in Environmental Design, 2000) p. 16.

Fig. 161: Le Corbusier, Palace of Justice, Chandigarh, India, 1951-5.

Fig. 162: Le Corbusier, Palace of Assembly, Chandigarh, India, 1955-63.

Fig. 163: Le Corbusier and Pierre Jeanneret, Chandigarh, India, 1951-66.

Fig. 164: Sarkhej Roza Complex, Makarba, Ahmedabad, India, 1446-51.

and considered the roof to be too "expensive and unnecessarily experimental, if not bizarre."[608] Nevertheless, Kahn in his forthcoming projects would continue to elaborate similar devices and acknowledged in 1961, in a statement tellingly titled "The Nature of Nature:" "[B]uilt into us is a reverence for the elements, for water, for light, for air – a deep reverence for the animal world and the green world."[609] Opposing the Modernist trend to discard nature in its capacity to agitate architecture, Kahn recognized in the elemental phenomena "very simple everlasting presences that should constantly talk to you [...]."[610] Respecting the peculiarities of a site, Kahn demanded: "You just don't plunk a building somewhere without the influence of what is around it. There is always a relationship."[611]

608 Letter from William P. Hughes, F.B.O., 26 August 1960, 030.II.A.34.35, LIKC.
609 Louis I. Kahn, "The Nature of Nature," in *Journal of Architectural Education*, vol.16, no.3, autumn 1961, p. 95.
610 Kahn, "A Discussion recorded in Mr. Kahn's Philadelphia Office in February 1961," p. 10.
611 Louis I. Kahn, "Talks with Students;" Rice University in 1964, in Latour, *Writings, Lectures, Interviews*, p. 172.

3.7 Context and the Historical Roots of the Second Wall

Having stated that Kahn came to the realization of the second wall through his reminiscences of ancient, respectively contemporary, ruins, it should not be overlooked that his younger Philadelphian colleague Robert Venturi had worked out a similar spatial strategy a few years earlier. The two architects had known each other since 1947, when Venturi, working for Robert Montgomery Brown, fortuitously encountered Kahn in the elevator. Studying architecture at Princeton, Venturi invited Kahn together with Howe to judge his master's thesis in 1950. Entitled "Context in Architectural Composition," it tackled a topic that would remain at the heart of his future endeavors.[612] Much ahead of his time, Venturi sought to demonstrate that "its context gives a building expression," and therefore "change in context causes change in expression."[613]

After his graduation, Venturi worked shortly for Stonorov – assisting him in the preparation of the grand Wright exhibition in Philadelphia – before moving upon Kahn's recommendation to Bloomfield Hills, Michigan, to join the office of Saarinen. Working on the puritanical office complexes of the General Motors Technical Center, Venturi missed Wright's organic impulsions since he "was a Wright man, which was not a popular position [...]."[614] Opposing the minimalist Modern vocabulary that made a school or chapel in Denver or Leningrad all look alike, he would soon conclude that less was not more, but "simply a bore." Upon winning the prestigious Rome Prize, again upon Kahn's recommendation,[615] Venturi spent between October 1954 and June 1956 at the American Academy. Discovering the Italian Neo-Realism debate to be a fertile ground for cultivating his own imperatives,[616] he also learnt to value the layered façades of Armando Brasini's architecture, for instance in the church of Il Cuore Immacolato di Maria Santissima in Rome (1923-54). They revealed to him the spatial concept of placing "things within things," besides a mannerist tendency to distort a preconceived order with circumstantial adaptations.

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612 Cf. Robert Venturi, "Context in Architectural Composition," (1950) in Robert Venturi, *Iconography and Electronics upon a Generic Architecture* (Cambridge: The MIT Press, 1996) pp. 333-74.

613 Ibid., p. 335.

614 Robert Venturi, "Frank Lloyd Wright Essay for the Pennsylvania Academy of the Fine Arts" (1991), in Venturi, *Iconography and Electronics*, p. 67. To emphasize Venturi's appreciation of Wright, he and his later office partner William Short conducted an interview with the American master architect in Talisien on 21 August 1954. Cf. VSB.500 "RV – Manuscript Files: 1958-66," VSBC. Influenced was this interest also by Donald Drew Egbert, Venturi's art history professor in Princeton. Cf. "The Idea of Organic Expression and American Architecture," in Stow Persons, (ed.), *Evolutionary Thought in America* (New Haven: Yale University Press, 1950) pp. 336-96.

615 Cf. Kahn's letters of recommendation for Venturi to the Jury of the American Academy, 21 January 1952 and 29 January 1954, 030.II.A.61.1, LIKC.

616 Cf. Venturi's letters to his parents, VSB.500 "Rome – Misc.," VSBC. A summary is also given by Martino Stierli, "In the Academy's Garden: Robert Venturi, the Grand Tour and the Revision of Modern Architecture," in *AA Files*, no.56, 2007, pp. 42-55.

A first written testimony of these new insights is discernible in a few notes from Venturi's travels in Egypt, where he visited Ramesses III's Mortuary Temple in Medinet-Habu (c. 1170 BC; Figure 165). As it was recognizable there, Egyptian temples were ordered according to a *Babushka*-principle, since the processional pathway led in a layered sequence of *temenos* walls, pylons, courtyards and hypostyle halls to the innermost sanctuary. In 1962, Venturi verified that the principle of "things in things" was found in Egyptian building at all scales, for instance, "spatially in the series of perimeter walls at Edfu; in relief, in the graduated series of false doors at Karnak."[617] It was not only in Egypt, however, but also in Italian Baroque architecture that Venturi discovered a layered principle of spatial organization in both horizontal and vertical extension.[618] The airy interiors and exterior physiognomies of these edifices starkly deviated from each other – the one responding to interior necessities, the other to contextual parameters.[619]

Just as he had done before his departure, Venturi worked shortly in Kahn's office after his return to Philadelphia, besides becoming his teaching assistant at the University of Pennsylvania.[620] In 1957, he opened his own office, but remained in close contact with Kahn.[621] Characteristic of Venturi's early work – strongly

617 Robert Venturi, "Ideas of Reconciliation in Architectural Composition," 15 February 1962, 030. II.A.61.2, LIKC.

618 Venturi discerned this tendency to accommodate the counter-requirements of the inside and outside also in the *Shingle Style*. Informing Kahn several times about his activities in Rome, he wrote in 1956: "My reading, surprisingly enough, has centered on Vincent Scully's *Shingle Style* book dealing with the domestic work as you probably know, of Richardson, early McKim, Mead, and White, and also Philadelphia's Wilson Eyre of the 'eighties. He deals with an idiom very familiar in suburban Philadelphia of course, which I have not especially appreciated before, and the beginnings of a tradition relevant to us which we can learn from." Cf. Venturi's letter to Kahn, 28 March 1956, VSB.500 "Rome – Notes: Letters," VSBC. Altogether, the Shingle Style had achieved a unique fusion of architecture and landscape by employing deep decks comparable to a *peristasis* or *engawa*. At the same time, the inner programmatic functions found direct expression in the buildings' irregular massing.

619 When Venturi left the "golden air" of Rome, he considered his stay as "the richest experience of my life; if I shall be able to make any contribution in architecture, I shall credit an essential share of it to my experience in Italy at the Academy. I owe a particular debt to Ernesto Rogers there, for his friendship and his introduction to the best of current Italian architecture, and to Professor Krautheimer who shared so generously and enthusiastically his vast knowledge of Baroque architecture in Rome and many other subjects." Venturi's letter to James Kellum Smith, Chairman of the Board of Trustees of the American Academy in Rome, 14 October 1956, VSB.500 "Rome – Notes: Letters," VSBC. For a detailed account of the activities with Richard Krautheimer, behold Venturi's letter to his parents, 3 April 1956, VSB.500 "Rome – Notes: Letters," VSBC.

620 Venturi and Kahn collaborated on the City Tower, the Washington University Library and the Lewis Residence in Philadelphia (1957).

621 Cf. Venturi's letter concerning his wish to show Kahn the last revisions of the Venturi House, 21 September 1959. In a letter of recommendation for Venturi in 1963, Kahn noted: "He has been a constructive critic of my work and I have in turn been invited to react to his. I recommend him without reservation as the finest choice a client can make." Whereupon Venturi answered: "My mother says your letter comes straight from a great heart." Cf. 030.II.A.59.7, LIKC.

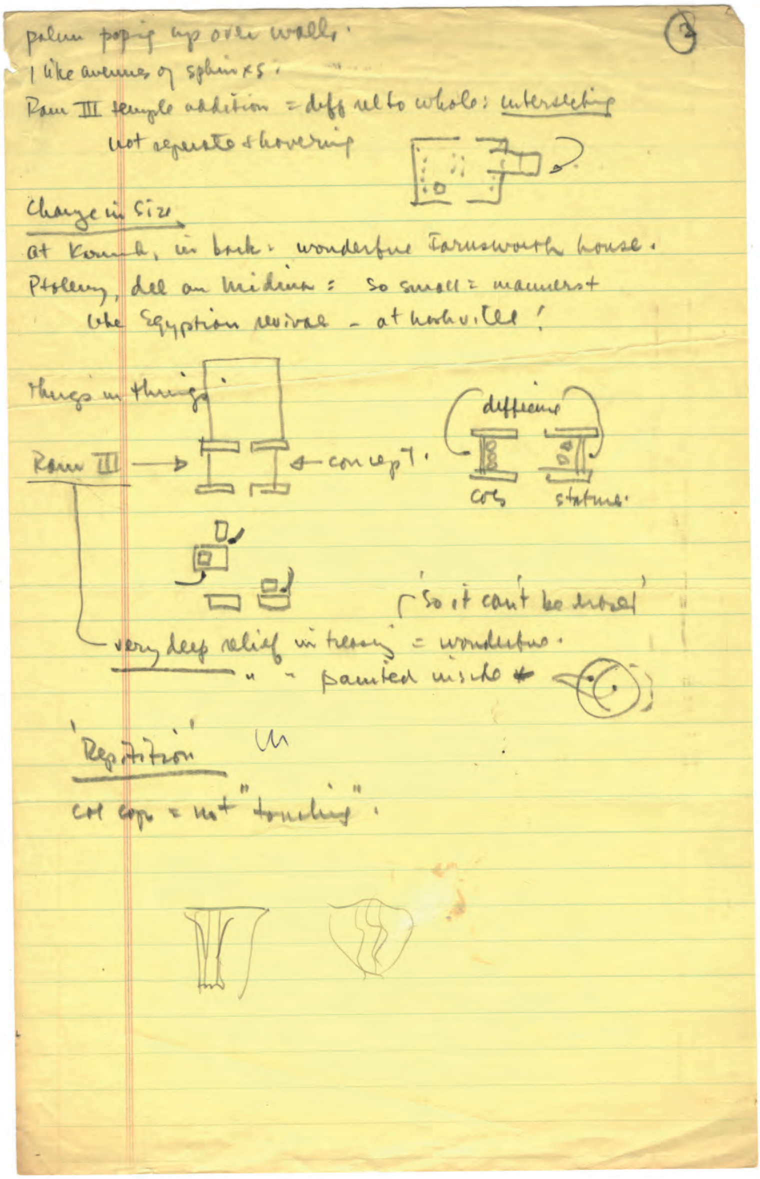

Fig. 165: Robert Venturi, "Things in things," (1955) Ramesses III's Mortuary Temple, Medinet-Habu, Egypt, c. 1170 BC.

influenced by Kahn's Richards Laboratories, "but the negative lessons"[622] – was the employment of freestanding walls in a layered arrangement. As early as 1957, this concept found application in both plan and section in the unrealized Pearson House in Chestnut Hill, Philadelphia, notably three years before Kahn's use of comparable devices. Several other projects like the Foulkeways at Gwynedd (1959, not built), the North Penn Visiting Nurses' Association (1961-3) and the Haas Cottage, both in Ambler (1963; Figure 166), used "valid false façades" that also featured prominently on the poster for a talk at the Architectural League in New York in the early 1960s (Figure 167). However, the creation of a "difficult whole" found its most comprehensive manifestation in the Vanna Venturi House in Chestnut Hill (1959-64), which following the logics of the "decorated shed" juxtaposed a *blind* corresponding to contextual impulses with a *shed* adapting to programmatic needs.[623] The appended plan from July 1959 (Figure 168) conspicuously shows the detached wall fragments, but also 45° diagonals breaking the orthogonal order. Incidentally, the drawing stems from the same time that Kahn employed diagonals in the Goldenberg House.[624]

Alongside, Venturi embarked on a theoretical analysis of contemporary architecture that he published as *Complexity and Contradiction in Architecture* in 1966.[625] Kahn kept in his notes a first outline of Venturi's research, initially termed "Ideas of Reconciliation in Architectural Composition."[626] At the outset, Venturi tackled the issue of "The Inside and the Outside," referring to Le Corbusier's Villa Savoye (Figure 169) as a prime example:

> Its severe almost square envelope is juxtaposed on an intricate interior configuration glimpsed through openings and protruding above. A building often wants to be a space within a space, or a thing within a thing.

622 Interview by the author with Robert Venturi and Denise Scott Brown, 1 February 2008.

623 Accordingly, the façade as a screen communicated *house* on an urban scale, while the interior's programmatic distortions accommodated the more intimate aspects of *living*.

624 Kahn openly acknowledged that Venturi was "one of the most gifted men in the art of architecture. [H]is buildings are original and have the quality of permanence in time." Kahn's letter of recommendation for Venturi to the National Council of the Architectural Registration Board, 20 May 1963, 030.II.A.59.7, LIKC. That their relationship was based on mutual respect is indicated by a letter from Venturi's mother Vanna to Kahn concerning his recent obtainment of the Bryn Mawr commission in 1960: "[T]he capricious gods decided in favor of the best architect. [...] Bob commented just before he hung up, 'There is some hope for the world.'" 030.II.A.65.35, LIKC.

625 The research on *Complexity and Contradiction in Architecture* was largely sustained by Venturi's lectures on "Theories of Architecture" at the University of Pennsylvania since 1960.

626 Upon Kahn's suggestion Venturi sent John D. Entenza his outline "Ideas of Reconciliation in Architectural Composition" on 15 February 1962; Cf. 030.II.A.61.2, LIKC. The proposal "would be several things at once. It would be a work of criticism in the form of a book; by intention a relevant contribution to architectural thinking. It would be also an anticipated apologia; an explanation, by implication, of some ideas of my current work as an architect. At the least general level it would become an exercise through analysis and comparison, to clarify my own directions as an artist and teacher: a sort of manifesto for myself."

Fig. 166: Robert Venturi, Haas Cottage, Ambler, Pennsylvania, 1963 .

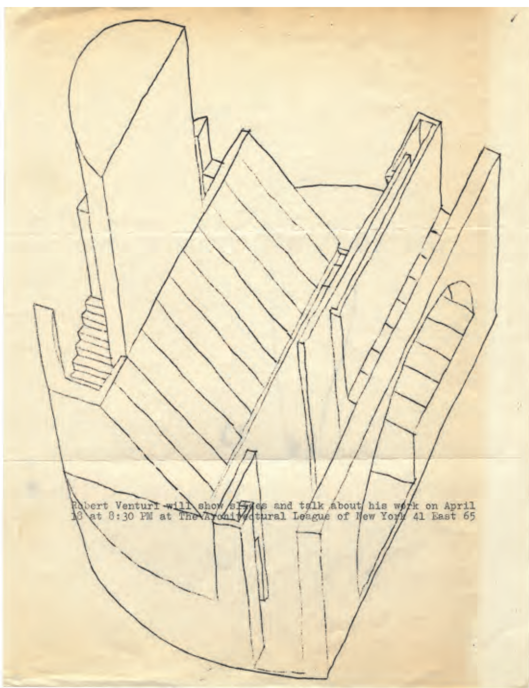

Fig. 167: “Valid false façades” on the Poster of Robert Venturi’s Lecture at The Architectural League, New York City, New York, 1966.

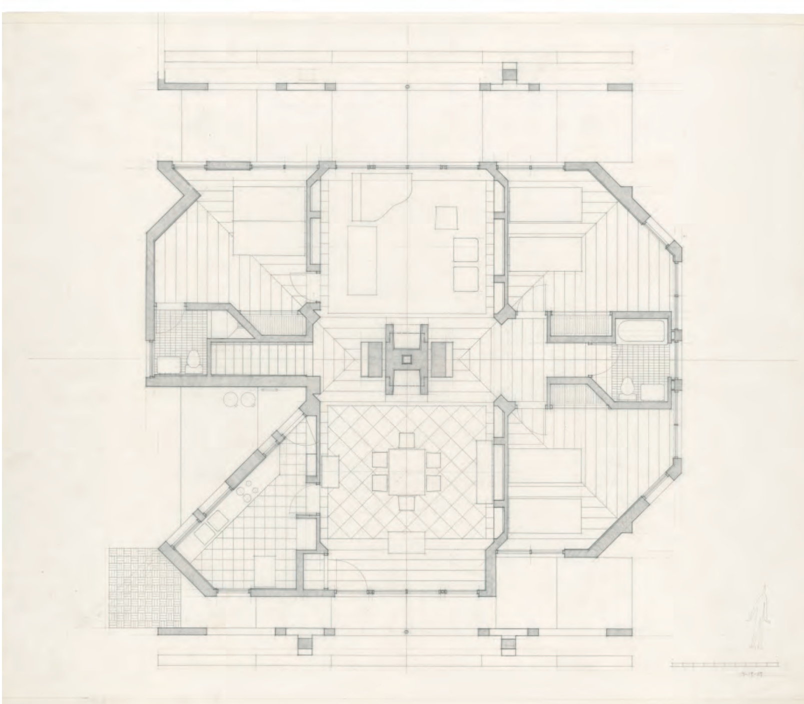

Fig. 168: Robert Venturi, Mother's House, Chestnut Hill, Pennsylvania, 1959-64.

Fig. 169: Le Corbusier, Villa Savoye, Garches, France, 1928-31.

Appreciating Le Corbusier as "master of the eventful exception,"[627] the Villa Savoye's inside adjusted to "multiple functions, domestic scale and partial mystery," while the outside expressed "the unity of the idea of house at an easy scale appropriate for its great field of grass."[628] Elaborating this idea, Venturi postulated:

> I tend to design from the outside in as well as the inside out. The necessary tensions help make architecture. Since the inside is different from the outside, the point of change is an architectural event. […] Architecture as the wall between the inside and outside becomes the spatial record of this resolution and its drama.[629]

With this focus on the in-between Venturi directly continued Van Eyck's deliberations, whom he overtly acknowledged.[630] Like the latter he also criticized the hitherto dominant emphasis on the inner premises guiding a project's morphological development:

> When Wright wrote, 'an organic form grows its structure out of conditions as a plant grows out of the soil, both unfold similarly from within', he had the impressive backing of Greenough, Thoreau and Sullivan. […] Even the urbanist Corbusier wrote: 'plan proceeds from within to without'. But Wright's biological analogy limits itself. The development of a plant is influenced by the particular forces of its environment as well as its intrinsic internal growth.

Venturi's organic morphogenesis took recourse to the theories of Thompson, who "saw form as 'a record of development in environment',"[631] and Kepes: "[E]very physical configuration is a product of the duel between native constitution and outside environment."[632] Referring to Alvar Aalto's architecture, Venturi argued that the Finnish architect's buildings with their paramount tendency to purposefully include the complexities of life "are circumstantial distortions which, like aberrations in biology, result from exceptions to a rule, or to a norm, or to an order."[633] However, the largest biological impact on Venturi's theory was due to Edmund W. Sinnott's *Problem of Organic Form* (1963). Recurrently citing from it, Venturi wrote, almost as

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627 Robert Venturi, "Princeton Lecture," 24 November 1964, VSB.502 "6607 Complexity + Contradiction, Yale/Penn Lecture Outlines, Notes, Exercises, Exams," VSBC.

628 Venturi, "Ideas of Reconciliation." Numerous further examples of "things in things" – like the Maritime Theater at Hadrian's Villa in Tivoli (118-34), John Soane's Bank of England in London (1788-1833), the screening loggia of Santa Maria Maggiore in Rome (1743) and the arcades surrounding the inner courtyard of Charles V's palace in Granada (1527) – are referred to in *Complexity and Contradiction*.

629 Robert Venturi, "Lecture II: Site and Context; the Inside versus the Outside," 26 January 1965, VSB.502 "6607 Complexity + Contradiction, Yale/Penn Lecture Outlines, Notes, Exercises, Exams," VSBC.

630 Cf. Venturi, *Complexity and Contradiction*, p. 84.

631 Cf. Thompson, *On Growth and Form*, p. 221.

632 Venturi, "Ideas of Reconciliation."

633 Venturi, "Princeton Lecture."

a paraphrase of the Villa Savoye's earlier description: "'The external configuration is usually rather simple, but there is packed into the interior of an organism an amazing complexity of structures [...].'" Another quotation clarified: "'A given gene does not control a specific trait, but a specific reaction to a specific environment.'"[634]

Venturi's further evolution cannot be understood without introducing his partner Denise Scott Brown (née Lakofski) to the discussion. Having studied architecture at the University of Witwatersrand, she transferred to the Architectural Association in London in 1952. As a self-defined "radical," she came under the spell of the Independent Group, and particularly the Smithsons' concept of an "active socioplastics."[635] After graduating in 1955, she married fellow South African architect Robert Scott Brown, and upon Peter Smithson's recommendation, "go wherever Louis Kahn is,"[636] they moved to Philadelphia in 1958. In Philadelphia, Scott Brown enrolled in the urban planning department, attended the lectures of McHarg's first "Man and Environment" series, besides becoming deeply influenced by the sociologist Herbert Gans and his current inquiries: "Can't you architects hold off your criticism of strips and sprawl just long enough to find out why people use them?"[637] Similar to the Smithsons, Gans' new objectivity was concerned with accepting the *status quo* and valuing its encroachments. If "dysfunctional" activities and urban patterns continued to exist, they obviously needed to be appreciated by someone. Appointed to the faculty in 1961, Scott Brown became the recipient of Kahn's "long, one-sided telephone calls,"[638] took the opportunity to have dinner with Van Eyck,[639] and met Venturi for the first time in 1960.

Five years later, Scott Brown transferred to the School of Environmental Design at Berkeley. There she embarked on an urban study of Las Vegas, whose strip had unleashed in her an "artist's shiver. All those bright and garish signs jostling one another in the brilliant sunshine – did I hate them or love them? I did both."[640] Venturi, whom she invited to lecture, visited the desert town with her and became similarly

634 Venturi, *Complexity and Contradiction*, p. 71. Cf. Sinnott, *Problem of Organic Form* (New Haven: Yale University Press, 1963) p. 44 resp. p. 116.

635 The "radical" students went to work in the Smithsons' office, since in the latters' opinion "radical architects did not teach." Interview by the author with Robert Venturi and Denise Scott Brown, 10 June 2009. Notably, her former art teacher in South Africa had already awakened her interest in the everyday landscape: "How can you be a creative artist if you don't respond to the landscape directly around you?" Scott Brown, "Towards an Active Socioplastics," in Denise Scott Brown, *Having Words* (London: Architectural Association, 2009) pp. 23-4.

636 Interview by the author with Robert Venturi and Denise Scott Brown, 1 February 2008.

637 Denise Scott Brown, "Learning from Brinck," in Chris Wilson and Paul Groth, *Everyday America: Cultural Landscape Studies after J. B. Jackson* (Berkeley: University of California Press, 2003) p. 51.

638 Denise Scott Brown, "A Worm's-Eye View of Recent Architectural History," in *Architectural Record*, vol.172, no.2, 1984, p. 73.

639 Interview by the author with Robert Venturi and Denise Scott Brown, 10 June 2009.

640 Scott Brown, "Learning from Brinck," p. 54.

spellbound by its commercial vernacular. It was precisely this twist, this positive or at least neutral reading of the products and features of the common landscape, which made Venturi and Scott Brown's theories appear so different at the time. While the writings of Blake and others had been bills of indictment, Venturi and Scott Brown regarded reality as "mostly terrible, but it could also be revealing."[641] One critical voice informing their ideas was J. B. Jackson, who in "Other-Directed Houses" had predated their ideological stance by more than a decade.[642] Viewing the American landscape from a positive-pragmatic angle, he noticed the

> potentialities for trouble – aesthetic, social, economic – are as great as its potentialities for good, and indeed it is this ambidexterity which gives the highway and its margins so much significance and fascination. But how are we to tame this force unless we understand it and even develop a kind of love for it?[643]

3.8 St Francis, the Lincean Academy and the Bay Region Style

Kahn's quest to integrate contextual forces pinnacled in the planning of the Salk Institute for Biological Studies in La Jolla between 1959 and 1965. As he recalled:

> The simple beginning requirement of the laboratories and their services expanded to cloistered gardens and studies over arcades and spaces for meeting and relaxation interwoven with unnamed spaces for the glory of the fuller environment.[644]

This "fuller environment" consisted of 27 acres on the Torrey Pines Mesa overlooking the Pacific from sandstone cliffs above a widening arroyo with wind beaten land, sparse greenery and sandy beaches (Figure 170). On his first site visit in January 1960, Kahn made again a series of sketches to *internalize* the landscape and requested the United States Department of Commerce once more to back him with a report on the local climatological data.[645] Additionally, he summoned his employee Galen Schlosser to deepen the contextual research, as the latter

> left for California […] to analyze the particular characteristics of the California environment and climate; the breeze, the light, the plants: in other words the whole site environment.[646]

641 Interview by the author with Robert Venturi and Denise Scott Brown, 10 June 2009.
642 Cf. Scott Brown, op.cit., p. 55. Venturi got to know Jackson in 1967 and Scott Brown in 1963 when he introduced her to Wagner's *The Human Use of the Earth* that "became a bible for me on landscape and culture." Ibid., p. 49.
643 John Brinckerhoff Jackson, "Other-Directed Houses," in *Landscape*, vol.6, no.2, Winter 1956-7, pp. 30-4.
644 Ronner, Jhaveri and Vasella, *Complete Work*, p. 144.
645 Cf. Report on "Local Climatological Data," 1960, 030.II.A.108.36, LIKC.
646 Latour, *l'uomo, il maestro*, p. 111.

Fig. 170: View from La Jolla Cove towards Torrey Pines Mesa, California.

The considerable time Kahn invested in learning about the site's characteristics suggests that he truly bent his consciousness to grasp the *genius loci* of the place. According to ancient belief, every location had its guardian spirit or in Kahn's terminology, its specific "will to be." For early man, before a tree went down, a mountain was mined, or a river was dammed, the spirits in charge were placated through conciliatory rituals. Architecture by setting up its foundations and rising into the air (Figure 171) came to embody a place's submerged energies. This task to construct a location was

Fig. 171: Louis I. Kahn, Salk Institute for Biological Studies, La Jolla, California, 1959-65.

also targeted, in phenomenological terms, by Martin Heidegger.[647] In "The Origin of the Work of Art" (1935) the German philosopher used the example of a bridge crossing a river to illustrate that the rivers' banks gathered meaning only through the bridge's existence. By consequence, architecture was the *making of places*, the turning of generic space into specific places, and the opening up of a world that had hitherto been inexistent.

With regard to the belief in an enlivened universe, it is noteworthy that Kahn's client Jonas Salk alluded to the 13th-century Monastery of St Francis in Assisi, which had captivated him during a visit in 1954 and which Kahn had sketched in 1929 (Figure 172), as a model for the new institution. In his "Canticle to the Sun" (1224), the monastery's patron – here depicted in the "Sermon to the Birds" in a fresco by Giotto di Bondone (1297-9; Figure 173) – had praised the sun, wind, air and fire as his brothers, the moon, water and birds as his sisters, and the earth, the Lord's sister, as his mother. An early ecological prophet, St Francis dethroned man from his limitless rule and installed a democracy of equal rights among all creatures. Besides this

647 Cf. Christian Norberg-Schulz, "Heidegger's Thinking on Architecture," in *Perspecta*, no.20, 1983, pp. 61-8.

Fig. 172: Louis I. Kahn, *Monastery of St Francis of Assisi*, Italy, 1929.

agreement upon a bond of unity pervading the natural world, Kahn and Salk agreed on the expressive nature of man. Beyond the lawful world of science, where Kahn argued the scientist was concerned "with measures and with the nature of nature,"[648] there lay an immeasurable sphere of poetic potential. Instead of dissecting life, art created new life, or as Kahn put it in 1964: "Science finds what is already there, but the artist makes that which is not there."[649] Based on this central dichotomy – on the one side a deep respect for all natural phenomena, and on the other a strong belief in the sovereignty of man's creative powers – the two men, transcending the limits of science and art, discovered a common footing that should attract like-minded *Renaissance Men*.

That Salk, who like Kahn was born to Eastern European Jewish immigrants, and who had achieved nationwide fame through his discovery of a vaccine against *poliomyelitis*,[650] carried such a composite ideal in mind becomes apparent when

648 Kahn, "A Statement," p. 18.

649 Kahn, "Talk with Students," p. 157. For Kahn this shared enthusiasm became apparent when Salk summoned up the program by stating that he imagined Picasso as a future resident (p. 163): "He said, 'There is one thing which I would like to be able to accomplish, I would like to invite Picasso to the laboratory.' He was implying, of course, that in science, concerned with measurement, there is this will of the least living thing to be itself." Notably, Salk married the artist's former muse Françoise Gilot in 1970.

650 Salk was nominated for the Nobel Prize in 1954, which went to John Enders, however, for having

Fig. 173: Giotto di Bondone, *Sermon to the Birds*, Basilica of St Francis of Assisi, Italy, 1297-9.

perusing the booklets that were prepared during the institute's planning. "Man's Potential," for instance, demanded "unification of knowledge fundamental to an understanding of the processes of life," and warned: "Having begun to subdue nature, man now exceeds nature as an obstacle to his own progress and a threat to

discovered the mechanisms to grow under laboratory conditions the polio-virus. The mayor of San Diego, Charles Dail, had been crippled by polio as a child. Cf. Victoria Sherrow, *Makers of Modern Science: Jonas Salk* (New York: Facts on File, 1993).

his own survival." The same pamphlet placed the institute's aims in comparison with historical models: first of all Bacon's "House of Solomon," besides paying tribute to Galilei and his colleagues at the Accademia dei Lincei in Rome (founded in 1603; Figure 174), which had extended "the Platonic tradition from mere contemplation of nature to actual investigation."[651]

In 1962, the institute's initial faculty was announced, consisting of ten scientists including Crick, recipient of the same year's Nobel Prize in medicine; the Hungarian Leo Szilard who with Enrico Fermi had devised the first American chain reaction system in 1942; Jacques Monod, a distinguished French biochemist; and Jacob Bronowski, a British mathematician, scholar of William Blake and best known for his "Ascent of Man" series produced for the BBC in the 1970s.[652] The latter's role was to devise a department concerned with "the study of human aspirations and values, seen as a natural expression of the biological nature of man."[653] For Salk the work at the frontiers of biological research necessarily raised broad questions about the future of humanity. In *The Survival of the Wisest* (1973), he stated:

> Man has evolved so successfully that he is now to be tested for his capacity to 'invent' appropriate means to limit the harmful or lethal excesses of which he is capable.[654]

Right "judgment" was inevitable in Salk's opinion, since "Man and Nature together are now, in effect, the joint authors of the human predicament."[655]

Kahn's intention to create a climatologically well-adapted building belonged to a longstanding tradition in the region. Parallel to his efforts, Charles Moore and Joseph Esherick with the help of the landscape architect Lawrence Halprin designed the Sea Ranch community on the north coast of San Francisco (1963-72).[656] Aspiring to create an environmentally fit ensemble, together with the geographer Richard Reynolds a

651 Cf. "Man's Potential," n.d., no author, published by the Salk Institute of Biological Studies, 030.II.A.108.20, LIKC. Alongside, the *Accademia del Cimento* (1657) in Florence, the Royal Society of London (1662) and the *Académie Royale des Sciences* (1666) comprised a lineage that should be continued in San Diego.

652 Cf. "Faculty Members: The Salk Institute for Biological Studies," 030.II.A.108.20, LIKC.

653 From a memo including Bronowski's biography and tasks, n.d., 030.II.A.108.56, LIKC.

654 Jonas Salk, *The Survival of the Wisest* (New York: Harper & Row, 1973) pp. 2-4.

655 Ibid., p. 117.

656 Kahn first encountered Moore in 1955, while the latter was an assistant of Peressutti at Princeton. After finishing his dissertation on "Water and Architecture" (1954-7), Moore began to teach at his *alma mater* and invited Kahn as his master thesis advisor. Subsequently, Moore and four students drove one night a week to Philadelphia to discuss their projects in Kahn's office. Cf. 288.1.106, RSWC. In 1959, he returned to his native California to become associate professor at the newly founded School of Environmental Design at Berkeley, where Kahn would occasionally lecture as well. The influence of Kahn on Moore's early projects was decisive: the principle of spatial layering characterized the light wells of his house in Orinda (1962), the baldachins in the Sea Ranch Condominium (1964-5), and the screens of the Faculty Club for the University of California in Santa Barbara (1966-8).

The great British prophet of modern experimental science was Lord Francis Bacon, an Elizabethan herald of the future of man and a visionary advocate of scientific institutes.

Bacon bespoke man's ascendance to conscious sovereignty over nature, a position achievable only by nations free to question the doctrines of the past. He championed

a concerted quest for demonstrable truth, the stuff of freedom, and he argued that truth, when discovered, must not be allowed to moulder on the bookshelves of the few but must be applied to the affairs of humanity. Toward

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Fig. 174: Accademia dei Lincei in the Salk Institute's pamphlet "Man's Potential," early 1960s.

thorough analysis of the flora and fauna, soil permeability, water and topographical features, sun, wind and rain patterns was performed to define a whole inventory of ecological criteria for future building actions. Consequently, lines of cypress hedgerows acting as windshields segmented the coastal grassland, while the houses' pitched gable and shed roofs echoed the "Monterey deformation" of the wind-bent trees (Figures 175, 176).

Fig. 175: "Monterey Deformation".

Fig. 176: Charles Moore and Joseph Esherick, Sea Ranch Community, Coast of San Francisco, California, 1963-72; Landscape Design by Lawrence Halprin.

Since the late 1940s Esherick's office, which acted as a sort of relay station for Kahn at the beginning of his contract, carried out sun shading and wind tunnel studies to define a climatically *appropriate* Californian architecture.[657] Mumford advanced the idea of a "Bay Region Style" in 1947, recognizing that these "native and humane" Modernists were able to achieve "a free yet unobtrusive expression of the terrain, the climate, and the way of life on the Coast."[658] Among these, across the street from Irving Gill's futuristic Dodge House in West Hollywood (1911-6) – a cubic composition that penetrated asymmetrically into the landscape and employed a keyhole window in the entrance portico as well as free-standing *ruins* to surround an annexed courtyard[659] – Rudolph Schindler, Wright's former project manager in the area, built a meandering, the garden with *shoji*-like walls interlocking home and studio (1921-2). Also Schindler's wooden houses on hillside plots in Los Angeles, superbly tucked into the surrounding topography, should be distinguished besides his progressive concrete structures like the Lovell Beach House at Newport Beach (1926). His younger compatriot, Richard Neutra,[660] in his later designs like the Tremaine House in Santa Barbara (1947-8; Figure 177), often employed Wrightian pinwheel plans paired with a Modernist formal canon to make the surrounding gardens an integral part of the interior atmospheres.

In 1957, the Austrian architect warned in *Perspecta* that "lasting comfort hangs on the nourishing navel cord of natural circumstances, which must not be cut off carelessly." He concluded that man and all his organic ancestry had "survived by

657 Cf. Marc Treib, *Appropriate: The Houses of Joseph Esherick* (San Francisco: William Stout Publishers, 2008). Esherick, the brother of Margaret and the nephew of Wharton, had like Kahn, studied under Cret and founded his office in San Francisco in 1946. Cf. Esherick's letter to Kahn, 27 February 1961, 030.II.A.34.12, LIKC.

658 Lewis Mumford, "The Sky Line: *Status Quo,*" in *The New Yorker*, vol.23, 11 October 1947, p. 99. This movement is usually divided into two generations, the first consisting of Bernard Maybeck, Julia Morgan, Bertram Goodhue, Charles and Henry Greene, besides Irving Gill; and the second including the Austrian architects Rudolph Schindler and Richard Neutra, Esherick, Harwell Hamilton Harris and William W. Wurster. Kahn was quite frequently in contact with Wurster, the husband of Catherine Bauer and dean at the School of Architecture in Berkeley; Cf. 030.II.A.54.22, LIKC. Emphasis in the first generation should be placed upon the work of the Greene brothers, who, influenced by the East coast's Shingle Style, achieved a similar conflation of the interior and the exterior.

659 Irving Gill, two years younger than Wright, had worked like his friend for Joseph Silsbee in Chicago before entering the office of Adler and Sullivan in 1891, which he left after two years due to health issues. He moved to San Diego, where the cubic outlines of his buildings forestalled the work of Adolf Loos. Overall, Gill intended his pioneering reinforced concrete architecture to be "simple, plain and substantial as a boulder, then leave the ornamentation of it to Nature, who will tone it with lichens, chisel it with storms, make it gracious and friendly with vines and flower shadows as she does the stone in the meadow." Gill, "The Home of the Future: The New Architecture of the West: Small Homes for a Great Country," in *The Craftsman*, May 1916, pp. 140-51. Cf. Esther McCoy, *Five California Architects* (New York: Praeger Publishers, 1975).

660 Richard Neutra, a former attendee of Loos's evening sessions, had worked in Switzerland for Karl Moser and in Germany for Erich Mendelsohn before immigrating to the United States, where he was shortly employed by Sullivan and met Wright at the former's funeral.

Fig. 177: Richard Neutra, Tremaine House, Santa Barbara, California, 1947-8.

adaptation to the outer universe."[661] Already six years earlier, in *Mystery and Realities of the Site*, he had called for an architecture attuning itself to the potentials of the given place. Neutra realized in contrast to his earlier fascination with the United States' industrialization in *How America Builds* (1926) that the "wished-for effects have been deeply overshadowed by unforeseen by-products and sorry after-effects."[662] The belief that the human race was becoming self-destructive figured centrally in his compilation *Survival through Design* (1954). Questioning the division between the natural and the man-made, he inquired: "Is man really separable from the world at large so that he can act upon it?"[663] At least for Neutra the answer was clear: "Neither physically nor biochemically nor sociologically can the individual really be segregated or isolated as a separate entity."[664]

661 Richard Neutra, "Notes to the young Architect," in *Perspecta*, no.4, 1957, pp. 50-3.
662 Richard Neutra, *On Building: Mysteries and Realities of the Site* (New York: Morgan & Morgan, 1951) p. 14.
663 Richard Neutra, *Survival through Design* (New York: Oxford University Press, 1954) p. 9.
664 Ibid., p. 12.

3.9 Elements as Form versus Elements as Force

In 1962, Kahn described the emerging design of the Salk Institute as being developed "out of a respect and understanding of the nature of nature."[665] With "nature of nature" he no longer implied an abstract Renaissance understanding of the term – the more Platonic *natura naturata* that regarded the elements primarily as *form* – but rather emphasized the potential of the classical elements earth, water, air and light to guide the design process in direct-pragmatic and phenomenological-poetic terms – something more related to the Aristotelian *natura naturans* and its focus upon the elements as *force*. Accordingly, Kahn verified that he was at present "becoming increasingly conscious of the architecture of water, the architecture of air, the architecture of light [...]."[666] Further explaining his appreciation of the natural elements, Kahn described the planning of Besor, a town of 50,000 people in Israel:[667]

> It began with the gathering of rainwater, which happens at certain points at certain times of the year, which goes to the reservoirs and the town was formed in this way rather than by the not too deeply thought out development, which would look more like the ordinary way of approaching it. But with the consciousness of the light, given by the closeness of the buildings to each other, and the spacing of the courts, in such shapes as to cause a venturi, there was an architecture of the air, there was an architecture of the water and of the light, form which perhaps the architecture begins.[668]

With similar ideas in mind, in the Salk Institute's initial scheme Kahn elaborated three building groups: on top of the main arroyo he placed the laboratories, on its eastern side the scientists' residences, and on the western exposure a meetinghouse (Figures 178, 179). Due to financial problems, the further planning of the meetinghouse – inspired in its volumetric juxtaposition by Hadrian's Villa and intended to be the focal point of the humanistic part of the program – but also the residences halted in 1963. Nonetheless, concerning the "wrapping of ruins around buildings" these entities continued Kahn's credo to define the wall as an intermediary element. The meetinghouse did so most stringently: its dining rooms, seminaries and lecture halls were either placed as cubic volumes within cylindrical *ruins*, or as cylinders within cubic envelopes (Figure 180). Again, these "anti-glare walls" were designed to temper

665 Louis I. Kahn, "Law and Rule in Architecture;" lecture held at the R.I.B.A. in London, 14 March 1962, 030.II.A.53.4, LIKC.
666 Ibid.
667 In the fall of 1961, Kahn had received the commission through the mediation of the Israeli architect Ram Karmi. Cf. Solomon, "Secular and Spiritual Humanism," p. 215.
668 Kahn, "Law and Rule in Architecture." Generally speaking, windward facing walls are high-pressure areas, while the leeward side is a low-pressure zone. Since air flows from higher to lower pressure zones, the leeward side acts as a suction area causing a *venturi*. Placing small wind-inlets on the windward and larger outlets on the opposite side increases the effect.

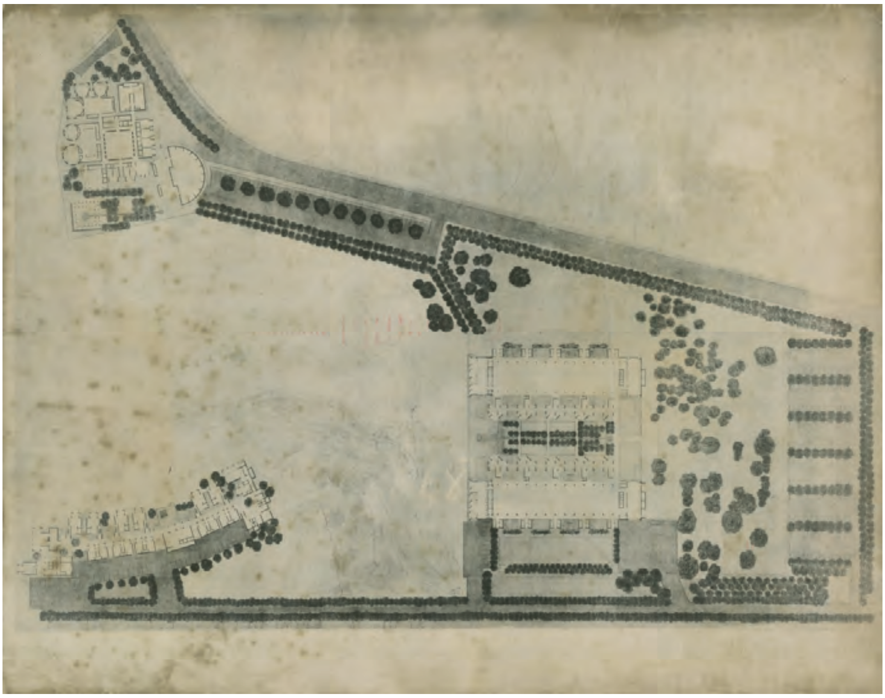

Fig. 178: Landscape Design by Roland S. Hoyt (1962); with later Help on the Courtyard by Lawrence Halprin and Luis Barragan.

Fig. 179: Louis I. Kahn, Salk Institute for Biological Studies, La Jolla, California, 1959-65.

the dazzling sunlight albeit without compromising the view and the possibilities of circumnavigation. Kahn stated in 1962: “You see no glass; you see only the walls that are modified with the wind and the glare; so there is an architecture of wind and of light […].”[669] Obviously, the elimination of glass, the Modernist material *per se*, made the structures appear as being surrounded by incomplete hollow shells that remained as *ruins-in-reverse* ambiguously open as to whether they were still under construction, in use or already abandoned.[670]

Characteristically, Kahn made countless sketches to convey a feeling of the institute’s future ambiance. Incidentally, in their compositional arrangement these drawings followed closely the renderings of Claude Gellée called Le Lorraine. As is recognizable in Kahn’s perspective with a residence vestibule in the foreground (Figure 181), the freestanding wall-structure, like Le Lorraine’s Corinthian temple (1637; Figure 182), framed the view towards the vaster pastoral scenery. Furthermore, in both cases, groups of people and smaller natural features directed the viewer’s gaze into the canvas’ depth. Evoking a feeling of quiescent peacefulness and ethereal solemnity, Le Lorraine like Kahn tried to grasp the secret allure of a grand and mythological nature.[671] Kahn was well aware of the painter, since in the early 1960s he handed Harriet Pattison, a landscape architect and close affiliate of his a book of the French painter’s drawings, which, as she remembered, he continued to look at abundantly.[672] Kahn’s shift to appreciating the peculiar characteristics of a site and his general transfer towards an architecture of adaptation that recognized in the natural elements important resources to negotiate and structure the interaction between man and the surrounding world coincides with his first meeting of her in late 1958.[673]

A native of Chicago, Pattison had attended the Francis W. Parker School that was based on the progressive educational doctrines of John Dewey,[674] and developed

669 Ibid.

670 Cf. Levine, “The Architecture of the Unfinished and the Example of Louis Kahn,” pp. 323-42; and Stanislaus von Moos, “Ruins in Reverse: Notes on Photography and the Architectural ‘Non-Finito’,” in Von Moos, (ed.), *Chandigarh 1956* (Zurich: Scheidegger & Spiess, 2010) pp. 45-66. The term “ruins-in-reverse” is borrowed from Robert Smithson, who assessed: “This is the opposite of the ‘romantic ruin’, for the buildings don’t fall into pieces after having been built, but they rise to the status of ruins before being built.” Smithson, “The Monuments of Passaic: Has Passaic Replaced Rome as the Eternal City?,” in *Artforum*, vol.VI, no.4., 1967, p. 50.

671 Cf. Walter Friedlaender, *Claude Lorraine* (Berlin: Paul Cassirer, 1921) p. 160.

672 Interview by the author with Harriet Pattison, 13 June 2009. The compendium referred to is Marco Chiarini, (ed.), *Selected Drawings of Claude Lorraine* (Philadelphia: Penn State Press, 1968).

673 In December 1958, Kahn was introduced to Harriet Pattison at a Christmas party hosted by Wharton Esherick. Cf. William Whitaker, “Chronology,” in Von Moos and Eisenbrand, *The Power of Architecture*, p. 26. They had met once before in New Haven during the early 1950s, when Kahn informally talked with a group of art students in the Waldorf cafeteria. Cf. Charles A. Birnbaum, *Harriet Pattison: Oral History* (Washington, DC: The Cultural Landscape Foundation, 2016) p. 25.

674 In Bergsonian terms John Dewey argued that the intrinsic nature of events was only revealed in immediately felt experience. In the forward to *Experience and Nature* (1925, p. iii), he wrote:

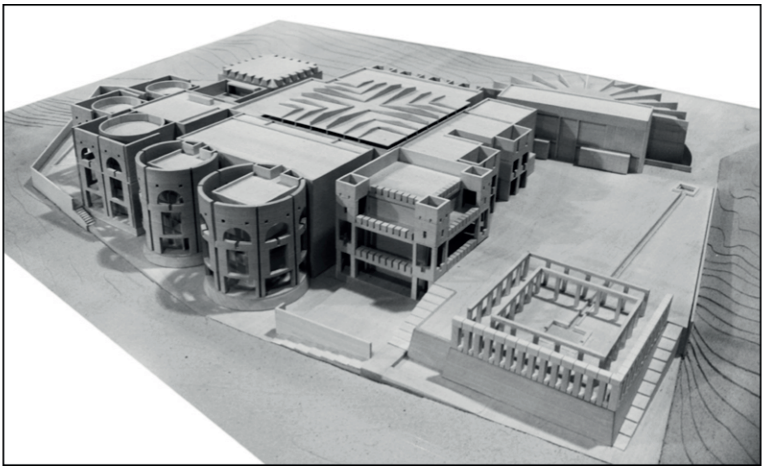

Fig. 180: Louis I. Kahn, Salk Institute for Biological Studies, La Jolla, California, 1959-65.

Fig. 181: Louis I. Kahn, Salk Institute for Biological Studies, La Jolla, California, 1959-65.

“Experience is not a veil that shuts man off from nature; it is a means of penetrating continually further into the heart of nature.”

Fig. 182: Le Lorraine, *Corinthian Temple*, 1637.

an early likening for Wright's local architecture and the arts. After studying stage design in the early 1950s at the Yale drama school, Pattison left for a one-and-a-half year sojourn to Europe with the "official excuse" to study philosophy in Edinburgh, although she went on to spend large amounts of time traveling. She became mesmerized by the classical gardens of England, Spain, Italy and France; realizing that "these landscapes were 'real' paintings."[675] After her return to the United States, Pattison began to work upon Kahn's recommendation as an apprentice in Kiley's office,[676] before enrolling in the landscape department at the University of Pennsylvania (1964-7) – a time when she also worked for Patton, her "master," who had his office underneath Kahn's.[677]

As Pattison recalls, when she met Kahn he "was really an urban man, yet with a heightened sensitivity for nature."[678] As in Kahn's earlier auspicious encounter with Tyng, their friendship was marked by a fertile exchange of ideas, many books – for

675 Interview by the author with Harriet Pattison, 13 June 2009.
676 Cf. Birnbaum, op.cit., p. 33.
677 Cf. Kahn's letter to McHarg recommending Pattison to enter the School of Fine Arts as a student in Landscape Architecture, 18 September 1964, 030.II.A.55.63 LIKC.
678 Ibid.

example, Kahn gave Pattison – besides the compendium of Le Lorraine's drawings – Charles Eliot's *Autobiography* (1902), *History of Garden Art* (1928) by Marie-Luise Gothein, *English Gardens* (1925) by H. Avray Tipping, and *España: Castillos y Alcázares* (1956) by Jose Ortiz Echagüe; while in return, she introduced him to the works of Le Nôtre, Gertrude Jekyll and Beatrix Jones Farrand, but also *Italian Gardens of the Renaissance* (1925) by John Shepherd and Geoffrey Jellicoe with its delicate plans dissolving the borders between the architectural and landscape-architectural intervention. In sum, Pattison decisively helped to redirect Kahn's architecture from one being mainly designed from the inside out towards one integrating the environmental givens: she emphasized the moment of a building's meeting with the ground, the necessary appreciation of building and site as a unified whole, and the accommodation of outdoor spaces complementing the inner ones.

While Pattison figured as a "companion of thoughts" in most of Kahn's upcoming projects, he would receive direct help in the design of the Salk Institute's landscape architecture from Roland S. Hoyt, a former associate of the Olmsted Brothers landscape firm. Besides him, who mostly assisted Kahn in the appropriate selection of plants as well as the design's final execution and maintenance,[679] Halprin became involved as well, whom Kahn had met through Esherick in 1959.[680] Halprin had earlier worked for Thomas Church, the doyen of California's landscape architects and innovator of "outdoor living rooms." It was Halprin's garden layout for Esherick's McIntyre House in Hillsborough (1961) with its intricate network of water courses on several levels that touched upon a theme that would also preoccupy Kahn:[681] already pivotal in Angola, in the Salk Institute, too, water and vegetation elements should temper the climate, activate the open spaces and unify the buildings with the site and with each other.

Consequently, long *allés* of formally planted trees flanked the roads from the laboratories towards the meetinghouse and framed the entire composition, while in the immediate surroundings of the different building entities the trees were supposed to be planted more loosely. In both the forecourt of the meetinghouse, surrounded by a double-layered roofless peristyle pillar structure, and the inner courtyard of the laboratories, Kahn envisioned narrow water canals to invigorate the open plazas with splashing sounds and constant movement. In the case of the laboratories, the central rill was flanked in its intermediary stages by cypress trees that continued in their formal arrangement the building's inner organization (Figure 183). To resume Kahn's

679 Cf. Hoyt's preliminary plant list, 21 November 1961, 030.II.A.27.21, LIKC; and John MacAllister's letter serving Hoyt as a guideline in his "selection of appropriate plant materials," 30 September 1965, 030.II.A.108.42, LIKC.

680 Cf. Joseph Esherick's letter to Kahn, wherein he informed him that Halprin would call him in Philadelphia, 20 June 1959, 030.II.A.34.12, LIKC.

681 In architectural terms, the McIntyre House clearly approached the Trenton Bath House, as it was segmented into smaller entities all crowned by pyramidal roofs.

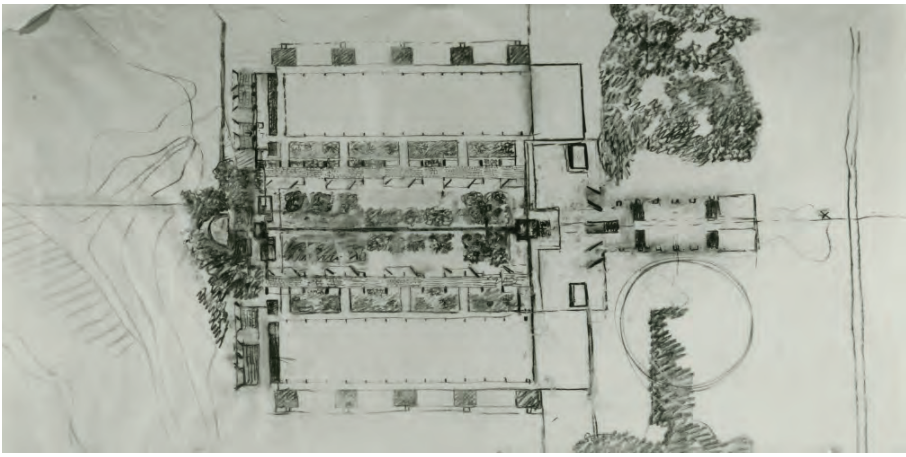

Fig. 183: Louis I. Kahn, Salk Institute for Biological Studies, La Jolla, California, 1959-65.

aforementioned quotation, in which he considered the Institute's architecture as one of light and air, he thus added one of water, too:

> In the San Diego project, the rainwater, scarce as it is, is gathered in a cistern and then sent up to a higher point where it is distributed by gravity, and these pools are linear and shaded by trees so that evaporation does not too quickly occur. This is a kind of design out of respect and understanding of the nature of nature.[682]

Precedents for these water channels can not only be found in Halprin's garden, however, but also in a series of Mughal examples that Kahn saw at the time – for instance, in the surrounding gardens of Humayun's Tomb in New Delhi (Mirak Mirza Ghiyath, 1556-72; Figure 184), the Lalbagh Fort in Dkaha (under Prince Muhammad Azam, commenced 1678) or the Shalimar Gardens in Lahore (under Shah Jahan, 1641-2).[683] Furthermore, Kahn brought a book on Moorish courtyard designs to the office and

682 Kahn, "Law and Rule in Architecture."

683 In the Islamic tradition two broad strategies existed to structure the environs: on the one hand, the centrifugal *bagh* surrounding a palace, pavilion or mausoleum followed the *charbagh* tradition, whereby the gardens' quadrilateral order was in a recursive manner further subdivided to establish a grid to irrigate the fragrant vegetation and provide shaded promenades. The resulting landscapes symbolized the "manifest" (*al-zahir*) and "immanent" (*tashbih*) aspects of the Divine emanation. On the other hand, the centripetal *sahn* or "inner courtyard," usually square in outline and annexed to mosques and theological colleges, was more restrained, i.e. without ancillary vegetation and with only a central fountain for ablution. Its abstract invocations of nature represented the "hidden" (*al-batin*) and "transcendent" (*tanzih*) dimensions of the incombustible Deity. In sum, the Islamic gardens as verdant oases within their usually hostile desert environments came to symbolize a glimpse of

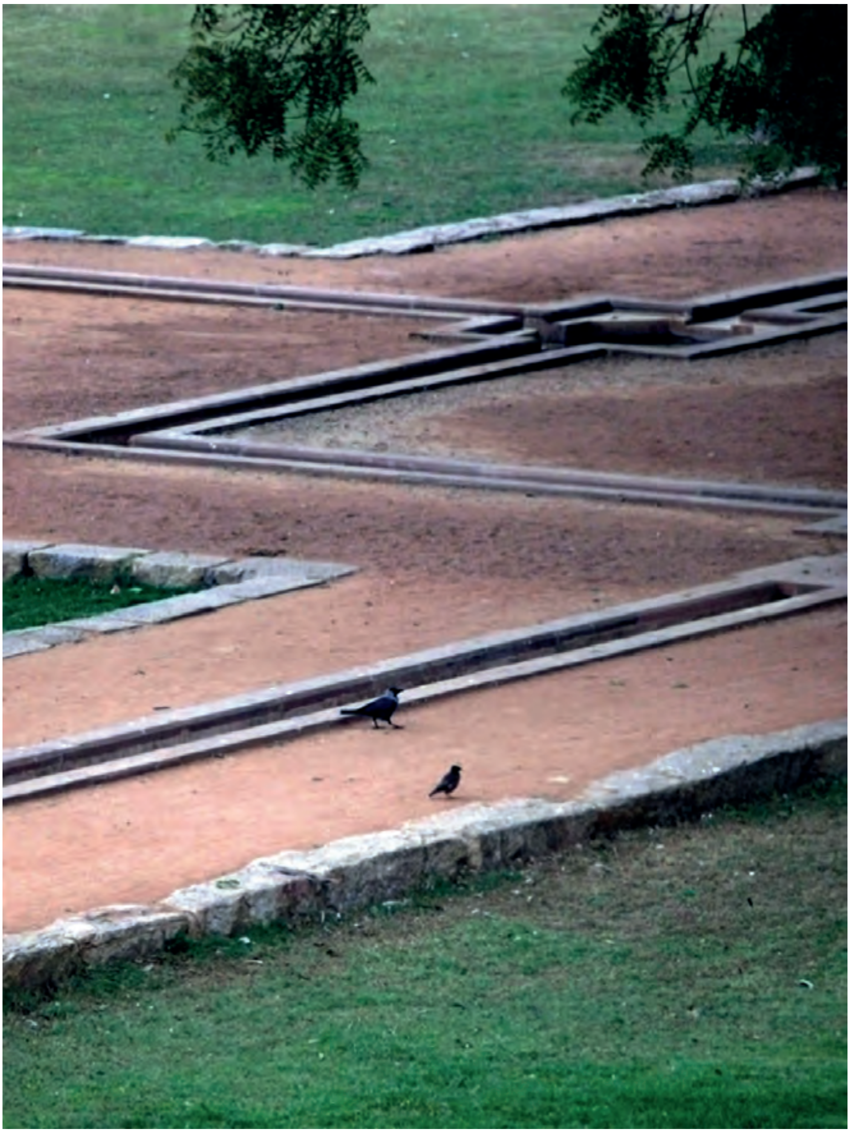

Fig. 184: Mirak Mirza Ghiyath, Humayun's Tomb, New Delhi, India, 1556-72.

paradise in a dual sense, as they were places of direct physical renewal, but also offered spiritually a foretaste of the abiding home promised to the righteous. Cf. Nader Ardalan, "'Simultaneous Perplexity:' The Paradise Garden as the Quintessential Visual Paradigm of Islamic Architecture and Beyond," in Attilio Petruccioli and Khalil K. Pirani, (eds.), *Understanding Islamic Architecture* (London: RoutledgeCurzon, 2002) p. 10.

Fig. 185: Patio de los Naranjos, Cordoba, Spain, 10th century.

asked John MacAllister, the project manager, to visit on an upcoming trip to Europe the celebrated Patio de los Naranjos in Cordoba and Seville (Figure 185; photographs by Patton), where the rills, just as in Kahn's case, watered the shade-giving orange trees and echoed the building's interior pillar structure.[684] MacAllister was also to investigate the tranquil patios and gardens of the Alhambra fortress in Granada (13th and 14th century). Its Patio de los Leones (1362-91; Figure 186) with canals penetrating from a central fountain along four perpendicular axes into the surrounding pavilions must be regarded as a direct antecedent of Kahn's peristyle courtyard. To heighten its influence, in Kahn's intermediary scheme the main plaza's canal first formed a cross as well, before tumbling down a straight axis. Reminiscent of several passages from *Genesis*, a life-sustaining river issued forth in Eden to water the Garden, where it divided into the four branches of Pison, Gihon, Hiddekel (Tigris) and Euphrates.

Functionally adhering to the organizational precept of differentiation, Kahn's two laboratory blocks symmetrically framed the central plaza, while each was further subdivided into the actual research areas and annexed studies that overlooked the courtyard. This separation into more public and private areas apparently followed the ideal of a *cenobium*. In each of the Salk Institute's studies, the otherwise relentless geometrical ordering of the whole composition – the outline of the entire intervention

684 Pattison might have induced Kahn's fascination for Moorish gardens, since she considered them the "most romantic places" she had seen during her stay in Europe. Interview by the author with Harriet Pattison, 13 June 2009. Cf. Marc Treib, "To End a Continent: The Courtyard of the Salk Institute," in *Journal of the Society of Architectural Historians*, vol. 65, no.3, September 2006, p. 411.

Fig. 186: Patio de los Leones, Alhambra, Granada, Spain, 1362-91.

was square, while further square, Golden Section- and √2-values proportioned the individual elements[685] – was interrupted by oblique walls facing the Pacific. These enhanced privacy and oriented the entire complex towards the ocean. In section, the separated studies, reachable only via covered decks and bridges, were raised a level to be on equal height with the laboratories' mechanical installation chambers.

685 Cf. Gast, *The Idea of Order*.

Fig. 187: Louis I. Kahn, Salk Institute for Biological Studies, La Jolla, California, 1959-65.

Because of this half open and half closed disposition (Figure 187), the Institute's façades towards the plaza appeared fragmentary and activated an intensified play of light and shadow.

Contrasting the porosity of the studies, the laboratories were completely sealed off and no air entered them without first being artificially treated.[686] Resuming the tradition of the universal space, the working areas were column-free to afford a maximum of flexibility (Figure 188), while their ceilings as interstitial floor-high Vierendeel spaces contained all the necessary serving utilities (Figure 189). Salk recalled, the edifice "was built with an evolutionary plan in mind; the capacity to adapt and to change is an integral part of the structure itself."[687] In Kahn's words, the functional strategy of spatial individuation derived "from what Dr. Salk called the mesenchyme space. One serves the body, and one is the body itself."[688]

Besides these organizational considerations, the structural system of the Laboratories was optimized with the aid of Komendant. Abrogating an initial solution of prefabricated and pre-stressed box-truss girders with folded concrete plates, the

686 Cf.Fred S. Dubin's description of the proposed mechanical systems, 8 June 1961, 030.II.A.27.21, LIKC.

687 Jonas Salk, "L'architettura della realità," (Architecture of Reality) in *Rassegna*, vol.VII, no.21, 1985, p. 28.

688 Louis I. Kahn interviewed by Peter Blake, 20 July 1971, in Wurman, *What will be has always been*, p. 130. Halprin noted that Salk considered the institute as "a body – functions are separated but all working together." "Dr. Salk on the Salk Institute," 014.I.A.2323, LHC.

Fig. 188: Louis I. Kahn, Salk Institute for Biological Studies, La Jolla, California, 1959-65.

Fig. 189: Louis I. Kahn, Salk Institute for Biological Studies, La Jolla, California, 1959-65.

actual design was all cast-in-place.[689] With respect to the dangerous seismic conditions, Kahn's engineer took three precautions: first, he placed between the Vierendeel elements and their supporting columns lead-zinc-covered steel-plate interfaces which allowed partially free rotary movements in the event of seismic overloading. Second, posttensioned vertical steel-bars within the pillars were tied together with the ends of the trusses' reinforcement in the lower tension section to resist the lateral forces' negative moments. Lastly, a tapered cross-section of the Vierendeel trusses reduced the beams' dead load in order to make the section more efficient.

Komendant also assisted Kahn in obtaining the desired quality of concrete, since left exposed towards the outside for the first time in Kahn's career, it would decisively determine the buildings' character and sensual appeal. Fred Langford, supervisor of the concrete works, in a letter to the Fuller Construction Company emphasized in Kahn-like parlor:

> We must make the concrete in this building say 'I am expressive of the hands and forms that held me in place until I could grasp my inner steel and gain the strength and power that I now possess; that I must possess to hold back the tremendous earth pressures with my retaining walls, to span the laboratories in a single leap, to lift the studies to the grand view of the sea, and still be friendly enough to touch with human hands.'[690]

In order to ameliorate its quality, a report dissecting the work into seven phases – formwork drawings, formwork make-up, formwork setting, placing of concrete, formwork stripping, curing of concrete, cleaning of concrete – was prepared, and a testing laboratory was installed to compare in a series of trials different mixtures and formwork arrangements.[691] Ultimately, following the example of Le Corbusier's Carpenter Center in Cambridge, Massachusetts (1961-3), Kahn also employed large plywood sheets, which at their junctions were chamfered at 45° angles to create V-shaped grooves.[692], On the one hand, this created a delicate relief of fine shadow projections (Figure 190), and on the other, it enabled the release of excessive bleeding. Particular care was invested in determining the concrete's color, which in order to create an architecture of earth should "blend with the natural soil and surrounding."[693] To

689 Cf. Komendant's letter to Kahn explaining the structural system, 27 January 1962, 030.II.A.26.12, LIKC; and "Unbonded Stressteel Bars provide Seismic Protection to Salk Laboratory," in *Technical Bulletin: Stressteel Corporation*, no.21, August 1966, 030.II.A.108.57, LIKC.

690 Fred Langford's letter to Greer Ferver of the Fuller Construction Company, 5 April 1963, 030.II.A.89.3, LIKC.

691 Cf. Report on "Concrete Specifications," no author, 23 December 1963, 030.II.A.107.19, LIKC. A more detailed pamphlet was drawn up a year later by Langford: "Report on Concrete Work – Salk Institute for Biological Studies," 23 March 1964; Cf. 030.II.A.107.7, LIKC.

692 Cf. Anna Rosellini, *Louis I. Kahn: Towards the Zero Degree of Concrete, 1960-1974* (Lausanne: EPFL Press, 2014) p. 11.

693 Cf. Letter from Jonas Salk's employee D. L. Harvey to Kahn's office, 25 October 1962, 030.II.A.107.36, LIKC. The geological report "Soil Investigation for the Proposed Instituted for Biology"

Fig. 190: Louis I. Kahn, Salk Institute for Biological Studies, La Jolla, California, 1959-65.

obtain the desired attunement, lastly *pozzalan* – a volcanic high-strength cement that the Romans had already employed as binding material in their *opus caementicium* – found application, while the formworks were coated with six layers of polyurethane resin to guarantee a smooth finish. Monolithically coupled with Roman travertine as the second major surface material – installed sawn-faced and without polishing to express the stone's authentic character – Kahn later affirmed:

from 16 October 1961 described the rocky sandstone landscape as having an ochre hue; Cf. 030. II.A.107.4, LIKC.

> There's something about nature's making of the materials – somehow there's more sympathy amongst materials, a cross-sympathy of materials in nature [...].[694]

Compared to these meticulous efforts to control the Salk Institute's constructive ornament, Kahn intentionally retained minor marks or "fossils" which evidenced the construction process.[695] Already in 1957, he had stated:

> In a building these details should not be put in a mitten and hidden. Space is architectural when the evidence of how it is made is seen and comprehended.[696]

The modularity of the applied formwork panels ultimately bound the entire design together and achieved an effect not unlike *tatami* mats, which afforded traditional Japanese houses with a fine sense of rhythmic coherence. Besides, as Anna Rosellini comprehensively pointed out, Kahn's procedures with exposed concrete remained

> the only path capable of progressing beyond the *béton brut* of Le Corbusier and beyond any New Brutalism, laying the groundwork for an idea of exposed concrete architecture seen as control of the entire construction process.[697]

As is already implicit in the title of her study *Towards the Zero Degree of Concrete* (2014), Kahn with the use of such smooth panels erased any material imprint that was not justified by the detailed specifications. Detecting its true nature as "molten stone," poured-in-place concrete should be the predominant material of the laboratories, while for the more representative entities of the complex Kahn had experimented with the creation of literal ruins around buildings. Initially, he had envisioned the enveloping walls of the meetinghouse as prefabricated concrete shells while later they should be covered with cut stone, "preferably Cordova Shell or Travertine."[698] This cladding, however, should not merely be applied as veneer or "a mask with no role in the making of the structure,"[699] but would remain in place after the cast. This procedure had been the *modus operandi* in Roman times where similarly the stone- or brick faced rind constituted an inseparable unit with the concrete nucleus.[700]

694 Kahn interviewed by Marshall D. Meyers, "The Wonder of the Natural Thing," 11 August 1972, 030.II.A.37.19, LIKC. Cf. Réjean Legault, "Louis Kahn and the Life of Materials," in Von Moos and Eisenbrand, *The Power of Architecture*, pp. 219-33.

695 Cf. Marshall D. Meyers, in Latour, *l'uomo, il maestro*, p. 81.

696 Ronner, Jhaveri and Vasella, *Complete Work*, p. 116.

697 Rosellini, op.cit., p. 10.

698 Abstract of program for the Institute of Biology at Torrey Pines, La Jolla, San Diego, n.d., 030.II.A.27.16, LIKC. Considering Cordova Shell stone as a possible surface material, Rosellini (p. 14) poignantly remarked that the Salk Institute would have "become a great fossil concretion facing the ocean [...]."

699 Ibid., p. 354.

700 Kahn could glimpse such ancient construction procedures in Frank E. Brown's *Roman Architecture* (London: Prentice-Hall International, 1961), where the author stated (p. 21): "From rubblework came

Ultimately discarded, Kahn's attempt to employ real *opus caementicium* makes apparent that he not only in compositional and spatial, but also in constructive terms assimilated ancient building techniques.

3.10 The Architectonization of Nature

To recapitulate, beyond being merely adaptive to the contextual constraints, the Salk Institute also brought into a wholesome synthesis the principles of optimization and organization. Thus, the building was not solely designed from without, but just as much from within, and, in analogy to nature's principles of growth, juxtaposed a generative grammar with local adjustments. However, with the two laboratory wings nearing completion, Kahn was still struggling to determine the design of the courtyard. In 1965, he received a copy of Elizabeth Kassler's *Modern Gardens and the Landscape* (1964), which accompanied an exhibition at the Museum of Modern Art in New York. Discovering therein the work of Luis Barragan, whose Plaza del Campanario in Los Arboledas (1960) figured on the cover (Figure 191), in January 1965, Kahn inquired whether the Mexican architect might help him with the landscape design:

> I was very much impressed with your work in the MoMA booklet on Landscape Architecture, and feel that your guidance will be of importance in the land development of the canyon site of the Salk Institute for Biological Studies in La Jolla, near San Diego. I also feel that from the work of yours I have seen, you are in touch with the virility of approach to man's will of shaping of ground and the planting of shrubs, compared to the ways of nature.[701]

Barragan replied that he would consider any collaboration with Kahn to be a great honor.[702] Nevertheless, before Barragan first came to the site, Kahn visited his works in Mexico City in November the same year. Barragan's House (1947-9) astonished Kahn with "its simplicity, its nobleness,"[703] whereas the garden – containing no paths, no flowers, but just wind-blown grass and wildly growing trees – was conceived as a sequence of open-air rooms to complement the interior spaces. Barragan maintained: "Architecture and landscape architecture are both creations of space on the same continuum. Landscape architecture is architecture without a roof."[704] A few years later, Kahn described Barragan's garden more elaborately:

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concrete, laid between masonry forms, which yielded its permanent faces." Cf. G. T. Rivoira, *Roman Architecture and its Principles of Construction under the Empire* (New York: Hacker Art Books, 1972).

701 Kahn's letter to Barragan, 20 January 1965, 030.II.A108.53, LIKC.

702 Barragan's letter to Kahn, 9 February 1965, 030.II.A108.53, LIKC.

703 Kahn's letter to Barragan, 8 February 1966, 030.II.A108.53, LIKC.

704 Ignacio San Martin, *Luis Barragan: The Phoenix Papers* (Tempe: Arizona State University, 1997) p. 21.

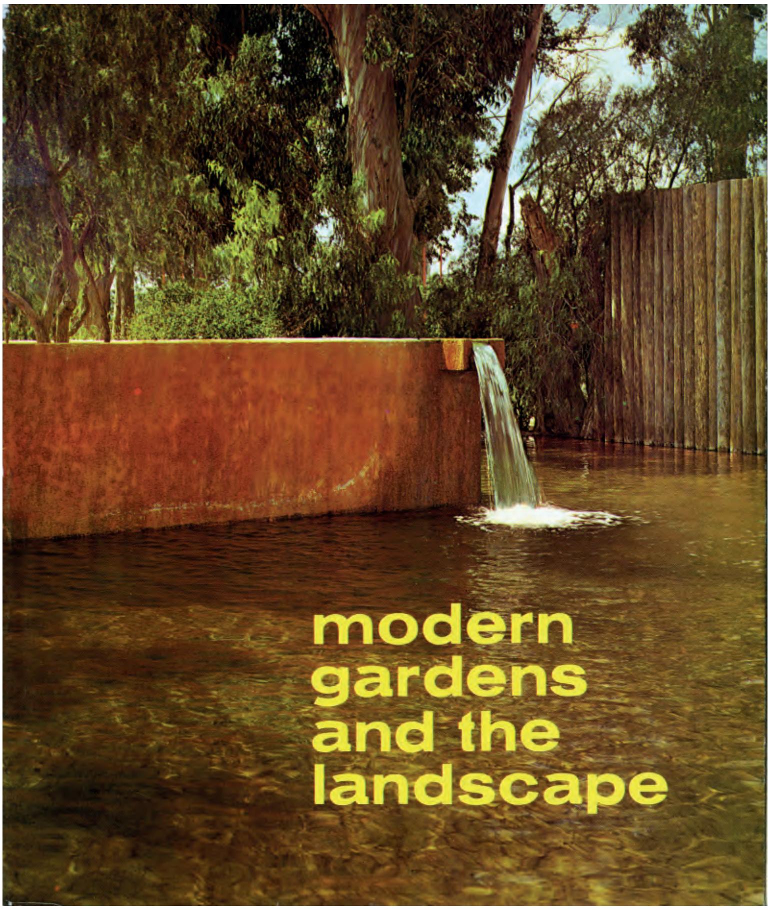

Fig. 191: Luis Barragan, Plaza del Campanario, Los Arboledas, Mexico, 1960; on the Cover of Elizabeth Kassler, *Modern Gardens and the Landscape*, 1964.

> Out of the Odyssey in nature of the stream from the tiniest mountain sources, through the varied grooves of its path in light and shade, he selected the darkest place of its dance on the rocks to sense silver of water in a dark bowl and brought it home to contribute to the sense of silence which, as even in the song, prevails in all his house.[705]

Kahn sensed having invaded an unfathomable ceremony between man and nature, whereas the Mexican architect intentionally shrouded his works in an ineffable veil that allowed "for the interior placid murmur of silence, and in my fountains, silence sings."[706] Kahn also visited Barragan's residential enclave of El Pedgregal

705 Louis I. Kahn, "Silence," in *Via*, no.1, 1968, p. 89.
706 San Martin, *Phoenix Papers*, p. 128.

(1945-54), where the raw volcanic stone of the ground was intervened with concise spatial operations. As Kassler observed, "[a]rtifact and natural fact are separate, antagonistic, yet made mutually dependent by the tensions between them."[707] Altogether, Barragan's introspective landscapes were intended to create "magic" settings with an "air of bewitchment" as they derived from the work of Ferdinand Bac, who had argued that "'the soul of gardens shelters the greatest sum of serenity at man's disposal' [...]."[708]

On February 24, 1966, Barragan finally visited the Salk Institute, which left him "deeply impressed and visiting it I was moved in a way that rarely happens in one's life."[709] In a letter to James Britton, editor of *Urban Design Review*, Kahn explained in more detail what happened that day:

> When [Barragan] arrived at the site, he put his hand across the surface of the concrete and across the spaces of the buildings. He turned to us and said, 'I would put not a single tree in this area. I would make a Plaza.' Both Jonas and I felt the undeniable appropriateness. Barragan, encouraged, added, 'If you make a plaza, you will have another façade to the sky.' I was so jealous of this idea that I could not help adding to it by saying, 'Then we would get all those blue mosaics for nothing', pointing to the Pacific Ocean.[710]

Despite their initial approval, shortly after the meeting both Salk and Kahn felt uneasy about the idea of turning the entire surface into a paved courtyard. Subsequently, Halprin, who would maintain for years that planting the courtyard with trees would have created a better solution in terms of human comfort,[711] conceived another option

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707 Elizabeth B. Kassler, *Modern Gardens and the Landscape* (New York: The Museum of Modern Art, 1964) p. 50.

708 Federica Zanca, (ed.), *Luis Barragan: The Quiet Revolution* (Milan: Skira, 2001) p. 11. Barragan had encountered Bac's garden of Les Colombières near Menton (1918-27) and the splendidly illustrated book *Jardins enchantés* (1925) on a journey to Europe between 1925 and 1927. Furthermore, the Mexican architect considered to have grown up in the "ambience of a fairy tale" – a ranch near a pueblo village that was watered by an elaborate aqueduct system. Cf. Emilio Ambasz, *The Architecture of Luis Barragan* (New York: The Museum of Modern Art, 1976) p. 9. He also considered the inner courtyards of the Hispano-Moorish tradition, besides cloisters and religious architecture in general as sources of his work. Among his contemporaries, Barragan valued Rudofsky, in whose practical œuvre, for example the Arnstein House in Sao Paulo (1939-41), atria also played a major role, as well as Mies van der Rohe's proposals for Courtyard Houses (1931-8), which sought to achieve a comparably withdrawn atmosphere of arcane enchantment.

709 Barragan's letter to Kahn, 6 April 1966, 030.II.A.108.53, LIKC.

710 Kahn's letter to James Britton, 12 June 1973, 030.II.A.46.48, LIKC.

711 Cf. Treib, "To End a Continent," p. 422. In a letter dated 2 December 1966 and addressed to Kahn and Salk, Halprin stated: "As you know I think the architecture is sheer poetry. Louis feels very strongly about the directions the courtyards should take and he has lived with this a long time. I suggest, therefore, that he simply go ahead and do what he feels is right. My own calligraphy would be <u>very</u> different than what he is proposing." Cf. 030.II.A.26.5, LIKC. In a letter of response from 5 January 1967, Kahn was most pleased with Halprin's offer and clarified their distinctive duties: "We with grass planted in the joints of the stone cover to soften Barragan's proposal. Finally, in a lengthy letter to Salk in December 1966, Kahn explained why he thought the courtyard's design should follow Barragan's advice:

> I believe that this solution is good in bringing together the two Laboratory Wings, to encourage free circulation and to inspire use and activity within the Plaza. The sensitivity of the building and this space to the many moods of the sky and the atmosphere will make the Plaza a place always changing, never static, full of the never ending anticipation of the rising and the setting of the sun.[712]

The last sentence gains further astronomical relevance since the courtyard was positioned on a precise east–west axis, meaning that it was oriented towards the sun and the moon's setting on the vernal and autumn equinox above the Pacific horizon (Figures 192, 193; the image shows the full moon around the time of winter solstice when it reaches its greatest altitude).

Accordingly, a travertine covered plaza reinforcing the monolithic unity of the whole ensemble was lastly implemented that as a genuine celebration of the place helped to unveil the landscape and cosmos. Without vegetation, but with a central *théâtre d'eau*, the courtyard's design had transformed in Islamic terms from a *bagh* to a *sahn*, that is, from an outwardly focused to a more contemplative state, whereby its material restraint promoted meditative submersions and phenomenological observations. Attuned to the celestial proceedings, the resultant plaza was like a canvas open to be adorned by nature's ever-changing spectacle. It was an offering to be invaded and invigorated by the sun, wind and rain, whose presence in mutual communion with the man-made structure was reasserted. In a substantial way, the plaza and the buildings' pervious mass interwove with the different moods of the weather. Released to the vastness of space, the courtyard – only bordered by the celestial vault and the ocean's stable horizon – undermined Juhani Pallasmaa's credo that architecture could turn "the soulless physical world into a home of man,"[713] and exemplified its capacity to mediate man's existential experience of being-in-the-world as it re-confronted one

> with gravity, the elements, the realities of life, and the wonder of construction, as if space were claimed for human occupation for the first time.[714]

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will do all of the drawings for the Plaza and Lower Gardens, but will appreciate your criticism of the overall scheme and your assistance in selecting plant materials and in developing the pools and fountains. You will do all the drawings for the site landscaping." Cf. 014.I.A.2323, LHC.

712 Kahn's letter to Salk, 19 December 1966, O30.II.A.26.43, LIKC.

713 Juhani Pallasmaa, *The Thinking Hand* (Chichester: John Wiley & Sons, 2009) p. 128.

714 Juhani Pallasmaa, *The Embodied Image: Imagination and Imagery in Architecture* (Chichester: John Wiley & Sons, 2011) p. 109.

Fig. 192: Louis I. Kahn, Salk Institute for Biological Studies, La Jolla, California, 1959-65.

Fig. 193: Louis I. Kahn, Salk Institute for Biological Studies, La Jolla, California, 1959-65.

In this sense, the Salk Institute with its grey and withdrawn degree-zero aesthetic acted as a quiescent and modest background to carefully stage the natural elements in their sorcerous unfolding.[715] Yet, Kahn's longing was not merely to introduce and harbor, but in fact to *activate* these primordial forces. He realized that architecture had the *power to bring nature to presence*, to animate its myriad poetic energies all acting synergistically at once. Manifesting this potential to *architecturalize* nature as the Japanese architect Tadao Ando specified, and awaken its inherent beauty in dialogue with the man-made,[716] Kahn insisted, "the sun was not aware of its wonder until it struck the side of a building."[717] In this paraphrase of the American poet Wallace Stevens crystallized the idea that in fact architecture empowered nature and not *vice versa*. It was not a raw or artificial nature that resulted, but a *humanized* landscape of epic grandeur.[718]

Again, Pattison had introduced Kahn to the work of Stevens and his poem "Architecture" (published in the first edition of the *Harmonium* in 1923).[719] Following the initial inquiry, "[w]hat manner of building shall we build for [t]he adoration of beauty?" Stevens advanced "to build the building of light" by inquiring:

> How shall we hew the sun,
> Split it and make blocks,
> To build a ruddy palace?
> How carve the violet moon
> To set in nicks?

This idea of the activation of nature also figured prominently in the work of Heidegger:

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715 According to Tadao Ando architecture should not "speak too much. It should be silent and let nature in the guise of sunlight and wind speak." Ando, "Interior, Exterior," in Francesco dal Co, *Tadao Ando: Complete Works* (London: Phaidon Press Limited, 2000; orig. published as "Introduction," in Kenneth Frampton, (ed.), *Tadao Ando: Buildings, Projects, Writings* (New York: Rizzoli, 1984) p. 449.

716 Discussing his projects of the Church on the Water (1991) and the Church of the Light (1989), Ando clarified that his "idea of nature is different from that of nature-as-is. For me, the nature that a sacred space must relate to is a man-made nature, or rather an architecturalized nature." Ando, "From the Church on the Water to the Church of the Light," in Dal Co, *Tadao Ando*, p. 455; orig. published in *The Japan Architect*, no.386, June 1989.

717 "The great American poet Wallace Stevens prodded the architect, asking, 'What slice of the sun does your building have?' To paraphrase: What slice of the sun enters your room? What range of mood does the light offer from morning to night, form day to day, from season to season and all through the years?" Louis I. Kahn, "The Room, the Street, and Human Agreement;" award address receiving the American Institute of Architects Gold Medal, 24 June 1971, 030.II.A.52.12, LIKC.

718 As Yuzuru Tominaga explained, in Japan "landscape (as *fukei*) is a humanized natural scenery, staged through wind and light, and not nature as matter itself." Tominaga, "Reflections on the Architecture of Tadao Ando," in Dal Co, op.cit., p. 510.

719 Cf. David G. De Long and David B. Brownlee, *In The Realm of Architecture* (Los Angeles: Universe, 1997) p. 223.

> The luster and gleam of the stone, though itself apparently glowing only by the grace of the sun, yet first brings to light the light of the day, the breadth of the sky, the darkness of the night. The temple's firm towering makes visible the invisible space of air.[720]

To conclude, the wondrous spell of the Salk Institute derived just as much from the presence of the articulated volumes as from its voids and absences. While the buildings' porous façades were as much open as closed, its placement also left the animated ground with its telluric forces untouched. Accordingly, the courtyard was a device for appropriating a fragment of nature that through its cautious isolation was raised to a higher degree of human awareness. Thereby, Kahn was following a number of noteworthy historical examples, for instance, the previously discussed Greek ceremonial plazas, but also the common *agora* at the center of Hellenistic grid-iron settlements that were bounded by covered walkways (*stoa*) against sunshine and rain – a tradition also revived in Michelangelo's Kahn-affine design of the *Piazza del Campidoglio* in Rome (1534-8). In the East, the concept of *Ma* or nothingness highlighted the *non-form*, i.e. the gap, pause or interval between different accentuated parts, whether they were spatial or tonal.[721] In *The Book of Tea*, Okakura paraphrased Laotse: "The reality of a room [w]as to be found in the vacant space enclosed by the roof and walls, not in the roof and walls themselves."[722]

Suggesting that the Salk's courtyard was similarly a void to be filled *with life*, for which Kahn served the "street as the space to breath" but also the early American village green as the ideal paragon,[723] the building also paid homage to Thomas Jefferson's architecture in Charlottesville, Virginia. Jefferson's own house in nearby Monticello (1786-92) embraced the front lawn with two outspread wings containing the servant's

720 Martin Heidegger, "The Origin of the Work of Art," (1935-6) in Martin Heidegger, *Poetry, Language, Thought* (New York: Harper Collins, 2001) p. 41. Cf. Benedicht Weber, "Nature et construction: Incursion compare à travers les œuvres de Martin Heidegger et Louis Kahn" (Lausanne: EPFL, Chaire de theorie d'architecture de Jean-Marc Lamunière, 1983).

721 As a musical reference may serve the Eastern influenced explorations into *Silence* by John Cage. Epitomized in the piece *4'33*, Cage's improvisations put their focus upon the virtues of quiescence and randomness. Cf. John Cage, *Silence: Lectures and Writings* (Middletown: Wesleyan University Press, 1961).

722 Okakura, *The Book of Tea*, p. 24. Cf. Tyng, *The Rome Letters*, p. 89; letter 8 January 1954. In *The Wisdom of Laotse* is recorded the following comparison regarding "The Utility of Not-Being:" "Mold clay into a vessel; From its not-being (in the vessel's hollow) Arises the utility of the vessel. Cut out doors and windows in the house (-wall), From their not-being (empty space) arises the utility of the house." Lin Yutang, (ed.), *The Wisdom of Laotse* (New York: The Modern Library, 1948) I, Ch. 11. Similarly, Rasmussen stated in *Experiencing Architecture* (1959): "Instead of letting his imagination work with structural forms, with the solids of a building, the architect can work with the empty space – the cavity – between the solids, and consider the forming of that space as the real meaning of architecture." Rasmussen, *Experiencing Architecture*, p. 46.

723 Cf. Prown and Denavit, *Kahn in Conversation*, p. 154. Following this logic, a meetinghouse was "only a roofed over street."

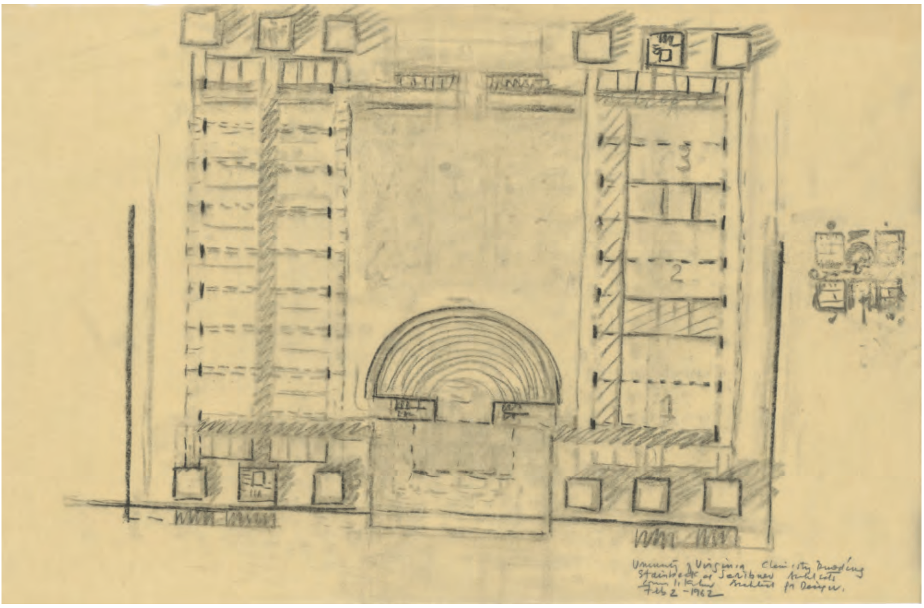

Fig. 194: Louis I. Kahn, Chemistry Building, University of Virginia, Charlottesville, 1960-3.

facilities,[724] while in the University of Virginia (1817-28) continuous arcades framed an open, unadorned communal space. In retrospect, this close analogy to Jefferson's work was not coincidental, since in parallel with the Salk Institute Kahn planned a Chemistry Building – as seen here in a plan from 1962 (Figure 194) – on its campus (1960-3). This unexecuted design incorporated a series of motifs such as the square overall plan, two rectangular blocks framing a central courtyard, deep loggias as in-between spaces, separate studies, and the splitting up of the section into served and servant zones, which would reappear in the design of the Salk Laboratories. Overall, Jefferson's campus manifesting the birth of American culture within the continent's boondocks assimilated readily with Kahn's aspiration to confront in an open dialogue the existing grounds with respect, but also dignity.

724 In the same manner Wright in his planning of Taliesin in Spring Green, Wisconsin (from 1911 onwards) wrapped the main structure carefully *around* a small hilltop.

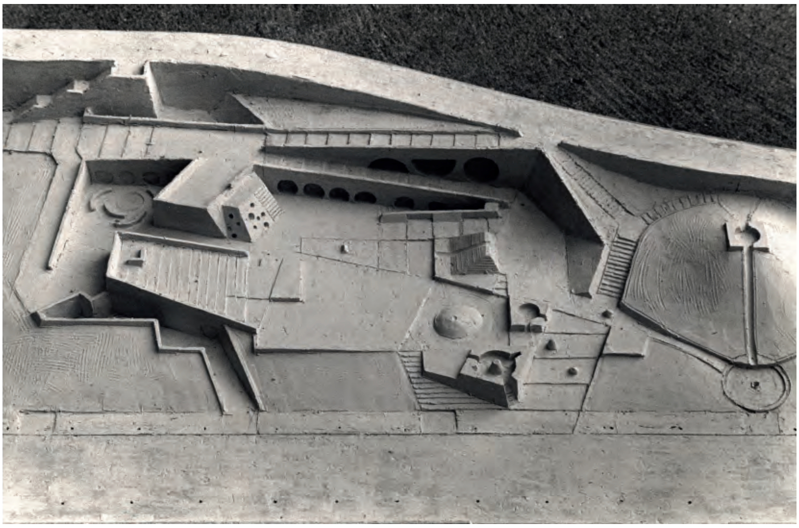

Fig. 195: Louis I. Kahn and Isamu Noguchi, Adele Levy Memorial Playground, New York City, New York, 1961-6.

3.11 Grounding and Playing like Early Man

With the intention to present alternative landscape approaches to the "cruel and meaningless dreariness of the man-altered environment, this creeping wasteland in which we have our being,"[725] Kassler showed in *Modern Gardens and the Landscape* alongside Barragan's work a number of Scandinavian landscape designs, examples from the work of Roberto Burle Marx, Church and Halprin, but also a project by Kahn – the unexecuted Adele Levy Memorial Playground (Figure 195), which he conceived in collaboration with Isamu Noguchi between 1961 and 1966. The Japanese-American artist and landscape architect had received the commission in 1961, but being aware of the difficulties involved, he contacted Kahn "with only one criterion that I considered him the best."[726] With regard to the site, which was part of Riverside Park in New York City designed by Olmsted and Vaux (from 1875 onwards), both Kahn and Noguchi readily appreciated the given contours of the parcel with its hilly bluffs. As Kahn contended,

> a playground building in a park must give itself to the park and its natural characteristics. [...] Play must be free and uninhibited, spaces to be discovered with shapes not imitative of nature yet unrestrained in their making.[727]

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725 Kassler, *Modern Gardens and the Landscape*, p. 6.
726 Isamu Noguchi, "On Louis Kahn," in *Architecture and Urbanism*, vol.5, extra edition, October 1975, "Louis I. Kahn," p. 244.
727 Ronner, Jhaveri and Vasella, *Complete Work*, p. 203.

Noguchi added that he wanted the children "to confront the earth as, perhaps, early man confronted it."[728] They developed five schemes in total; common to all, the ground itself was to be tilted and sculpted into a multi-dimensional landscape. Consisting of indoor play spaces that disappeared beneath grass-covered roofs, a play mountain, a water-slide tumulus, a fountain-cum-wading pool, an amphitheater, a stepped pyramid and a sand garden, Kahn and Noguchi intended to form an irregularly shaped, humanized topography. Their formal approach, using taut yet dynamically interrelated geometries, showed similarities with the Grass Mound in Aspen (1955) by the former Bauhaus teacher Herbert Bayer. That, too, appeared like a prehistoric arrangement of grass-covered, elemental geometric forms.

An important working tool to accomplish the intended fusion of building and ground was Noguchi's use of plasticene models, which helped to define more accurately the project's topographical outlines. Kahn in his future projects would repeatedly reutilize such models, the first time in the competition entry for the Lawrence Memorial Hall of Science at the University of California, Berkeley (1962), and later, for instance in the planning of the President's in Islamabad (1963-6; Figure 196). As can easily be recognized in the latter case, both the architectural objects and the ground consisted of the same material, and as a consequence the buildings virtually appeared to *grow out* of the earth, since the man-made and natural were seamlessly conceived *en bloc*. One may relate this tendency to modulate the earth to sculptures of the Magdalenian era: Not like Greek sculptures in the round which proudly depicted man as liberated from his natural vessels, in Paleolithic sculpture the objects and their ground constituted an inseparable whole. Hollowing out and peeling away the cave's rock, the figures remained interwoven with the surface just as in the appended picture of two aurochs in Le Fourneau du Diable in Dordogne (Figure 197). An inextricable oneness had characterized primitive existence and visibly permeated its art as well. Notably, between 1949 and 1951, Noguchi had travelled on a grant from the Bollingen Foundation to some of the world's most ancient monuments including Lascaux.[729]

As Kazi Khaleed Ashraf has convincingly pointed out, at this point of his career Kahn was beginning to understand architecture as a landscape event, in which through a process of "grounding" his buildings inscrutably related to the larger topographical, geological and climatic strata.[730] Literally, "building took *place*,"

728 Isamu Noguchi, in Watari-Um, (ed.), *Play Mountain: Isamu Noguchi and Louis Kahn* (Tokyo: The Watari Museum of Contemporary Art, 1996) p. 4.

729 Noguchi visited a large number of prehistoric sites with the aim to demonstrate that art could benefit the masses by bringing emotional stability to a community.

730 Cf. Kazi Khaleed Ashraf, "Taking Place: Landscape in the Architecture of Louis Kahn," in *Journal of Architectural Education*, vol.61, no.2, pp. 48-58. According to Ashraf, three broad "realities" are targeted by Kahn's more "grounded" architecture: first, it being "a topographic, telluric reality;" second, "a climatic reality;" and third, "a geological reality," i.e. a causal expression of gravitational attraction.

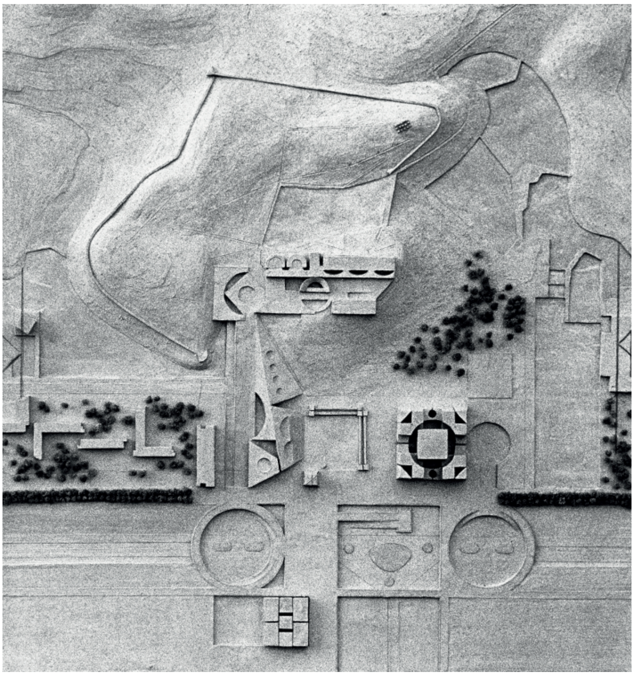

Fig. 196: Louis I. Kahn, President's Estate, Islamabad, Pakistan, 1963-6.

Fig. 197: Aurochs in *Le Fourneau du Diable*, Dordogne, France, 16th millennium BC.

and this direct physical interference with the earth was as much a reality to be articulated as the structure's existence in space where it intermingled with the other elements. Following these implications, in Kahn's *earthworks* the "Form" was no longer implemented from a transcendent realm above, but inversely materialized from a submerged world beneath. The earth became nothing more than a material manifestation of the "psyche," in which the seed or "nature of the space" was planted and from which the "design" sprouted forth. Nonetheless, due to Kahn's expressive aspirations there was always a purposeful geometrical disjunction with the more or less natural topography, too. Arguably, he intentionally exaggerated this dichotomy between a relaxed connectedness with and a man-made counterpoint to nature in order to highlight that man's position in the world was fundamentally just as paradoxical and inconsistent.

In all cases, Kahn's atavistic earth architecture stood in marked contrast to Modernist practice where buildings hovered on pillars above the ground.[731] Since the early 1950s, Kahn's buildings had been characterized by such rootedness, yet, now they were no longer just autarchic volumetric compositions designed from the inside out, but retaining their supra-mundane appeal also intermingled with the topographic and geo-physical givens. Major aids in this transformation were, on the one hand, the more elaborate planning of the gardens and plazas in order to extend the buildings' inner compositional logic towards the outside, and on the other, the use of porches to draw nature back in. In regard to these double-functioning elements Kahn came to realize that "[t]he arcade is a landscape thing. It belongs to the building, certainly, but it also belongs to the entrance and belongs to the ground."[732] In 1968, using the term "land architecture," Kahn found an appropriate terminology to address his deliberations:

> It should not be called landscape architecture because you are not making pictures, you're treating land as though it were a great conservation, as though you're taking a piece out of the whole, as though you really appreciate the nature of things. Land isn't just a junk of real estate. Even a little square inch of it has many worms. Something's going on. You can go as microscopic as you like. It's a recognition of oneness, not division.[733]

731 In *Arts and Crafts* circles it had still been common practice to wed buildings to the ground. Gaudí's Park Güell in Barcelona (1900-14) and Edward Schroeder Prior's Home Place in Kelling (1903-5) may serve as examples: in both cases the rubble obtained from the site's excavation was directly re-utilized in the built structure.

732 Louis I. Kahn, "Comments on the Library, Philips Exeter Academy," (1972) in Wurman, *What will be has always been*, p. 181.

733 Louis I. Kahn, "Lecture at the Architectural Society of Drexel University," p. 31. He added: "If he were to change it to land architect, then I would say that even the President of the United States would understand his role in the affairs of the world." Wurman, op.cit., p. 38; from an extended version of the interview "Clearing," 11 January 1969, later partly published in *Via*, vol.2, 1973, pp. 158-61.

In a similar vein, Noguchi had argued in his submission for a Guggenheim Foundation fellowship in 1927:

> It is my desire to view nature through nature's eyes, and to ignore man as an object for special veneration. [...] Indeed, a fine balance of spirit with matter can only concur when the artist has so thoroughly submerged himself in the study of the unity of nature as to truly become once more a part of nature – a part of the very earth, thus to view the inner surfaces and the life elements.[734]

After receiving the scholarship, Noguchi traveled to Europe and the Far East, where he immersed himself in Zen studies and Japanese garden design, besides becoming impressed by ancient grave mounds, for example the Tumulus of Emperor Nintoku in Osaka (300 BC and 600 AD).[735] Having returned to the United States, "[o]ne day, in the winter of 1933-4," Noguchi had a vision, seeing the "earth as sculpture."[736] The first project visualizing his idea was the unrealized "Monument to the Plow" (1933; Figure 198), a gently sloping pyramid of immense scale, which, according to Noguchi, was

> actually a monument to Benjamin Franklin and Jefferson, who invented the American plow – a plow which digs the earth, a plow with which they were able to 'break the plains' [...] It was to be a monument to the American beginning.[737]

Noguchi's project would anticipate by more than a generation the *Land* and *Earth Art* that arose in the 1960s.[738] In parallel with its conception, he conceived the unexecuted Play Mountain (1933), a project for a playground in New York the size of one city block, and arguably the earliest predecessor of the Adele Levy Memorial Playground. In contrast to the megalomaniacal "Monument to the Plow," Play Mountain was considerably reduced in size, more tactile and physically tangible. It made use of a biomorphic formal vocabulary to modulate the ground's surfaces and was designed to be open to the public as a "sculptured space."[739] While Noguchi's former intervention

734 Isamu Noguchi, "Proposal to the Guggenheim Foundation," (1927) http://www.noguchi.org, accessed 23 September 2008.
735 Noguchi also admired other *geo-glyphs* like the Serpent Mound in Ohio (first millennium BC) or the Nazca Lines in Peru (800 BC to 600 AD).
736 Isamu Noguchi, "The Road I Have Walked," in Watari-Um, (ed.), *Play Mountain*, p. 100.
737 Ibid.
738 Presented initially at the "Earthworks" exhibition at the Dwan Gallery in New York in 1968, the sculptures of heroic scale were based upon a minimalist formal canon, directly interfered with the ground, and addressed the human potency to transform the earth's surface. Michael Heizer's *Double-Negative* in the desert of Nevada (1969) glorified technological power – drills, explosives, and the bulldozer – but also acknowledged man's destructive capacities. In Robert Smithson's *Spiral Jetty* in the Great Salk Lake in Utah (1970) nature's *invasion* and reclaiming of the human intervention played an essential role.
739 Only during and after the turmoil of the Second World War, to give his grief relief, Noguchi again proposed landscapes of a vast scale, for instance with the *Memorial to Man* (1947), which in form of

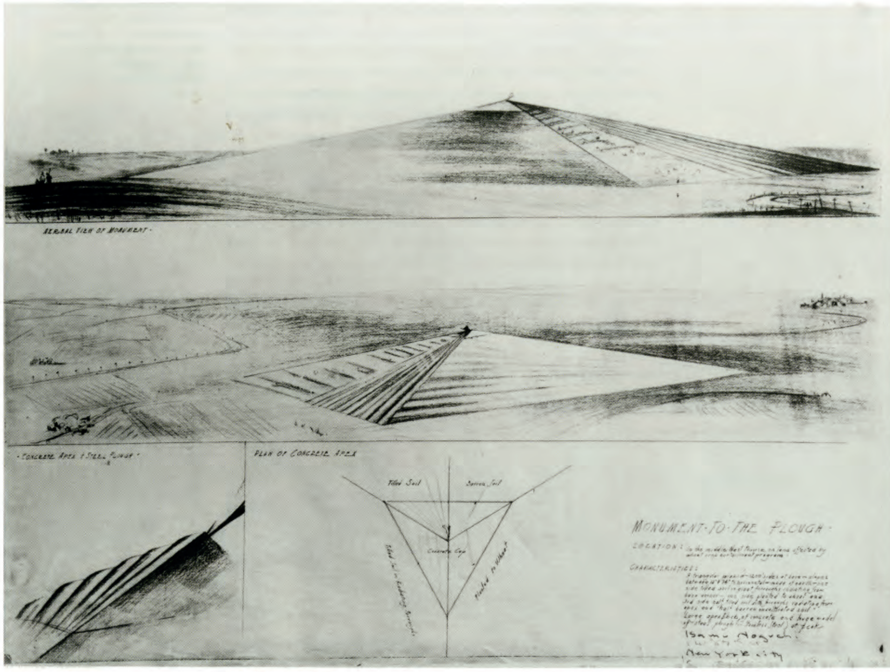

Fig. 198: Isamu Noguchi, *Monument to the Plow*, 1933.

of cosmic dimension was intended to cause sublime astonishment, the smaller-scale playground evoked a sense of the more tender and intimate.

This change of approach also characterized Kahn's architecture at the time as it evolved from being abstract and dismissive towards being more sensitive and accommodating of the environment. To further illustrate Kahn's exceeding willingness to engage with the contextual order through a set of adaptive measures, the unexecuted design of the Dominican Motherhouse of St Catherine de Ricci in Media, Pennsylvania, developed between 1965 and 1969, should be mentioned. In the earliest presentation of the project in October 1966, Kahn placed the private cells of the dormitories in a staggered configuration following the site's contours to create an interior courtyard, which was closed off by asymmetrically arranged, square-shaped public buildings. This scheme was partly restricted in the final revision, since the dormitories were now aligned rectilinearly in a U-shaped frame that was itself bounded by a U-shaped alignment of regularly planted trees, a sort of *natural* buffer wall. This version was akin to St Catherine's Monastery on Mount Sinai (mid

a magnified human face symbolized the banishment of life on earth. Cf. Isamu Noguchi, *A Sculptor's World* (New York: Harper & Row, 1967).

6^{th} century), where a rigid fortification wall also housed an irregular juxtaposition of different sized volumes in its interior. Embracing opposites, both of Kahn's schemes drew their power from the coalescence of the twin-phenomena of order and disorder, the static and the dynamic, and the regular and irregular.

For Kahn, the Dominican Motherhouse had been the second opportunity to plan a monastery, following an earlier design of the St Andrew's Priory in Valyermo, California (1961-7; Figure 199). Both projects shared in common the use of Noguchi-inspired plasticene models, a discrete differentiation between the private cells and communal rooms, besides a free assembly of these independent elements. Of special interest in the St Andrew's Priory was the detailed planning of the outdoor areas consisting of a garden, a paved entry zone and a courtyard. Again placed to frame the site, the individual buildings *surrounded* the hilltop to enforce a more conscious encounter with it. Abbot Raphael Vinciarelli's discovery of water amidst the most arid Californian desert prompted Kahn to design an "architecture of water," which began with the setting up of a chapel at the place of the precious source, and the planning of a star-like system of linear water channels to irrigate the garden and choreograph the formal pattern of the open spaces. During the later stages, Kahn assigned the project to his students and invited Roman J. Verostko from the St Vincent Archabbey in Latrobe, Pennsylvania, to lecture in his studio. The Benedictine monk described the ideal monastery as a harbinger of the New Jerusalem and the glorious completion of creation after the *Parousia*, the second coming of Christ. Making reference to St Bernard's notion of the *paradisus claustralis* and *hortus dei*, Verostko considered a cloister as "an enclosed paradise where the seeds of the heavenly paradise were eminently cultivated," and compared it to the Garden "where one chants a celestial praise [...]."[740]

Overcoming the mere status of a project to exemplify the essential traits of Kahn's contextual fitting was the Fisher House in Hatboro, Pennsylvania, designed and built between 1960 and 1967. Consisting of three slightly elongated wooden cubes – two larger, obliquely connected ones and a smaller separate shed – the house was placed on a masonry foundation that visibly rooted it to the ground along the seam of a gentle slope (Figure 200). In organizational terms separating the more public and private functions – the cube closer to the stream consisted of a double-height kitchen and living space, while the other contained on two floors the sleeping quarters and bathrooms – Kahn also reasserted the wall's potential to adapt to the place and obtain the quality of light most suitable for each space: In the private cube facing the morning sun, Kahn made a lucid distinction between windows for viewing and ventilation, whereby large-scale panels of fixed glass had next to them smaller wooden window shutters in recessed niches. The living cube, exposed all day to the

740 Roman J. Verostko, "Letter for an Architect from a Monk about Monasteries," 16 December 1963; sent to Kahn in October 1965, 030.II.A.59.1, LIKC.

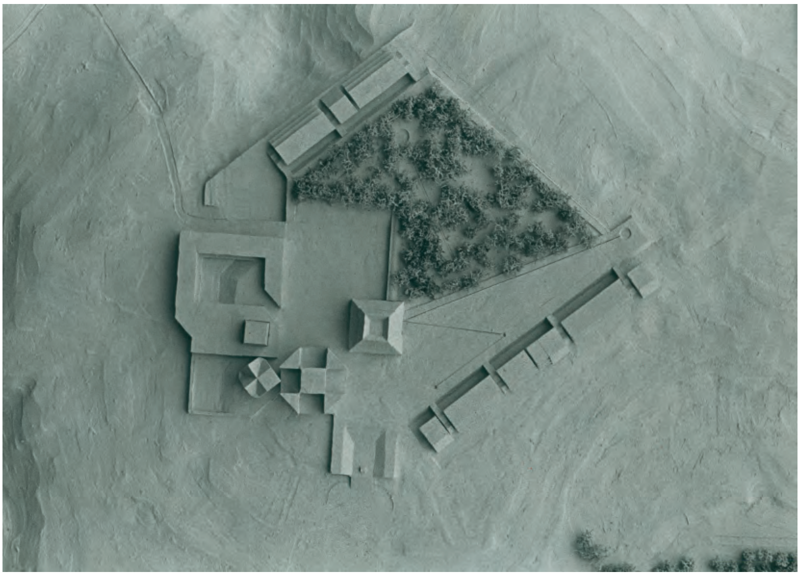

Fig. 199: Louis I. Kahn, St Andrew's Priory, Valyermo, California, 1961-7.

Fig. 200: Louis I. Kahn, Fisher House, Hatboro, Pennsylvania, 1960-7.

tranquil northern light, had at its northeastern corner an elaborate corner window with an integrated bench to sit down and enjoy the view. Overall, the house's firm geometrical disposition was slightly distorted to gain the greatest impact from the surrounding landscape. Also, the use of local cedar wood and variegated stone as basic building materials helped to incorporate the textures, colors and geology of the existing site.

4 In Praise Of Silence And Light. The Expression Of In-Commonness

In the early 1960s Kahn received the opportunity to work on several large-scale projects in India and Pakistan. In a letter to the photographer Julius Shulman he alluded to the difficulties the workload presented:

> By now you must have heard I am busier than a one-arm paperhanger with the St Vitus dance. If you would see me perform in this state in the office, you would realize my impatience to go back to the days when thought and work were at least equally divided.[741]

This final corpus of work further refined the principles of adaptation, while it also triggered new means of expression that aimed to make the buildings not solely function from an operative standpoint, but also from a psychological one. Exploiting the human capacity to communicate on a symbolic level, a trans-cultural repertoire of forms and compositional strategies arose that would touch people in both East and West. Following the etymological roots of the word symbol – deriving from Greek *symballein*, "to unite" and "connect" – Kahn had set out to create civic institutions that gave stability to mankind's eternal aspirations.

Naturally, expression as such also occurs in nature, as Kahn acknowledged:

> Everything that nature makes it records, in what it makes, how it was made. In the rock is the record of the making of the rock; in man is the record of the making of him. And in the making, the consciousness of man as contrasted with the non-consciousness nature, sets up in my mind a feeling of dichotomous existence of man and nature.[742]

As in the appended sedimentary rock formation (Figure 201), natural forms enunciate with utmost honesty the present state of their being: they are unambiguous manifestations of the teleological powers acting from within and the physical forces penetrating them from without. Counteracting this non-conscious expressionism, bowerbirds have highly sophisticated rituals of courtship, in which the male birds build special nests to seduce and later couple with their female partners (Figure 202). Arranging leaves, feathers and berries in ornamental patterns, while whistling songs and performing acrobatic flights, they consciously appear to realign their colorful compositions. Studying their exceptional behavior, Karl von Frisch noted: "He behaves exactly like a painter critically reviewing his own canvas. He paints with flowers […]."[743]

741 Kahn's letter to Shulman, 26 August 1963, 030.II.A.66.7, LIKC.
742 Louis I. Kahn, "Address by Louis I. Kahn," in *Boston Society of Architects Journal*, no.1, 1967, p. 8.
743 Karl von Frisch, *Animal Architecture* (New York: Harcourt Brace Jovanovich, 1974) p. 243.

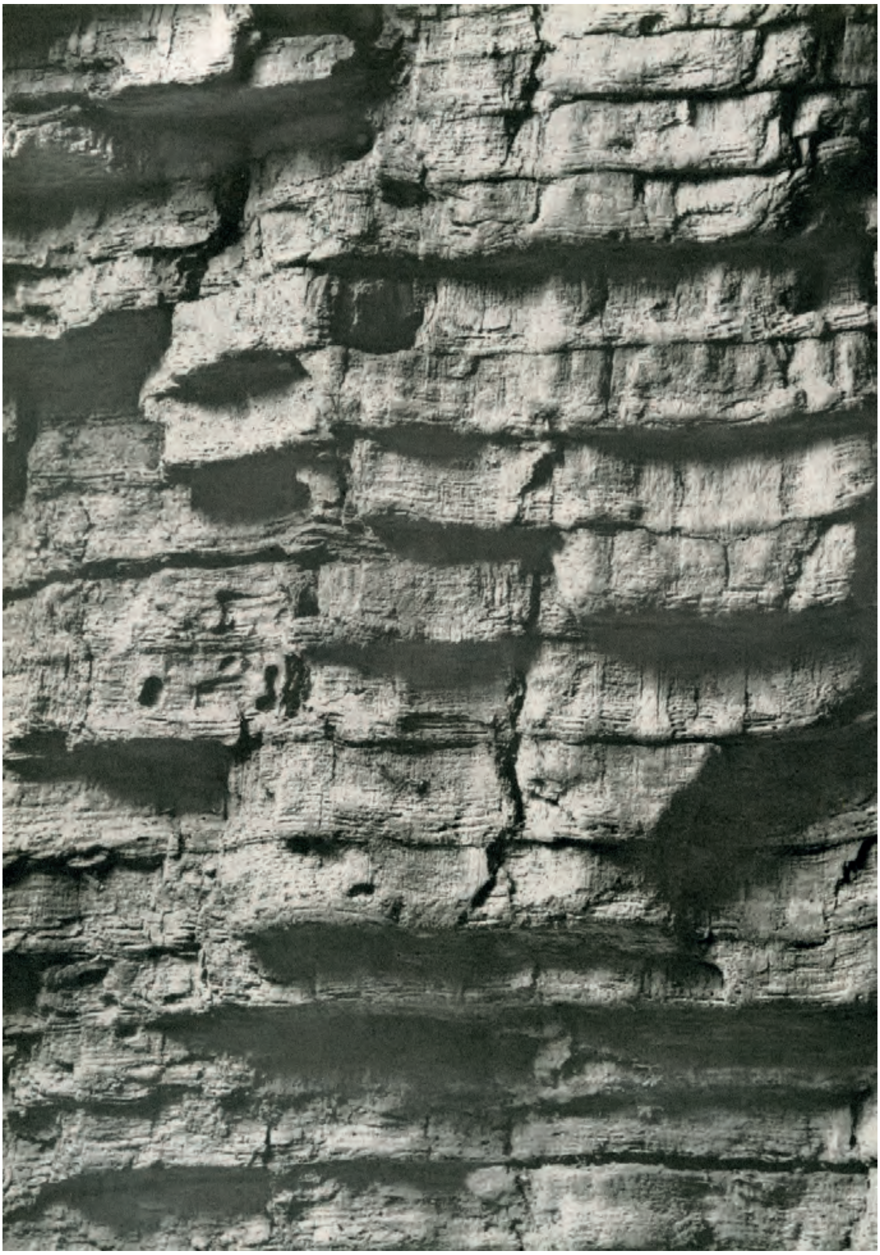

Fig. 201: Rock Formation.

Fig. 202: Bowerbird's Nest.

Like the bowerbird, man is *de facto* an animal, too, and every artistic act might have implicit biological causes. In support of this argument, Adolf Loos unabashedly declared, "all art is erotic."[744] The Austrian architect was convinced that without sexual attraction nobody would want to earn money and "even the poets would have no more reason to sing."[745] For him, the cross was

> [t]he first work of art, the first artistic act which the first artist, in order to rid himself of his surplus energy, smeared on the wall. A horizontal dash: the prone woman. A vertical dash: the man penetrating her. The man who created it felt the same urge as Beethoven, he was in the same heaven in which Beethoven created the *Ninth Symphony*.[746]

744 Adolf Loos, "Ornament and Crime," (1908) in Ulrich Conrads, (ed.), *Programs and Manifestoes on 20th-Century Architecture* (Cambridge: The MIT Press, 1971) p. 19.
745 Elsie Altmann-Loos, *Mein Leben mit Adolf Loos* (Vienna: Amalthea, 1984) p. 27; transl. by the author. Cf. Claire Beck Loos, *Adolf Loos: A Private Portrait* (Los Angeles: DoppelHouse Press, 2011; *Adolf Loos Privat*, 1936).
746 Loos, "Ornament and Crime," p. 19. Notably, Loos and Le Corbusier shared a longing for Josephine Baker, the "Black Venus" of their time. Meeting the *femme sauvage* on board the Giulio Cesare in 1929,

Obeying as a biological body the same rules that govern all life, mankind, nevertheless, can enlarge the existing world into a human one. Human art surpasses the natural condition in which strict necessity demarcates an allegedly neutral standard of beauty. The artist may write of incredible birds that resurrect from their ashes, paint a tree blue despite it being green, make fantastic water-splashing machines out of worthless garbage, or build gigantic memorials for nothing more than the meditation of an inconspicuous flame. *Doubling the world*, art brings to realization through associated meanings that we, or at least groups of us, share in common the most intangible and sensuous qualities of our being-in-the-world.

According to Wilhelm Worringer, abstraction in human expression originated from a need to give relief from cosmic anguish,

> to divest the things of the external world of their caprice and obscurity in the world picture and to impart to them a value of necessity and a value of regularity.[747]

For primitive man such abstract signs were real – they possessed active powers – and only much later did they become purely intelligible means to link the scientific mind with the cosmos. As André Malraux demonstrated in *The Voices of Silence* (1953), another book given to Kahn by Pattison, this primary tendency of “barbaric expressionism” to be abstract, and not naturalistic, would be decisive for the further development of man. Regarding art as “the creation, or invocation, of a world foreign to the real world, not its expression,”[748] for Malraux it derived “from a desire to wrest forms from the real world to which man is subject and to make them enter into a world of which he is the ruler.”[749] Adhering to his advice that

> [h]umanism does not consist in saying: ‘No animal could have done what we have done,’ but in declaring: ‘We have refused to do what the beast within us willed to do […],’[750]

Kahn also treated nature *à priori* as a plain instrument for implementing his ideas and visions. While for Malraux “[t]he man of genius has nothing to do with nature, apart from what he takes from nature and makes his own,”[751] the American architect asked,

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Le Corbusier’s rapport was instant and pinnacled in Baker singing Negro songs like “I’m a little black bird looking for a little white bird; I want a little nest for the two of us” to him – in the architect’s memory in her cabin, in the dancer’s on the bridge. Cf. Le Corbusier, *Precisions*, p. 12.

747 Wilhelm Worringer, *Abstraction and Empathy* (Chicago: Ivan R. Dee, 1997; *Abstraktion und Einfühlung*, 1908) p. 18.

748 André Malraux, *The Voices of Silence* (New York: Princeton University Press, 1978; 1953) p. 598.

749 Ibid., p. 320.

750 Ibid., p. 642. Similarly, Bachelard argued that a “man should be defined by the sum of those tendencies which impel him to surpass the *human condition*.” Bachelard, *Water and Dreams: An Essay on the Imagination of Matter* (Dallas: The Dallas Institute Publications, 2006; 1983; *L’Eau et les rêves, essai sur l’imagination de la matiére*, 1942) p. 16.

751 Ibid., p. 308.

> [i]sn't it marvelous that, out of what's around, you get the feeling that you make with the aid of nature what nature itself cannot make? Nature does not make a house, it does not make a motorcycle, it makes no airplane.[752]

Kahn thus made it abundantly clear that art was art precisely in that it was not nature: "What nature makes, it makes without man, and what man makes, nature cannot make without him."[753] Accordingly, one should

> take pot-luck from nature, because nature has no consciousness whatsoever. Nature is not conscious of the sunset; nature is not conscious that the sunset is beautiful. [...] Nature is unconscious, but the psyche is conscious, demands life, and gives life.[754]

Already at the dawn of his career in 1931, Kahn had acknowledged this deliberative creative impulse in man. Defending the introspective character of the Romanticist artist, he argued:

> [W]e must learn to see things for ourselves, in order to develop a language of self-expression. [...] I try in all my sketching not to be entirely subservient to my subject, but I have respect for it, and regard it as something tangible – alive – from which to extract my feelings. I have learned to regard it as no physical impossibility to move mountains and trees, or change cupolas and towers to suit my taste.[755]

A book that might have informed such lines of thought, since Kahn's mother greatly appreciated its author, was Friedrich Schiller's *On the Aesthetic Education of Man* (1794). Advocating the sovereignty of free thought, the German writer stated:

> NATURE deals no better with Man than with the rest of her works: she acts for him as long as he is as yet incapable of acting for himself as a free intelligence.[756]

However, withdrawing from being a slave of nature, man turned into its lawgiver, or as Schiller argued: "That which hitherto merely dominated him as <u>force</u>, now stands before his eyes as <u>object</u>."[757] In order to illustrate man's unique ability to rise beyond "man the species to become man the human,"[758] Kahn frequently referred to Giotto's frescoes:

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752 Louis I. Kahn, "Architecture and Human Agreement;" lecture held at the University of Virginia, April 1972, in Wurman, *What will be has always been*, p. 135.
753 Louis I. Kahn, "Architecture: Silence and Light," lecture delivered at the Guggenheim Museum, 3 December 1968, in Edward F. Fry, (ed.), *On the Future of Art* (New York: Viking Press, 1970) p. 25.
754 Kahn, "A Statement," p. 18.
755 Kahn, "The Value and Aim in Sketching," p. 21.
756 Friedrich Schiller, *On the Aesthetic Education of Man* (Oxford: Clarendon Press, 1967; *Über die ästhetische Erziehung des Menschen*, 1794) p. 11.
757 Ibid., p. 185. As Leopold suggested, nature was "the raw material out of which man has hammered the artifact called civilization." Leopold, *A Sand County Almanac*, p. 188.
758 Dagit, *Louis I. Kahn – Architect*, p. 91.

> Giotto was a wonderful painter. But why was he wonderful? Because he painted the skies black in the day-time, and painted dogs that couldn't run and birds that couldn't fly, and people who were larger than buildings [...].[759]

Giotto's *magical realism* as illustrated in "Joachim joins the Shepherds" (1304-5; Figure 203) from the Scrovegni Chapel in Padua, exemplified that artistic expression was less about the mimesis of the real, than the genesis of another world through the power of the mind to transform whatever it encountered. Kahn approved in 1966:

> You certainly realize that a painter can really paint a red dress when he sees a blue one. You wonder why he does it, but still, you see: well, he really can – you see, he *does* it. Is he inhuman? Of course not. *Terribly human* – in fact, more so than those who are so amazed by it.[760]

For Kahn, the imagination was operative in the mind, whereas it depended upon the physical structure of the brain.[761] Immeasurably it formed a co-existent part of the larger *status quo*: "Utopia somehow is a reality, it's in reality. That's the point: Utopia is real."[762] Amplifying this rationale, Kahn made a stringent distinction between the "existence" of an ideal and the "presence" of real architecture:

> *Architecture really does not exist*.
> Only a work of architecture exists.
> Architecture does exist in the mind. [...]
> *There* is architecture, and it is the embodiment
> of the unmeasurable.
> Can you measure the Parthenon?[763]

For their power of "existence," Kahn revered Piranesi's etchings – particularly his delineation of the Campus Martius (1757; Figure 204), a half-authentic and half-imaginary reconfiguration of ancient Rome. Kahn insisted that the inspiration's

759 Kahn, "Talk at the Conclusion of the Otterlo Congress," p. 211. Expression in architecture obviously operates within narrower limits than the other arts: Unlike a painter, the architect cannot suspend a building in the air, build an igloo in the desert, or make a door too small for people to enter.

760 Kahn, "Lecture at the University of California, Berkeley, 1966," p. 5.

761 As Kahn intimated, one should "honor the mind of a person. Within lodges the spirit; in the brain, it doesn't lodge. The brain is simply a mechanism." Kahn, "1973: Brooklyn, New York," p. 92.

762 Cook and Klotz, *Conversations with Architects*, p. 192.

763 Kahn, "Talk with Students," p. 168. Kahn had already alluded to the precept that the source of architecture's delight rested within the mind in his essay "Monumentality:" "Neither the finest material nor the most advanced technology need enter a work of monumental character for the same reason that the finest ink was not required to draw up the Magna Carta." Kahn, "Monumentality," p. 578. This quote recalls Edward Young's aphorism: "The pen of an original writer, like Armida's wand, out of a barren waste calls a blooming spring [...]." Edward Young, *Conjectures on Original Composition* (London: printed for A. Millar and R. and J. Dodsley, 1759) p. 10. http://www.poetryfoundation.org, accessed 12 November 2009.

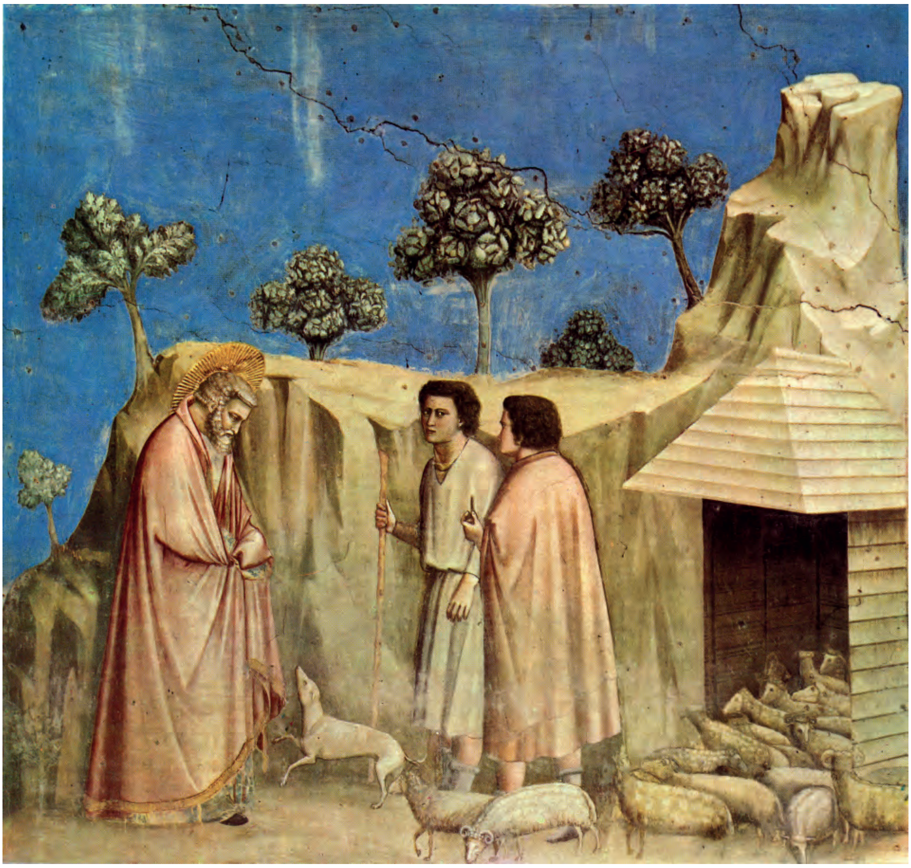

Fig. 203: Giotto di Bondone, *Joachim joins the Shepherds*, Scrovegni Chapel, Padua, Italy, 1304-5.

premises, the "will to express" constantly urged to find a tangible precipitate, which, nevertheless, was never entirely possible, since "the first line was always less."[764] Between these two poles — between idea and matter — operates artistic expression.

764 Louis I. Kahn, "The New Art of Urban Design: Are we Equipped?" (1960); transcript from a speech delivered at the *New Forces in Architecture* conference at the Architectural League of New York and later published in *The Architectural Forum*, vol.114, no.5, June 1961, pp. 88-9. Kahn recalled a conversation with a Polish architect, who asked: "When I try to put this dream on paper, the first line already makes it less. Why is it that it is less?" Whereupon Kahn answered: "A line on paper is a measurable act; the immeasurable – the unmeasurable – is our aspirations, our dreams." Cf. 030.II.A.61.43, LIKC. The statement is reminiscent of Percy Bysshe Shelly's observation in "A Defence of Poetry" (1821): "When composition begins, inspiration is already on the decline, and the most glorious poetry that has ever been communicated to the world is probably a feeble shadow of the original conceptions of the poet."

Fig. 204: Giovanni Battista Piranesi, *Campus Martius*, Rome, Italy, 1757.

Derived from Latin *exprimere*, meaning "to press out," it seeks to reveal a *world* through the establishment of *earth*. According to Giorgio Agamben, the Greeks used to make "a clear distinction between *poiesis* (*poiein*, 'to pro-duce' in the sense of bringing into being) and *praxis* (*prattein*, 'to do' in the sense of acting)."[765] Thus, against the limited present understanding of production in terms of establishing material things,

> central to *poiesis* was the experience of pro-duction into presence, the fact that something passed from nonbeing to being, from concealment into the full light of the work.

765 Giorgio Agamben, *The Man without Content* (Stanford: Stanford University Press, 1999; 1994) p. 68. Cf. Heidegger, *The Origin of the Work of Art*, pp. 41-57.

This notion of giving birth to a *world* through both a physical and poetical unveiling (*aletheia*) – understandable either in terms of the creative act bringing an idea to realization or with regard to the ultimate artifact revealing the *earth* – also sheds light upon Aristotle's remark that the "arts are called 'beginnings,' and of these especially the architectonic arts."[766] Suggesting that true poetry was "a function of awakening,"[767] Kahn also admired *beginnings* through a deep "love of that which yet is not:"[768]

> It's like if you thought that the first house that was ever made is incredible [...]. Because it was built not from any examples of Nature, but made out of the will.[769]

4.1 Functioning beyond Function

Not specifically in reference to one of Piranesi's renderings, but calling upon a subject the Italian had also etched, Kahn mentioned at a panel discussion in 1960: "If you look at the Baths of Caracalla – the ceiling swells a hundred and fifty feet high. [...] It goes beyond function."[770] Explaining his thoughts in more detail, Kahn stated years later:

> I'll now talk about functionalism. I think you can talk about machines being functional; bicycles being functional; beer plants being functional, but not all buildings are functional. Now, they must function, but they function psychologically.[771]

In this sense a building was not just a physical structure answering the primal need of space, but as Pallasmaa inferred, it also had a "psychic function of establishing our mental foothold in the lived reality."[772]

This demand that architecture ought to be *more* than a mere functional entity had also been a widely discussed issue in post-war C.I.A.M. circles. Giedion's insistence that there existed a dire "need for imagination"[773] to create a "New Monumentality"

766 Aristotle, *The Metaphysics*, V, § I.
767 Cf. Bachelard, *Water and Dreams*, p. 16.
768 Cook and Klotz, op.cit, p. 181.
769 Kahn, "Interview with *Via,*" p. 44. The first time Kahn used the term "beginnings" was in a letter to Tyng in 1954 with reference to *The Book of Tea*: "It puts into words the feelings of beginnings. [...] 'The primeval man in offering the first garland to his maiden thereby transcended the brute. He became human in thus rising above the crude necessities of nature. He entered the realm of art when he perceived the subtle use of the useless.'" Tyng, *The Rome Letters*, p. 89; letter 8 January 1954.
770 Louis I. Kahn, "On Philosophical Horizons," in *AIA Journal*, vol.33, no.6, June 1960, p. 100.
771 Kahn, "Silence and Light," p. 449.
772 Pallasmaa, *The Embodied Image*, p. 64.
773 Sigfried Giedion, "The State of Contemporary Architecture: The Need for Imagination," in *Architectural Record*, vol.115, no.2, February 1954, pp. 186-91.

drew on his studies on *The Eternal Present*, a series of lectures on the beginnings of art and architecture delivered in 1957. Drawing conclusions for his own period, he maintained:

> Whereas in primitive eras magic, myth, and religion provided man with a spiritual armor against a hostile environment, today he stands stripped and naked.[774]

Giedion's line of thinking was informed by his wife, the art-historian Carola Giedion-Welcker, but also by Van Eyck, who had written to him in 1950: "There is only one guide left to us, call it imagination, call it creative sensibility. Without this third eye, everything remains dark."[775] Anticipating the title of Giedion's later study, the Dutch architect added: "Lascaux, Brancusi, Easter Island, etc., suggest eternal change through eternal constancy [...]."[776] For Van Eyck, imagination stood at the origin of man *actually* being man:

> If one refuses to accept imagination, one has to leave the world's existence to the flowers, the animals and the landscape, like 50,000 years ago. Without imagination we are decomposing corpses.[777]

In the same breath, Johnson harshly criticized in "The Seven Crutches of Modern Architecture" (1955) the super-functional domes of Fuller.[778] His underlying separation of architecture into a rational-pragmatic procedure on the one hand and a creative act accommodating a certain *extra* on the other – reaching back at least to Vitruvius' times with his distinction of *firmitas* and *utilitas* from *venustas* – echoed Ruskin's doctrines in *The Seven Lamps of Architecture* (1849), where the English art critic had clearly differentiated between "building" and "architecture:" while the former signified the process "to put together and adjust the several pieces of any edifice,"[779]

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774 Sigfried Giedion, *The Eternal Present: The Beginnings of Art* (New York: Bollingen Foundation, 1957) p. 80.

775 Aldo van Eyck, "On the Function of a UNESCO Art Review," in Ligtelijn and Strauven, *Collected Articles and Other Writings*, pp. 48-9; from an undated letter of Van Eyck to Giedion, presumably written in September 1950. During the 6th C.I.A.M. congress in Bridgewater in 1947, Van Eyck and Giedion had collaborated in a committee on "Architectural Expression." Van Eyck's presentation found immediate support by Le Corbusier: "'*Enfin l'imagination entre le CIAM!*'"

776 Ibid., p. 49.

777 Van Eyck, "Intervention at CIAM 6, Bridgewater 1947," in Ligtelijn and Strauven, op.cit., p. 41. Van Eyck later consolidated his opinion by quoting the artist Hans Arp: "Everything functions, only man himself does not." Van Eyck, "Some Comments on a Significant Detour," in *Via*, no.1, 1968, p. 125.

778 Johnson declaimed, "for goodness sakes, let's not call it architecture," and concluded: "Why not realize that architecture is the sum of inescapable artistic decisions that you have to make." Philip Johnson, "The Seven Crutches of Modern Architecture," in *Perspecta*, no.3, 1954, pp. 43-4.

779 Ruskin, *The Seven Lamps of Architecture*, p. 8.

the latter had a certain character impressed upon it that was “beautiful, but otherwise unnecessary.”[780] Quite simply, something *useless*, at least in functional, but not psychological terms, needed to be added in order to turn a firmly resting structure into a *true* work of architecture. A similar distinction was upheld by Le Corbusier, who, like Kahn was a passionate painter and even admitted, “[t]he secret of my quest must be sought in painting.”[781] Repudiating the substantial elimination of the subjective contribution from the design process, he pronounced in thoroughly Ruskinian terms:

> ARCHITECTURE is an artistic fact, an emotional phenomenon that is outside questions of construction, beyond them. Construction: THAT’S FOR MAKING THINGS HOLD TOGETHER; Architecture: THAT’S FOR STIRRING EMOTIONS.[782]

Likewise, Kahn’s mentor Cret asserted that

> [d]esign, after it has consulted construction to find what it can do or not do, has to rely on those faculties more specially artistic: imagination, taste, harmony, sense of plastic values.[783]

To remain in Philadelphia, Ruskin also made a lasting impact on Furness, whose work like the University of Pennsylvania Library (Figure 205) was characterized by at times whimsical de-stabilizations of the classical canon. Enriched with a quasi-natural ornament that nevertheless bore the conspicuous imprint of human invention, his formal articulations in a bizarre manner cultivated odd exuberances and dissonant juxtapositions. As Sullivan remembered, Furness “’made buildings out of his head’,”[784] while the latter maintained that “the true cause of a building is not external, but internal. It lies, proximately, in the mind of one man, and that man is the architect.”[785] Just as Kahn insisted that architecture had its source in the intangible realm, Furness believed a design to commence in “that world we know not – that world of the silent, immeasurable, creative spirit [...].”[786]

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780 Ibid., p. 9.
781 Le Corbusier, *Modulor 2*, p. 310; transl. by the author.
782 Le Corbusier, *Toward an Architecture*, p. 97.
783 Paul Philippe Cret, “Design and Construction,” (1933) in White, *Paul Philippe Cret*, p. 71.
784 Louis H. Sullivan, “Reminiscences of Frank Furness,“ in George E. Thomas, Michael J. Lewis and Jeffrey A. Cohen, *Frank Furness: The Complete Works* (New York: Princeton Architectural Press, 1991) p. 359.
785 Sullivan, *Kindergarten Chats*, p. 32. In Sullivan’s opinion the “dreamer-man” as a nucleus of creative energy was capable of bringing forth that which hitherto had been non-existent. He averred (p. 166) that “man’s emotional nature lay a germ, an unshapen idea, which gradually grew in assertiveness within him and sought outward realization. This germ was the inarticulate beginning of the desire to express himself wholly; the earliest indication of his need of an art of expression; the latent beginning of the CREATIVE IMPULSE.”
786 Ibid., p. 44.

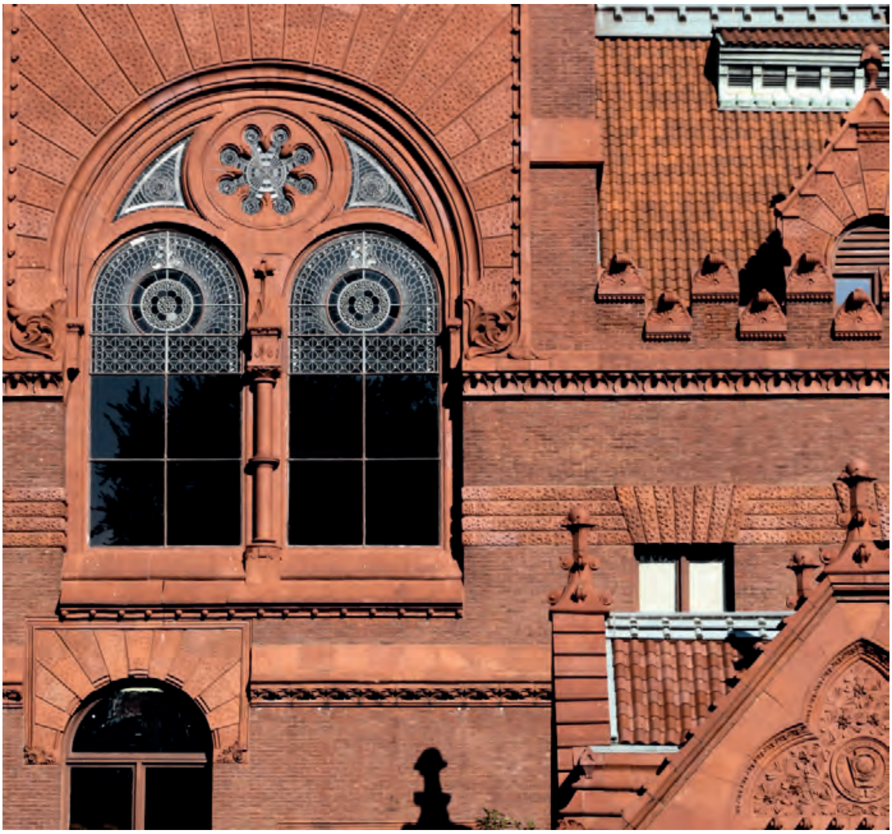

Fig. 205: Frank H. Furness, Library, University of Pennsylvania, Philadelphia, 1888-91.

Furness' mannerist tendency found strong repercussions in the work of Venturi, who immediately recognized the potential of the *second wall* as a possible conveyer of meaning. Exploiting architecture's inherent narrative potential, the "valid false façades" as in the Venturi House (Figure 206) clearly distinguished between architecture's sheltering and expressive aspects. Besides the decorated shed's communicative potential, Venturi and Scott Brown recognized in *Learning from Las Vegas* (1972) with its notable subtitle "The Forgotten Symbolism of Architectural Form," also the "duck" (Figure 207) – a building whose actual form had turned into an emblematic signifier – as another feasible mode of architectural articulation.[787] In

787 Probably the first "duck" in architectural history had been *Lucy the Elephant* by James V. Lafferty. Receiving a patent in 1882, the Irish-American inventor considered the building may also possess the form of any other animal like "that of fish, fowl, etc." Lafferty, "Patent for a Building from James V. Lafferty of Philadelphia," 5 December 1882, in *Perspecta*, no.12, 1969, p. 127.

Fig. 206: Robert Venturi, Mother's House, Chestnut Hill, Pennsylvania, 1959-64.

Fig. 207: Robert Venturi and Denise Scott Brown, "The Big Duck," Flanders, New York, c. 1970.

fact, this tendency to employ natural metaphors enjoyed great popularity throughout the postwar years. In devising Ronchamp's sculptural roof, Le Corbusier had been inspired by a crab,[788] while a shell served as impetus for Jorn Utzon's Sydney Opera House (1957). In 1956, *Time* magazine described Saarinen's unorthodox design approach, as he:

> casually turned over his breakfast grapefruit, began carving out elliptical parabolic arches which he then carried off to the office to see if they might do as an idea for the office model of TWA's new terminal at Idlewild.[789]

In Saarinen's own evaluation,

> [t]he principle of structure has moved in a curious way over this century from being 'structural honesty' to 'expression of structure' and finally to 'structural expressionism'.[790]

With the emergence of reinforced concrete at the dawn of the 20th century, completely novel sculptural possibilities had become available. While it was not yet possible to realize its continuous properties in the Einstein Tower in Potsdam, designed by Erich Mendelsohn between 1917 and 1924, a few years later, in the Second Goetheanum in Dornach, Switzerland (1923-8), Rudolf Steiner exhausted the material's expressive potential. The emergent school of *German Expressionism* – influenced by the flamboyant drawings and models of Herman Finsterlin – sought to petrify nature's plastic force. During the 1950s, as an alternative to the orthogonal objectivism of the International Style, these curvilinear visions were transposed to other materials as well and resurfaced in the baroque pomp of Hans Scharoun's Berlin Philharmonic (1957-63) that Kahn appreciated "immensely,"[791] in the spatial verve of Aalto and in the multi-dimensional designs of Kiesler, but also the Sculptures habitacles by André Bloc of which Kahn received a postcard in 1964 (Figure 208).

4.2 The Natural Flow of Things

Needless to say, Kahn's expressionism developed in an eminently different and non-biomorphic direction. Supporting the ideal of the artist in his capacity to yield a world within the world, the American architect stressed that the highest goal of art was to suppress the ego. In other words, the exteriorization of the mind through expressive means should not lead to a subjective style, but rather to the development of a constructive, organizational and formal order that charged a building with

788 Cf. Niklas Maak, *Le Corbusier: The Architect on the Beach*, p. 15.
789 "The Maturing Modern," in *Time*, vol. LXVIII, no.1, 2 July 1956.
790 Saarinen, *Eero Saarinen on his Work*, p. 6.
791 Prown and Denavit, *Kahn in Conversation*, p. 148.

Fig. 208: André Bloc, *Sculpture habitacle*, No.2, Meudon, Paris, France, 1964.

collective meaning. Explaining his maxim, Kahn elucidated upon reading Goethe's autobiography in 1963:

> It isn't just a question of believing something yourself, because the reality you believe isn't your belief, it's the belief of everyone: You are simply the radar of this belief.[792]

In countless statements from the late 1950s onwards, Kahn asserted, "[o]ne feels the work of another in transcendence – in an aura of commonness and in Belief."[793] All mankind had shared access to a common stock of feelings, and it was the artist's obligation to articulate these in order to establish "a true sense of religion of 'in-

792 Louis I. Kahn, "Remarks," in *Perspecta*, no.9-10, 1965, pp. 304-5. Noguchi had likewise declared: "'Self-expression' has no meaning in art, great art is selfless." Isamu Noguchi, "Collodials in Time," in *Shelter*, vol.2, no.5, May 1932, p. 111. Shelley supplemented in "A Defence of Poetry:" "A man to be greatly good, must imagine intensely and comprehensively; he must put himself in the place of another and of many others; the pains and pleasures of his species must become his own."
793 Wurman and Feldman, *Notebooks and Drawings*, n.p.

touchness' with commonness […]."[794] In 1968, Kahn alluded to the fact that if man could also penetrate into the consciousness of his fellow creatures,

> then a wider sense of commonness would enter expressions in art, giving the artist greater insight in presenting his offerings answering to the prevalence of order, the prevalence of commonness.[795]

This search for human agreement through architectural expression found its primal built manifestation on a global scale in the Indian Institute of Management in Ahmedabad, planned and realized between 1962 and 1974. On October 7, 1958, Kahn had received a letter from the office of S.O.M., in which he was asked if he could grant some time to a young Indian named Balkrishna V. Doshi, "a very brilliant architect, who was the resident architect for Le Corbusier at Chandigarh."[796] Remaining in contact throughout the next years, in 1962, as Doshi recalls, "the grand old man of Indian industry and a great patron of architects, Kasturbhai Lalbai […] asked me to design the Indian Institute of Management."[797] The same year he met Kahn again at the International Design Conference in Aspen, where he proposed that the latter be the architect, while he would act as his local associate on the project.[798]

What distinguished Kahn's endeavors in India was his application of the second wall as an expressional device, i.e. as a "valid false façade" upon which abstract forms could be exerted (Figure 209). This applied order was based, however, on a rigorous constructive and tectonic expressionism: sensing the inner nature of the materials, a symphonic quality should establish itself through their detailed and controlled arrangement. Altogether, only a few materials were available in India – mainly brick with its favorably low thermal conductance, while building in concrete was expensive and due to its increased radiation not necessarily the most appropriate choice. Kahn finally opted for a composite order of earth-colored brick with concrete lintels that in combination with low-lying segmental relieve arches permitted larger openings.[799]

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794 Kahn, "Lecture at the University of California, Berkeley, 1966," p. 8.

795 Kahn, "Architecture: Silence and Light," p. 26.

796 Letter of S.O.M. to Kahn, 7 October 1958, 030.II.A.54.57, LIKC.

797 Balkrishna V. Doshi, *Le Corbusier and Louis I. Kahn: The Acrobat and the Yogi of Architecture* (Ahmedabad: Vastu-Shilpa Foundation for Studies and Research in Environmental Design, 2007) p. 25.

798 Cf. Kahn's letter to the Consulate General of India, 25 June 1963, 030.II.A.16.32, LIKC.

799 In progressive manner Le Corbusier had primarily used concrete in his Indian projects. Yet, construction procedures in Kahn's time had not changed much from those in Chandigarh: "We had 20,000 women and children, oxen and donkeys by the thousands. We got the big concrete structures up with a mess of cockeyed scaffolding. We really built it like the Pyramids." Maxwell Fry in "Corbu," in *Time*, vol.LXXVII, no.19, 5 May 1961, p. 49.

Fig. 209: Louis I. Kahn, Indian Institute of Management, Ahmedabad, India, 1962-74.

Kahn's brick-order reactivated the imagery of Roman ruins: it was the concealed masonry structure like in the Pantheon (Figure 210), its ingeniously infixed archivolts above the niches that made the ancient structure resist gravitation and vanquish time, which Kahn sought to openly express.[800] Hence, following the Stoic maxim to act in "accordance with nature," Kahn's tectonic ornament as the "adoration of the joint" was less a spectacle of invented forms than a concise demarcation of the timeless order involved in erecting a brick structure.[801] Considering the many circular apertures of grand size, Kahn overtly alluded to Roman sources:

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800 Kahn argued: "The fact that it was Roman is only that the Romans used an order of brick which every mason knew as being the way you make brickwork." Prown and Denavit, *Kahn in Conversation*, p. 94.

801 Already in 1953, Kahn acknowledged: "If we were to train ourselves to draw as we build, from the bottom up, when we do, stopping our pencil to make a mark at the joints of pouring or erecting, ornament would grow out of our love for the expression of method." Kahn and Tyng, "Proposed City Hall Building," p. 23. Such *constructedness* had also characterized Dutch and German brick architecture half a century earlier. Not surprisingly, Kahn during his first stay in Europe had taken keen interest in the expressionistic work of Hendrik P. Berlage and Piet Kramer of the Amsterdam School, or in Germany in Hans Pölzig's Grosses Schauspielhaus (Berlin, 1918-9) and Fritz Höger's Chile House (Hamburg, 1922-4). Cf. Lewis, "Louis Kahn's Art and his Architectural Thought," pp. 70-1.

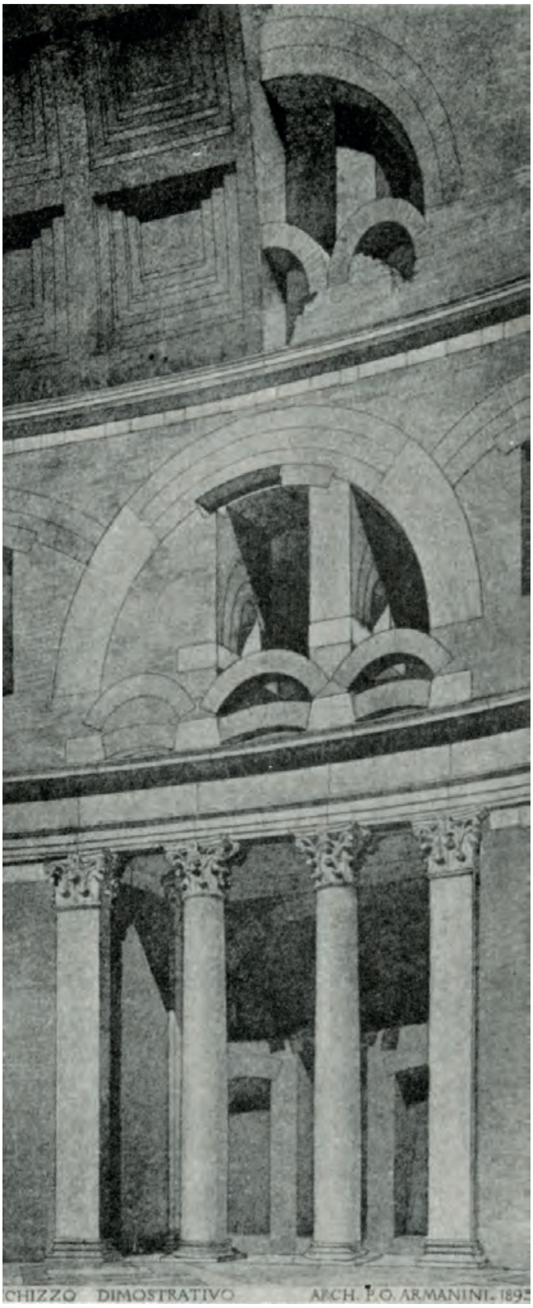

Fig. 210: Structural Order of the Pantheon.

> If you look at it carefully, some of the circles are really not a circle. They're even broken in the center, and I chose them for earthquake reasons. In Hadrian's Villa, you see the use of some circular forms, which I know very well. But who owns the circle?[802]

The circle, thus, was chosen for a constructive and an aesthetic reason. In the case of the second, it was a "non-choice" – a form so universal that nobody could claim its authorship. In the case of the first, Kahn clarified in 1966, although in relation to the earthquake conditions in Bangladesh:

> You have a gravity force, but you also have a force this way [upwards]. Leonardo in his sketch book says, 'In the remedy for earthquakes you reverse the arches.'[803]

While Kahn directly referred to Da Vinci, he might have also used the Fabricio Bridge as drawn by Piranesi as an example to convey his interest in a bare and infrastructure-like constructive logic (Figure 211). Doshi remembered that "easiness and naturalness" were the central attributes that Kahn pursued by articulating "the natural flow of things."[804] Altogether, the lintels, arches, and textures of brick came to stand as the depersonalized strokes of his artistic-architectural palette.

Kahn by respecting the tectonic structure and materials of a building as if they were alive and had a will of their own[805] – something Doshi alluded to as Kahn's "super-consciousness"[806] – set into practice his theoretical outlines regarding the universal "psyche" and INA. In 1971, he clarified:

> The work of art is the making of life. [...] I do not say that a wall wants to be a wall in the same sense that a leaf wants to be a leaf. You must instill this prerogative into the wall, because the wall is not a living thing. [T]hat which man makes, inspired by nature's ways and finding availabilities through nature's constructions, is a miracle of man and the availability. That which is made in that sense is given, in my mind, a consciousness. It wants to be a wall. It's proud to be a wall.[807]

In other words, just as nature, and in this respect man, consisted of inanimate elements that were activated by a life-sustaining breath, the artist, sensing that intangible

802 Cook and Klotz, *Conversations with Architects*, p. 195.
803 Kahn, "Address by Louis I. Kahn," pp. 19-20. Cf. Jean Paul Richter, (ed.), *The Literary Works of Leonardo da Vinci* (London: Phaidon, 1883; 1970) § 781. As Carlos Vallhonrat, Kahn's chief design assistant at the time, remembers, it was initially Komendant's suggestion to use a circular arch. Cf. Carlos Vallhonrat, "Tectonics Considered: Between the Presence and Absence of Artifice," in *Perspecta*, no.24, 1988, p. 128. Giorgio Martini had depicted a similar set of circular foundation arches in his *Trattato di architettura* (f.9V Tav.14).
804 Interview by the author with Balkrishna V. Doshi, 31 December 2008.
805 Famously, Kahn had asked brick what it wanted to be: "It will say, 'Well, I like an arch.'" Kahn, "I love Beginnings," p. 281.
806 Ibid.
807 Kahn interviewed by Blake, *What will be has always been*, p. 127.

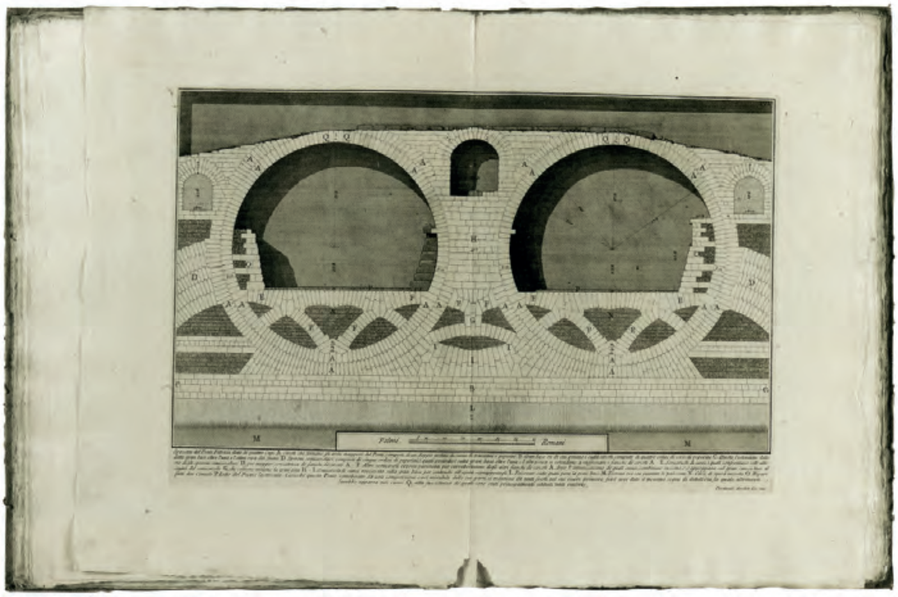

Fig. 211: Giovanni Battista Piranesi, *Fabricio Bridge*, Rome, Italy, 1756.

potential, could transfer its energy to lifeless matter through the creative act. This reconciliation of the subject with a collective force was closely aligned with Hindu thought. Quite fittingly, Doshi referred to Kahn as "a Yogin because of his 'Samadhi' to discover the value of the eternal – the Truth – the Atman – the Soul."[808] In a state of *Samadhi*, man through deep meditation (*Yoga*, literally meaning "union") renounced the self and became aware of the higher spiritual cohesion with the One.[809]

As noted, Kahn had alluded to a similar principle of unity in nature as early as 1959, at least three years before his first visit to India. However, in a newsletter dated December 1, 1959, Kahn had been welcomed as a new member to the Tagore

808 Balkrishna V. Doshi, "Louis Kahn in India," in *Architecture and Urbanism*, October 1975, p. 313. Marked by a deep reverence for the material world, the *Vedas* envisioned nature as a diaphanous veil, behind which the imponderable forces of the paramount *Paramatman* were active: "The one God hidden in all beings, pervading the universe, the inner self of all beings, the overseer of the work, dwelling in all beings, the witness, the spectator, alone, devoid of qualities [...]." Patrick Olivelle, (transl.), *Upanisads* (Oxford: Oxford University Press, 1996) Svetasvatara Upanisad 6.11-2.
809 This supersession of the self is described in the Chandogya Upanisad (6.10.1) as the ending of individual rivers in the ocean. In this state one was "not aware that: 'I am that river', and 'I am this river'."

Society of Philadelphia,[810] in which he must have encountered the central epistles of Rabindranath Tagore's trans-subjective philosophy. In any case, the fact that Kahn mentioned his philosophy of the INA for the first time at the end of the same month in a letter to Pattison, appears to be more than a mere coincidence.[811] The Bengali philosopher and poet Tagore, who gave Gandhi the name *Mahatma*, the "Great Soul," recurrently advised in his writings to enlarge the consciousness by growing with and into the world at large. Crossing the barriers of the self in order "to become more than man, to become one with the All"[812] was precisely the *leitmotif* that Kahn also sought to achieve in his process of creative self-annihilation.

4.3 Indian Elements at Work

In a wholesome dialogue with the environment, Kahn's Institute of Management was not only attuned with the natural flow of things in constructive-expressive terms, but also tried to embrace in exemplary fashion the demanding climatological constraints. Following the principles of adaptation, the passive energies of sun, wind, earth and water should become active resources to temper the hot-humid subtropical Gujarat weather with its drastic swings: a cool and dry winter with broiling summer heat as opposed to torrential downpours in the monsoon season. These geo-physical facets should not be hindrances, but qualities to be unveiled through the architectural intervention. Kahn could glean hints about the essentials of vernacular Indian construction from the brochure *Rural Houses of the Punjab* (undated) by Balwant Singh Saini. The author warned that with industrialization the "complexity of the natural environment" had increasingly become ignored:

> [I]ncorrect orientation, inadequate knowledge of climatic phenomena and singular lack of understanding of people's physiological and psychological needs are frequently evident.[813]

Saini asserted that, over millennia, the native population had successfully met the severest climatic challenges, because the builders revealed

810 In Kahn's archives, the earliest item related to the Tagore Society is a letter sent out to all its members dating from 28 July 1959. Cf. 030.II.A.64.18, LIKC.

811 Cf. Kahn's letter to Harriet Pattison, 29 December 1959; reprinted in Tyng, *Beginnings*, pp. 159-60.

812 Rabindranath Tagore, *Sadhana: The Realization of Life* (Radford: Wilder Publications, 2008; 1916) p. 16. As Tagore wrote in *Gitanjali*, the voice of the One took "wing in songs from every one of my birds' nests, and thy melodies will break forth in flowers in all my forest groves." Tagore, *Gitanjali* (New York: MacMillan, 1971; 1913) p. 38.

813 Balwant Singh Saini, *Rural Houses of the Punjab*, n.d., 030.II.A.113.30, LIKC.

> a precise and detailed knowledge of local climate conditions on the one hand and, on the other, a remarkable understanding of the performance characteristics of the indigenous building materials.[814]

Doshi added that "[t]o integrate physical and spiritual needs, due importance was given to nature and its basic laws. Nature was accepted as it is."[815] He recollected that also when Le Corbusier arrived,

> [h]e saw many things for the first time, the bright blue sky, the relentless sun, the hot winds, the cool moon, the beauty of tropical nights, the fury of the monsoon, and he said to me once that while his work so far had been a counterpoint to nature, he now realized that he had to have a pact with nature.[816]

As one of few architects who had close contact with both Le Corbusier and Kahn, for Doshi, the former – the "acrobat" – enjoyed chaos, found virtues in every crisis, was not concerned with consistency, always improvised, and apotheosized plastic emotion to answer multiple needs; while the latter – the "yogi" – preferred order and austere ordinance, strove towards simplification, emanated equanimity, and showed infallible tenacity in his pursuit to build "silence – totally integral, without any ripples of any kind."[817] In 1955, Doshi founded the Vastu-Shilpa organization, and five years later sent Kahn a rough draft explaining its purpose:

> We would like to teach an approach which thinks of design in terms of understanding traditions, customs, materials, climate as well as the aesthetics of a good object and its desirable environment.[818]

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814 Ibid.

815 Balkrishna V. Doshi, "Cultural Continuum and Regional Identity in Architecture," in Robert Powell, (ed.), *Regionalism in Architecture* (Singapore: Concept Media, 1985) p. 87. To elucidate Doshi's words, Heschong indicated in regard of India's temple architecture that its basic arrangement included "the means for being blessed by the four elements," since "[b]efore entering the temple gates, one removed one's shoes to touch and be blessed by the earth. Then upon passing through the temple gateway, one is blessed by the air with a gust of wind. […] A blessing by water is obtained by bathing in the temple tank, or at least descending its steps to touch the water and get a piece of one's garment wet. Finally, on entering the cool interior of the sanctuary, the worshipper is given a mark on the forehead with ashes taken from a small sacred flame by an attendant priest." Heschong, *Thermal Delight in Architecture*, p. 64.

816 Doshi, *Le Corbusier and Louis I. Kahn*, p. 8. Le Corbusier confirmed: "At the end of 1951, in Chandigarh: the possibility of getting in touch with the essential joys of Hindu principles: a brotherhood of relationships between the cosmos and all living things: stars, nature, sacred animals, birds, monkeys, and cows, and in the villages, children, adults, and still active older people, the pond and the mango trees, all present and all smiling, poor but in proportion." Zaknic, *The Final Testament of Père Corbu*, p. 89.

817 Ibid., p. 21.

818 Doshi's rough draft explaining the purpose of the *Vastu-Shilpa* organization, 8 December 1960, 030.II.A.66.9, LIKC.

Attempting to overcome the clash between an "assumed traditional pattern" and a "presumed non-traditional possibility," Doshi immersed himself in the study of the *Vastu-sastra*. Discovering the sanctity of life as its highest principle, he stated in 1979 that the architect's task was to "search for 'the inner happiness of man'. It is to discover the spirit in every man. As a Hindu, I would say, even in every living creature."[819] Incorporating Doshi's suggestion that "the court in a house and the central open space in an urban structure are, according to ancient Indian tenets of planning, presided over by Lord Brahman,"[820] in the initial scheme of the Institute of Management, Kahn placed the school building around a large atrium. Situated in the northeastern corner of the site, the further plan preceded towards the south and west in a monastery-like distribution of diagonally arranged dormitory buildings containing the individual cells, all linked by an intricate network of cloisters and walkways, while the independent faculty houses were placed in further distance. For Kahn, everything was "sort of closely knit because the closer the buildings are, the more comfortable they are. Always a sun problem."[821]

As a further reaction against the fierceness of the sun's radiance, Kahn's design was characterized from the outset by a layered arrangement that created shaded circulation areas and enhanced the building's elevations with deep shadow-pockets. Having recognized that many Indians lived outside under shade, these "internal streets" belonged both to the inside and the outside, and thus, in a non-dualistic fashion reconciled the two conditions (Figure 212). As Kahn argued,

> [t]he fact that you're always thinking in terms of never allowing the sun to come in makes the maintenance of the air conditioning much less. These walls are sun screens, and they give you a wall of reflected light, which cuts the glare that comes from the openings.[822]

Recognizing the porch as an "offering to the sun," Kahn followed an age-long tradition on the Indian subcontinent. Typical houses were built with a *baramdah*, an arcade surrounding it on the first floor, whereas on the upper floors *jharokas* or cantilevering

819 Balkrishna V. Doshi, "Ahimsa Paramo Dharma," (1979) in William J. R. Curtis, *Balkrishna Doshi: An Architecture for India* (Ahmedabad: Mapin, 1988) p. 166.

820 Ibid., p. 167. According to Doshi, the traditional central space, as left open to the sky, infused "in the individuals and the community a consciousness of the universe and nature. They also bring the occupants into daily contact with the supernatural, i.e. the mythical as well as natural-climatic elements and instill a sense of humility."

821 Prown and Denavit, *Kahn in Conversation*, p. 236. The large atrium possessed different climatic advantages as well: as evening advanced, the warm air having collected there during the day rose up and was gradually replaced by colder currents. In the morning, the temperature in this reservoir of coolness remained low, since the patio's walls offered shade and prevented a rapid heating up. Grass as ground cover increased this effect besides raising the vapor content of the air.

822 Cook and Klotz, *Conversations with Architects*, p. 197.

Fig. 212: Louis I. Kahn, Indian Institute of Management, Ahmedabad, India, 1962-74.

balconies shielded by *jalis* overlooked the street. Intrigued by Mughal architecture, Kahn observed on several journeys across the country some of its finest examples:[823]

> All of it is just superb. Though I shall never get taken by the elemental parts and details the overall effect of the buildings in their courts is strong and forever good.[824]

In general, Mughal architecture rising to such prodigious heights in its *Golden Age* and "Reign of Marble" under emperor Shah Jahan (1627-58), promoted intermediary spaces, for instance in the common prayer halls of the mosques like the Jami Masjid in Ahmedabad (1424) or New Delhi (1650-6; Figure 213). In addition, the *Diwãn-e-Aam* ("Hall of Public Audiences") and *Diwãn-e-Khas* ("Hall of Private Audiences") in Agra (1631-40), in the Red Fort of Delhi (1638-48) and the Royal Fort at Lahore (1631-1645) were conceived as large porches open to their surroundings. In the gardens, permeable pavilions called *chattri* were placed at strategic intersections to enable the enjoyment of the pleasant greenery. Unique among these parasol structures was the Panch Mahal, also known as *bãdgir* ("windcatcher"), in Fatehpur Sikri's palace complex (under Akbar, from 1570 onwards) – a trabeated tower structure, consisting of five floors that, while decreasing in size towards the top, remained open to the wind on all sides.[825]

As stated, Kahn's arcades, besides counteracting the glare, were also supposed to catch the breeze to mitigate the temperature and carry away the bad odor. A truly breath-taking experience in one of the *Sheesh Mahal*'s (Crystal Palace, 1631-2 by Shah Jahan) lavish interiors in Lahore made Kahn realize the value of good air quality:

> [T]he guide showed us the ingenuity of craftsmen who had covered an entire room with multi-colored mirrored mosaics. To demonstrate the mystery of the reflections, he closed all the doors and lit a match. The light of the single match gave multiple and unpredictable effects but two people fainted for lack of air in the short moment that the room was shut from the breeze. In that time, in that room, you felt that nothing is more interesting than air.[826]

Furthermore, on his way from Lahore to Karachi, Kahn might have visited Hyderabad, a city famous for its multidirectional wind towers creating drafts through a natural stack effect.[827] In Ahmedabad, in order to allow for the flow of the prevailing breezes down the alleyways, the initial scheme was horizontally reflected upon Doshi's suggestion in 1963, while the formerly closed central court was opened towards the

823 Kahn visited Jaipur, Fatehpur Sikri, Agra, New Delhi, Chandigarh, Karachi and Lahore in 1963. Both Pattison and Vallhonrat, who accompanied Kahn, confirmed the visits in separate interviews with the author.

824 Goldhagen, *Situated Modernism*, p. 180.

825 Similarly diaphanous was the open colonnaded Palace of Mahmud Shah in the Sarkhej Roza complex. To remain in Ahmedabad, one of the distinguishing features of its mosques was the use of clerestory windows with delicately traced and perforated stone screens to filter the incoming light like in the Sidi Said Masjid (1572-3).

826 Ronner, Jhaveri and Vasella, *Complete Work*, p. 265.

827 The *mecca* of masterful wind-tower construction is the Persian town of Yazd.

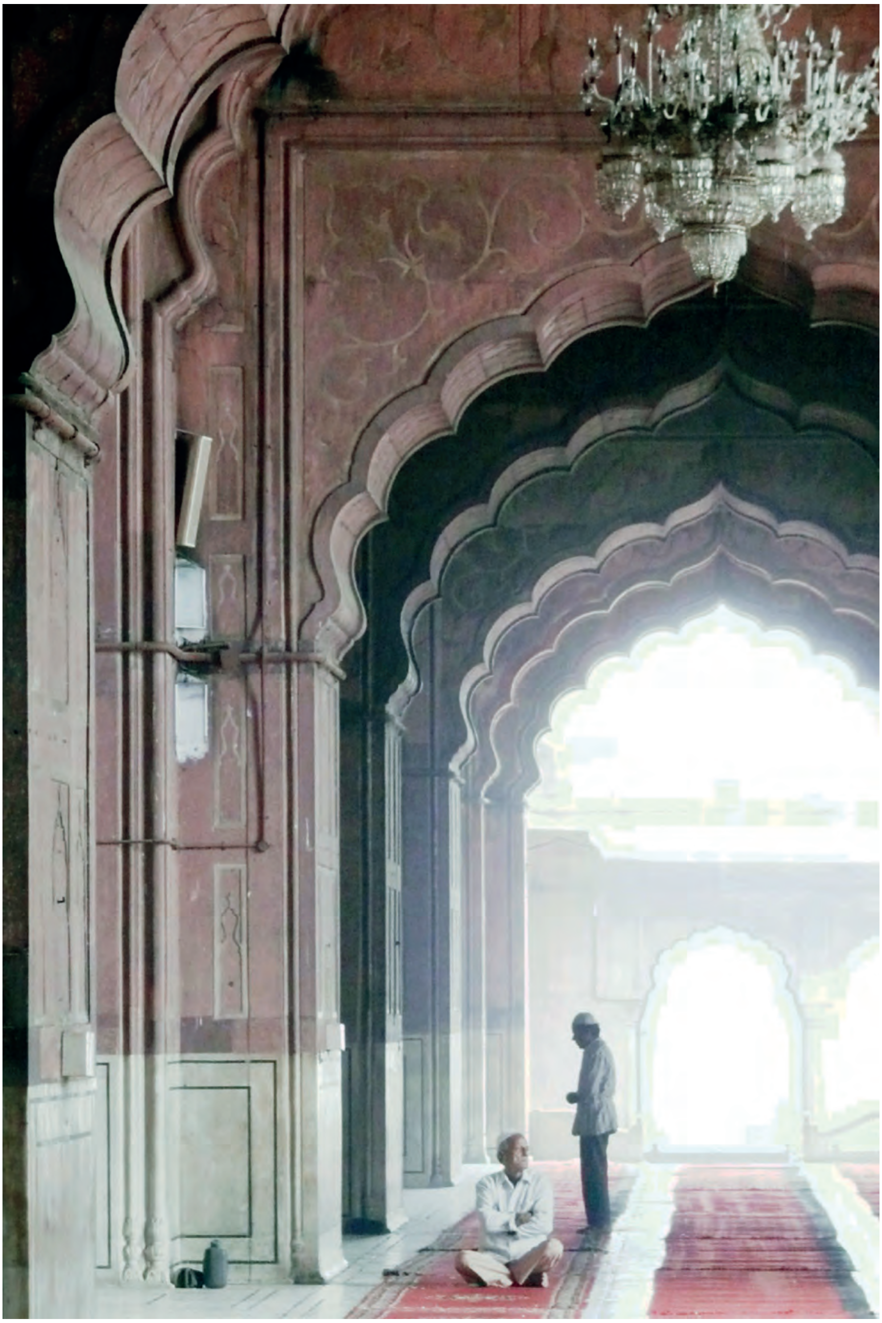


Fig. 213: Jami Masjid, New Delhi, India, 1650-6.

west.[828] Doshi had learnt to orient a building to the wind from Le Corbusier, who "had made charts indicating the breezes' direction."[829] In elaborating Doshi's proposition, Moshe Safdie,[830] one of Kahn's employees at the time, made two comparative schemes, dated July 15, 1963 (Figure 214), which analyzed the combined impact of the sun and the wind.[831] Based on the assumption that in the hottest months of the year the prevailing winds came mainly from southwest, Safdie proposed in scheme B that all the walls of the dormitories and residential units should be parallel to the wind's direction. Noticing, however, that in the same direction the buildings would be exposed to the hot afternoon and evening sun, Safdie concluded that tall trees should be planted to ward off the glare while allowing salutary breezes to blow through.[832]

In the further determination of the general layout (Figure 215), Kahn fully incorporated Safdie's propositions in the planning of the staggered housing units, whereas in the case of the dormitories protected by deep balconies, he oriented the individual chambers 45° off the wind, but left open a slit in the corner to channel the wind and aerate the communal areas. The breeze-through effect was increased by the position and size of the openings: following the best precepts of aerodynamics a maximum air current was secured by locating the narrow slit on the windward side and large, circular perforations on the leeward one (Figure 216).[833] Additionally, Kahn positioned the staircases in vertical shafts (Figure 217), which like a *bãdgir* pointed

828 Cf. Kahn, "Remarks," pp. 322-4.

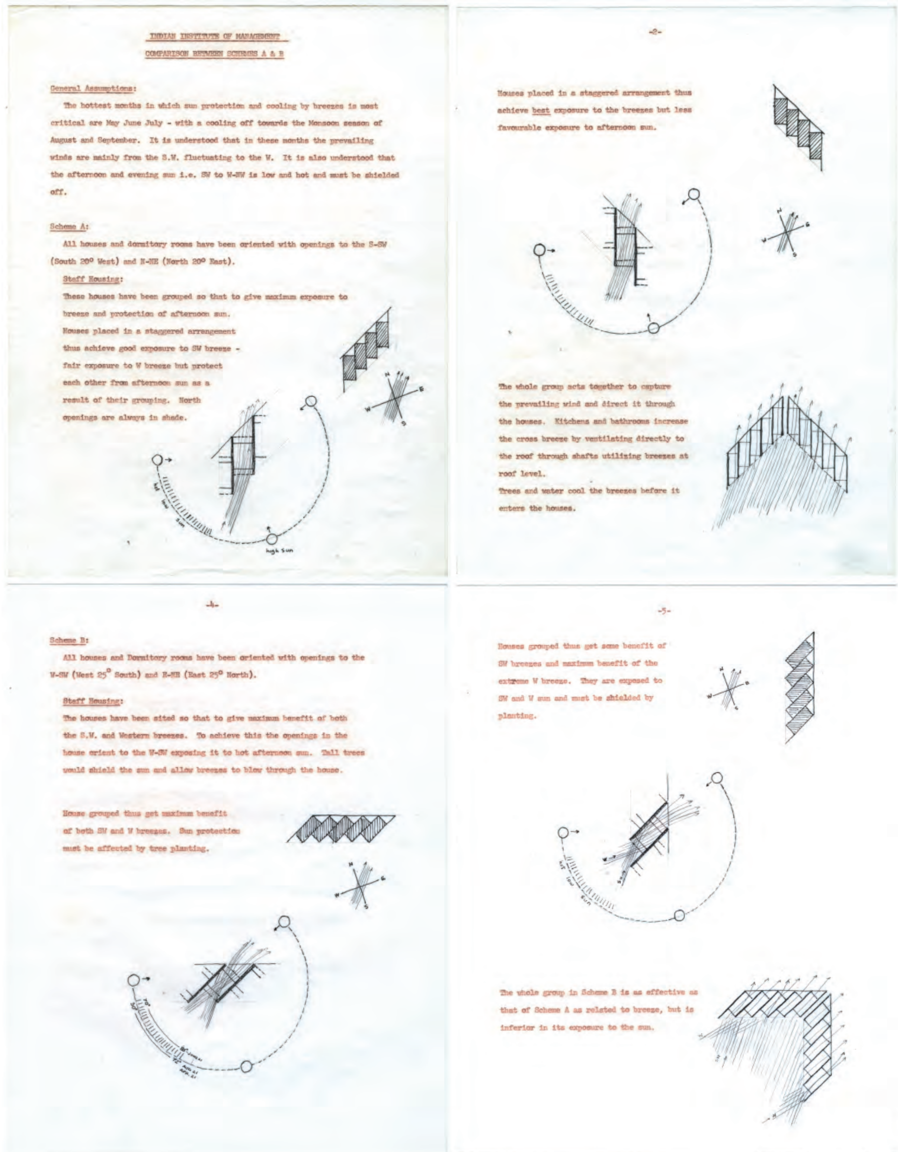
829 Interview by the author with Balkrishna V. Doshi, 31 December 2008. Le Corbusier had the habit in India to indicate on all plans within the compass sign both an arrow pointing north and one for the prevailing wind direction.

830 The first correspondence between Safdie, who was working at the time in the office of Lemco van Ginkel in Montreal, and Kahn dates from 23 September 1961; Cf. 030.II.A.66.14, LIKC. In follow-up letters from early 1962 (24 January 1962 and 19 February 1962, 030.II.A.57.65, LIKC), the young Israeli architect enclosed two issues of *Habitat* (vol.4, no.4, July-August 1961, pp. 2-7; and vol.4, no.6, November-December 1961, pp. 2-10), which included his essays "Fallacies, Nostalgia and Reality" and "A Case for City Living." Safdie attacked therein both the single family house as "a complete waste of land," but also Mies van der Rohe's multi-story buildings that were in "conflict with the essential requirements of dwellings," namely the more "obvious ones – such as orientation, climate control, views, varying room fenestration needs – and the more subtle ones – such as expression of the individual dwelling both internally and externally, identity, circulation."

831 Cf. Safdie's environmental studies for the Indian Institute of Management, 15 July 1963, 030.II.A. Box 115, LIKC.

832 It should be supplemented that in Le Corbusier's buildings in Ahmedabad – the Sarabhai and Shodan House, for example – the main walls were also placed parallel to the breeze, while in the Textile Mill Owner's Association the front façade's vertical blades were directed that way.

833 Airflow over and around the buildings caused a low-pressure suction zone on the leeward side that ensured a steady air-exchange. Besides, openly segmented brick arches afforded welcome drafts to the roofs, which were intended as sleeping areas during hot nights. To provide such galleries with textile awnings for night shelter was common practice in both the vernacular tradition of hot-humid and hot-arid countries.



INDIAN INSTITUTE OF MANAGEMENT

COMPARISON BETWEEN SCHEMES A & B

General Assumptions:

The hottest months in which sun protection and cooling by breezes is most critical are May June July - with a cooling off towards the Monsoon season of August and September. It is understood that in these months the prevailing winds are mainly from the S.W. fluctuating to the W. It is also understood that the afternoon and evening sun i.e. SW to W-NW is low and hot and must be shielded off.

Scheme A:

All houses and dormitory rooms have been oriented with openings to the S-SW (South 20° West) and N-NE (North 20° East).

Staff Housing:

These houses have been grouped so that to give maximum exposure to breeze and protection of afternoon sun.

Houses placed in a staggered arrangement thus achieve good exposure to SW breeze - fair exposure to W breeze but protect each other from afternoon sun as a result of their grouping. North openings are always in shade.

-2-

Houses placed in a staggered arrangement thus achieve best exposure to the breezes but less favourable exposure to afternoon sun.

The whole group acts together to capture the prevailing wind and direct it through the houses. Kitchens and bathrooms increase the cross breeze by ventilating directly to the roof through shafts utilizing breezes at roof level.
Trees and water cool the breezes before it enters the houses.

-4-

Scheme B:

All houses and Dormitory rooms have been oriented with openings to the W-SW (West 25° South) and E-NE (East 25° North).

Staff Housing:

The houses have been sited so that to give maximum benefit of both the S.W. and Western breezes. To achieve this the openings in the house orient to the W-SW exposing it to hot afternoon sun. Tall trees would shield the sun and allow breezes to blow through the house.

House grouped thus get maximum benefit of both SW and W breezes. Sun protection must be affected by tree planting.

-5-

Houses grouped thus get some benefit of SW breezes and maximum benefit of the extreme W breeze. They are exposed to SW and W sun and must be shielded by planting.

The whole group in Scheme B is as effective as that of Scheme A as related to breeze, but is inferior in its exposure to the sun.

Fig. 214: Climatic Studies by Moshe Safdie, 1963.

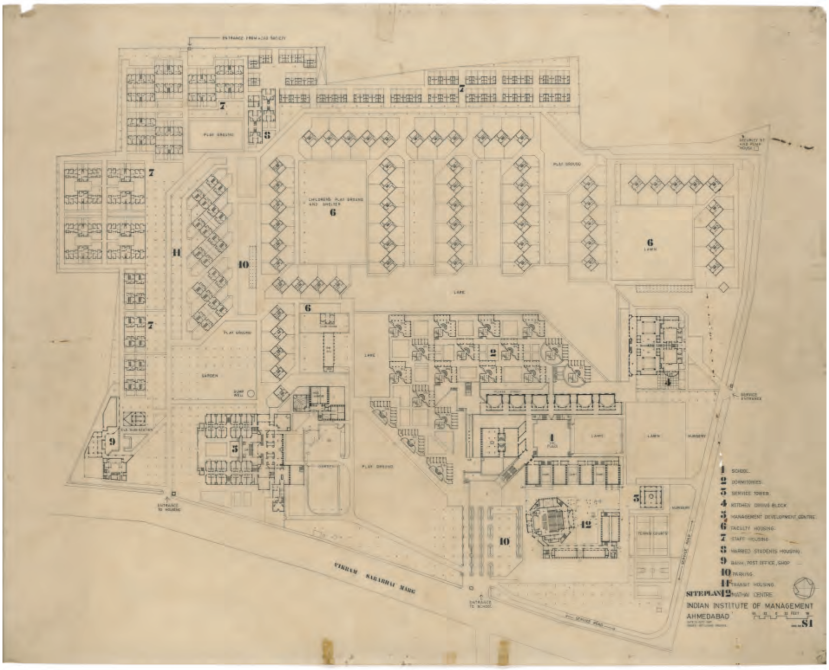


Fig. 215: Louis I. Kahn, Indian Institute of Management, Ahmedabad, India, 1962-74.

Fig. 216: Louis I. Kahn, Indian Institute of Management, Ahmedabad, India, 1962-74.

Fig. 217: Louis I. Kahn, Indian Institute of Management, Ahmedabad, India, 1962-74.

away from the wind with their finial to propel air-exchange. Regarding the annexed and closed-off kitchen cubicle, Kahn remarked that it was

> like a big ventilator. Because they make so many foods that are highly spiced and so smelly, the kitchen is made as though it were a big fan. Yes, and a big venturi. It's really a venturi.[834]

In a concluding manner, Kahn postulated: "The orientation, the sense of the order of wind, made the Ahmedabad plan what it is."[835] Classrooms and administration areas should be air-conditioned, however, and for that reason Kahn placed a "service tower" at the northwestern corner of the site – far outside, since "you don't want to take the exhaust air from the cooling tower in the line of the breeze that can go over buildings." The tower itself "was made also like a giant venturi" to aerate and cool the water of the air conditioning plant. In order to increase that effect Kahn played with the idea to make "the cooling pipes play over balls of glass," since this way the air "just gets more surfaces of water."[836]

A final element that Kahn intended to employ in order to make his design fully climatically responsive was a large water tank, which in surrounding the dormitories

834 Prown and Denavit, *Kahn in Conversation*, p. 238.
835 Ibid., p. 222.
836 Ibid., pp. 239-40. In traditional houses in Cairo the incoming air was funnelled over wet charcoal, small water basins or a *salsabil* (watered marble plate), from which it entered more humid and cooled by evaporation the main hall.

Fig. 218: Sarkhej Roza Complex, Makarba, Ahmedabad, India, 1446-51.

would on the one hand psychologically mark them off from the faculty units, and on the other help lower the temperature. Although the tank remained unexecuted as the clients persuaded Kahn that it would above all be a breeding ground for insects, the crucial role water played in the overall context of Ahmedabad must have motivated the idea.[837] The Sarkhej Roza complex (Figure 218) had been set around an excavated 17-acre rectangular pond, whereby a sluice with three circular apertures connected it with a larger water reservoir in the north. As recognizable in the elaborate water wells and cisterns (*vav*) of Dada Harir (1499; Figure 219) or Ruda Baoli (1501), both in the town's outskirts, water was significant not only from a biological, but also from a spiritual and social standpoint, creating centers of communal life.

An architecture of water also figured as the main incentive for Kahn's proposed master plan of Gandhinagar, "City of Gandhi" (unexecuted, 1961-6). As Kahn recalled, the city of 500,000 inhabitants was to be located close to a large river, which

> becomes flooded in the time of rain. [...] My idea was to capture this water at intersections, with structures over the water – kinds of bridges – and bring the water to the city, and hold it in tower reservoirs. This way, the city would never be dry in the summertime. [...] Water is a gift to a city in India.[838]

In 1965, trying to pursue Noguchi to participate in the design, he asserted that it would be "a wonderful opportunity to work with nature and ride with its blows."[839] Besides this "aqueduct architecture," Kahn intended to create a park that would be entirely shaped by the aquatic forces' proclivity to carve out valleys and flatten plains:

> The monsoon rains, as they fell from the land to the high banks of the river, form very picturesque and sculptural erosions. My thought was to make a park out of these washaways, firming up the ground with brick construction, following the contours as they are, just making them firm so they wouldn't continue to wash away. They could have become the most magnificent nature-inspired playground you can possibly image.[840]

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837 Edwin Lutyens and Howard Baker made extensive use of water canals in their layout of the new capital in New Delhi (1912-31), most prominently in the immense avenue leading up to the *Rashtrapati Bhavan* (Viceroy's House, 1920-31). Another source for Kahn's intended use of water, as Doshi suggests, was the walled city of Mandu. In the 15th century, a number of artificial lakes had been laid out to picturesquely mirror the palaces and collect through a network of cisterns and ditches the rainwater. Besides, Doshi's own studio *Sangath* (1979-81) is a selfless essay in how water can accentuate architecture: In a landscape of cascades, ditches and glimmering barrel vaults, all rainwater is gathered and directed towards a small pond in the center of the grounds.

838 Cook and Klotz, *Conversations with Architects*, p. 201.

839 Kahn's letter to Noguchi, 26 August 1965, 030.II.A.33.13a, LIKC.

840 Cook and Klotz, op.cit.

Fig. 219: Water Well, Dada Harir, Ahmedabad, India, 1499.

Fig. 220: Louis I. Kahn, National Capital of Bangladesh, Dhaka, 1962-83.

4.4 Grounding and Orientating the Sangsad Bhaban

Congruently with these undertakings in India, Kahn planned the National Capital of Bangladesh in Dhaka (1962-83).[841] There, at last, an artificial lake (Figure 220) spatially organized the entire ensemble consisting of the National Assembly, a prayer hall, offices, and different hostels. Referring to the spatial role of the tank with a second crescent-shaped "lunar lake" in the north, Kahn explained in 1965:

> The architecture of the hostels with deep protecting porches is the same as that of the Assembly. Conceived as studies and their gardens they are placed looking toward the Assembly, forming a triangular composition. The lake in which the buildings are reflected and the interweaving of lesser lakes, fountains, and gardens, holds the entire composition in balance. Other buildings related to the lake or on the grounds contiguous will be of masonry construction following the principles of architecture, which respect the influence of indigenous conditions and from which all architecture gets its beginnings.[842]

841 While Islamabad was installed as the new administrative capital of Pakistan in 1947, to placate growing discontent in the country's eastern part, General Ayub Khan implemented Dhaka as the government center containing the legislative assembly.
842 Kahn, "Remarks," p. 313.

Placed on an 840-acre site called Sher-e-Bangla-Nagar, the “City of the Bengal Tiger,” Kahn distinguished the Sangsad Bhaban (“National Assembly”) from its surroundings by introducing the tank, “because it’s a delta country, and all important buildings were on mounds. That’s the way to protect yourself from flood.”[843] In this statement, Kahn was referring to two important facts: first, the alluvial Bengal delta in which Dhaka is situated that is shaped by the annual floods of the Ganges and the Brahmaputra, and second, the traditional architecture in the area characterized by a general “dig and mound” technique:[844]

> Physical conditions of this region, particularly of the site, demand that a positive design attitude must be developed for the conditions of sun, wind, weather, rains, and floods. The tradition is the making of lakes to obtain fill to make mounds for roads, directing the drainage and raising the building locations above water problems.[845]

To illustrate Kahn’s observations, the English painter George Ginnery had drawn such a traditional edifice on a vignette in Sir Charles D’Oyly’s *Antiquities of Dacca* (1814-27) with a descriptive text by James Atkinson (Figure 221).[846] Regarding the general climate, where vegetation was “rapid and abundant” the latter commented:

> If a bird drop a seed, or the wind waft one where it may find permanent lodgement among the chinks of a building it presently puts forth fibres which soon become roots and branches, clinging among the stucco and fissures, and finding nourishment, as it were, in the midst of sterility [...].[847]

Altogether, D’Oyly’s documentation showed how monumental architecture had coped with these special conditions in the past, as visible, for instance, in the depiction of the Saat Gombuj Masjid (under Mughal Subadhar Shaista Khan, c. 1680) on the banks of the Buriganga (Figure 222). Atkinson noted that this mosque reminded him

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843 Kahn’s note 20 May 1964, 030.II.A. Box 122, LIKC.

844 In March 1963 Kahn accompanied by Komendant and Vallhonrat visited Dacca for three weeks to present preliminary plans, study local conditions and discuss the further procedure with local authorities. Crisscrossing the parcel of the future parliament in a jeep, he felt quite desperate as a letter to Pattison indicates: “The site is a no man’s land completely without distinction; not a contour, a cluster of trees, not a distant landmark.” Whitaker, “Chronology,” p. 27.

845 Kahn, “Remarks,” p. 313. As Komendant recalled: “The farmhouses were built on a pile of soil up to several feet higher than the surrounding area. The resulting pit of excavation was used as a fish pool. When snow melted in the Himalayas, the rivers overflowed and put the lower terrain under water. The fish, when the water level lowered, escaped to the deeper waters and filled the pools. So the farmers had plenty of fish year-round.” Komendant, *18 Years*, p. 77.

846 Cf. “Modern habitations at Dacca,“ in Charles D’Oyly, *Antiquities of Dacca* (London: John Landseer, 1823) III, pl.5; http://www.bl.uk, accessed 7 September 2009.

847 James Atkinson, “Mosque of Syuff Khan, Dacca,” in ibid., 1814, I, pl.19.

Fig. 221: “Modern Habitations at Dacca,” in Charles D’Oyly, *Antiquities of Dacca*, 1823.

Fig. 222: “Mosque on the Booragunga Branch of the Ganges,” in Charles D’Oyly, *Antiquities of Dacca*, 1814.

of Venice, since it "rises immediately from the margin of the river, with an effect at once stately and picturesque,"[848] while Kahn attested:

> The examples of intelligent cooperation with these pervasive elements of water and vegetation in some of the best examples of Mughal Garden Architecture has been a great inspiration to me.[849]

When speaking of Mughal garden architecture, Kahn might have been referring to the local Lalbagh Fort with its water channels surrounding the central Tomb of Bibi Pari. Among the ingenious ways in which Mughal architects integrated water in their large-scale projects, however, the concept to position a pavilion in the middle of an artificial lake was rarely employed. Nonetheless, there are possible references for this approach, too: In Mandu, the Jahaz Mahal (c. 1469 to 1500) as befits the name, "Ship Palace" was like a dam stretched out on a narrow strip of land to divide a couple of water tanks. An excavated lake that gave Amritsar its name, "Pool of the Nectar of Immortality," surrounded the Harmandir Sahib ("Golden Temple," 1585-1604), the holiest site of the Sikhs. Isolating the heavenly mansion from the worldly domain, also Kahn's National Assembly should loom like an otherworldly dream castle in the waters, where the sky's reflections colorfully etherized in moving shadows the building's solid mass (Figure 223).

The epic prospect of Kahn's task included alongside the construction of the "citadel of assembly" in the south also the planning of housing units in the far north and a "citadel of institutions" in the center.[850] Answering to the demands of the low-lying flood-prone area, Kahn imagined for the residential units bridge-like structures that bordered at flood basins following the aquatically carved-out contours of the land. The creation of an "architecture of the land" also stood at the center of the Sangsad Bhaban's design,[851] which as an *isthmus*, a castellated protective citadel, was to offer the parliamentary members a place of seclusion to discuss the future of the country.[852] As William J. R. Curtis suggested, Kahn's Assembly might be compared to

848 James Atkinson , "Mosque on the Booragunga branch of the Ganges," in ibid., 1814, I, pl.17.
849 030.II.A. Box 120, LIKC.
850 On 26 March 1971, the civil war broke out between West and East Pakistan, leading ultimately to the independence of the Eastern part and its renaming as Bangladesh. Kahn's project for the "citadel of assembly" restarted in August 1972, but was only finished after his death in 1983 by his long-term collaborator David Wisdom (since 1943 in the office), Henry Wilcots and Reyhan Tansal Larimer. Realized according to Kahn's plans in the northern part was the Ayub Hospital (1962-74) with its spatially overwhelming double-layered and cross-arched front porch. Cf. Lesser, *You Say to Brick*, pp. 344-5.
851 Cf. Kazi Khaleed Ashraf, "Capital Complexity: Kahn's Architecture in Dhaka," in Ashraf and Saif Ul Haque, *Sherebanglanagar: Louis I. Kahn and the Making of a Capital Complex* (Dhaka: LOKA, 2002) p. 15.
852 This also symbolic gesture to unify two shores was further emphasized in Kahn's design of the Palace of Congress in Venice (not built, 1968-74), which as an actual bridge crossed a canal and provided in its hulk space for an auditorium.

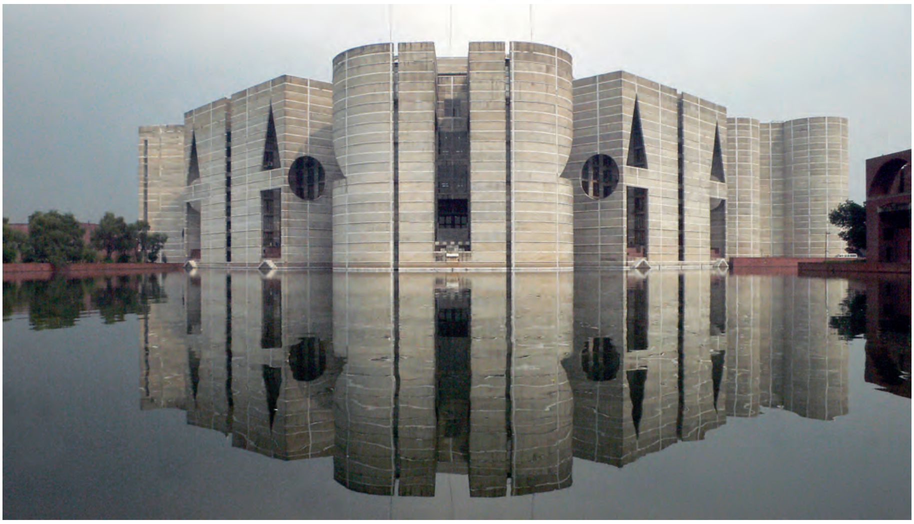

Fig. 223: Louis I. Kahn, National Capital of Bangladesh, Dhaka, 1962-83.

a "vessel" that carried "the state through the fluctuations of events, and over the ever threatening waters."[853] Kahn recognized, too, that

> [b]y applying ourselves to the problems of the sun, wind, excessive rain and realizing the beauty of sparseness and directness, the buildings are taking on a nobility of spirit.[854]

Nevertheless, he again struggled to find the right orientation of the complex.[855] In the sketches drawn after the initial site visit, the Sangsad Bhaban, the mosque and the court were aligned on a west-east axis (Figure 224). Marking the direction of the prevailing wind from south-southeast with an arrow, Kahn already indicated with hatched lines the direction of the buildings' façades in interrelation with the prevailing drafts. However, for the first presentation on March 12, 1963, Kahn rotated the entire disposition by 90°, making the lake the southernmost point of the arrangement. In possible correspondence with the shifting of the buildings in Ahmedabad, for the next presentation on May 16, Kahn mirrored the entire complex once more, so that

853 William J. R. Curtis, "Presence of Absence – Louis I. Kahn and Modern Monumentality," in *ptah*, no.1, 2002, p. 29.
854 Kahn's letter to Mary Stewart French, Bureau of Educational and Cultural Affairs, Department of State, 2 March 1965, 030.II.A.58.4, LIKC.
855 Climatological information was sent to Kahn in November 1963, "PAC-Cablegrams to/from Addl Chief/2 years 1966-1967," and October 1964, „PAKCAP- Correspondence to/from ROYGUS October 8, 1964 thru June 30, 1965," Box 117, LIKC. Cf. Ksiazek (Goldhagen), "Architectural Culture in the Fifties," p. 431.

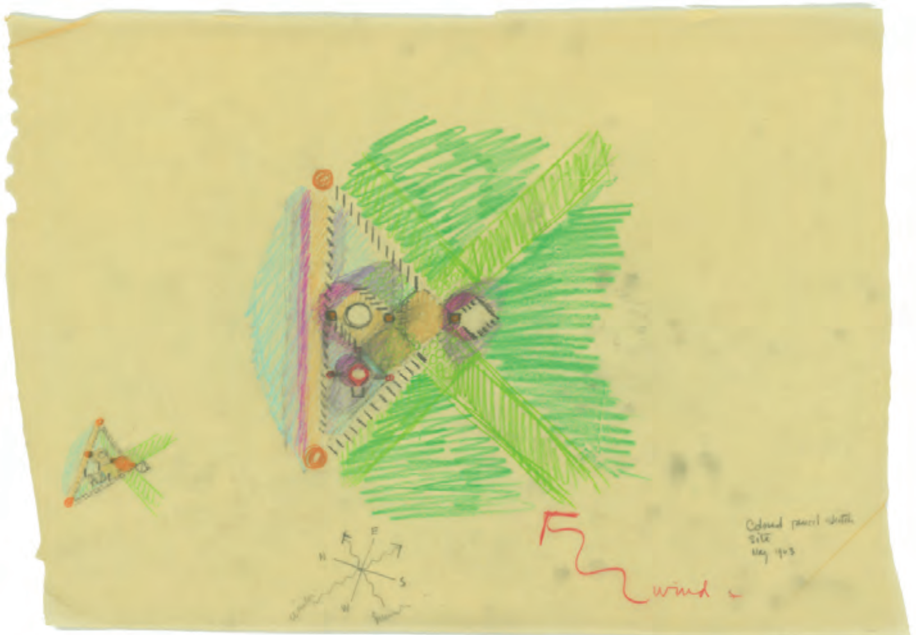

Fig. 224: Louis I. Kahn, National Capital of Bangladesh, Dhaka, 1962-83.

the tank now pointed northward (Figure 225). Hence, just like in Ahmedabad, the buildings were now not confronting the wind, but aligned in its flow. The hostels, placed alongside the southern bank, opened with their recessed façades towards the calmer light in the north, while the eastern ones were protected from the evening glare by hollow cylinders containing peripheral ramps and bridges within their layered walls. Assertive in their ruinous nature, these curvilinear volumes with segmental breakthroughs facilitated an intricate play of light.

After this basic configuration had been attained, in December 1963 Kahn received a letter from Victor Olgyay, offering that he "would be very glad to analyze the climatic side of the problem."[856] Following his bioclimatic doctrines as outlined in *Design with Climate* (Figure 226), Olgay in his appended orientation diagrams (Figure 227) basically confirmed Kahn's deliberations, calculating that

> the resultant orientation axis [the mean axis derived from the most appropriate sun (helio) and wind (thermo) alignment] would add up to an approximate 12° east of south axis.

856 Olgyay's letter and climatic orientation sketches, 20 December 1963, 030.II.A. Box 122, LIKC.

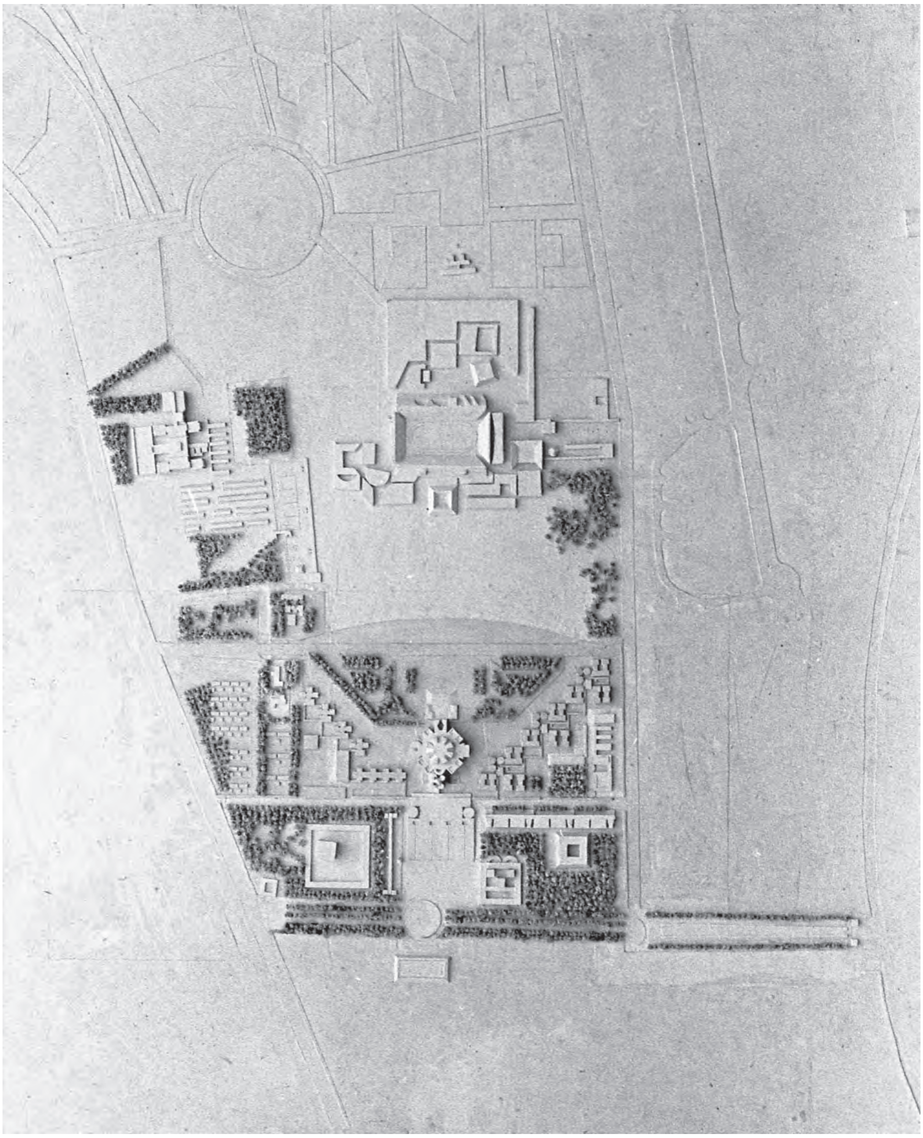

Fig. 225: Louis I. Kahn, National Capital of Bangladesh, Dhaka, 1962-83; Landscape Design by Harriet Pattison.

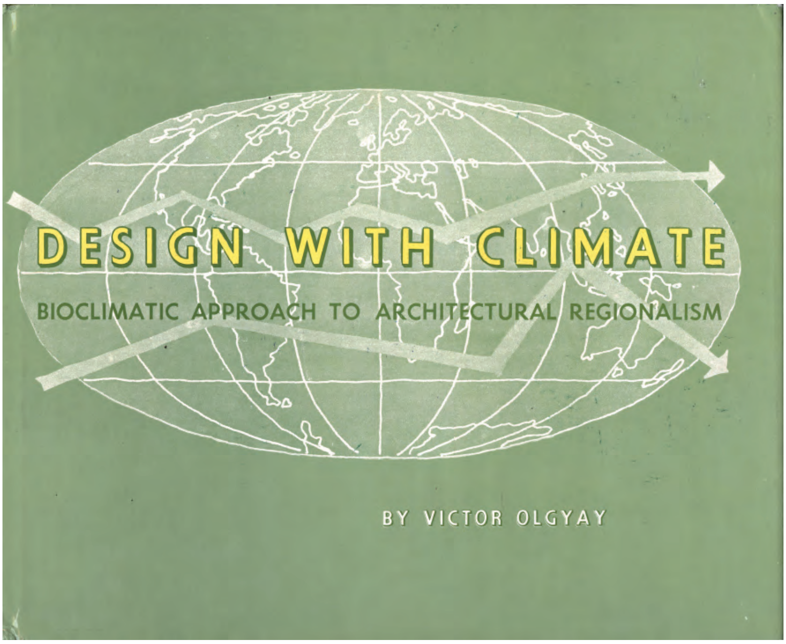

Fig. 226: Victor Olgyay, *Design with Climate*, 1963.

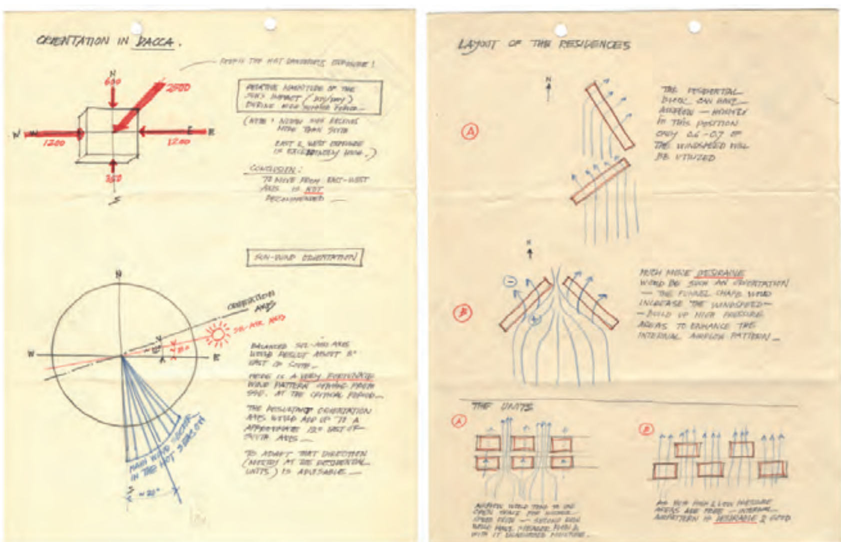

Fig. 227: Victor Olgyay, Climatic Studies of the National Capital of Bangladesh, 1963.

In Kahn's plan of May 1963 – with the exception of the annexed mosque in the south, whose *mihrab* ("prayer niche") was directed due west according to the law of the *qibla* ("direction of prayer")[857] – it had been 8°, and in the final implementation approximated 6° east of south, thus, being slightly shifted off a precise north-south alignment to receive the more fortunate draughts. Consequently, Olgyay, who had played a preeminent role in establishing a field of research concerned with the question of how to affect a house's interior climate by natural means, basically approved Kahn's general disposition, but in his opinion the hostels should face southward. Apart from this last proposition, since Kahn placed his buildings *with* and not against the wind, the general layout achieved by May 1963 was not unlike a Palladian country villa, where outspreading *arms* supplemented a central *head* building.

Kahn, who as mentioned before seemed to be aware about the prevalent climatic conditions before Olgyay made his suggestions, had probably received pertinent information from the Bengali architect Muzharul Islam, who, just as Doshi in Ahmedabad, introduced him to the contextual particularities.[858] A year later, by May 1964 the main components of Kahn's plan had been further defined: the Assembly was preceded on both the northern and southern side by ceremonial plazas with grand stairs. Recognizable at that point were also long avenues of trees that were supposed to extend the formal order of the buildings towards the surrounding environs, define and frame the public spaces, and help moderate the climate. While a large lawn had been planned from the start to precede the northern presidential plaza, in January 1973 Kahn reconfigured the entire garden layout on the southern side. As certain public buildings were no longer required, he first proposed a series of garden courts, until these too were eliminated to reach the final solution: "I want nothing but grass as a setting, a great carpet in front of a strong geometry."[859] Hence, adding further calmness to the site, the entire ensemble with its taut geometries and solemn dignity was designed to act as a tranquil oasis within the frenetic city life.

857 Kahn here clearly followed common Indian practice. For instance, the Taj Mahal, Humayun's or Bibi Pari's Tomb, but also a vast majority of the mosques were placed in the landscape to face the cardinal directions. According to Islamic ritual, a mosque should face the Ka'ba in Mekka, yet, randomly one and practically none in India confronted its actual direction. Kahn's applied option derives from the first generation of Muslims, who recalled that the Prophet when praying in Medina faced due south. Cf. David A. King, "The Orientation of Medieval Islamic Religious Architecture and Cities," in *Journal for the History of Astronomy*, vol.XXVI, no.8, 1995, pp. 253-74.

858 Muzharul Islam had initially been chosen to design the new capital building, yet he proposed that the commission should go to an international architect. Since both Le Corbusier and Aalto declined, Kahn, whom Islam had known from his days as a student in Yale, was contacted on 27 August 1962. Cf. Stanley Tigerman, "Thoughts about Louis I. Kahn," in Ashraf and Haque, *Sherebanglanagar*, p. 9. In his own prolific works, Islam sought to blend elements from the universal repository of Modern architecture with the vernacular idiom of Bengal. Consequently, it was for Islam essential not only to import the knowledge he had gained during his education in the West, but also to retrace the steps of his own cultural identity distorted under colonial rule.

859 Cook and Klotz, *Conversations with Architects*, p. 178.

While actual construction began in October 1965, a year earlier Kahn had instructed his employees Roy Vollmer, Gus Langford and Henry Wilcots to establish a field office and build a sample building surrounded by a plant nursery. As Wilcots remembered:

> The nursery was developed with various plants of the country, and the idea was to bring these plants and place them on the site. This was developed long before Lou knew where these plants were to be, and, one time there was a gentleman from the horticultural department who came out and together, he and Lou, went across the site and they talked about the various plants and what they would like and how they would grow and where they should be placed.[860]

Besides these concerns for the future landscaping, Kahn recognized immediately that both materials and building knowledge were lacking in the area, and thus, also assigned his three collaborators to train a workforce, which would eventually comprise 2000 laborers. While the auxiliary structures utilized locally kneaded and fired clay-bricks to root the dwellings in the ground from which they stemmed, the decision to employ reinforced concrete in the National Assembly magnified its transcendent status and clearly underlined Kahn's intention to merge the local with the global.[861] However, due to the significant seismic requirements the brick masonry structures also needed to be reinforced with steel armatures. Lastly, Kahn, thus, obtained *opus caementicium*, since the visible brick faces were in fact the casts that remained in place after the pouring of the concrete over the sheathing in-between them.[862]

Once again revealing the pathos and plain logic of the unadorned construction, Kahn surprised the local builders who "had in mind that it was all going to be plastered [...]."[863] Recalling archaic construction sites, only bamboo scaffolding was available, specialized heavy equipment was lacking, and manual crafts had to be exploited to a maximum. Consequently, the concrete was carried in small metal pans to the pouring sites, and the inability to pour larger vertical segments prompted

860 Henry Wilcots, "Thoughts about Louis I. Kahn," in *Architecture and Urbanism*, November 1983, p. 230.

861 The use of concrete already demanded an international network to obtain its basic ingredients: while the cement had to be imported from China, the steel for the reinforcing rods had to be shipped from Europe and Japan. Cf. Kahn's letter to Mary Stewart French, Bureau of Educational and Cultural Affairs, Department of State, 2 March 1965, 030.II.A.58.4, LIKC; and Lesser, *You Say to Brick*, pp. 245-7. Komendant, who accompanied Kahn to Dhaka in March 1963, in his preliminary outline for the construction requirements requested that besides the implementation of cement plants in Bangladesh, "[a] most necessary adjunct to the project is a precast concrete plant capable of producing efficiently and economically the many structural elements required by the structural design." Cf. "New Capital City: Preliminary Outline for Design and Construction Requirements," n.d., 027.II.376, AEKC.

862 Cf. Rosellini, *Towards the Zero Degree of Concrete*, p. 187.

863 Henry Wilcots interviewed by Richard Saul Wurman, "Kahn a Dacca: *Lavori in corso*," (Kahn for Dacca) in *Domus*, no.548, July 1975, p. I.

Kahn in the Assembly to inlay white marble stripes at five feet intervals.[864] Imagining the result to be “a many-faceted precious stone,”[865] this decision imparted a more human scale to the monumental structure, while the fillets also acted as dripstones protruding slightly from the surface. As Florinda Fusaro rightfully concluded, the successive castings testified to the growth of the building “just as the concentric rings of a tree-trunk.”[866]

4.5 Hieroglyphs, Archetypes and Geometric Extensions of Consciousness

Quite naturally the dignifying white marble stripes also related the Sangsad Bhaban to the great heritage of Mughal architecture – for instance, the Taj Mahal (Ustad Ahmad Lahori, 1632-48) in Agra with its white marble surfaces that were penetrated in graceful patterns using *pietra dura* technique, the local Tomb of Bibi Pari with its white marble veneered central chamber, or Humayun’s Tomb with its white marble accentuations around the recesses and false windows in the red sandstone façade. Besides, the Assembly’s layered arrangement and formal rigor appealed to Mughal precedents. Geometrical stringency as a kind of universal scripture had bound together Islamic artistic production from the Atlantic to the Indian Ocean. Kahn with his humanistic inclination for primary forms could easily assimilate with this abstract aniconism that captured in one sweep the secular and spiritual realm. However, despite providing this legitimate basis for consensus with the local population, Kahn did not mimic the Islamic style: he did not employ its characteristic pointed arches or minarets, and as quoted earlier, he was more touched by the overall effect than by the small-scale arabesques.

864 Guadet when discussing *opus caementicium* in *Éléments et théorie de l’architecture* (I, p. 227) noted that after a few layers of brick that corresponded with one pour of concrete, an intercourse of bricks was inserted to stabilize the construction. According to M. G. Siddiqui, the Additional Chief Engineer of the Public Works Department, Kahn considered the two materials to have different sexes, marble being the “‘Woman’ and concrete is the ‘Man’. The combination of these ‘male & female’ materials, one giving strength and the other beauty and colour, symbolises creation.” M.G. Siddiqui, “Philosophy of architecture of Ayus Nagar,” n.d., received by Kahn’s office 21 August 1967, in Rosellini, *Towards the Zero Degree of Concrete*, p. 237.

865 Kahn, “Remarks,” p. 313.

866 Florindo Fusaro, “The Dacca Assembly Building and New Capital,” in *Rassegna*, vol.VII, no.21, 1985, p. 40. To undermine this notion of organic accretion, Heschong inferred with regard to Hindu architecture that “[t]he tradition of the great shade tree as the sacred meeting place at the center of the village may have served as a model for the great stone temples [...].” Heschong, *Thermal Delight in Architecture*, p. 62.

Overall, Kahn's geometrical language should be open and abstract enough for everybody to feel at ease. To achieve this state of transcendence, it was once again required for him to achieve a neutralization of the self, "to become everybody, not only yourself."[867] In the all-embracing domain of "in-common-ness," which he had defined in 1961 in allusion to Martin Buber's book *I and Thou* (1923) as a realm "where you and I become 'thou', instead of just I,"[868] the subjective and the collective should meet.[869] Kahn's longing to reach such a universal state is especially evident in the ornament excised from the anti-glare walls with its circular, triangular and quadrangular perforations (Figure 228). Beyond the pressing issues of adaptation that Kahn addressed by making the buildings permeable like a sieve, there was a supplementary psychological desire denoting *assembly* that had to find expression, too. While, as Ashraf argued, the adaptive tendency was "landscaping in a phenomenal sense, that is, allowing nature – the sun, wind, and rain – to 'invade' a man-made artifact, erode its envelope, make it porous, and finally repossess it,"[870] following the same logic, the expressive tenor sought to penetrate the mind. At the same time, while Kahn's adaptive measures acknowledged the vernacular idiom of the common Bengali hut to enable as much draught as possible, the symbolic perforations were more akin to monumental Mughal architecture, where individual strata of the elevation responded to different contextual and programmatic requirements. In the Taj Mahal, for instance, a recessed layer with small and operable windows was preceded with larger and contextually interactive voids (Figure 229).

Nevertheless, the elevations' triangles and squares had entered at a rather late stage in Kahn's design process (1966), whereas until then only circular apertures had been applied. In a repetitive pattern, circle, triangle and square appeared a total of eight times, always in the same constellation on the outer corners of the four office blocks surrounding the Assembly, and also in various juxtapositions on the inner elevations adjoining its ambulatory. The mnemonic power of Kahn's ciphers remained indeterminate, yet, symbols were according to him

> the rallying point around human agreement, human response. A great work can become symbolic, not because one person has anything to say, but because there's a human sympathy that brought us to it.[871]

867 Louis I. Kahn interviewed by Arnold J. Aho, 1970-1, in Wurman, *What will be has always been*, p. 101.

868 Kahn, "The Nature of Nature," p. 96.

869 "On the night of the third day, I fell out of bed with a thought which is still the prevailing idea of the plan. This came simply from the realization that assembly is of a transcendent nature. Men came to assemble to touch the spirit of community, and I felt that this must be expressible." Kahn, "Remarks," p. 306.

870 Ashraf, "Capital Complexity: Kahn's Architecture in Dhaka," p. 21.

871 Louis I. Kahn interviewed by Jamine Mehta, 22 October 1973, in Wurman, op.cit., p. 220.

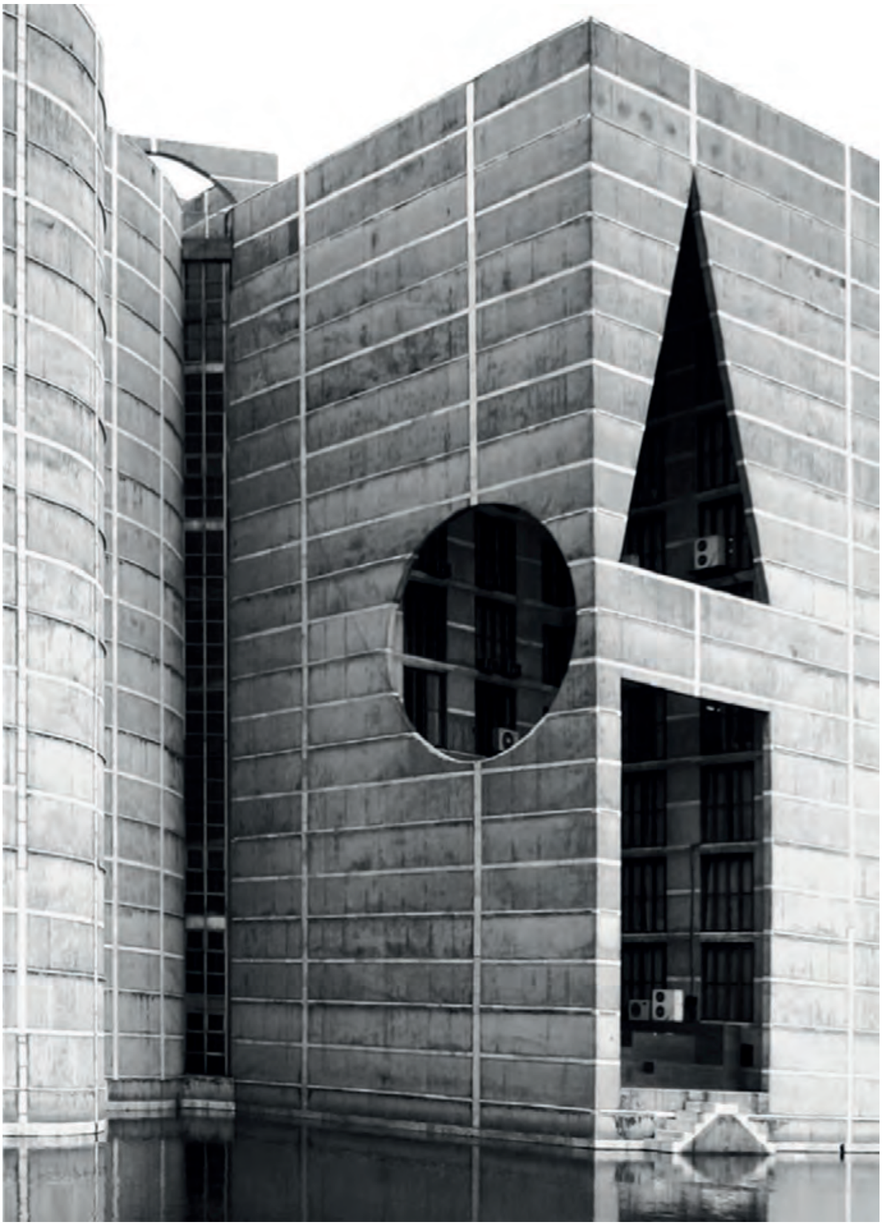

Fig. 228: Louis I. Kahn, National Capital of Bangladesh, Dhaka, 1962-83.

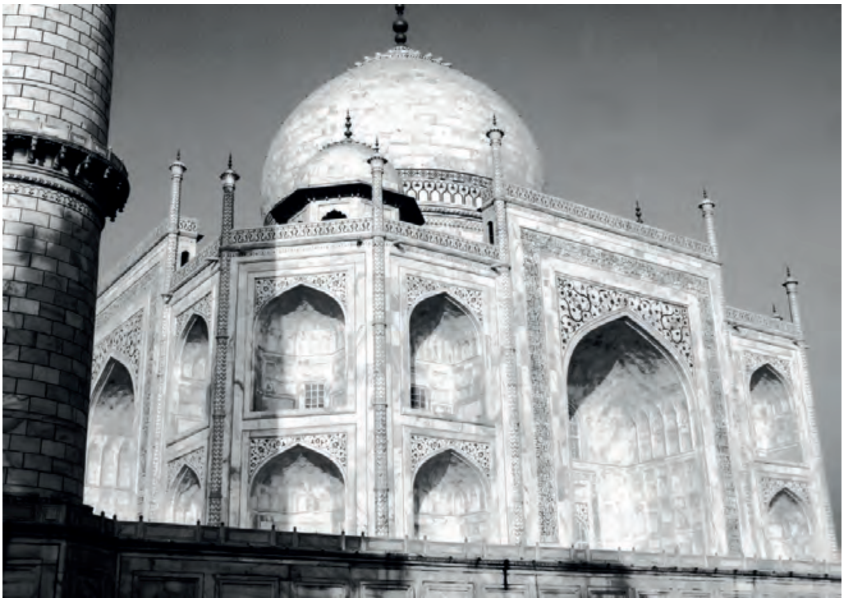

Fig. 229: Ustad Ahmad Lahori, Taj Mahal, Agra, India, 1632-48 .

As George Kubler, an art historian among the Yale faculty remarked in *The Shape of Time* (1962),

> [a] symbol exists by virtue of repetitions. Its identity among its users depends upon their shared ability to attach the same meaning to a given form.[872]

Kahn had shown a fascination for symbolic writing, and particularly hieroglyphs, since his visit to Egypt.[873] Fascinated by the universalism of the hieroglyphic characters, he valued their capacity to communicate meaning without words through mental images.[874] As Joseph A. Burton indicated,[875] the architect's library

872 Kubler, *The Shape of* Time, p. 74.

873 This early interest in hieroglyphs materialized in an abstract composition that Kahn applied to the façade of an intermediate version of the Jewish Community Center's Day Camp in Trenton in 1955, but also in the abstract murals he contrived for the Morton Weiss House.

874 Alberti had already alluded to this fact: "The Egyptians [...] maintained that each nation knew only its own alphabet, and that eventually all knowledge of it would be lost [...] whereas the method of writing they used could be understood easily by expert men all over the world [...]." Alberti, *On the Art of Building*, VIII, § IV.

875 Cf. Burton, "Notes from Volume Zero," pp. 76-8. As Esther Kahn further indicated, her husband and their daughter Sue made special trips to study the Egyptian collections at the museums of the University of Pennsylvania and Yale University. Cf. Joseph A. Burton, "Castles of Eternity: The Architectural Hieroglyphics of Louis I. Kahn," in *Rassegna*, vol.VII, no.21, 1985, p. 68.

contained several books illustrating his interest in primitive pictographic scriptures. For example, E. A. Wallis Budge's *The Nile: Notes for Travellers in Egypt and the Egyptian Sudan* (1912), which Kahn bought in Egypt, was according to his wife a long favored book of his. It gave several examples of translated hieroglyphic stories and listed some of the principal signs and their phonetic values.[876] Later, in September 1972 Kahn also acquired a special issue of *Scientific American* devoted to the topic of "Communication," including the essay "The Visual Image" by Ernst H. Gombrich.

To bridge the gap from hieroglyphs to psychology is no easy task, but according to Sigmund Freud not an impossible one, since "the interpretation of dreams is completely analogous to the decipherment of an ancient pictographic script such as Egyptian hieroglyphs."[877] As Kahn's wife, who had been a doctoral student in experimental psychology in the late 1930s, and who later worked as a neurology technician at the University of Pennsylvania,[878] recalled, Kahn would "quiz her on Gestalt psychology" and "continue to peruse her accumulated text books on psychology throughout his life."[879] Besides, he read Carl Gustav Jung's autobiography *Memories, Dreams, Reflections* (1961) and owned the Swiss psychoanalyst's *Man and his Symbols* (1964) (Figure 230).[880] While for Kahn the artist was a creative vehicle of the universal "psyche," Jung professed that man could draw "upon the healing and redeeming forces of the collective psyche [...]." Returning to a state of *participation mystique*, the creative agent penetrated

> to that matrix of life in which all men are imbedded which imparts a common rhythm to all human existence, and allows the individual to communicate his feelings and strivings to mankind as a whole.[881]

Accordingly, for Jung the artist in the creative process activated the "archetypes," Freud's "archaic remnants of the mind," which were retaining and transmitting the psychological inheritance of mankind. In Jung's opinion, they were "aboriginal, innate and inherited shapes of the mind," and

> [j]ust as the human body represents a whole museum of organs, each with a long evolutionary history behind it, so we should expect to find that the mind is organized in a similar way.[882]

876 Cf. E. A. Wallis Budge, "Egyptian Writing," in *The Nile: Notes for Travelers in Egypt and the Egyptian Sudan* (Westport: Negro Universities Press, 1970; 1912) pp. 229-48. Cf. Hutton Webster, "Writing and the Alphabet," in *Early European History* (New York: Heath & Co., 1917) pp. 8-11.

877 Sigmund Freud, "The Claims of Psycho-Analysis to the Interest of the Non-Psychological Sciences" (1913), in James Strachey, (ed.), *Sigmund Freud* (London: Vintage, 2001; 1955) XIII, pp. 176-7.

878 Cf. 030.II.A.56.2, LIKC.

879 Burton, "Notes from Volume Zero," p. 88.

880 Cf. Tyng, *Beginnings*, p. 21.

881 Carl Gustav Jung, *Modern Man in Search of a Soul* (London: Routledge, 1966; 1933) p. 198.

882 Carl Gustav Jung, *Man and his Symbols* (New York: Doubleday & Company, 1964) p. 67. In agreement with Kahn's wish to abandon the self, Jung noted: "The personal idiosyncrasies that creep

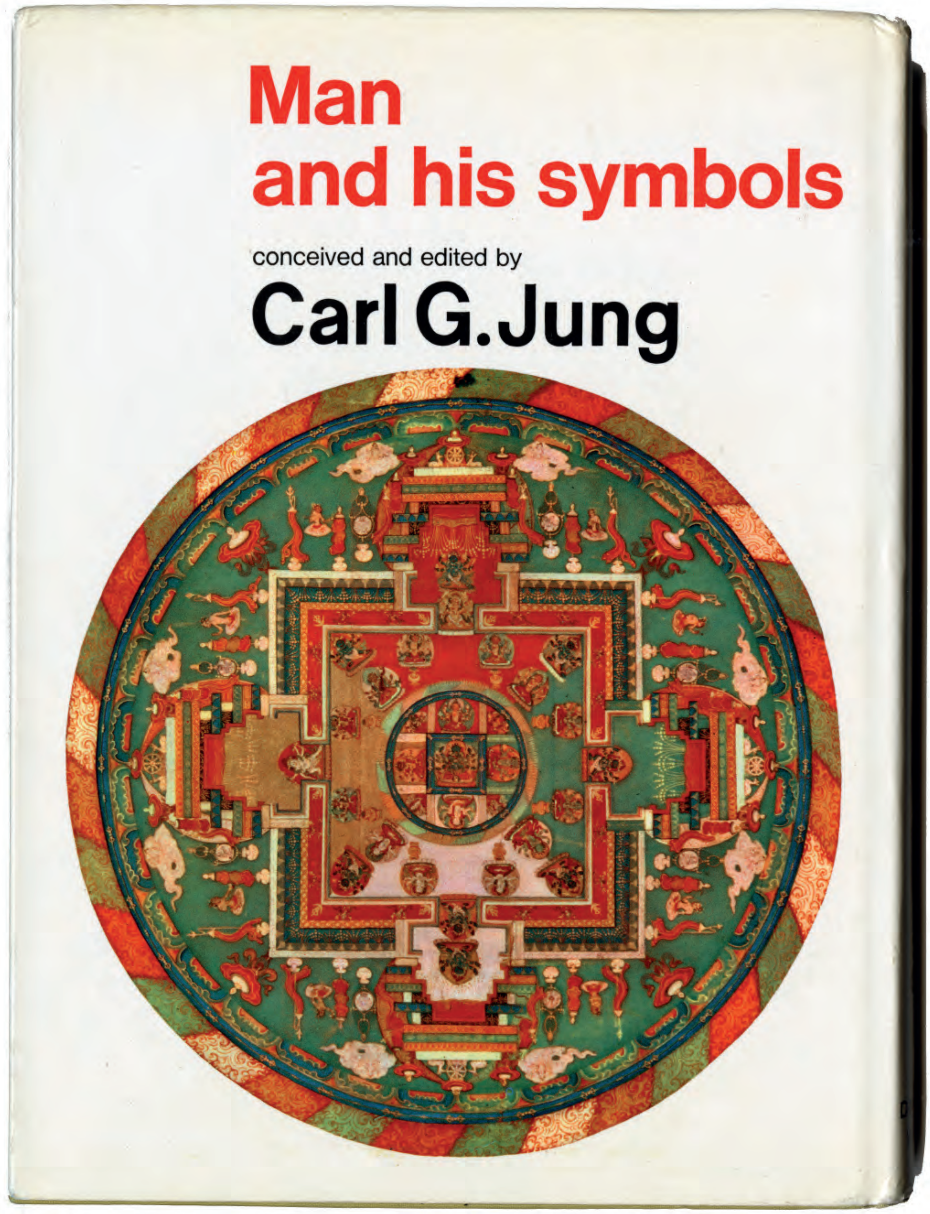

Fig. 230: Carl Gustav Jung, *Man and his Symbols*, 1964.

into a work of art are not essential; in fact, the more we have to cope with these peculiarities, the less is it a question of art. What is essential in a work of art is that it should rise far above the realm of the personal life and speak from the spirit and heart of mankind." Jung, *Modern Man in Search of a Soul*, p. 194.

Alongside Kahn, Tyng also became seriously interested in Jung's theories. A funding member of the C. G. Jung Study Center of Philadelphia in 1957,[883] in a letter sent to Lancelot Law Whyte on August 4, 1964, she noted that his "*Unconscious before Freud* is a book I hope to read soon. Recently I attended a lecture of Dr. Dieter Baumann (Carl Jung's grandson)." Furthermore, she mentioned having "worked with a Jungian analyst as well as on my own in attempting a 'penthouse' which might express my own 'spirituality'."[884] In several papers written during the 1960s, she quoted from both Jung's *Archetypes and the Unconscious* (1934) and *The Interpretation of Nature and the Psyche* (1955) including Pauli's essay "The Influence of Archetypal Images on the Scientific Theories of Kepler." Lastly, in a letter to Fuller dated May 4, 1969, she enclosed

> an issue of a new interdisciplinary publication which I thought might be of interest to you, *The Journal for the Study of Consciousness* [...] I thought you might be intrigued by the article, 'Some Examples of Hyperdimensional Awareness'.[885]

Summing up her research in "Geometric Extensions of Consciousness" (Figure 231), Tyng proposed that four "energy-form-tensions" – the rotational, helical, spiral and bilateral – acted as "archetypes of the archetypes,"[886] whereby each one was characterized by a particular set of forms and determined in recurring patterns the biological, psychological and creative development of man, as well as that of all other organic constitutions.[887] Placing her scheme in analogy with Jung's process of "individuation," she acknowledged the *rotational* period represented by the circle to be characterized by a conscious ordering of the external world. The *helical* phase stressed the triangular polarity between the personal conscious, the collective unconscious and time. In the *spiral* phase, the spatial-rotational and the temporal-helical tensions were joined to indicate a cycle of growth. Lastly, the *bilateral* phase signified balance and stable symmetry, besides being formally akin to the square.

Furthermore, Tyng considered the "architect" – deriving from "'arche' as in archetype, a pre-existent image, and 'tekton' a carpenter or builder" – as "a man who relates his inner images to the creation of physical reality."[888] Consequently, the architect could not

883 Cf. Inrid Schaffner and William Whitaker, "A Life Chronology," in Schaffner, *Inhabiting Geometry*, p. 102.
884 Tyng's letter to Whyte, 4 August 1964, 074.II.A.6, AGTC.
885 Tyng's letter to Fuller, 4 May 1969, 074.II.A.51, AGTC.
886 Tyng, "Geometric Extensions of Consciousness," p. 149. Cf. Anne G. Tyng interviewed by Srdjan Jovanovic Weiss, "The Life Geometric," in *Domus*, no.947, May 2011, pp. 96-103.
887 One example of the metamorphosis through the four stages was the butterfly's development: after the rotational aspect of the eggs came the helical phase of the larva; then followed the spiral phase of the pupa, until the butterfly finally revealed itself in bilateral symmetry.
888 Anne G. Tyng, "Man made Forms," n.d., 074.II.A.39.1, AGTC.

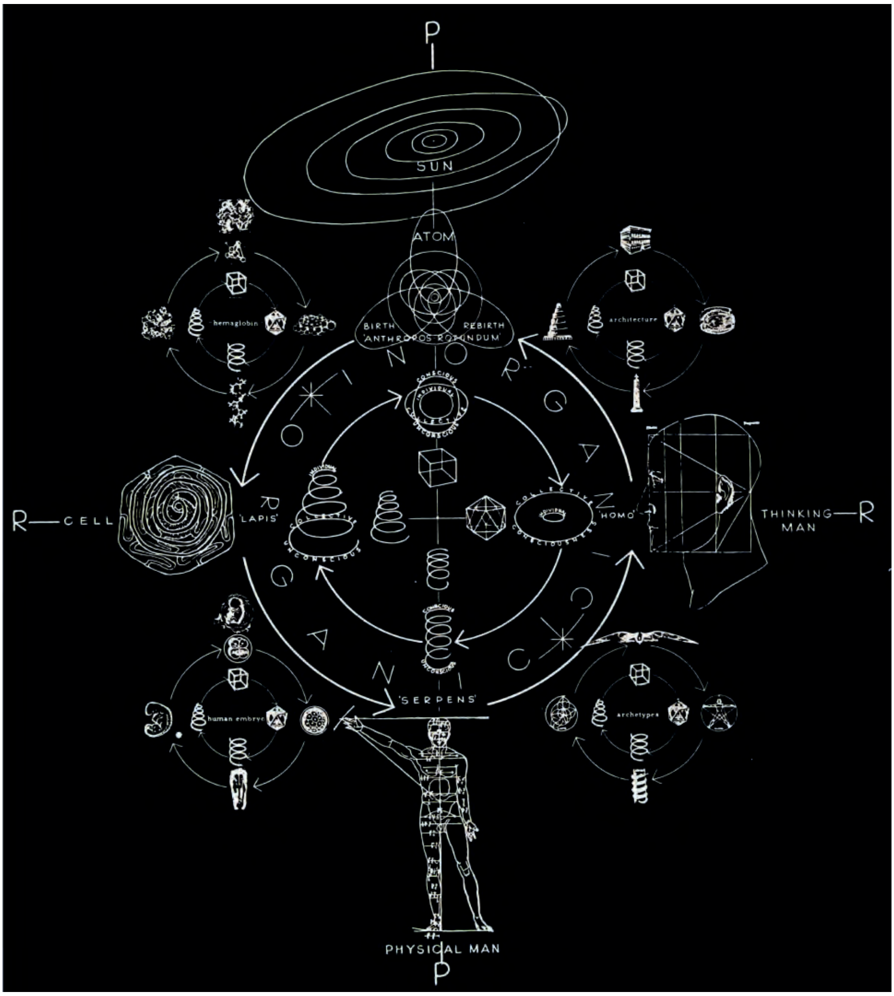

Fig. 231: Anne Griswold Tyng, "Geomtric Extensions of Consciousness," 1969.

> be satisfied with geometry alone, but as he comprehends it more fully, it seems to hold a numinosity for him where it corresponds to his own inner images.[889]

In Tyng's opinion geometrical archetypes like the Platonic Solids or the Divine Proportion not only characterized the spatial organization of all matter, but being at the basis of the structure of the brain as well, decisively influenced man's creativity and perception of the world. "In simplest terms," she contended that the same

889 Ibid.

Fig. 232: Sengai Gibon, *Circle, Triangle, and Square*, Edo period, early 19th century.

principles "underlie psychic attitude and underlie the geometry of the universe."[890] To support her claim that forms possessed ancillary connotations linking them with the unfathomable depths of the mind, in a lecture delivered in 1980, Tyng quoted Wright, who had hinted at a similar conjunction:

> [C]ertain forms have come to symbolize for us and potently suggest certain human ideas, moods and sentiments – as for instance: the circle, infinity; the triangle, structural unity; the spire, aspiration; the spiral, organic progress; the square, integrity.[891]

In further defense of her "geometry of meaning," Tyng compared in the same lecture the calligraphy "Circle, Triangle, and Square" by the Japanese Zen monk Sengai Gibon from the Edo Period with the Platonic Bodies (Figure 232). In Sengai's *universe*, the circle was associated with the infinite and formless, while the square signified the multitude of material things.[892] The human triangle overlapped with both the

890 Tyng, "Louis I. Kahn: A Modern Architect's Response to Egypt, Greece and Italy."
891 Frank Lloyd Wright, "The Japanese Print: An Interpretation," (1912) in Bruce Brooks Pfeiffer, (ed.), *Frank Lloyd Wright Collected Writings* (New York: Rizzoli, 1992) I, p. 117.
892 Cf. Daisetz T. Suzuki, *Sengai: The Zen Of Ink And Paper* (Boston: Shambhala, 1999; 1971) pp. 36-7. The square by time-honored custom has signified earthbound solidity, order and stability. It is suggestive of the

measurable and the immeasurable; and thus, in its triple aspect the body had a physical, spiritual, and intellectual component which, represented by the triangle's free corner, signified the sovereignty of man. In her Platonic interpretation, Tyng stressed that the square stood for the *earth*, which she associated with the cube; the circle represented the *cosmos* and was related to the dodecahedron; while the triangle linked earth and sky just like the three Platonic Solids with triangular faces.[893]

4.6 Mandala and the Poetic Unveiling of the World

Symbolizing rootedness and, according to Tyng, "permanence," the square, which Kahn had employed as a basic form in almost every project since the early 1950s, also figured as the constitutional motif in the Sangsad Bhaban's plan. As the most lucid indication of his wish to achieve a depersonalized expression, Kahn commented that he used this form so frequently, "because the square is a non-choice, really. In the course of development, I search for the forces that would disprove the square."[894] As Fusaro revealed in her geometrical analysis of the National Assembly's ground plan,[895] in a rotated square sequence the project grew centrifugally outwards from the octagonal assembly chamber (Figure 233), whereby the geometrical progression's underlying $\sqrt{2}$ ratio bound the plan's individual components together in organic proportion. This sequence of natural development was common to both Hindu and Islamic architecture, too.[896] The appended diagram (9th or 10th century; Figure 234) shows the Ka'ba in Mecca at the center of a series

material world with its four cardinal directions and perennial elements. The triangle embodies the Cartesian dimensions of measurement, while the circle is linked to some of the most impressive natural forms like the sun disk or the full moon. Without beginning or end, it suggests wholeness and the unity of life.

893 Kahn's own interest in Eastern calligraphy can be deduced from his having owned Tseng Yu-ho Ecke's *Chinese Calligraphy*, a catalogue of an exhibition held at the Philadelphia Museum of Art in 1971. Concerning its contents, he remarked: "The Oriental does not make portraits of nature. He makes the rhythms of the rocks, the rhythms of the atmosphere, the rhythms of the clouds, the rhythms of the streams. The tip of his brush is his soul." Kahn, "Architecture and Human Agreement," pp. 138-9. It should be added that Zen Buddhism had a profound influence on American art throughout the 1950s and '60s: one may think of Willem de Kooning's glorifications of the brushstroke, but also its tremendous impact upon the development of *Minimal Art*. Kazimir Malevich's suprematist compositions like *Black Square* and *Black Circle* (both 1913) heralded this movement, while Wassily Kandinsky, the first champion of "concrete art," posited: "Form alone, even though abstract and geometrical, has its internal resonance, a spiritual entity whose properties are identical with the form." Kandinsky, *Concerning the Spiritual in Art* (New York: Wittenborn, Schultz, 1947; 1912) p. 47.

894 McCarter, *Louis I. Kahn*, p. 209.

895 Cf. Florindo Fusaro, *Il Parlamento e la nuova capitale a Dacca di Louis I. Kahn* (Rome: Officina Edizioni, 1985) p. 75.

896 In Dhaka, the Tomb of Bibi Pari is outlined by a square and has octagonal minarets, while a false-octagonal dome covers its central square-domed hall. Similarly, the Taj Mahal is outlined in plan by an irregular octagon, while its central chamber and corner chapels consist of regular ones.

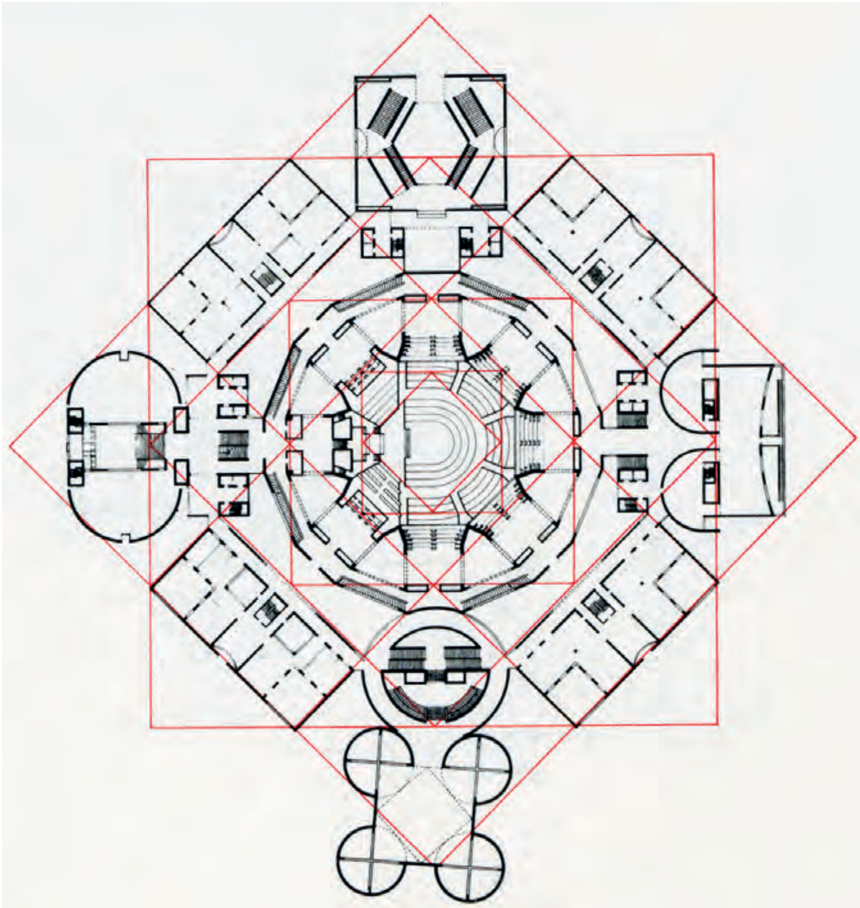

Fig. 233: Florinda Fusaro, Geometrical Analysis of the Sangsad Bhaban, 1985.

of superimposed squares and circles that related it to the four elements and seasons besides the eight classical winds.[897] As Jung inferred, *mandala* were also

> based on the squaring of a circle. Their basic motif is the premonition of a centre of personality, a kind of central point within the psyche, to which everything is related, by which everything is arranged, and which is itself a source of energy.[898]

897 Notably, the "Tower of the Winds" by Andronicus of Cyrrhus in the Roman agora in Athens (48 BC by), also called the *horologion* and acting as an early clock tower with sun-dials on each side, was an octagonal building directed towards the eight winds.
898 Carl Gustav Jung, "Concerning Mandala Symbolism," in Jung, *The Archetypes and the Collective Unconscious* (London: Routledge, 1969) pp. 355-84.

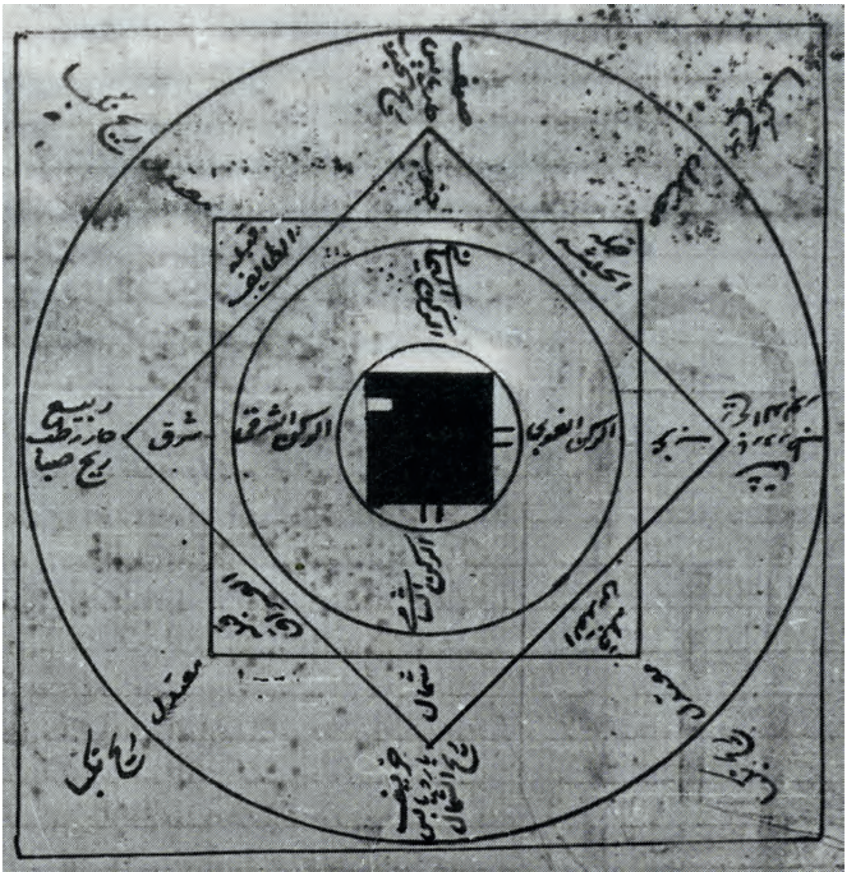

Fig. 234: Diagram of the Ka'ba, Mecca, Saudi Arabia, 9th or 10th century.

If not through Jung, Kahn was introduced to mandala and their possible imprint upon architecture by 1973 at the latest, when he was mentioned in the introduction of Nader Ardalan and Laleh Bakhtiar's *The Sense of Unity: The Sufi Tradition in Persian Architecture* as having reviewed the manuscript.[899] Ardalan and Bakhtiar unveiled a set of mandala configurations underlying Islamic architecture, and hinted from a concise historical and alchemical perspective at the Pythagorean-like nebulosity

899 Cf. Nader Ardalan and Laleh Bakhtiar, *The Sense of Unity: The Sufi Tradition in Persian Architecture* (Chicago: University of Chicago Press, 1973) p. xvii. Ardalan, an Iranian born architect, received his master degree in architecture from Harvard in 1962. Working for S.O.M. until 1964, he then moved back to Iran to assist on archeological excavations in southern Iran. In 1972 Ardalan became managing director of the Mandala Collaborative in Teheran, and two years later, he invited Kahn together with Tange to make an urban design proposal for the Abbas-Abad Development in Teheran.

interlinking numbers and figures with universal meaning.[900] Hassan Fathy, when discussing the *gunbad* or Islamic dome, provided the following reason for the use of the square and octagon as the geometrical basis of Islamic architecture:

> The Arab comes from the desert. [...] The kindly aspect of nature for the Arab is the sky – pure, clean, promising coolness and life-giving water. [...] Now with his adoption of a settled life the Arab began to apply architectural metaphors in his cosmology, so that the sky was regarded as a dome supported by four columns. [...] In fact, the metaphor was extended further to the eight sides of the octagon that supports, on squinches a dome symbolizing the sky; these eight sides were held to represent the eight angels who support the throne [*arsh*] of God.[901]

Likewise, Hindu temples were regulated by the *Vastu-Purusha* mandala (Figure 235), which, always square, was similar to the Roman templum outlined prior to the start of construction on the ceremonially leveled ground.[902] The form was square, because in traditional Indian cosmology, Mount Meru was thought to rise from a square base, but also the surface of the earth, not its outline, was demarcated by sunrise and sunset, that is, by the points of east and west, as well as north and south.[903] Thus, the square held the four-cornered earth (*caturbhrsti*) in the embrace of the sky, while the circle

900 According to a compendium on the arts and sciences of the "Brethren of Purity" from the 10th century, the Creator was linked to a point, the Intellect to a line, the Soul to a triangle, and the *materia prima* to a square. Nature being perceivable through the five senses was associated with the pentagon, while the Human Body with its six directions of movement was symbolized by the hexagon. Furthermore, the Heavens with the seven visible planets were delineated by a heptagon, while the octagon stood for the Elements' qualities and their admixtures. The nonagon gathered all beings of the world (mineral, plant and animal with three sub-categories), whereas the decagon acknowledged the "Holy Tetractys" and the dodecagon the Zodiac. Cf. Ardalan and Bakhtiar, *The Sense of Unity*, pp. 26-30; and Seyyed Hossein Nasr, *Science and Civilization in Islam* (New York: Plume Books, 1968) pp. 153-7.

901 Also in the *sahn*, "[t]he four sides of the courtyard represent the four columns that carry the dome of the sky. The sky itself roofs the courtyard, and is reflected in the customary fountain in the middle. This fountain, or basin, is in fact an exact projection of a dome on squinches [...] just as if a real dome were mirrored in the water." Fathy, *Architecture for the Poor*, pp. 55-7. Squinches as the central motive of Sassanid domes – early examples being the Palaces at Feruz-Abad (250 AD) or Sarvistan (350 AD) – should not be mistaken for spherical pendentives constituting the triumph of Byzantine architecture, where the square is transformed into a circle. Titus Burckhardt further attested: "Geometrical development out of an octagon, or more exactly out of two squares inscribed in a circle, is the most habitual in Islamic art." Titus Burckhardt, *Art of Islam* (Bloomington: World Wisdom, 2009; 1976) p. 68.

902 Cf. Stella Kramrisch, *The Hindu Temple* (Calcutta: University of Calcutta, 1946) I, pp. 14-7.

903 According to Kramrisch (I, p. 227), "[t]he process of drawing the initial square is described in the same way throughout the Vastu-sastras. In the middle of the site the gnomon of a given length is fixed in the ground; attached to it is a string. A circle is drawn with a radius twice the peg. Where in the forenoon and the afternoon, the shadow of the peg reaches the periphery of the circle, there lie the East and West points; the line which then is stretched between the two intersection points of the arcs, described from those two points, lies North to South. With the East-West and the North-South lines ascertained, the square should be drawn." Kramrisch, an Austrian art historian, taught South Asian art at the University of Philadelphia between 1950 and 1964, and mounted the major exhibition "Unknown India" at the Philadelphia Museum of Modern Art in 1968.

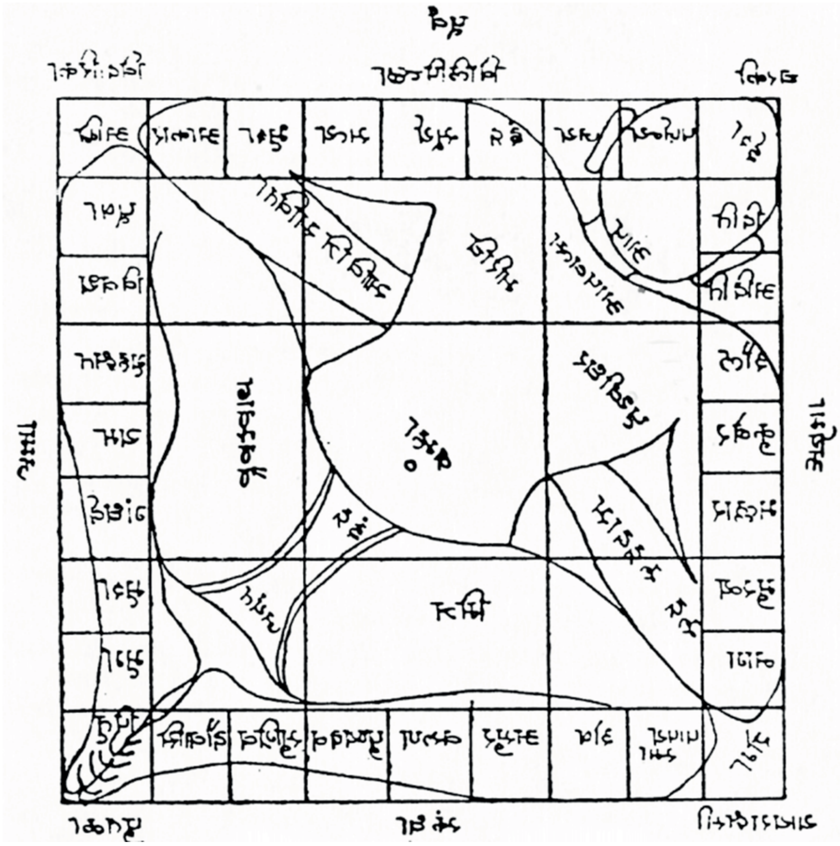

Fig. 235: *Vastu-Purusha* Mandala.

was associated with terrestrial change.[904] Wherever this mandala was laid out by the *sthapati* ("architect") under the guidance of the *sthapaka* ("priest") it denoted the presence of the Purusha, the "cosmic man," on earth. Once construction started, the rite of *Garbhadhana* was performed, in which the "womblike" earth received from the sacrificing priest a square vessel that contained in its central compartment the *bija* ("seed") or *garbha* ("embryo") of the future building. The location of inception at the navel of the Purusha became the temple's secluded inner sanctum (*Garbhagrha*).[905]

904 According to this distinction, a temple's two main altars were aligned on an east-west axis: the one at the eastern end, the high altar with the celestial fire was square, while the other, denoting the terrestrial world, was circular. A half-moon shaped one denoting the atmosphere stood in-between. Cf. Kramrisch, op.cit., pp. 17-23; and Subhash Kak, "The Axis and the Perimeter of the Temple," (2005) http://www.arxiv.org, accessed 12 February 2012.

905 As Fathy indicates, also "[t]he ancient Egyptians, when they built a temple, would mark out the corners of the precinct with pegs, and then at a chosen point within this they would dig down until

There, in utter darkness, in a small cave-like chamber outlined by a square and usually entered from the east after crossing a pillared vestibule, the holy light shone forth, and the sanctum's towering superstructure, the *Sikhara*, pointed as an *axis mundi* to the origin of the primeval descent. Lastly, an *Amalaka*, a Lotus-like stone disk with ridges on its rim and a vertical finial in its center, crowned the sacred structure.[906]

The reference to the Lotus (*Nelumbo nucifera*), a national symbol of India, is significant, since in the epic poem *Mahabharata* (c. 8th and 9th centuries BC) it is told that *Brahma*, the god of creation, was self-born out of a Lotus flower that grew from the navel of Vishnu.[907] Both the Lotus and the Water lily (*Nymphaea pubescens*; Figure 236), the national flower of Bangladesh, called *Shapla*, are quadrangularly structured and flower forth from the turbid waters in which they live. The Sangsad Bhaban similarly emerged undefiled from its tank to ultimately blossom in a Lotus-like shell structure (Figure 237).[908] Of course, it cannot be unequivocally determined whether Kahn, who most probably visited the famous Baldah Botanical Garden in Dhaka (established in 1909), where several varieties of the *Nymphea pubescens*, as well as an Amajan Lotus (*Victoria regia*) were maintained, consciously employed the natural metaphor of the Shapla. No matter whether the roof's shape was ultimately inspired by an organic model or an architectural source – Bramante's cupola in the apse of Santa Maria delle Grazie in Milan (after 1490) that Kahn visited in 1967, the pumpkin dome covering the Temple of Apollo in Hadrian's Villa as depicted by Francesco di Giorgio Martini,[909] or Candela's octagonal shell design of Los Manantiales near Mexico City (1957-8) – all these references point to the same root, namely the recuperation of Kahn's earlier interest in optimized continuous structures.

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they came to the *secret* water, which would be the subsoil water, probably choosing the winter solstice for this, when the water would be at its lowest. Then they would put a layer of sand in this hole, as sand is incompressible and does not expand when wet. On this they would plant a papyri-form or loti-form column, as if it were to grow." Fathy, *Architecture for the Poor*, p. 180. The frequent use of lotus or papyrus columns with bud or palm capitals in Egyptian temples may be directly related to this understanding of the temple as emerging from the earth like a plant.

906 Cf. Percy Brown, *Indian Architecture* (Bombay: D. B. Taraporevala Sons & Co., 1959).

907 Brahman and Brahma stem etymologically from the root *brh*, meaning "to grow." A similar myth prevailed in Egypt: the original creation event occurred when the primeval mound (*tatanen*) rose from the primordial abyss. A lotus blossom then shot forth from the hill hock, while from its flower the young sun god emerged. Cf. Richard H. Wilkinson, *The Complete Gods and Goddesses of Ancient Egypt* (Cairo: The American University in Cairo Press, 2007) p. 17.

908 Developed only late in the design process (1969), the eventual ceiling structure was engineered by Harry Palmbaum with the assistance of Bernie Schwartz and Mario Salvadori, an expert in shell construction and translator of Leonardo da Vinci's notebooks into English. Kahn had problems finding the right solution, since the foundations had already been set in place and the seismic requirements necessitated an extremely light answer. The original design envisioned by Gianopulos and lster elaborated by Komendant was to consist of a structure with steel cables, metal panels and concrete cladding that was reminiscent of Ronchamp's ceiling.

909 Cf. Giorgio Martini, *Trattato di architettura*, I, f21.V Tav.38 and I, f.90V Tav.168.

Fig. 236: "Shapla," *Nymphaea pubescens*.

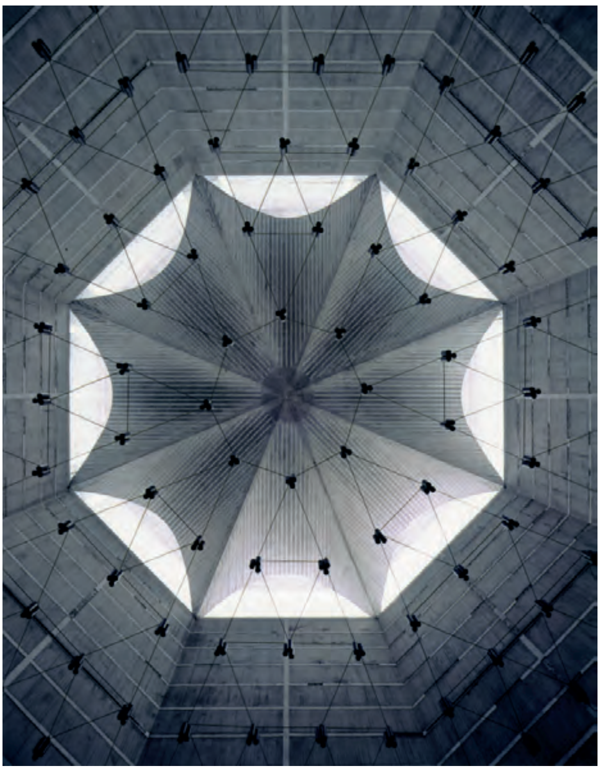

Fig. 237: Louis I. Kahn, National Capital of Bangladesh, Dhaka, 1962-83.

As implemented, the assembly chamber's roof consisted of eight concrete parabolic vaults that formed in unison an umbrella dome ominously suspended on its tips to dispense the forces of gravity. Zenithal light, radiating through clerestory openings, magically engulfed the ceiling and lent an atmosphere of otherworldly calm to the space. In an intermediate scheme (Figure 238), perhaps more consistent with the formalism of the façade's perforations, four suspended flying ribs with circular apertures crossed each other in star-like fashion to be surrounded by similar circular openings. As the ultimate prototype for the final modeling of the interior might have served the "Golden Octagon" of Nero's Domus Aurea (Severus and Celer; after 64 AD; Figure 239) with its ingenious system to illuminate the central room via an *opaion* and the adjacent rooms via clerestory openings facing the outer surface of the vault.[910] This majestic space would become the predecessor for all centralized dome-covered structures like the Pantheon, the Roman Temple of Minerva Medica (c. 310) and several ecclesiastical structures built under Constantine like the Lateran Baptistery in Rome (c. 315) with its octagonal ambulatory surrounding the top-lit baptismal font,[911] the Church of the Nativity in Bethlehem with its octagonal rotunda (327-39; destroyed 529), or the Golden Octagon at Antioch (327-41; destroyed 588), which composed of a central room surrounded by a lower ambulatory informed the Basilica of San Vitale in Ravenna (546-8).[912]

What both the ground plan of these churches of the focal type and the mandala-like spatial organization of Kahn's National Assembly evoked was a spiritual path leading towards an inner center. In religious terms, this implied worshippers to approach the inner sanctum through successive circumambulations that reproduced the rotation of the heavens around the *axis mundi*.[913] In Kahn's case, too, the citadel's four-cornered arrangement embraced the sky to create a powerful point of earthly reference, in which the central space soared vertically upwards towards the source

910 Cf. William L. MacDonald, *The Architecture of the Roman Empire* (New Haven: Yale University Press, 1982; 1965) I, pp. 31-41. E. Balwin Smith argued that Nero's imperial chamber derived from the domelike tent of Alexander the Great with its cosmic decorations. Baldwin summarized that "[t]he pre-Islamic Arabs, and perhaps all Emits, had the ancient tradition of a sacred domelike tent of leather, called the qobba. It was the portable dwelling of the divine baetyls, served as a kind of palladium, or ark, accompanying them into battle and leading them on their migrations, became an emblem of clan authority, and was frequently erected over the graves of ancestors and great men." Smith, *The Dome*, p. 83.

911 According to Richard Krautheimer, the common use of the octagonal form for baptisteries is based on the belief that "eight is the symbolic number of regeneration, salvation, and resurrection, as the world started the eight day after creation began, and Christ rose from the dead on the eight day of the Passion." Krautheimer, *Early Christian and Byzantine Architecture*, p. 95.

912 Embracing such a Roman ideal of spaciousness, the Sangsad Bhaban coevally acknowledged a Greek, Egyptian and Mesopotamian conception of space, which had focused upon a temple's status as an object to be wandered around, but not to be entered by the public.

913 Andreas Volwahsen indicated that the villages of the Aryan tribes were centered around a huge shade tree that "symbolized the axis around which the universe and the celestial realms were believed to rotate." Volwahsen, *Living Architecture: Indian* (London: Macdonald and Co., 1969) p. 46.

Fig. 238: Louis I. Kahn, National Capital of Bangladesh, Dhaka, 1962-83.

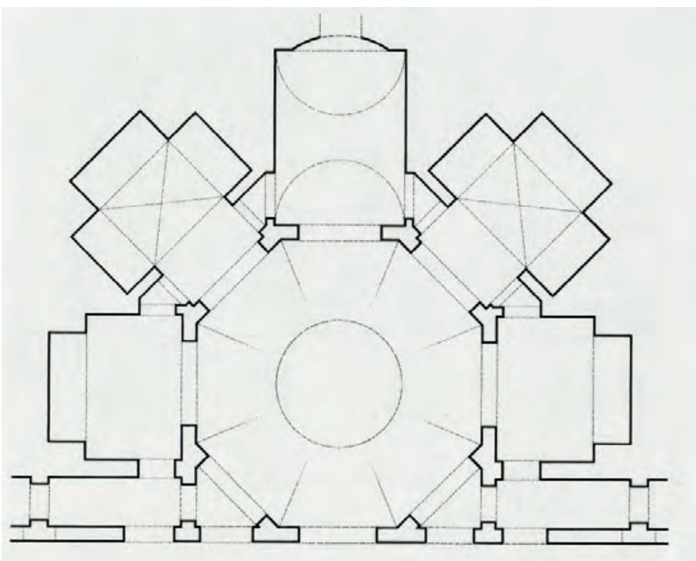

Fig. 239: Severus and Celer, “Golden Octagon,” Domus Aurea, Rome, Italy, after 64 AD.

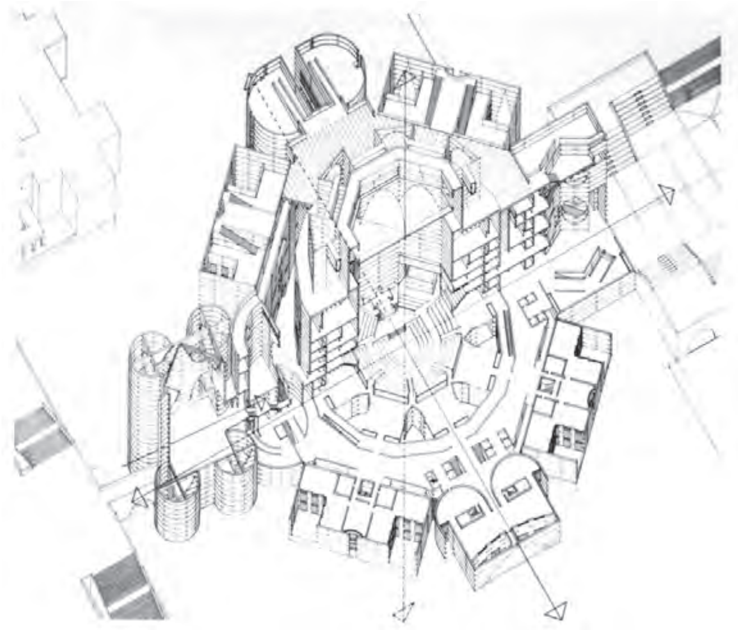

Fig. 240: Louis I. Kahn, National Capital of Bangladesh, Dhaka, 1962-83.

of light.[914] In a city-like configuration (Figure 240), the assembly chamber, occupying the nucleus and being ringed by subservient facilities, was set off by a seven-story-high ambulatory from a second, peripheral ring of interdependent volumes – four office blocks and four more elaborately distinguished units: the prayer hall above the public entrance; a northern gate with stairs majestically interwoven into its spatial fabric; a minister's lounge overlooking the site towards the west; and recreational facilities in the east.

Like the secular assembly chamber, the prayer hall's interior cube was indirectly lit as the natural light penetrated the flanking towers' hollow shafts with their quarter- and semicircular arched interior openings.[915] The space was characterized by an ambiance of absolute introversion that allowed no views towards the outside – only

914 Cf. William J. R. Curtis, "Modern Architecture and the Excavation of the Past: Louis Kahn and the Indian Sub-Continent," in Von Moos and Eisenbrand, *The Power of Architecture*, p. 237.

915 The prayer hall's robust outer appearance vacillated between a fortress and mosque, both sources having comparable corner towers or minarets. In the Mughal context, one may mention the Saat Gombuj Masjid in Dhaka, the mighty Chauburji gateway (c. 1646) in Lahore, or the massive Hathi Pol (c. 1600) leading into the fort in Agra. Intended to be open-topped, eventually too much rainwater entered the corner towers, while also the intended stack effect did not take place. Cf. David Wisdom, "Kahn's Building at Dacca," in *Rassegna*, vol.VII, no.21, 1985, pp. 48-50.

Fig. 241: Louis I. Kahn, National Capital of Bangladesh, Dhaka, 1962-83.

the changing hues of light indicated the rhythms of day. Continuing these pursuits to architecturalize light, the ambulatory space was equally awe-inspiring (Figure 241). Flanking the space on both sides were multiple-layered walls permeated by large-scale openings fostering a maze-like atmosphere perhaps only comparable to Piranesi's

Fig. 242: Louis I. Kahn, National Capital of Bangladesh, Dhaka, 1962-83.

Carceri or Gordon Matta-Clark's later "Cuttings." Dissolving the material boundaries, vistas of changing depth reached into the building's voids that were merely filled with the elements' eerie presence. While for Kahn "the whole thing just blossoms architecture,"[916] a small amount of natural light entered the ambulatory directly, though, through linearly aligned glass blocks between the ceiling's parallel ribs. These slits were of such minor dimensions, however, that no views towards the outside were possible and only refracted streams of light washed down the adjacent walls (Figure 242). Their effect was heightened through the indirect radiation entering laterally that made the ceiling appear to miraculously hover upon the sunbeams (Figure 243).

This exuberant use of zenithal light added significantly to the feeling, when inside, of having been transported: all the spaces spoke of suspension from the outer world – a world, in fact, palpable only through the elements' obscure, though magical presence. Kindling with its dimness the sun's brilliance, the Sangsad Bhaban's labyrinthine

916 Prown and Denavit, *Kahn in Conversation*, p. 112.

Fig. 243: Louis I. Kahn, National Capital of Bangladesh, Dhaka, 1962-83.

interior manifested architecture's inimitable capacity to *paint with light*.[917] As a true "machine à réaction poétique," Kahn's complex put nature to work, i.e. it ecstatically awakened the elements to produce a new architectonized nature. Bringing the art of architecture to expression did not imply for Kahn the creation of flashy objects, but rather the thoughtful delineation of walls, ceilings and their breakthroughs in a manner that the resulting provision of space evoked the wondrous unfurling of the world's riches. Furthermore, the audacious splendor of the Sangsad Bhaban's interior was based upon eight wedge-shaped "light wells" that Kahn positioned in the intermediate zone between the assembly chamber and the ambulatory (Figures 244, 245):

> If you see a series of columns you can say that the choice of columns is a choice in light. The columns as solids frame the spaces of light. Now think of it just in reverse and think that the

917 Pallasmaa underlined: "The art of chiaroscuro is a skill of the master architect too. In great architectural spaces, there is a constant, deep breathing of shadow and light; shadow inhales and illumination exhales light." Pallasmaa, *The Eyes of the Skin: Architecture and the Senses* (Chichester: John Wiley & Sons, 2011; 2005) p. 47.

Fig. 244: Louis I. Kahn, National Capital of Bangladesh, Dhaka, 1962-83.

> columns are hollow and much bigger and that their walls can themselves give light, the voids are rooms, and the column is the maker of light and can take on complex shapes and be the supporter of spaces and give light to spaces.[918]

With regard to these hollow shafts, Kahn always mentioned that they should function as "air wells" as well. Looking at Kahn's early sketch of the building, it is not difficult to imagine the scoops arising out of the building's mass as wind-catchers (Figure 246). Similar to a *bãdgir* or a *malqaf* in Egypt – the latter pointing towards the wind – they crowned the edifice to capture the breeze high up.[919] The cool air that was collected at the wells' bottom infiltrated the ambulatory and assembly hall, where heated up it would escape through the *claustrum* windows beneath the ceiling. Suction zones on the outside caused by venturi-action in combination with the cool water in the tank accelerated this cooling air-exchange. Kahn had developed such multifunctional wells in early schemes

918 Kahn, "Remarks," p. 311. Kahn's final disposition of the assembly chamber was akin to the Pantheon, where eight hollow buttresses facilitated the setting of the dome. As a further parallel Fusaro managed to inscribe a perfect sphere in both spaces. Cf. Fusaro, "The Dacca Assembly Building and New Capital," p. 41.

919 As Fathy explained, "it is important that the *qã'a* ["central hall"] is placed in the middle of the building and surrounded by rooms that protect the sides from external heat, thus ensuring a maximal temperature difference between the lower and upper parts of the *qã'a* to promote air circulation." Fathy, *Natural Energy and Vernacular Architecture*, p. 58.

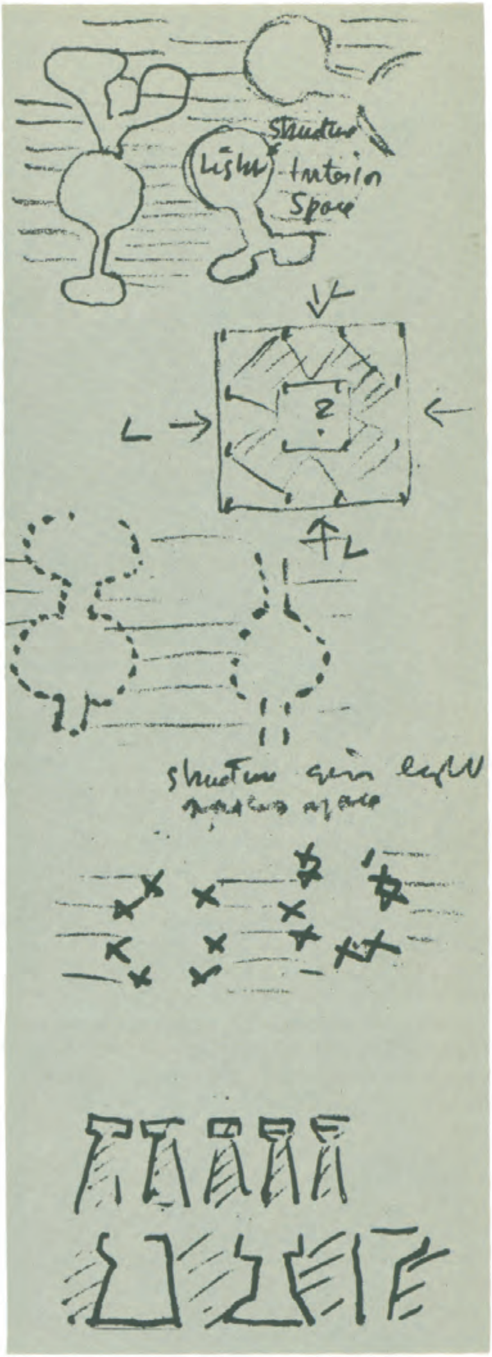

Fig. 245: Louis I. Kahn, “Structure as the Giver of Light,” 1965.

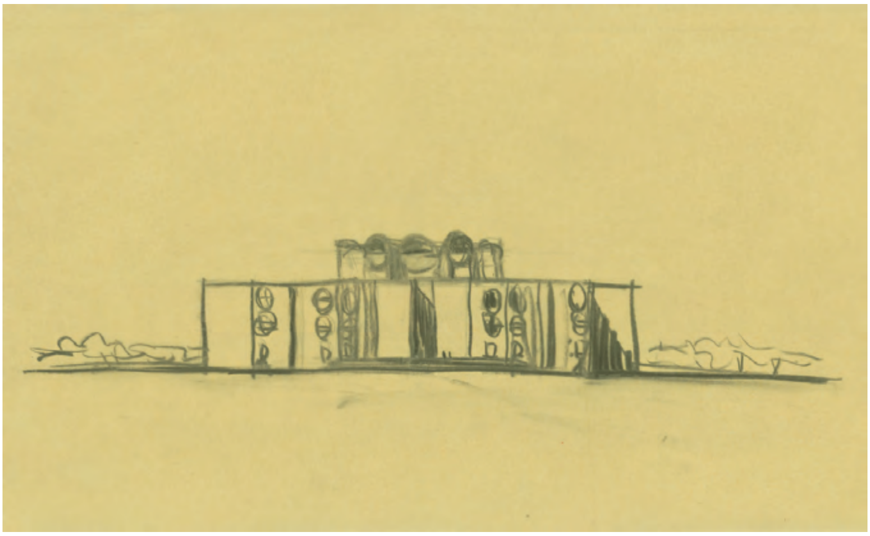

Fig. 246: Louis I. Kahn, National Capital of Bangladesh, Dhaka, 1962-83.

for the Indian Institute of Management by introducing cylindrical courtyards into the office complex. Allowing the surrounding spaces to be laterally lit, shaded and cooled, besides gathering the rainwater from the surrounding roofs, he immediately considered the solution superior to the earlier invented *sun shields*, "because there I put a wall up to shade the sun and modify glare, and here the solution is an integral part."[920]

4.7 From the Tree of Life to the Architecture of Shadows

Simultaneously with his engagements in India and Pakistan, Kahn worked on several projects in North America that allowed for the further exploration of such carriers of the natural elements, for example in the Fort Wayne Fine Arts Center (1961-5) or in intermediate versions of the auditorium and school building of the orthodox Sephardic Mikveh Israel Synagogue in Philadelphia (unrealized, 1961-72). Regarding the latter project, by January 1963, Kahn had drawn up a basic disposition, whereby the synagogue – a shrunken octagon with a square assembly space and preceded by a square entrance hall – was placed at the eastern end of the property, while a separate square chapel with a rudimentary *sukkah* was located next to it. Both the synagogue and the chapel were ringed by a passage that in a lobed formation strung

920 Kahn, "Remarks," p. 324.

Fig. 247: Louis I. Kahn, Mikveh Israel Synagogue, Philadelphia, Pennsylvania, 1961-72.

cylindrical "rooms of light" together.[921] These had glazed windows on the exterior, while larger unglazed perforations faced the central chamber (Figure 247). As Susan G. Solomon accurately observed, "[t]he light, free of glare, would have been diffuse and luminous, enveloping all the worshippers."[922] The actual wall segments were slightly detached from the light cylinders and carried an elliptically shaped hollow concrete ceiling reminiscent of Le Corbusier's at Ronchamp. In terms of the building's robust outer appearance that was akin to the prayer hall in Dhaka, one may mention as possible source the Cathedral in Albi with its bulwark of rounded piers, but also Spanish castles like the Villaréjo de Salvanés near Madrid (Figure 248) besides dozens of other examples in *Castillos y Alcâzares*. At the same time, Van Eyck, inspired by the round huts of primitive African villages, also used cylindrical shafts as a primary compositional motif and natural lightning element in the Wheels of Heaven Church in Driebergen (unrealized, 1963-4) and the Catholic Church in The Hague (1964-9).

921 Ibid., p. 320.
922 Susan G. Solomon, "Louis Kahn's Buildings for Three Faiths: 'Religion ... not a religion.'," in Von Moos and Eisenbrand, *The Power of Architecture*, p. 156.

Fig. 248: Villaréjo de Salvanés, near Madrid, Spain.

According to Luis Vincent Rivera, Kahn at the outset brought Gershom G. Scholem's *Zohar: The Book of Splendor* (1963) with Paulus Ricius' illustration of the "Portae lucis" (Augsburg, 1516) on its cover, to the office (Figure 249).[923] While the Mikveh Synagogue approximated in its ground floor disposition this Kabbalistic image of the "Tree of Life" (*Etz Chaim*), Scholem's book also included a description of the illustration: God revealed himself through ten divine emanations, the *sefirot*; at their top figured *Kether*, the "crown" and primordial energy, "which is a never-to-be-exhausted fountain of light, wherefrom he designates himself *eyn sof*, the Infinite."[924] In basic terms, the Etz Chaim alluded to the interconnectedness of all life: the power of God branched off from a monistic point of unity throughout all matter, whereas in a reverse process the worshipper might mount the spiritual ladder. Kahn, whose maternal grandfather, Abraham Mendelssohn, had been a re-known Jewish mystic and spiritual healer in Riga, regarded the cylindrical "columns, like the Tower of Babel aspiring to God."[925] Hence, the synagogue should be a place of spiritual ascension, and remarkably, reading from the *Torah* is called *aliyah*, literally "going up."

As mentioned at the beginning, next to the chapel Kahn had positioned a *sukkah*, which, at least judging from the detailed drawings he made of it (Figure 250), was of special significance. During the weeklong *Sukkoth*, the Feast of the Tabernacle, sukkah booths are erected to commemorate the temporary shelters in which the Jewish population had dwelled during the Exodus. Also referred to as "The Feast of Ingathering," the *Sukkoth* festival later became associated with the fall vintage. Following strict religious rules, Kahn envisioned a modest but permanent structure of six posts forming two squares, all topped by a fragile roof, on which the requisite organic cover (*s'chach*) was placed. Not unlike Filarete's depiction of the "Primitive Hut" in the *Trattato di architettura* (Figure 251) that showed a simple structure made up of branches strung together at their bifurcations and covered with leaves from the surroundings,[926] the planning of the sukkah was apparently the perfect occasion for Kahn to return to architecture's origins and express the archaic with modern means. Likewise, Rykwert in *On Adam's House in Paradise* (1972) considered the sukkah to be

923 Cf. Burton, "Notes from Volume Zero," p. 81; and Jeffrey Kieffer, "Criticism: A Reading of Louis Kahn's Salk Institute Laboratory," in *Architecture and Urbanism*, no.271, April 1993, p. 10.

924 Gershom G. Scholem, (ed.), *Zohar: The Book of Splendor* (New York: Schocken Books, 1949) p. 79.

925 Burton, "Notes from Volume Zero," p. 83.

926 Abbé Marc-Antoine Laugier further elaborated Filarete's imagery: "The man is willing to make himself an abode which covers but not buries him. Some branches broken down in the forest are the proper materials for his design. He chooses four of the strongest, which he raises perpendicularly and which he disposes into a square. Above he puts four others across, and upon these he raises some that incline from both sides. This kind of roof is covered with leaves put together, so that neither the sun nor the rain can penetrate therein; and now the man is lodged." Laugier, *An Essay on Architecture* (London: Printed for T. Osborne and Shipton, 1755; *Essai sur l'architecture*, 1753) pp. 10-1.

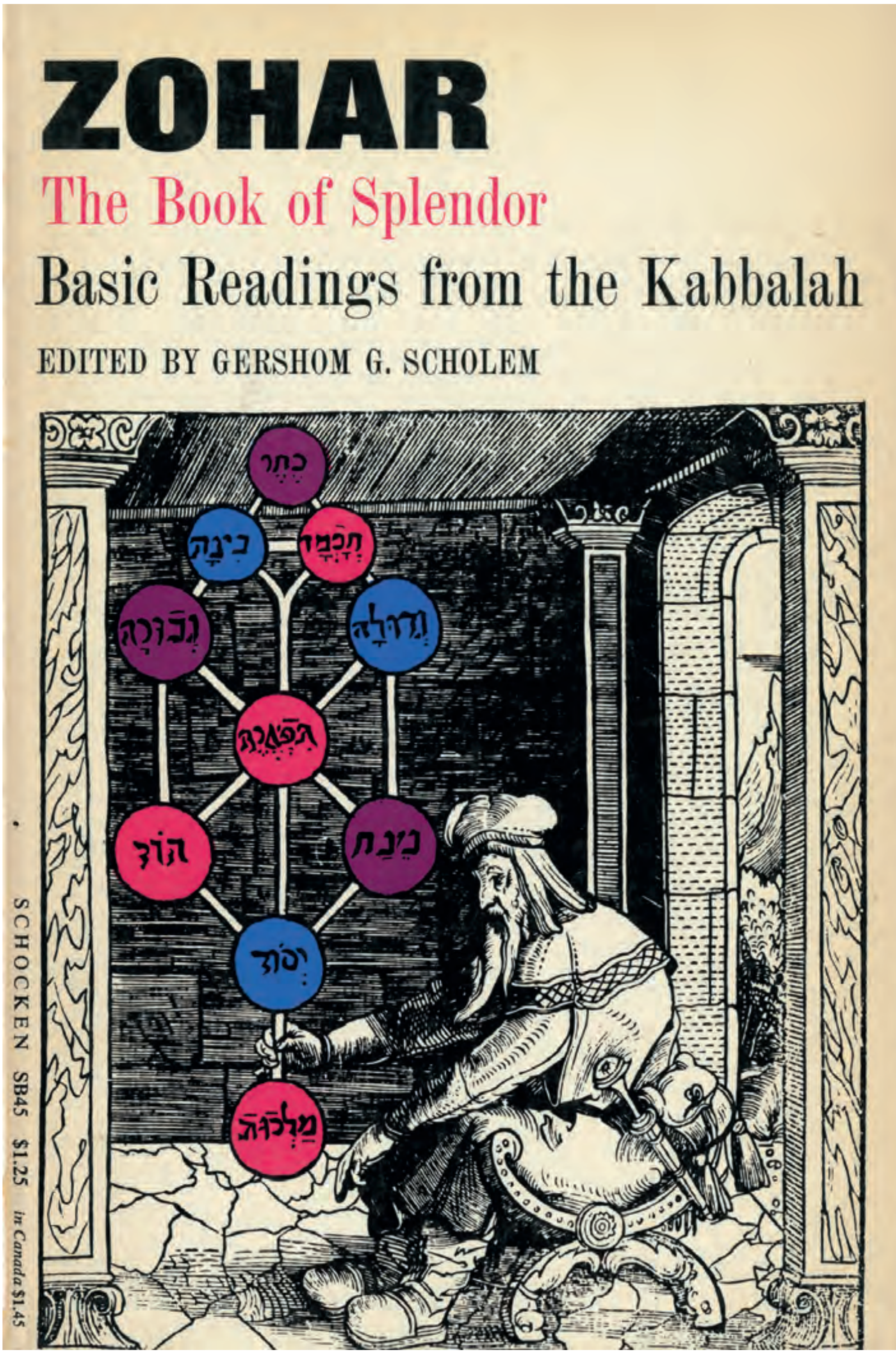

Fig. 249: Paulus Ricius' "Portae lucis" (1516) on the Cover of Gershom G. Scholem, *Zohar*, 1963.

Fig. 250: Louis I. Kahn, "Sukkah," Mikveh Israel Synagogue, Philadelphia, Pennsylvania, 1961-72.

"perhaps the most evident continuation of a ritual in which huts are built of green plants until our own times."[927]

Remaining in North America, Kahn subsequently planned the Phillips Exeter Library with an adjoining Dining Hall in New Hampshire (1965-72). In terms of the geometrical layout, both the library and the dining hall continued Kahn's paradigm to relate the plan's main elements in a √2 growth sequence. As he remembered, the proportions were painstakingly worked out over months, so "that one aspect or part cannot be removed without affecting all the others."[928] Furthermore, Kahn noted that the design

> began with the periphery, where light is. [...] I made the outer depth of the building like a brick doughnut, independent of the books. I made the inner depth of the building like a concrete doughnut, where the books are stored away from the light.[929]

927 Joseph Rykwert, *On Adam's House in Paradise: The Idea of the Primitive Hut in Architectural History* (Cambridge: The MIT Press, 1981; 1972) p. 154.
928 Kahn's letter to Rodney Armstrong, Exeter librarian, 17 April 1968, 030.II.A.6.3, LIKC. Furthermore, the Golden Ratio defined the ratio of height to width of the central chamber. Cf. Gast, *The Idea of Order*; and Jay Wickersham, "The Making of Exeter Library," in *The Harvard Architecture Review*, no.7, 1989, pp. 138-49.
929 Louis I. Kahn, "The Mind of Louis Kahn," in *The Architectural Forum*, vol.137, July-August 1972, p. 77; from a lecture delivered in the Lamont Gallery, Phillips Exeter Library, 15 February 1970.

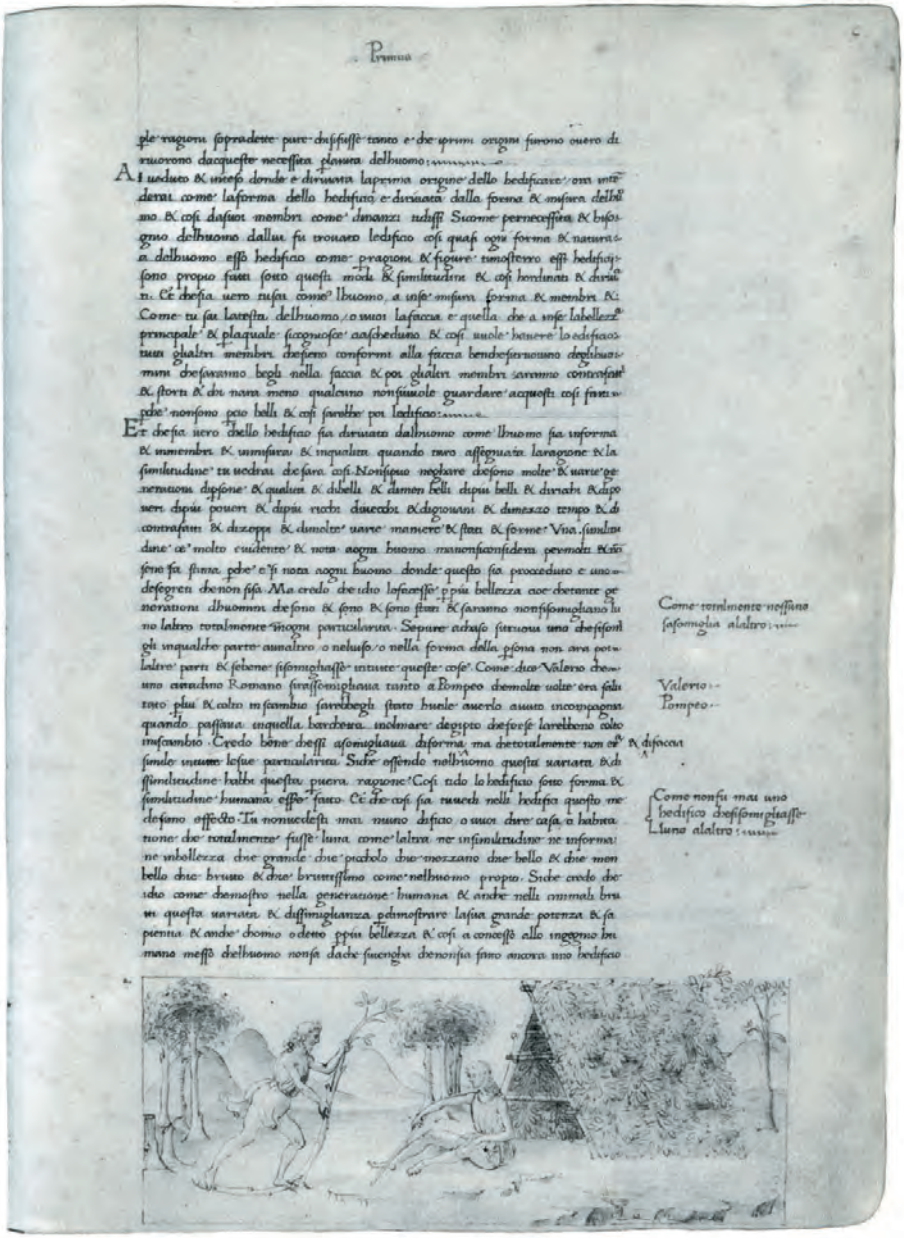

Fig. 251: Filarete, “Primitive Hut,” in *Trattato di architettura*, 1460-4.

Obviously another example of a ruin placed around a building, the outer brick "doughnut" with its refined texture, teak wood panels and delicate structural rhetoric indicating how the elevations' load progressively increased from top to bottom, related to a more intimate scale, while its surrounding arcade on the ground floor invited both people and the encompassing park to enter. Emphasizing the outer membranes' ruinous character, its screens did not touch at the corners, thus, making the *perfect* cube appear somewhat incomplete and broken. The concrete "doughnut" in the center, originally also planned in brick and fixed in its corners by four hollow columns containing the stairs, rest rooms and technical utilities, enveloped a spatially overwhelming void. The introvert space was framed by four concrete membranes with large circular breaches that acted as windows into the world of books (Figure 252). Similarly baffling as the strainer arches forming the diaphanous crossing of Wells Cathedral (c.1338-40; Figure 253), the Exeter Library's atrium was crowned by two diagonally crossed concrete blades conducting the laterally intruding light downwards to the *piano nobile*. Defining a vertically aspiring spatial experience, the main hall was expressive of the educational striving after *higher* knowledge. Besides, the employment of the circular forms accentuated that it was also a place of gathering, just as it had done earlier in the Trenton Bath House, Kahn's first centralized structure around an inner (in that case open) courtyard. Tyng, several years after the library's completion, speculated on the psychological dimension of the space:

> For the alchemists, and in this Tibetan mandala, the motif of squaring the circle marks the synthesis that occurs as a symbol of death and rebirth or renewal, the synthesis of the Spiral Order within a new Bilateral Order. The Exeter Library achieves such a synthesis of the archetype. […] Within the cube, the great circular concrete forms define a sphere. The archetypal diagram of 'squaring the circle' is articulated in three dimensions, the building achieves a <u>cubing of the sphere</u>, in a sense, the ultimate archetype […].[930]

When considering the autarchy of Kahn's invention, how the library's almost cubic volume with four equal facades confronted the given milieu,[931] the influence of the Revolutionary Architects becomes unequivocally apparent. Ledoux's impact was especially evident in the design of the Dining Hall, which with its congenial façades and cubic corner towers was reminiscent of the French architect's House of a Man of Letters (1773-9).[932] In October 1967, an exhibition featuring the work of the "visionary

930 Tyng, "Louis I. Kahn: A Modern Architect's Response to Egypt, Greece and Italy."
931 Pattison had drawn up plans with a paved forecourt on the side of the library's main entrance, which would have given the building a stronger orientation towards north.
932 The four chimneys placed slightly detached at the center of the Dining Hall's façades recalled similar elements that Venturi had used as a symbol for "house;" for instance, in the Pearson House (1957), the Beach House (1959) and in early stages of the Venturi House. Acting as *solar chimneys*, they enhanced natural ventilation just like in Kahn's Margaret Esherick House and the Richards Medical

Fig. 252: Louis I. Kahn, Phillips Exeter Library, Exeter, New Hampshire, 1965-72.

Fig. 253: William Joy, “Scissor Arches,” Wells Cathedral, Somerset, England, c. 1338-40.

architects" began its American tour in Houston. Kahn gave the opening lecture entitled "Architecture of the Incredible," as well as writing the forward to its accompanying catalogue. Just as the American architect affirmed that the "Spirit in will to express can make the great sun seem small," Ledoux was quoted in the booklet as saying: "The architect is the rival of nature, and out of it can form another nature."[933] Criticizing Vitruvius, who, according to Boullée, had put too much emphasis upon *building*, the French architect maintained that architecture was "the product of the mind,"[934] and "[t]o be reduced to what is called necessity when designing a temple is to forget one's subject."[935] Using the epigraph "Ed io anche son Pittore" attributed to Antonio da Corregio ('And I am also a painter') to open his treatise *Architecture, essai sur l'art* (1796-7), Boullée accredited nature as the majestic force that imparted vitality to a building's inert materials. He considered it the architect's foremost task to poetically unveil the world and bring nature to presence through the man-made artifact – *mettre la nature en oeuvre*, as Boullée put it.[936] When asked how one could express a temple's specific nature, the self-proclaimed inventor of "shadow architecture" answered:

> It is light that produces impressions which arouse in us various contradictory sensations depending on whether they are brilliant or sombre.[937]

933 Jean-Claude Lemagny, *Visionary Architects: Boullée, Ledoux, Leque* (Houston: University of St. Thomas, 1968) p. 67. Likely to be forgotten, also Gunnar Asplund, whose work Kahn might have encountered during his first visit to Europe, and which in different ways prefigured his – in terms of how the Swedish architect approached the profession through artistic means, or how he sought to find a fine balance between questions regarding contextual adaptation and the independence of architectural form – had been influenced by the idealism of the Revolutionary Architects. This was most explicit in the Stockholm City Library (1920-8), where a huge cylinder containing the reading hall surmounted a square plinth. The building's megalomaniacal and beautifully choreographed entrance sequence asserted that with due respect for natural limitations, no boundaries were set to man's creative aspirations.

934 Étienne-Louis Boullée, "Architecture, Essay on Art," in Helen Rosenau, (ed.), *Boullée & Visionary Architecture* (London: Academy Editions, 1976) p. 83.

935 Ibid., p. 91. The Revolutionary Architects' dictums would also affect the Austrian architect Hans Hollein and his colleague Walter Pichler, who sent Kahn a brochure of their recent work in 1963. In it, they plainly stated: "Architecture is a mental order, realized through building." Following the imperative to build a "pure, absolute architecture," for them form did not "follow function," it did "not develop by itself. It is the man's grand decision, whether a building ought to be a cube, a pyramid or a sphere [...]." Hollein and Pichler, "Architektur," (foreword by Joseph Esherick) Gallery St. Stephan, Vienna, May 1963; Cf. 030.II.A.64.11, LIKC; transl. by the author. Three years earlier, on 6 June 1960, Esherick had written to Kahn: "I have asked an Austrian graduate student of mine, Hans Hollein, to convey my greetings. [...] You met him when you were here – Hans will be heard from in the future."

936 In Boullée's words: "Finally, the architect of this beautiful place would demonstrate the command of his art, which lies in the use he makes of nature." Rosenau, *Boullée & Visionary Architecture*, p. 88.

937 Ibid., pp. 92-3.

Coincidentally, in his opinion, the most daring effect was to be achieved through indirect illumination, whose “mysterious daylight would produce inconceivable impressions and, in a sense, a truly enchanting magic quality.”[938]

4.8 No Plinth, but Silver Concrete and Green Rooms to the Sky

A further project attesting to the influence of the Revolutionary Architects was Kahn’s design of the Kimbell Art Museum in Fort Worth, Texas, for which he had received the commission in 1966. The final plan envisioned a series of parallel vaults with three intermingling, square courtyards. These, in anticipation of the kind of light their foliation and water features would give, were termed the “green,” “yellow” and “blue court.” While Kahn explicitly stated in relation to the project that his “mind is full of Roman greatness,”[939] especially the barrel-vaulted interiors, traversed by long, zenithal light-slits, approached Boullée’s proposal for the expansion of the Bibliothèque du Roi (1785; Figure 254). While the latter’s coffined ceiling was open to the sky at the ridge, Kahn hid the light source with a newly invented light reflector (Figure 255). Richard Brown, the museum’s future director, wanted to assure that natural illumination played a vital part in the project and demanded that

> the effects of changes in the weather, position of the sun, seasons, must penetrate the building and participate in illuminating both the art and the observer.[940]

To achieve the desired solution, which should permit daylight to enter and simultaneously diminish the sun’s dangerous effects upon the paintings, Kahn with the help of Richard Kelly, who had also assisted him in the lighting design of the Exeter Library and would continue to collaborate on the Mellon Center for British Art in New Haven (1969-74), developed a “beam splitter” or “modifier of the light, sufficiently so that the injurious effects of the light are controlled [...].”[941]

938 Ibid.

939 Louis I. Kahn, “Kimbell Museum Dedication,” (autumn 1972) in Wurman, *What will be has always been*, p. 177.

940 Wiseman, *Beyond Time and Style*, p. 210. Richard Brown was a specialist on the subject, since he had written his doctoral dissertation at Harvard on 19th century color science and the French Impressionist Camille Pissarro.

941 Nell E. Johnson, *Light is the Theme: Louis I. Kahn and the Kimbell Art Museum* (Fort Worth: Kimbell Art Foundation, 2002) p. 37. Kahn devised similar light-modifiers in the design of the Wolfson Center for Mechanical and Transportation Engineering in Tel Aviv (1968-77) and in the Mikveh Synagogue’s last version. Kelly, whom Kahn had first met at a “Conference on Architectural Illumination” in Raleigh in 1953 (Cf. 030.II.A.56.86, LIKC), and who as a lightning consultant had earlier worked with Johnson, Saarinen and S.O.M., received decisive help from Marshall D. Meyers: he recalls having gotten the idea from a 16mm Bolex movie camera he owned. Cf. Meyers, “Making the Kimbell: A Brief Memoir,” in Luca Bellinelli, (ed.), *The Construction of the Kimbell Art Museum* (Milano: Skira, 1997) p. 17.

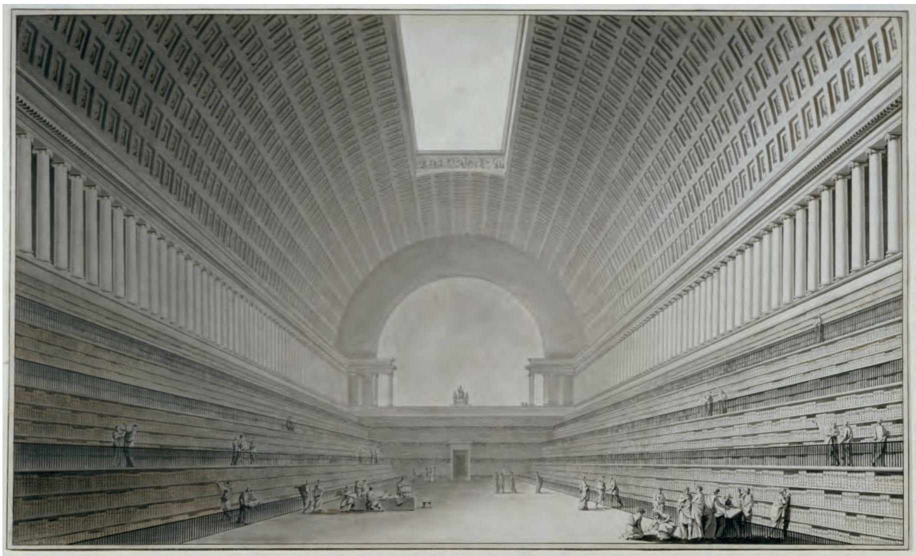

Fig. 254: Étienne-Louis Boullée, *Bibliothèque du Roi*, 1785.

Fig. 255: Louis I. Kahn, Kimbell Art Museum, Fort Worth, Texas, 1966-72.

A number of mock-ups were built to test different materials, while a computer program checked the fixture's curvature and the ratio of perforation that should be applied.[942] Finally, Kelly proposed employing aluminum, polished on one side, to mirror the incoming light towards the inner concrete surfaces, from which a soft glow of silvery radiation penetrated the spaces beneath. While the reflectors in the spaces housing art were left opaque, in the spaces not intended for exhibition, the light splitters were supposed to be perforated with countless tiny holes, thus, permitting a small quantity of direct light to enter. Apparently satisfied with the interior's lively radiance, Kahn acknowledged:

> We knew that the museum would always be full of surprises. The blues would be one thing one day, the blues would be another thing another day, depending on the character of the light. Nothing static as an electric bulb, which can only give you one idea of the character of light. The museum has as many moods as there are moments in time.[943]

From a structural perspective, the long slot at the crest naturally destroyed the integrity of the shell. When the local engineers felt overwhelmed with the given task, Komendant was asked for assistance.[944] While the idea to use a cycloid shape was Marshall D. Meyers', Kahn's project manager who had seen it described in Fred Angerer's *Surface Structures in Building* (1961),[945] Komendant recognized that the structure actually did not function like a vault, but like a beam. Consequently, he added stringers along the longitudinal edges to stiffen the pre-stressed concrete shells (only four inches thick) and inserted small concrete struts in the skylights, besides diaphragms at the shells' ends for their lateral stabilization.[946] Four post-tensioned pillars that were placed at the outer corners supported each vault. These were separated at their spring from the next by an eight-foot horizontal inlet, which contained the mechanical services that were vertically domesticated in six hollow columns positioned at the points, where the outer and the middle segments overlapped.[947]

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942 Cf. "Report on light, a year after the completion," n.d., no author, 030.II.A.37.25, LIKC; and Tanteri and Cooley, "Richard Kelly: Selected Works," pp. 11-2.

943 Kahn, "Kimbell Museum Dedication," p. 177.

944 Cf. Meyers' letter to Komendant, 27 November 1968, 027.II.70, AEKC.

945 Cf. Meyers, "Making the Kimbell," p. 17. A point on the circumference of a circle, which is rolled out on a horizontal line, generates the cycloid's curve. Dischinger, Komendant's former collaborator, had received a patent for it in 1923.

946 Cf. Aurelio Muttoni, "An Analysis of the Structure," in Bellinelli, *The Construction of the Kimbell Art Museum*, pp. 105-11.

947 A supplementary note on the diaphragms: until the design's last revision in June 1970, when the arched edge beams got thinner as they tapered down towards their structural supports, they had been constant in thickness from top to bottom forming a proper half arch. While Kahn supported the last mentioned option, Komendant advocated the structurally less fraudulent solution that was finally implemented. This detail reveals that as much as Kahn sought to follow the ways of nature and to annihilate his personal preferences, a predilection for certain forms did exist. Eventually, and

The project did not terminate with the interior, however, but extended outwards in a wholesome orchestration with the landscape design. Assisting Kahn in this effort were Patton and Pattison.[948] In a memo written in February, 1970, she summarized:

> The landscape architects believe their design proposal for the Kimbell Museum will extend the civilized environment of the museum beyond its walls to the limits of the site and in a manner that the structure and the landscape will fuse intrinsically.[949]

In an analogous manner, Kahn averred in a letter to Brown the following May: “We believe that the landscaping design as it now stands is an integral part of the design of this building […].”[950] The increasing effort to make the surroundings a part of the project can be recognized in the three stages of the design process, which all shared in common the use of water pools on the entrance side to the west. The initial scheme, devised in spring 1967 and outlined by a large square that was pierced by a number of interior courtyards, covered almost the entire site. Raised on a pedestal, this first proposal was clearly marked off from the encompassing environs and destroyed most of the existing park. By the time of the next presentation in the fall of 1967, the project had been reduced in size and was now arranged in an H-shaped disposition. Pattison had urged removing the plinth to make the building more rooted in the graded terrain, while additionally a continuous pair of porticos now preceded the garden entrance and as an interface helped to articulate the transition from the inside to the outside. For Pattison, these “ambulatories” were “the ambiguous middle ground that tied the museum to nature and lent the same dignity to life forms, that sculpture had within.”[951]

Sensing that the project had been split too much into two separate entities, the final U-shaped version was even more compactly arranged on two floors at the site’s eastern border, leaving most of the park untouched. (Figure 256) An existing *allée* of elm trees, with some newly planted oak trees, was to precede the intervention and border it from the large lawn, which, remaining traversable at any point, would offer

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perhaps just because he did not opt for the more formal solution, he reached the conclusion: “This building feels – and it’s a good feeling – as though I had nothing to do with it, that some other hand did it.” Kahn, “Kimbell Museum Dedication,” p. 177.

948 Patton, intending to use local plants as much as possible, on one of his first visits to the site learned that the neighboring Carter Museum’s planting had been done by an “excellent” local landscape contractor named Vernon Swanson, whom he proposed as the ideal man to help them in the design’s execution. Cf. Patton’s letter to Kahn, 29 January 1968, 033.III. Box 31 “Kimbell Art Museum,” GEPC. In a later visit, Patton confirmed to have “looked at and photographed the site and the existing trees thoroughly […].” From Patton’s letter to Kahn, 24 July 1968; Cf. 030.II.A.6.20, LIKC.

949 Harriet Pattison, “Memorandum ‘The Kimbell Art Museum’,” 10 February 1970, 033.III. Box 31 “Kimbell Art Museum,” GEPC.

950 Kahn’s letter to Brown, 22 May 1970, 030.II.A.37.12, LIKC.

951 Kay F. Edge, “Harriet Pattison, ASLA,” in *International Archive of Women in Architecture*, Virigina Polytechnic Institute and State University, no.18, fall 2006, p. 1.

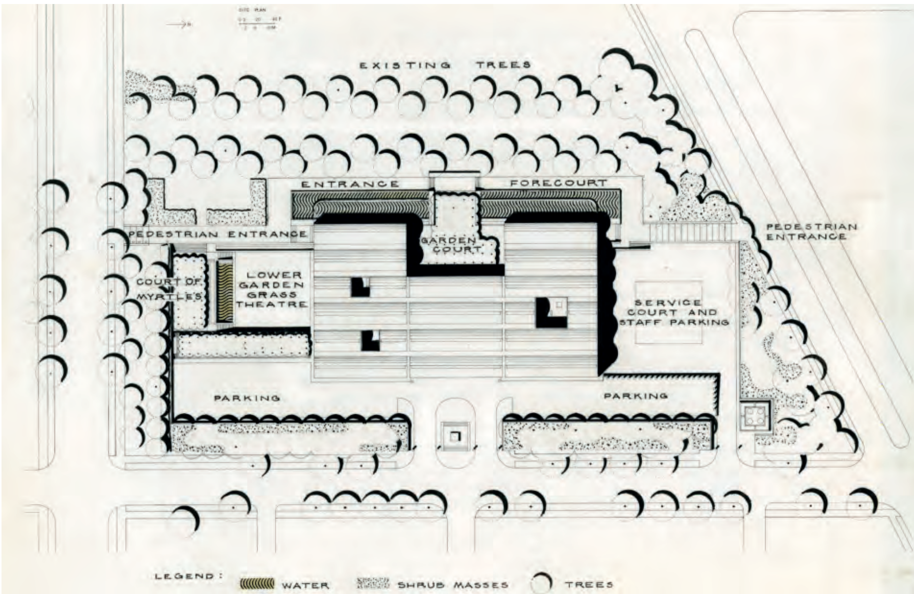

Fig. 256: Louis I. Kahn, Kimbell Art Museum, Fort Worth, Texas, 1966-72; Landscape Design by George Patton and Harriet Pattison.

relief and perspective. Overall, the landscape architects regarded the horticultural material not merely as an ornamental feature but insistently as a space-shaping device. Consequently, the gardens were drawn into the museum through loggias and courtyards, while the building reached outward through its retaining walls, ramps and terraced enclosures. Released from its podium, the building was partly dug into the earth to meet the ground at different levels, and a series of separate yet interlocking "green rooms" extended it *en plein air* to "animate a featureless site and attract the public."[952]

The first of these outdoor rooms — "The Odyssey of Water" — consisted of two overflowing granite water basins, whose shimmering light reflections brightened the front porches' ceilings with dancing illuminations, and guided the visitor's path to the spring in the reception court (Figure 257). Similar to the pool in the Maydan-i-Shah mosque in Isfahan (1611-38) with its bed of dark stone, the tranquil water in the higher basin was to mirror the sky, while the water's gurgling, splashing and murmuring sounds added a mercurial beauty to the design. As Pattison outlined:

> The lure of moving water will draw the visitor who comes on foot into the precincts of the museum. From the west, across the park, it is the dramatic long low line of the waterfalls that visually will

952 Ibid.

Fig. 257: Louis I. Kahn, Kimbell Art Museum, Fort Worth, Texas, 1966-72.

> attract him; from the street entrances, it is the sound. Whether he chooses to stroll through the portico in shade with a brimming pool at his feet or on the sunny path beside the splashing falls, he will inevitably be drawn to seek the water's source in the central or garden entrance court. Here the water courses at sitting level. It will share the focus with a high trellised arbor of evergreen roses that cast a dappled light over the central portion of the court and invite the visitor to linger and enjoy the shade, the sparkling water and a wide view of the park from a slight elevation.[953]

On the gravel surface of the entrance court Yaupon holly trees were planted in a ten-foot grid to form a canopy beneath which one entered the building.[954] Pattison added that upon departing the museum,

> the visitor may follow the trail of the water to its hidden ending in the water-room or cavern at the lower elevation beneath the south entrance portico, where the water plunges dramatically eight feet to a pool below, its echoes heard mysteriously outside, among the green walls of the lower court where another, but placid, pool reflects a silver-grey background of vines and a Maillol Sculpture in its clear black depths.[955]

Unlike the sunken garden grass court, ten feet below the garden entrance and approached by stepped lawns, the grotto-like water feature was ultimately not realized. The lowered garden, according to Kahn "a place to sit to watch the performance of a play of music or dance, the building with its arched silhouette acting as the backdrop of a stage,"[956] lastly featured Noguchi's basalt sculpture "Constellation." Pattison described this space as

> a major 'outdoor room' screened from the sounds and purposeful movement of cars and pedestrians by high walls and loose, evergreen hedges, a place apart to contemplate sculpture as for occasional museum functions in a serene architectural setting.[957]

Overlooking it was the "Court of the Myrtles" (a direct allusion to the Alhambra's Patio de los Arrayanes), where on a gravel-paved surface stood a grove of crepe myrtle trees, "their grey trunks and abundant blooms making interesting seasonal displays and affording a leafy gathering place during warm weather." According to Pattison, a third "room" would flank the pedestrian path to the west, more modest in size and carved out of the high evergreen hedges. This grass-carpeted enclosure, depressed slightly from the park level, but raised above the service court and staff parking,

953 Pattison, "Memorandum 'The Kimbell Art Museum'."

954 Patton insisted that the trees in the entrance area were "the most important trees on the job." First intending to use European Hornbeams, he argued, "it is essential that they be hand picked to create the architectural effect intended." Patton's letter to Meyers, 8 April 1971, 030.II.A.37.12, LIKC.

955 Pattison, op.cit.

956 Kahn's letter to Mrs. Kimbell, explaining the landscape design with an appended sketch of the site, 25 June 1969, 033.III.A.20, GEPC. This wish to integrate a theater for different kinds of artistic performances was an obvious reminiscence of Pattison's earlier studies in film and drama at Yale University, while, as indicated, also Patton had worked as a stage designer in Hollywood after the war.

957 Pattison, op.cit.

would open "its fourth side, when entered, to a sheltered view of the park providing thus a splendid background for open-air exhibits and small gatherings." The actual park as the largest of the "green rooms" should be

> an invitation to all ages providing freedom of movement, and expanse of sky and a domain which gives scale and dignity, without a trace of austerity, to the distant view of the museum.[958]

Lastly, the public parking area to the east, also at the lower concourse and having a separate entrance to the museum, was lined with trees as well. These, as Kahn emphatically noted, were "designed to overhang the cars as shelter. For this we must choose the right trees whose habits are respectful of the car tops."[959]

4.9 Architecture and Landscape Gardening are Sisters, not Antagonists

The accomplished blending of architecture with landscape architecture was ultimately only possible because of the close collaboration between Patton, Pattison and Kahn.[960] All three shared a similar inclination for the classical gardens of Europe, where the rhythms and grace of the palaces' interiors was continued in the formal ordering of the gardens. Kahn called the project "the villa and the garden," and to underline its Italian beginnings, he sent Pattison during the planning a postcard from the Villa d'Este saying "what a marvelous place it is."[961] In a sort of situated Neo-Classicism with a Salk Institute-*degree zero* aesthetic – a resolute gray-silver concrete canvas awaiting its adoration through the light and shadow's play – the Kimbell Art Museum exemplified that with all the given adulation for nature and the site, it was ultimately a human artistic decision how trees, bushes and flowers were arranged to form a unity with the built structure. In agreement, Kahn noted about gardens in general:

958 Ibid.
959 Kahn's letter to Mrs. Kimbell, op.cit.
960 Patton had collaborated with Kahn besides the Kimbell Art Museum on the Mill Creek Public Housing Development in Philadelphia (1955-62), the Unitarian Church in Rochester, the Erdman Hall Dormitories, the Exeter Library and the Olivetti-Underwood Factory. Pattison, before and while studying landscape architecture, was informally involved with the United States Embassy and Consulate in Luanda, the Salk Institute and the Levy Memorial Playground. More tangible was her contribution after receiving her degree in 1967, as she worked on the National Assembly in Dkaha, the Mikveh Israel Synagogue, the Hurva Synagogue in Jerusalem (1968-74), the Palazzo dei Congressi in Venice (1968-74), the Mellon Center for British Art (1969-74), the Inner Harbor Project in Baltimore (1971-3), the Honickman House in Fort Washington (1971-4), the De Menil Foundation in Houston (1972-4), the Graduate Theological Union Library in Berkeley (1973-4), the Pocono Arts Center in Luzerne County (1973-4), the preliminary site plans of the Abbas-Abad Development in Teheran (1974) and the Korman House in Fort Washington (1974); Cf. Pattison's hour sheets, 030.II.A.94.11 and 030.II.A.94.41, LIKC.
961 Birnbaum, *Harriet Pattison*, p. 63.

> [T]he architect is called in as the advocate of nature, and makes everything in the deepest respect for nature by not by imitating nature at all, and not allowing himself to think that he is a designer if he imitates how, let's say, the bird plants the tree. But he must plant the tree as a man, a choosing individual.[962]

Hence, in accord with the Stoic precept that one should "look at things as a man, as a human being,"[963] Kahn also insisted that man, beyond his inevitable subordination to nature's laws, had the capacity, and even obligation to utilize nature according to his own will and powers.

To underline this stance, further attention should be given to the design of the Franklin Delano Roosevelt Memorial at the southern tip of Roosevelt Island in New York City that he planned together with Pattison in 1973 and early 1974 (posthumously realized between 2010 and 2012). All the prepared schemes shared in common the creation of two *ur*-spaces – the one by architectural, the other by natural means. This was Kahn's point of departure, because

> the garden is somehow a personal nature, a personal kind of control of nature, a gathering of nature. And the room was the beginning of architecture.[964]

The first idea for the "room" envisioned a cylindrical bastion, sixty-feet high and open to the sky. Sheathed with a shiny and reflective metal cladding, for the initial presentation in April 1973 the project was reduced in size and now consisted of two barrel-vaulted cantilevering concrete structures. Positioned on either side of a square platform, they framed the view towards the Manhattan skyline. For the dedication ceremony held on September 25th, the design was once again revised to yield a minimal U-shaped configuration that was bordered by three massive stonewalls. Placing two statues of Roosevelt on the entrance side – one looking towards the room, the other to the garden – these were accompanied by four square pillars, which, aligned in a row in front of the framing walls symbolically represented Roosevelt's "Four Freedoms." In the final design, presented in spring 1974, the memorial was further simplified by removing these markers. Consequently, an abstract roofless room resulted, which engulfed by the largest obtainable solid granite slabs,[965] was both monumental and intimate, and conducive to both distant views and private encounters. In a *modern archaic* way, it allowed in its quiescent withdrawal the city, the people and the elements to fill the contemplative stage.

The arrival in this space touching upon the fundamentals of architecture was the culminating point of a dramatic *mise-en-scène*, a vigorously controlled

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962 Louis I. Kahn, "Clearing," in *Via*, vol.2, 1973, p. 160.

963 Marcus Aurelius Antoninus, *To Himself* (New York: The MacMillan Company, 1928) IV, § 3.

964 Kahn, "1973: Brooklyn, New York," p. 90.

965 According to Pattison, the granite slabs were so heavy that "[t]hey had to be brought by barge the way they were in Egypt [...]." Birnbaum, *Harriet Pattison*, p. 125.

Fig. 258: Louis I. Kahn, Franklin Delano Roosevelt Memorial, New York City, New York, 1973-2012; Landscape Design by Harriet Pattison.

pilgrimage through the precisely calibrated sequences of the preceding garden. At the beginning of that journey, one crossed a natural barrier created by a group of five trees, after which a laterally open plaza appeared with a raised mound in front that was accessible via a grand stair.[966] At its upper landing opened up a funnel-shaped lawn, framed by two "avenues" of cedar trees that subtly sloped downwards towards their focal point: the bust of Roosevelt (Figure 258). The trees encased the lawn, this freely usable "alternative space" and "representative of the American countryside,"[967] from distractive views towards the city. However, this forced perspective was not visible if one decided to approach the memorial along the walkways to the left or right side of the battered walls upon which the screening trees in their wall-like arrangement stood. At three-fourths of the distance, a successive group of tightly regimented trees diverted the path, so that the visitor was forced to traverse the second paved inlet axially. After a short moment of relief and as a final preparation, when crossing a small, trapezoidal court that was laterally open, one entered the memorial.

Interestingly, Peter Shepheard, one of Pattison's favorite professors,[968] had proposed a similar elongated triangular garden with grass terraces and avenues of

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966 In order to diffuse the crowd, Kahn and Pattison had initially sought to employ in the arrival area 40 trees of columnar height that were "inspired by a little drawing that Lou made of Isfahan [...]. There were 40 columns, and he was so impressed with this great room of columns, which looked onto a garden. [...]." Ibid., p. 123.

967 Ibid., p. 124.

968 Interview by the author with Harriet Pattison, 13 June 2009. Apparently, not only Pattison was impressed by Peter Shepheard, but also McHarg, who noted in a letter to Hideo Sasaki, the chairman of the Department of Landscape Architecture at Harvard, 22 February 1960: "He is very experienced and very well organized. He has an astounding knowledge of plants, botany and ecology. He draws like an angel and is the most unselfconscious teacher I have ever met." 109.II.A.I.103.1, ILMC.

trees for Greenwich Park in London (1969; Figure 259). It is more appropriate to say, however, that the English landscape architect was *only* rejuvenating the cascading earthworks that had originally been conceived by Le Nôtre (1662). Shepheard, professor in the landscape department in Philadelphia throughout the 1960s and dean of the Graduate School of Fine Arts until 1979, was the author of *Modern Gardens* (1953) and shared with Pattison a pivotal fascination for the landscapes of Gertrude Jekyll. As he remembered,

> I first found the books of Gertrude Jekyll as a boy of thirteen, newly in love with gardens. Ever since then she has been to me the ideal guide and mentor in the art of gardening.[969]

Approaching landscape architecture as a fine art that should "form pictures of living beauty,"[970] Pattison also came under the spell of Jekyll's gardens when seeing them during her extended stay in Europe. In a prolific liaison with Edwin Lutyens, Jekyll in numerous English country houses complemented the architect's spatial sequences with her insight into the vast palette of nature's colors and textures – a collaboration beginning with the design of her home and garden in Munstead Wood, Surrey in 1896 (Figure 260; photo by Patton). Considered by Tunnard "the first horticultural Impressionist,"[971] she straightforwardly followed in her practice the advice of her mentor William Robinson:

> [I]n setting a garden we are painting a picture – a picture of hundreds of feet or yards instead of so many inches, painted with living flowers and seen by open daylight […].[972]

Eventually, Pattison also introduced Kahn to Lutyens and Jekyll's work,[973] which he later visited and came to admire as well:

> [Lutyens] responded so beautifully to the landscape architect Gertrude Jekyll that his porches that looked into her gardens had the feeling of satisfying a greater order sympathizing with the garden itself.[974]

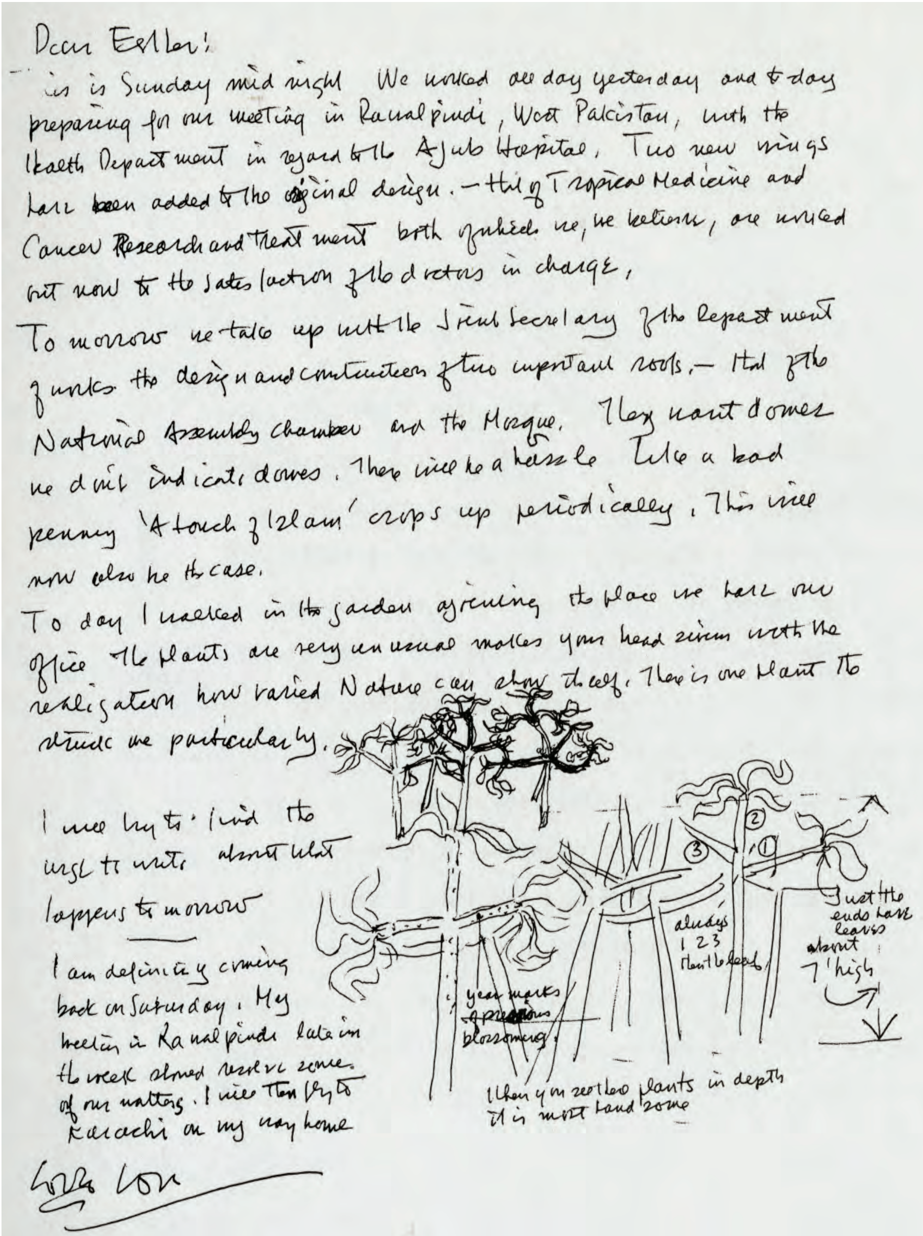
Of further inspiration, at least for Pattison, who idolized her,[975] was the work of another woman landscape architect, the American Beatrix Jones Farrand. Having

969 Peter Shepheard, "Gertrude Jekyll (1843-1934)," May 1982, 024.I.D.22, PSC.
970 Gertrude Jekyll, *Colour Schemes for the Flower Garden* (Salem: The Ayer Company, 1983; 1908) p. 3.
971 Cf. Tunnard, *Gardens in the Modern Landscape*, p. 56.
972 William Robinson, *The English Flower Garden and Home Grounds* (London: John Murray, 1901; 1883) p. 281.
973 Interview by the author with Harriet Pattison, 11 June 2009.
974 Kahn, "Architecture and Human Agreement," p. 137. Of particular interest must have also been Lutyens and Jekyll's inspired use of water to activate their sceneries, for instance in Gledstone Hall, where steps and pergolas flanked a pool overlooking the Yorkshire Moors (1925-7). Cf. Jane Brown, *Gardens of a Golden Afternoon* (Middlesex: Penguin Books, 1985).
975 Birnbaum, *Harriet Pattison*, p. 71.

Fig. 259: Peter Shepheard, Greenwich Park, London, England, 1969.

Fig. 260: Edward Lutyens, Munstead Wood, Surrey, England, 1896; Landscape Design by Gertrude Jekyll.

Fig. 261: Beatrix Jones Farrand, Gardens of Dumbarton Oaks, Washington, D.C., 1922-47.


Dear Esther:
This is Sunday mid night. We worked all day yesterday and today preparing for our meeting in Rawalpindi, West Pakistan, with the Health Department in regard to the Ayub Hospital. Two new wings have ~~been~~ added to the original design. — that of Tropical Medicine and Cancer Research and Treatment both pushed us, the relations, are worked out now to the satisfaction of the doctors in charge.
Tomorrow we take up with the Joint Secretary of the Department of Works the design and construction of two important roofs. — that of the National Assembly chamber and the Mosque. They want domes we don't indicate domes. There will be a hassle like a bad penny 'A touch of Islam' crops up periodically. This will now also be the case.
Today I walked in the garden adjoining the place we have our office. The plants are very unusual makes your head curious with the realization how varied Nature can show itself. There is one plant that struck me particularly.

I will try to find the urge to write about what happens tomorrow

I am definitely coming back on Saturday. My meeting in Rawalpindi late in the week should resolve some of our matters. I will then fly to Karachi on my way home

Love Lou

Fig. 262: Louis I. Kahn, "The plants are very unusual makes your head curious with the realization how varied Nature can show itself." Letter to Esther Kahn from Dhaka, c. 1965.

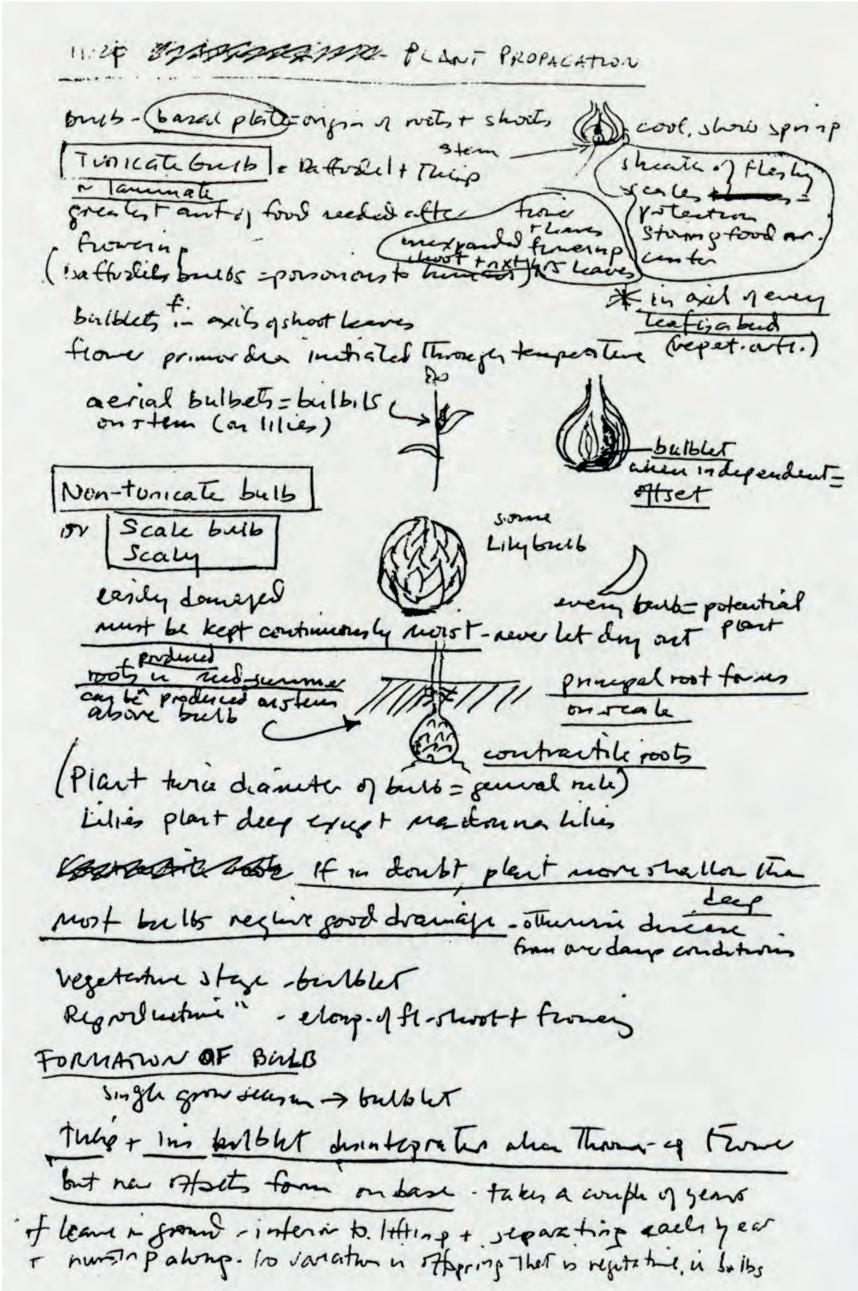


Fig. 263: Harriet Pattison, Notes from the Course “Lessons in Propagation” by John M. Fogg, University of Pennsylvania, Philadelphia, c. 1965.

visited both Robinson and Jekyll on a journey to Europe in 1895,[976] Farrand noted – establishing a guiding principle also for Pattison and Kahn – that

> the arts of architecture and landscape gardening are sisters, not antagonists. [...] The work of the architect and landscape gardener should be done together from the beginning, one supplementing the other but not, as too often happens, one crowding the other out.[977]

In her *magnum opus*, the design of the Gardens of Dumbarton Oaks on a ten-acre site in Washington, D.C. (1922-47), Farrand implemented a series of ever-changing outdoor rooms in reaction to the exceptionally difficult steep terrain (Figure 261). Similar to Pattison's interventions at the Kimbell Art Museum, these *green stage sets*, such as the "cedar" or "green terrace," were to complement the building's interior spaces. Others like the picturesque lawns permitted wide vistas, while the formal "urn terrace," the quasi-baroque "pebble garden" and the "hornbeam ellipse" provided more ordered settings. Alongside these, the "lover's lane pool" afforded a place of seclusion, while labyrinthine paths crisscrossed the flower gardens, and orchards and herbaceous borders bound the entire matrix of interwoven *nature spaces* together.

One last remark concerning Pattison: in addition to her direct influence on Kahn's projects, she generally heightened his sensitivity with regard to nature. A testament of this fact is a letter Kahn sent to his wife from Dhaka, of which Pattison also received a facsimile (Figure 262).[978] In it, he mentioned that in a garden next to their office "the plants are very unusual makes your head curious with the realization how varied Nature can show itself."[979] Likely referring to the Baldah Botanical Garden with its rich and rare collection of aquatic plants, roses, orchids and aroids, the appended drawings of a plant with supplementary comments like "year marks," "precious blossoming," or "just the buds have leaves," clearly indicate Kahn's deepened interest in plant growth. Pattison's coeval enrollment in Fogg's class "Lessons in Propagation" (Figure 263) might at least be a clue to explain the architect's attraction to such morphological traits.

4.10 Four Pillars and the Bull of Heaven

For the unrealized Hurva Synagogue, a commission Kahn obtained in 1967 through the mediation of the Israeli architect Ram Karmi, a memorial garden was envisioned

976 After Jekyll's death, Farrand purchased her entire collection.
977 Beatrix Jones Farrand, "The Garden in Relation to the House," in *Garden and Forest*, 7 April 1897, pp. 132-3.
978 Interview by the author with Harriet Pattison, 13 June 2009.
979 Kahn's letter to Esther, n.d., in Wurman, *What will be has always been*, reproduction at the end, n.p.

as well. Hoping with its implementation to re-activate the halted planning process, Kahn wrote in January 1974 to Jerusalem's mayor Teddy Kollek:

> I find that I must visit Jerusalem to spend time on the site of the Hurva, be in your company, and think about the whole thing in the presence of everything around it. I tried to design the garden. A garden is a special thing.[980]

After a meticulous archaeological survey of the environs and historical sub-structure[981] – Kahn was particularly fascinated by the underground synagogues with their minute light sources that had survived Jordanian rule[982] – he delivered a first proposal in July 1968. Intending to create in a pan-religious sense "a place where everyone could worship equally,"[983] the synagogue was supposed to become an integral part of the old city, as a lavish clay model of the entire site (Figure 264), a sepia-toned urban plan, and a panoramic section that related the design to some of the city's other monuments demonstrate (Figure 265). Positioned along the former *cardo* of Hadrian's Aelia Capitolina and next to the remains of the Old Hurva (destroyed in 1948) that should enclose the garden, Kahn's proposal, the tallest structure in the Old City,[984] overlooked the Wailing Wall (*Kotel*)[985] that supported the Haram al-Sharif, the sacred Islamic precinct on the Temple Mount containing the Al-Aqsa Mosque[986] and the octagonal Dome of the Rock.[987]

Similarly quadrangular organized and proportioned by a rotated square sequence like the latter, Kahn's initial scheme consisted of a bastion-like outer building, which "would absorb the light and heat of the sun,"[988] and an inner building, in which four hollow perforated columns each supported a folded concrete umbrella. Appropriate

980 Kahn's letter to Kollek, 7 January 1974, 030.II.A.39.4, LIKC.

981 Cf. Michael Avi-Yonah's "The Eternal City" (Cultural and Scientific Relations Department, Ministry of Foreign Affairs, Jerusalem; offprint from *ARIEL*, no.23, 1969); R. J. Zwi Werblowsky's "Jerusalem: Holy City of Three Religions" (The Jerusalem Committee, 1973); or Art Kutcher's "The New Jerusalem" (reprint from *The Architectural Review*, June 1973); 030.II.A.39.7, LIKC.

982 Cf. Solomon, "Secular and Spiritual Humanism," p. 413.

983 Ronner, Jhaveri and Vasella, *Complete Work*, p. 325.

984 Teddy Kollek questioned whether the new Hurva, this "world synagogue" should compete with the Dome of the Rock and the Holy Sepulcher (325-33 AD). In fact, he generally doubted whether there should be "any building which would compete in importance with the Western Wall of the Temple." Kollek's letter to Kahn, 29 August 1968, 030.II.A.39.4, LIKC.

985 These vestiges of Herod's rampart once enclosed the Second Temple, begun under Zerubbabal in 539 BC; destroyed 70 AD.

986 "The Furthest Mosque;" built under Caliph Al-Walid, 705-15 AD; rebuilt in 780 AD by Caliph Al-Mahdi.

987 Kubbet es-Sakhra; built under Caliph Abd Al-Malik, 688-92 AD. In its voided heart the worshippers circumambulated the *Sakhra* – a debris of natural rock. Cf. K. A. C. Creswell, *A Short Account of Early Muslim Architecture* (Harmondsworth, Middlesex: Penguin Books, 1958) pp. 17-40.

988 Ronner, Jhaveri and Vasella, *Complete Work* (1987) p. 363.

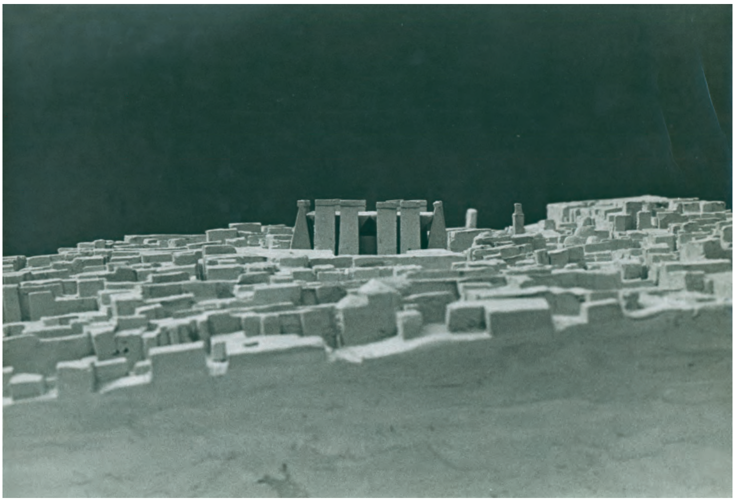


Fig. 264: Louis I. Kahn, Hurva Synagogue, Jerusalem, Israel, 1967-74.

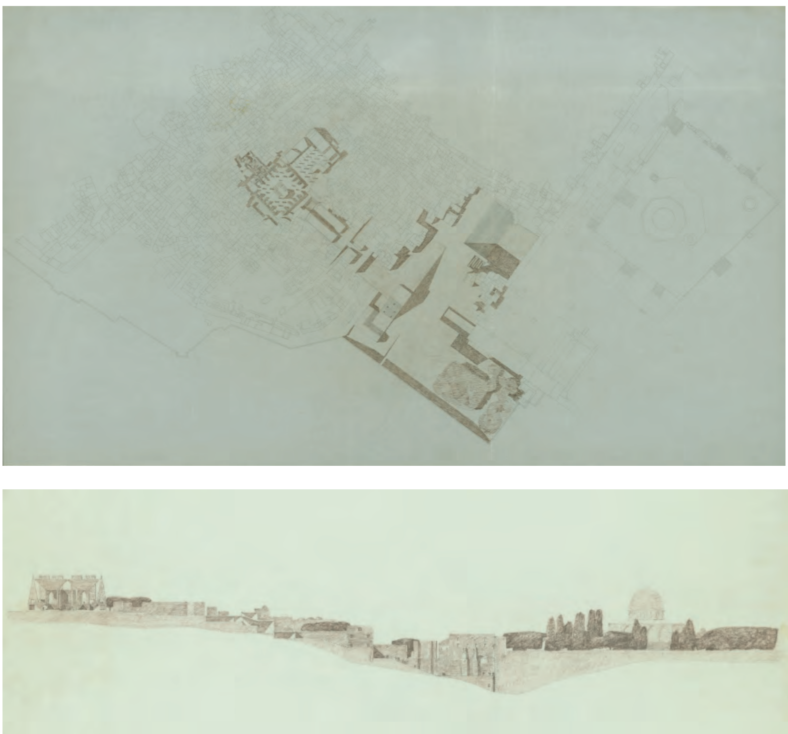


Fig. 265: Louis I. Kahn, Hurva Synagogue, Jerusalem, Israel, 1967-74.

to the name *Hurva*, meaning "ruin" in Hebrew, Kahn's strategy of "wrapping ruins around buildings" found a literal translation in this project. Terming the proposal "a natural architecture of Jerusalem,"[989] Kahn's structure, eschewing any glazing and hence without an impervious barrier, offered bare shelter against rain, wind and sun. Reconciling past and present, he intended to employ for the outer pylons the same ubiquitous limestone that comprised the Western Wall, while the slabs were to be "large, not small stones, rather as large as you can get, as monolithic looking as possible."[990]

One was supposed to enter, or rather squeeze into the synagogue through the four corners left open by the tapered pylons – four on each side and arranged in doubles – which contained candle-lit alcoves for quiet meditation. Allowing a minimum of outward views and celebrating the serenity of the light from above, Kahn assured, "[t]he construction of the building is like large leaves of a tree, allowing light to filter into the interior."[991] On the first level the pylons were pierced through to form a revolving ambulatory – a feature strikingly similar to a reconstruction of Solomon's Temple (completed c. 960 BC, destroyed 586 BC) in James Fergusson's *A History of Architecture in All Countries* (1862-7) that Kahn owned, and in which also four columns figured in the inner square sanctum.[992] However, Kahn abolished in the further process this idea of a giant baldachin or freestanding *ciborium* that was also reminiscent of the four pillars sheltering the ark in the Tabernacle.[993] Regarding the last, Rykwert argued that there existed

> an intimate connection between the Feast of Tabernacles and the Temple; as there was between the Temple and the desert Tabernacles tent, both reflecting on the identity of the people of Israel.[994]

In the project's second version, Kahn dropped the ambulatory, making the alcoves on the ground floor higher. In addition, he now proposed in the interior a square concrete container, which, separated into individual segments by narrow slits in the middle of each side, appeared fay-like suspended in the air as it rested only on two relatively slender columns on each side. Since this spatial receptacle curved outward at its top,

989 Ibid., p. 367.
990 Ibid., p. 363. Kahn imagined the outside to "be golden in color," while "the interior will be rather silver [...]."
991 Ibid.
992 Cf. James Fergusson, *A History of Architecture in All Countries, from the Earliest Times to the Present Day* (London: John Murray, 1865) I, p. 195.
993 In the Tabernacle was "[a] vail of blue, and purple, and scarlet, and fine twined linen of cunning work" representing the natural elements hung "[u]pon four pillars of shittim wood overlaid with gold." Exodus 26:31-2. Flavius Josephus states that the area within the four pillars "was like heaven devoted to God." Josephus, *Jewish Antiquities* (Cambridge: Harvard University Press, 1961; 93-4 AD) III, § 122.
994 Rykwert, *On Adam's House in Paradise*, p. 159.

and because the flat concrete ceiling was slightly raised above its edges, the light's source was hidden and an ethereal substrate illuminated the dark interior. Furthermore, removing the ark from the sanctuary heightened the non-directionalism of the interior space; making the project more closely approach the liturgical task of a synagogue, namely "to assemble."[995] At the same time, this gesture strengthened the proposal's affinity with the universalism of the Pantheon, where "only inspired worship can take place."[996] Conclusively, Kahn proclaimed, "the synagogue is the Ark."[997]

In the final version, the square container was altered into a double-wall arrangement held in place by four hollow pillars – an important vestige of the first phase that re-insinuated its ecclesiastical references. Atop, the space was closed off by a folded roof structure that was cut through in the middle of either side by a circular shaft and crowned by a square oculus.[998] What remained constant in all three proposals was the outer building, whose general arrangement assumed the form of two flanking corner towers facing each direction. As a model might have served Kahn a Biblical description of the altar in the Tabernacle, which, also square, had horns on its four corners (Exodus 27:2). More probably, though, the fortress-like appearance was inspired by a depiction of Solomon's Temple in Paul Thiry, Richard M. Bennet, and Henry L. Kamphoefner's *Churches and Temples* from 1954 (Figure 266), of which Kahn was given a signed copy. The authors remarked that the First Temple was "reminiscent of the twelfth dynasty Egyptian temples […],"[999] where hypostyle halls with forests of columns and high clerestory windows preceded the most sacred precinct. Clearly, in Kahn's schemes the large pillars and the light entering laterally from high above recalled this tradition.

The Egyptian impact upon the Hurva design becomes most obvious, however, when comparing the portals, which, as is visible in Kahn's pastel drawing of the Temple of Edfu (237-57 BC) from 1951 (Figure 267), also consisted of pylons that like a pair of horns framed the entrance. Giedion had argued that the New Kingdom's

995 From a liturgical standpoint, the First and Second Temple were the Houses of the Lord, i.e. the deity dwelled within them in the most sacred precinct, whereas a synagogue – deriving from Greek *sinago*, "to gather" – was devoted to the idea of assembly. Also animal sacrifices were only permitted at the high temple in Jerusalem.

996 Kahn, "Space and the Inspirations," p. 15.

997 Ronner, Jhaveri and Vasella, *Complete Work* (1987) p. 367.

998 Cf. Kent Larson, *Louis I. Kahn: Unbuilt Masterworks* (New York: The Monacelli Press, 2000) pp. 124-97.

999 Paul Thiry, Richard M. Bennet, and Henry L. Kamphoefner's, *Churches and Temples* (New York: Reinhold Publishing Corporation, 1954) p. 4J. That Kahn was fond about knowing more about the Temple's history is approved. In July 1968 he sent the librarian of the Jewish Theological Seminary of America a letter, in which he firstly thanked her for gathering material on the Old City of Jerusalem, besides inquiring if it was "possible to obtain a copy of Chancellor Finkelstein's article 'The Beginnings of the Synagogue'?" Cf. Kahn's letter to Mrs. Serata, Librarian of the Jewish Theological Seminary, 2 July 1968, 030.II.A.39.4, LIKC.

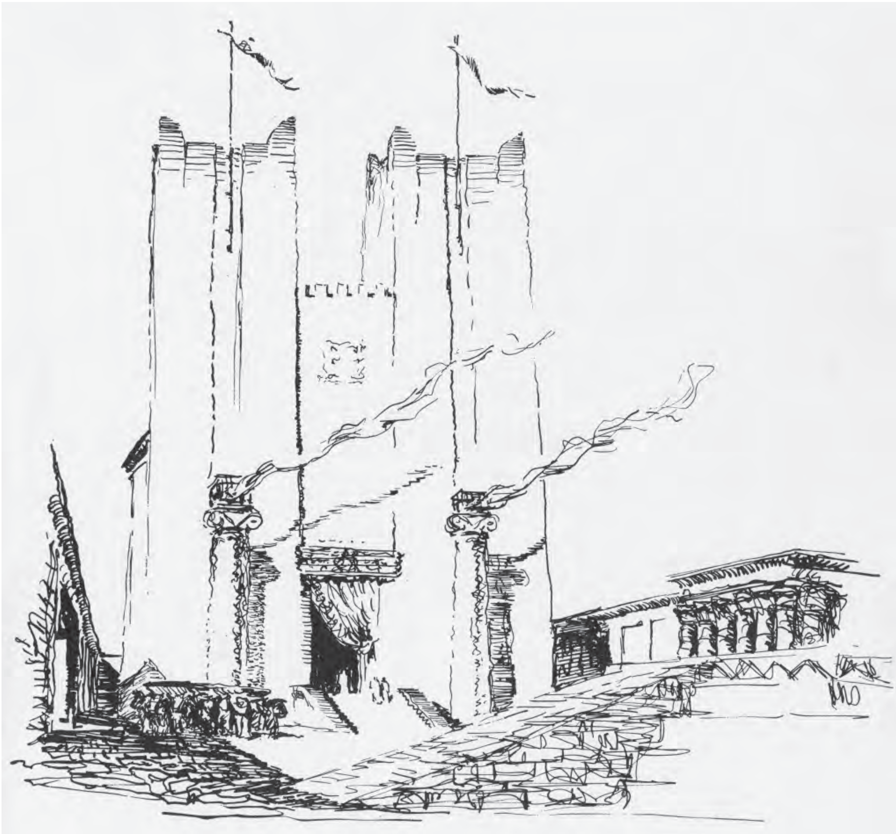


Fig. 266: Solomon's Temple, Jerusalem, Israel, begun c. 832 BC.

pylons were a transmutation of the hieroglyph for Amun-Ra, which showed the sun disk between two mountains and denoted: "The god is in his horizon."[1000] Of the two obelisks positioned in front of Queen Hatshepsut's Mortuary Temple (c. 1450 BC), it was stated: "The sun's disk shines between them as when it rises from the horizon of heaven."[1001] In ancient Egyptian mythology, the sun rose between the double-peaked mountains of Bakhatet and set between the horns of Manu.[1002] These mountains as "four pillars" were seen to hold up the vaults of heavens. Likewise, Utterance 685 of *The Pyramid Texts* states (after Mercer): "The two mountains divide, a god comes into

1000 Giedion, *The Eternal Present: The Beginnings of Architecture*, p. 374.
1001 Joseph N. Lockyer, *The Dawn of Astronomy* (Whitefish: Kessinger Publishing's Rare Reprints, 1997; 1894) p. 106.
1002 Cf. E. A. Wallis Budge, *The Egyptian Book of the Dead* (London: Penguin Books, 2008) p. 4.

Fig. 267: Louis I. Kahn, *Temple of Edfu* (237-57 BC), Egypt, 1951.

being [...].” Since the Egyptians put such great emphasis upon the diurnal passage of the sun in their religion, naturally their attention was concentrated upon the points where it vanished in the evening and appeared again in the morning.[1003]

Another interpretation suggests itself related to the prevalent cult of the *Ka*, whose hieroglyph consisted of two upraised arms. The *Ka* as a sort of vital force

1003 Cf. N. Rambova, *Mythological Papyri* (New York: Pantheon Books, 1957) pp. 29-50. Two interesting additions in support of this theory were brought forth by Juan A. Belmonte, Mosalam Shaltout and Magdi Fekri: first, that a small temple of the god Aton in Tell el Amerna was “orientated to a particular cleft at the horizon where the sun rises, perhaps representing the ancient name of the city, *Akhetaton*, the Horizon of Aton,” and, second, that the Sphinx of Giza –represented with the hieroglyph of an eagle on a sun-disc between two mountains – was orientated in such a way that on the summer solstice the sun set behind it on axis with the Pyramids of Khufu and Khafre. Cf. Juan A. Belmonte, Mosalam Shaltout and Magdi Fekri, “Astronomy, Landscape and Symbolism: A Study of the Orientation of Ancient Egyptian Temples,” in Juan A. Belmonte and Mosalam Shaltout, (eds.), *In Search of Cosmic Order: Selected Essays on Egyptian Archaeoastronomy* (Cairo: Supreme Council of Antiquities Press, 2009) pp. 232-55.

imparted the radiant power of the sun, i.e. Amun-Ra, to his *son* the pharaoh. It is striking that the same hieroglyph that denoted *Ka*, also represented *cow*,[1004] and this not by coincidence. According to Richard H. Wilkinson,

> [i]n Egypt, cattle were particularly important in the development of religious belief. Recent study of the sites of Nabta Playa and Bir Kisseiba in the Sahara to the west of the upper Nile Valley has shown that cattle were perhaps venerated there long before they were domesticated around 7000 BC. The horn cores of cows were placed on burials in Tushka in Nubia as early as 10,000 BC.[1005]

Furthermore, in the last millennium BC occurred a remarkable upsurge of an older cult reaching back to the First Dynasty: bulls were no longer merely venerated, but as the epitome of chieftaincy actually treated as a living deity. In Memphis, the creator god *Ptah* in his theriomorphic manifestation was the Apis bull,[1006] which lived in a splendid palace protected from slaughter by a sacred awe – illustrated here in an engraving by André Castaigne, which shows Alexander the Great, the "two-horned," paying tribute to him (Figure 268). Upon death, the Apis bull was mourned, mummified and then buried in a monolithic sarcophagus with the same expenditure as a pharaoh.[1007]

This is a comparably late, but striking example in a long history regarding the *Cult of the Bull* that had emerged in the Aurignacian culture of the Cro-Magnons,[1008] and which later in the Neolithic age in Anatolia and the Near East helped trigger the rise of more complex societies and religious practices.[1009] Architecturally speaking, the symbolic use of horns of consecration like in the Palace of Minos in Knossos (begun c. 1900 BC) conveyed, as Michael Rice stated, "the idea, by their presence, of a holy or consecrated place."[1010] This argument found further proof in the cross-cultural

1004 Cf. Budge, *The Nile*, p. 243.

1005 Wilkinson, *Gods and Goddesses of Ancient Egypt*, p. 15.

1006 Cf. Michael Rice, *The Power of the Bull* (London: Routledge, 1998) pp. 45 ff.

1007 Each time an Apis bull died and was buried in the Serapeum (rediscovered by Auguste Mariette at Saqqara in 1851), the priests searched the country for a successor, whom they identified by the bull's particular markings, which also Budge described in *The Nile* (pp. 534-5). In hieroglyphic depictions, the bull like Amun-Ra carried the sun disk between its horns.

1008 With regard to the paintings of aurochs like in the great rotunda in Lascaux, Amir D. Aczel postulated: "These images of bulls, present in great numbers and over a large geographical region, bear witness to what archaeologists have named a 'Cult of the Bull'." Aczel, *The Cave and the Cathedral* (New Jersey: John Wiley & Sons, 2009) p. 65.

1009 Jericho, one of the oldest cities in the world worshipped the bull (9,000 BC) and in Catal Hüyük, a culture reaching back to the 7th millenium BC, sophisticated rituals involving bulls evolved: while inside the houses imposing frescoes of bulls were painted, on the altars and walls of the sanctuaries skulls of auruchs were monumentally disposed. As Rice indicated in reference to the cults of Mithra, "[i]t was from Iran that the bull finally achieved something approaching a universally acknowledged role as the protagonist of a widespread, in effect universal, religion." Rice, op.cit., p. 111.

1010 Ibid., p. 205. In Crete the extraordinary legends around the Palace of Minos in Knossos are preserved in its bull-leaping frescoes. The monumental horns of consecration in the courtyard stood

Fig. 268: Alexander the Great at the Temple of Apis, Memphis, Egypt, 332 BC.

in relation to Mount Juktas with its horn-like cleft. Bulls appear frequently in Greek mythology, most famously in the legend of the *Minotaur* that begins with Zeus disguising himself as a white bull with golden horns to attract the attention of the beautiful maiden Europa. The result of their union is King Minos, the ruler of Crete, who shares with the imprisoned Minotaur in Daedalus' labyrinth his name: *Asterion*.

employment of bull-related motives at the entrance to many ancient temples as they guarded like the bell-towers of a Gothic cathedral the inner sanctum.[1011]

4.11 Cosmic Attunement with the Sun and Moon

As an essential part of the Jewish religion, apotheosis of bulls but also any other graven image was prohibited. Aaron had illegitimately gathered the Jewish people, collected their gold, melted and cast it into a calf, proclaiming this to be the God of Israel, when his younger brother Moses did not return from Mount Sinai.[1012] In Edward W. Maunder's more subtle interpretation of this event, the Israelites' worship of the golden calf was actually the veneration of the constellation Taurus, the "Bull of Heaven."[1013] Maunder pointed out that for the Hebrews the year commences at the time of the vernal equinox, which was also the time of Moses' ascent to Mount Sinai. From c. 4000 BC until 700 BC in the northern hemisphere Taurus was the leader of the Zodiac:[1014] consequently, the sun stood at the tips of its celestial horns at the beginning of spring, the heralding of a new cycle of fecundity that might also explain the bull's significance as sacrificial animal. Undermining this archetypal notion of the bull as being both a terrestrial and celestial creature in the imagination of man, it is important to clarify that, while the sun indicated the equinox, the first day of the month occurred when the slim crescent of the new moon was sighted low in the western horizon (Figure 269).[1015] The holiday of *Rosh Chodesh* marks until this day in

1011 One may think of the winged bull-man (*lamassu*) on the monumental gateways to the Assyrian Palaces of Assurnasirpal II in Nimrud (completed in 879 BC) and Sargon II at Khorsabad (Dur-Sharukkin, 717-706 BC), or later Darius's Temple in Persepolis (begun 518-460 BC). Regarding the reconstruction of the Moon Temple in Harran it states in the *Nabonidus Cylinder from Sippar* (c. 556-539 BC): "With gold and silver glaze I coated its wall and made it shine like the sun. I set up in its chapel a 'wild bull' of shining silver alloy, fiercely attacking my foes. At the Gate of Sunrise I set up two 'long haired heroes' coated with silver, destroyers of enemies, one to the left, one to the right." http://livius.org; accessed 3 April 2016.

1012 Cf. Exodus 32:1-7.

1013 Cf. Edward W. Maunder, *The Astronomy of the Bible* (London: Hodder and Stoughton, 1909) p. 193. With reference to the *solar barque* in which Amun-Ra traversed the sky each day, it states in utterance 568 of *The Pyramid Texts* (after Mercer): "A ladder is made for [the pharao], upon which he mounts, in its name of 'That which mounts to heaven.' His boat is brought to him by the scepters of the imperishable stars. The bull (or, ox) of heaven lowers its horn, so that he may pass thereon to the lakes of [twilight in the eastern or north-eastern part of the sky]." The highest gods of the Sumerian pantheon – Anu, the Lord of the Sky, and his son Enlil, the Lord of the Air – were both identified as "Great Bull," while the "Bull of Heaven" features prominently in the *Epic of Gilgamesh*. Cf. Rice, op.cit., p. 88.

1014 Cf. Edward and Annie Maunder, "Note on the Date of the Passage of the Vernal Equinox from Taurus into Aries," in *Monthly Notices of the Royal Astronomical Society*, vol.64, March 1904, p. 491; and Lockyer, *Dawn of Astronomy*, p. 406. Of particular importance in the constellation of Taurus are Aldebaran (*α Tauri*), its eye, and the Pleiades' star cluster.

1015 The actual new moon crosses the sky exactly with the sun and never becomes visible except during a solar eclipse.

Fig. 269: *Rosh Chodesh*, Crescent of the New Moon in Spring.

Judaism the beginning of each month and celebrates the sickle's resurgence after a few nights of utter darkness.[1016]

1016 Cf. Susan Berrin, (ed.), *Celebrating the New Moon: A Rosh Chodesh Anthology* (Lanham: Rowman & Littlefield Publishers, 2006). This sanctification of the moon was the first order given to the people of Israel before the Exodus and marked a clear departure from the Egyptian solar fixation. Cf. Exodus 12:2. From earliest times the bull appears to have been a lunar deity in Mesopotamia. A son of Enlil, the moon god called *Nanna* in Sumerian and *Su'en* or *Sin* in Akkadian was the tutelary deity of the city of Ur in Chaldea. Worshipped in the city's ziggurat called the House of the great Light (*E-gish-shir-gal*; built under Ur-Namma and his son Shulgi, 3rd dynasty, c. 2050 BC), but also in the important Temple to the Moon (*Ehulhul*) in Harran, the daughter of the reigning monarch was appointed as the god's high-priestess and *wife*. The cult experienced a final Babylonian revival during the reign of Nabonidus (556-539 BC; his mother Adad-guppi had been the high priestess of the moon god in Harran), when the Ziggurat at Ur and the *Ehulhul*

However, these celestial horns had possible architectural repercussions not only in formal terms considering the creation of horn-like phalanxes, but also with regard to a temples' orientation: at the time of the spring and autumnal equinox, the sun rises due east and sets due west, while the new moon follows its course.[1017] Not surprisingly, in ancient cultures whose year began with the vernal equinox, the main shrines also pointed in that direction. The function of early temples as centers of communication with the heavenly order was directly linked to issues of survival, since astronomical knowledge made agricultural procedures more efficient. Not surprisingly, all three of the main Jewish festivals, the Feast of Passover, Pentecost and the Feast of the Tabernacle, are directly related to the equinoxes.

The Feast of Passover or *Pesach*, lasting a week and celebrating the Exodus from Egypt but also the arrival of spring and the planting season, starts on the evening that the first new moon of the year becomes full during the month of Nisan (Leviticus 23:4-6).[1018] Pentecost or *Shavuot*, lasting a day and celebrating the grain harvest, occurs seven weeks afterwards, and commemorates God giving the Ten Commandments to Moses on Mount Sinai. Lastly, the Feast of the Tabernacle or *Sukkoth*, commences in the seventh month of Tishrei, i.e. at the time of the autumnal equinox, once again on the 15th day when the so-called harvest moon is full. Notably, Kahn in his sketch for the sukkah of the Mikveh Synagogue also indicated this astronomical detail.[1019] As recorded, King Solomon dedicated the Temple on *Sukkoth* (1 Kings 8:2), and a number of sources indicate its equinoctial alignment. Based on the orientation of the Tent of Meeting, which also had its gates on the eastern side,[1020] Ezekiel, a priest in the Temple before the Babylonian Exile, remembered (43:1-4):

> Afterward he brought me to the gate, even the gate that looketh toward the east: And, behold, the glory of the God of Israel came from the way of the east: and his voice was like a noise of many waters: and the earth shined with his glory.[1021]

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were re-constructed. Cf. Adam Stone, "Nanna/Suen/Sin (god)," (2016) in *Ancient Mesopotamian Gods and Goddesses*, http://oracc.museum.upenn.edu; accessed 12 February 2016. The Hebrews still use a luni-solar calendar based on Babylonian models. Since the lunar year is about eleven days shorter than the solar one, to ensure that the festivals occur in their proper season the two cycles are periodically synchronized with the insertion of an intercalary month called Adar I (seven times per 19 years). Islam follows exclusively a lunar cycle (*Ramadan* starts and terminates with the sighting of the new moon during the ninth month of the year), while the sickle is a prominent symbol of its faith.

1017 The full moon being opposite the sun in the sky rises in the east during twilight and sets in the west in the morning.

1018 For Christians, Easter Day is the Sunday that follows the full moon that follows the spring equinox.

1019 Cf. Solomon, "Louis Kahn's Buildings for Three Faiths," p. 153.

1020 In the *Tanakh* (JPS) it says in Exodus 25:20: "And for the rear of the Tabernacle, to the west, make six planks."

1021 In the inner court, Ezekiel beheld (11:1): "At the door of the temple of the LORD, between the porch and the altar, were about five and twenty men, with their backs toward the temple of the LORD, and their faces toward the east; and they worshipped the sun toward the east."

That Kahn felt deeply about the Temple can be discerned from his speech delivered at the inauguration of the Temple Beth-el (1966-72) in Chappaqua, New York:

> [Y]ou must always say when you have been in the synagogue – is it worthy of the Temple? Though it's only a branch of the Temple, I know one must feel the synagogue is part of the Temple [...].[1022]

At least from an astronomical perspective, Kahn's synagogue designs clearly related to the Temple. All five that he planned or built – the Ahavath Israel Synagogue in Philadelphia (1935-9), the Adath Jeshurun Synagogue, the Mikveh Israel Synagogue, the Hurva and the Temple Beth-el – faced towards Jerusalem, meaning the ark was placed in the east.[1023] Generally, the custom of *mizrah*, the direction of prayer, was based on a hymn of Solomon (I Kings 8:48):

> [P]ray unto thee toward their land, which thou gavest unto their fathers, the city which thou hast chosen, and the house which I have built for thy name.[1024]

Similarly, the churches Kahn planned, with the exception of the Unitarian Church in Rochester, whose altar was in the west, were oriented eastward towards Jerusalem.[1025] Among these, the one Kahn planned for the Dominican Congregation (plan of October 23, 1968) faced due east, whereas among the synagogues, only the Hurva was aligned cardinally. As a consequence, the rays of the rising sun would penetrate through the eastern pylons in the dawn of the equinox, while the perishing sun disk would be visible

1022 Ronner, Jhaveri and Vasella, *Complete Work* (1987) p. 355.

1023 The first scheme's sectional drawing was misleading in this respect, since the ark, in contradiction to the plan, was indicated in a northerly position. This north-south alignment would have related Kahn's design even more to the Pantheon that opens its gates towards north.

1024 In *Churches and Temples* it says (p. 25J): "Biblical law says that the orientation should be toward Jerusalem [...]." The word *orientation* derives from the practice of facing towards the orient. In the catalogue accompanying the exhibition "Recent American Synagogue Architecture," curated by the Jewish Museum and Richard Meier in 1963, which also featured Kahn's Mikveh Synagogue, it was stated in accordance with the Babylonian Talmud: "[A] person should pray [...] facing towards the land of Israel; if he is in Israel he should face Jerusalem; if in Jerusalem he should face the site of the Temple." Rabbi Raphael Posner, "The Synagogue in Jewish Law," in Richard Meier, (ed.), *Recent American Synagogue Architecture* (New York: The Jewish Museum, 1963) p. 14.

1025 There is no data available on the St Andrew's Priory. Yet, William Whitaker, comparing current maps and a site model, concludes that the churches' altar was in the east as well. Christian churches have traditionally been facing sunrise, while according to Michael Hoskin, "the builders often ensured this would happen by laying the church out to face sunrise on the very day that construction began," usually in the fall after the harvest when there was enough time for such lengthy enterprises. Hoskin, *The History of Astronomy: A Very Short Introduction* (Oxford: Oxford University Press, 2003) p. 2. Lockyer approves this practice, since "in England the eastern windows of churches face generally – to the place of sunrising on the festival of the patron saint." Lockyer, *Dawn of Astronomy*, p. viii.

through the western ones in the evening. Thus, the Hurva, along with all other meridian-equinoctial shrines – a number of ziggurats with their corners,[1026] the Pyramids of Gizeh with their sides,[1027] the Parthenon and Saint Peter in Rome, most Hindu temples and a vast majority of Mughal shrines – would have manifested in its positioning the cyclic cadences of the cosmic order. The only verbal proof of Kahn's interest in an astronomical interlinking derives from a project description of the Roosevelt Memorial in *The New York Times*. Laurie Johnston, the article's author, noted:

> A slit in the east wall, according to present plans, will admit the rays of the rising sun on the anniversaries of President Roosevelt's birth, which occurred Jan. 30, 1882. Rays from the setting sun will enter through a west-wall slit on the anniversaries of his death on April 12, 1945.[1028]

Kahn's suggestion that the memorial was a "pre-Grecian temple" gains further significance in this respect,[1029] because not only its huge granite slabs, but also its purposeful alignment with the sun set it in relation to Neolithic monuments such as Stonehenge (begun around 3100 BC, the actual monument c. 2480-2280 BC), this "prelude to Paestum" as Tyng called it in "Geometric Extensions of Consciousness." Notably, in the same article she indicated Stonehenge's use as a temple-observatory:

> The extraordinary effect of sighting the setting sun at the winter solstice and the rising sun over the heelstone at midsummer would have been most powerful in a solar cult.[1030]

While no solstitial alignment can be discerned in Kahn's projects, equinoctial orientations are not solely restricted to his religious designs. While existing street patterns and climatic-contextual considerations may have strongly influenced the exact orientation, the following buildings by Kahn face the cardinal points: as noted earlier, the prayer hall in Dhaka is aligned due west; the Kimbell Art Museum's entrance and

1026 One may mention the Ziggurats in Borsippa (Ur III period, 2112-2004 BC) or Choga Zanbil (Untash-Napirisha, 1250 BC). Oriented along the meridian with its northern and southern corners but forming a rectangle, the main ramp of the Ziggurat in Ur pointed towards the sunrise at the summer solstice respectively half a year later the rise of the harvest full moon. Cf. Giulio Magli, *Mysteries and Discoveries of Archaeoastronomy: From Giza to Easter Island* (New York: Copernicus Books, 2009) p. 103.

1027 Tyng, taking I. E. S. Edwards' *The Pyramids of Egypt* (1947) as a reference, alluded to the north-south orientation of the Pyramids in "Geometric Extensions of Consciousness" (p. 153). The Pyramids, nevertheless, were tombs, not temples, whose main function as measurers of time was agronomical, and hence other considerations including an orientation to the *fixed* circumpolar stars (*Meskhetyu*) were decisive in their meridian alignment. Nonetheless, the adjacent mortuary temples, but also the Sphinx, faced the rising sun on the equinox.

1028 Laurie Johnston, "Plans for Memorial at Roosevelt Island Announced During Dedication Ceremony at Site," in *The New York Times*, 25 September 1973, p. 25.

1029 Cf. Wolf von Eckhardt, "Famed Architect Louis Kahn Dies," in *The Washington Post*, 21 March 1973.

1030 Tyng, "Geometric Extensions of Consciousness," p. 153. Originally it had been a pair of megaliths between which the sun rose on the summer solstice.

the Salk courtyard also point in that direction, so that in La Jolla the sun sets on axis with the water channel on the equinoxes, while it perpendicularly lightens on the same days the front porches in Fort Wayne. In addition, the Solar House (where the short side of the trapezoid faced south), the Adler House, the Martin Research Institute, the Tribune Review Building, the Consulate in Luanda, the Carborundum Warehouse and Regional Offices in Niagara Falls (1961), the University of Virginia Chemistry Building (where the courtyard points in north-south direction), the Maryland College of Art (1965-9), the Inner Harbor Development in Baltimore (1970-3), the Family Planning Center in Kathmandu (1970-4), and parts of the Wolfson Engineering Center in Tel Aviv (1968-77) are aligned cardinally. Like Palladio's Villa Rotonda, Kahn's Goldenberg and Honickman House (Fort Washington, 1971-3) pointed with their corners to the cardinal points, while the Korman and Esherick Houses approach this mark within a margin of 3°.

Notably, Le Corbusier had been drawn to cardinal alignments, too, for instance in his layouts for the Ville contemporaine for three million inhabitants (1922), the Musée mondiale in Geneva (1929) – screwing upward like the Tower of Babel – and the Museum of Contemporary Art in Paris (1931), which horizontally unfurled itself like a shell to accommodate the art of the future. Ronchamp's altar faced due east, while the Unité in Marseille was stretched out like a compass needle from north to south. In Le Corbusier's Parliament Building in Chandigarh – depicted here in a photograph by Doshi with the architect in the foreground (Figure 270) – the assembly chamber faced due north, while the hyperbolic shaft towering above with a horn-shaped finial cut obliquely southward at an angle of 30°, the latitude of Chandigarh. Likewise, the 18th-century sundial in Jaipur, the Samrat Yantra (begun in 1728), points with an angle of 26.5°, its location's latitude, towards the Polar Star. Kahn visited Jaipur as well, and in his slide collection kept a couple of photographs of the Observatory in New Delhi (begun c. 1720) (Figure 271).[1031]

Besides, Le Corbusier not only employed a crescent-like silhouette to crown the Parliament and its preceding porch, but also applied horn-like forms in the parapet roofs atop the Palace of Justice and the Governor's Palace. Among the many "objets à réaction poétique" that Le Corbusier employed as collective signifiers, horns and cows figured prominently (Figure 272).[1032] While passing through Egypt on one of his journeys to India, he drew the *Ka*-gesture on top of the goddess of the twilight-sun Isis (Figure 273), who was closely interlinked with Hathor and her associated cow

1031 Both the Samrat Yantra and the Observatory at New Delhi were erected under Sawai Jai Singh II, who built further ones in Varanasi, Ujjain, and Mathura. Cf. Virendra Nath Sharma, *Sawai Jai Singh and his Observatories* (Jaipur: Publication Scheme, 1997) and Andreas Volwahsen, *Cosmic Architecture in India* (Ahmedabad: Mapin Publishing, 2001).
1032 Cf. Stanislaus von Moos, "Natur und Geometrie im Werk von Le Corbusier," in *Kunstnachrichten*, vol.2, no.6, March 1966; and William J. R. Curtis, "Authenticity, Abstraction and the Ancient Sense: Le Corbusier's and Louis Kahn's Ideas of Parliament," in *Perspecta*, no.20, 1983, pp. 181-94.

Fig. 270: Le Corbusier on the Construction Site of the Palace of Assembly, Chandigarh, India, 1955-63.

Fig. 271: Sawai Jai Singh II, Observatory, New Delhi, begun c. 1720.

Fig. 272: Le Corbusier, *Ox and Farmers in Front of the Parliament Complex*, Chandigarh, 1956.

Fig. 273: Le Corbusier, *Isis*, Cairo, Egypt, 1952.

symbolism.[1033] In the Hindu pantheon the cow held a supreme position, too, being both associated with "mother earth" (*prithivi*) and the "celestial cow" whose *milk* brings fertility to the lands.[1034] Accordingly, before planting the *garbha* of the future temple, the *sthapati*

> should graze cows with bulls and calves on the land till it is stamped down by the cows and homage is paid to it by their breath; its impurities are cleaned away by the bellowing of the bulls; it is washed with the milk [...].[1035]

Conspicuous in Le Corbusier's planning of the Parliament is also his deep respect for the climatic constraints. Not only did he position the buildings in the capitol complex, the city's *head*, parallel to the prevailing winds, but Chandigarh's entire city layout with its social *heart* and green *lungs* was subordinated to that orientation.[1036] One also notices in the Parliament Building that while the horizontal blades of the *brise-soleil* shielded against the sun, the vertical shutters were directed towards the wind. Additionally, a large water pool next to the pergola of the Parliament, but also one in front of the Palace of Justice, tempered the air.[1037] Projecting eaves, porticoes and perforated walls also characterized the architecture of the residential units, where according to Jane Drew the houses were "essentially a shade, a shelter from the elements."[1038]

Besides these adaptive measures, the Parliament's interior hypostyle hall with its slender, mushroom-capped columns and its light entering through high clefts above recalled Egyptian paragons. Even more, on the roof next to the hyperbolic tower with

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1033 Hathor, a goddess already depicted on the *Narmer Palette*, was represented as a cow, as a woman with the head of a cow, or in human form with horns on top of her head – in each case, bearing within the cornets the sun's disk.

1034 Priests of Shiva may designate any bull as the living vehicle of god. Cf. Jack Randolph Conrad, *The Horn and the Sword: The History of the Bull as Symbol of Power and Fertility* (London: MacGibbon & Kee, 1959) p. 60.

1035 "Mayamata," IV.4-8, in Kramrisch, *The Hindu Temple*, I, p. 16.

1036 Albert Mayer with Julian Whittlesey, M. Milton Glas and the late Matthew Nowicky, besides Clarence S. Stein as a consultant, in their initial planning of Chandigarh received the assistance of Helmut Landsberg, a noted American climatologist. He determined the optimum orientation of the streets in accordance with the wind. Once Le Corbusier arrived in 1951, he recognized a dire need to "re-establish the natural conditions." Cf. Le Corbusier, "Album Punjab," (1951) Fondation Le Corbusier, vol.1, W1-5-3-001. In the further development, the project team headed by Le Corbusier, Jeanneret, Drew and Fry (the later two leaving in 1954) employed a "grille climatique" (15 March 1952); a reference table indicating the air temperature, relative humidity, wind, and solar radiation. Cf. Tom Avermaete and Maristella Casciato, *Casablanca Chandigarh: A Report on Modernization* (Zurich: Park Books and Canadian Centre for Architecture, 2014) pp. 142-3.

1037 Furthermore, Le Corbusier planned a *charbagh*-like garden, crisscrossed by water channels and lakes, behind the Governor's Palace as a reference to the close-by Pinjore Gardens of the Maharaja of Patiala (under Aurangzeb, late 17th century).

1038 Jane Drew, "Chandigarh Capital City Project," in *Architects' Year Book*, no.5, 1953, p. 65.

Fig. 274: Senenmut, Queen Hatshepsut's Mortuary Temple, Deir-el Bahari, Egypt, c. 1450 BC.

its quasi-astronomical hyper-structure, a tilted pyramid housing a second, also top-lit assembly chamber alluded to Pharaoh Mentuhetep II's Funerary Temple in Deir-el Bahari (c. 2050 BC). There, too, in a stepped configuration with porticoes on three sides a pyramid topped the entire complex. Half a millennium later, the royal architect Senenmut built Queen Hatshepsut's Mortuary Temple (c. 1450 BC) right next to it. Similar to its precedent, it had in its front a monumental ramp that led up to an open courtyard with the *adytum* cut into the bedrock. Kahn, who visited the site during his stay in Egypt (Figure 274; photo by Patton), might have noticed the Mortuary Temple's placement on axis with the major Temple of Amun in Karnak. This alignment coincided with the sun's setting on the summer solstice – a general indicator of the rise of the Nile and the beginning of the Egyptian year.[1039] Half a year later, in the morning of the winter solstice, the sun would penetrate in a straight line through the eastern

1039 Lockyer argued that practically "two different races" existed in Egypt, the one worshipping the solstice, the other the equinox. The Egyptian year traditionally began with the helical rise of *Sopdet* (Sirius) indicating the summer solstice. Shaltout and Belmonte indicated that in Thebes an extraordinary combination of both topographical and astronomical influences concurred, since it "is located at the only site in the Nile Valley, above the first cataract, where the river flows in such a way that the average perpendicular direction to the water course is the solstitial line connecting winter solstice sunrise and summer solstice sunset." Mosalam Shaltout and Juan A. Belmonte, "On the Orientation of Ancient Egyptian Temples: (1) Upper Egypt and Lower Nubia," in *Journal for the History of Astronomy*, vol.36, n.3, 2005, p. 286.

Fig. 275: Senenmut, Queen Hatshepsut's Mortuary Temple, Deir-el Bahari, Egypt, c. 1450 BC.

doorway of Hatshepsut's Mortuary Temple to illuminate the statue of Amun at the far western end in the *naos* – a spectacular hierophany establishing the Cosmic Order (*Ma'at*) on earth (Figure 275).

Senenmut's colonnaded structure was supposedly once graced on its parterres with trees. This image of the stepped pyramid shrouded in greenery – a "pleasure garden for eternity" as Giedion termed it[1040] – not only served as the impetus for the Mausoleum of Augustus in Rome (25 BC), but also kindled Kahn's imagination when designing the Graduate Theological Union Library in Berkeley (1971-4; exectuted by Esherick and Richard Peters after his death). There, he proposed a stepped pyramid, which in the early sketches was pointing with its corners towards the cardinal points. On the balconies, a natural buffer wall consisting of trees and shrubs was supposed to mitigate the microclimate, offer shade, and in simple terms bring the studies into a garden. In many ways this project fulfilled Kahn's aspiration to use nature as an integral part of the architectural project, to complement human activities with nature's charms, and to highlight their mutual dependencies in a larger, universal system. It was Kahn's final testament to how man, without renouncing his creative striving for expression, could establish profitable synergies with nature.

4.12 Joys of Silence versus Mountains of Light

Together with the cropped pyramidal skylights in the Mellon Center for British Art and Studies, the Graduate Theological Union Library was the last occasion on which Kahn employed the pyramid form. First appearing in 1951 in a study for a mural based on the Pyramids' dissolving into geometrical patterns of light and shadow (Figure 276), and in built form in the ceiling structure of the Yale Art Gallery, pyramids would also crown the Trenton Bath House and in stepped form delineate the Washington University Library. During the 1960s, Kahn proposed tapered pyramidal profiles in intermediate schemes for the entrance tower of the Dominican Motherhouse, the church of the St Andrew's Priory and the Exeter Library, while in the Temple Beth-el, atop an octagonal base rested a cube that ended in a pyramid. In Dhaka, possibly influenced by the pyramids of the Buddhist monastic complexes of Nalanda (5th century) and Paharpur (8th century),[1041] in preliminary studies Kahn proposed a stepped pyramid for the National Assembly, while he envisioned the mosque to have a pyramid roof with the pitches striped by marble cornices.[1042]

1040 Cf. Giedion, *The Beginnings of Architecture*, p. 433.

1041 Cf. Ashraf, "Capital Complexity: Kahn's Architecture in Dhaka," p. 19.

1042 Apparently, for the local building committee the pyramidal roof carried too much the "stamp of church," and consequently, Kahn should "consider the possibility of providing a flat roof or a dome." Cf. Rosellini, *Towards the Zero Degree of Concrete*, pp. 269-70.

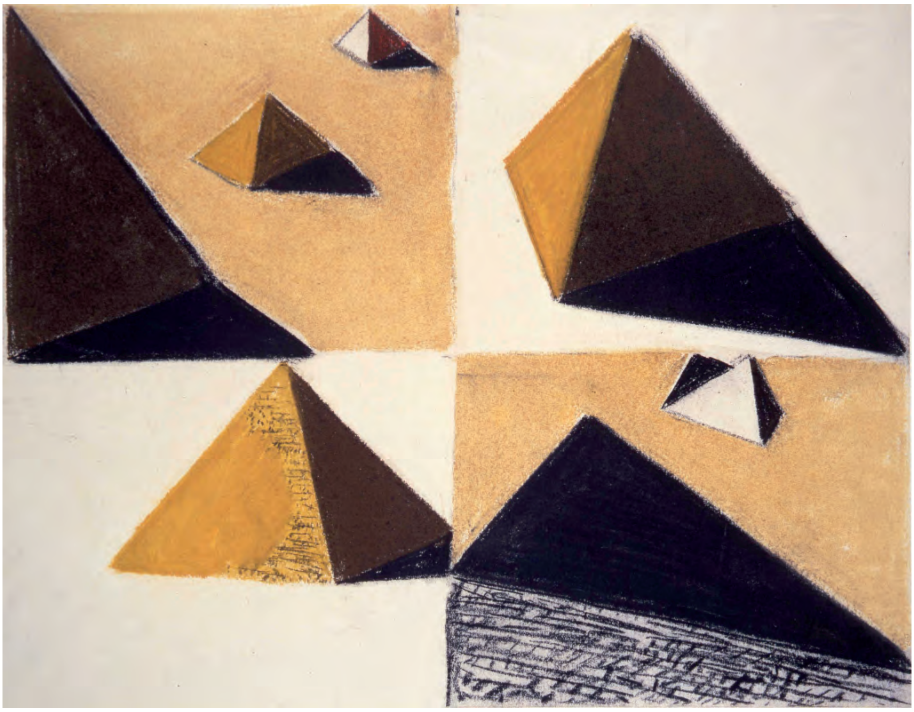

Fig. 276: Louis I. Kahn, *Pyramids of Gizeh*, Cairo, Egypt, 1951.

The symbolic connotations the Egyptians associated with the pyramid form were twofold, and Iorwerth E. S. Edwards explained both in *The Pyramids of Egypt*, a book Kahn received from his daughter Sue after returning from Italy in 1951.[1043] During the Pyramid Age, the focal worship of the sun had its origins in the cults developed by the priesthood in Heliopolis. As Edwards suggested:

> The most sacred object within the temple was the *benben*, a pyramid-shaped stone on which the Sun-god was believed to have revealed himself in the form of a phoenix.[1044]

Triggering the installment of the Pyramids during the 3rd Dynasty was the belief that the king after his death would assist Atum-Ra in its cosmic wandering. This reveals the first meaning, "a stairway to heaven," on which the pharaoh after his death ascended. While ziggurats – the one at Sippar was termed the "House of the Staircase

1043 Cf. Burton, "Notes from Volume Zero," p. 78.
1044 I. E. S. Edwards, *The Pyramids of Egypt* (Harmondsworth: Penguin Books, 1955; 1947) p. 21.

of the bright Heaven"[1045] – in fact had fights of outer steps, the Pyramids had none. Still, the imposing view from the mortuary temples below to the capstones high above suggested a celestial ramp with an infinite vanishing point. According to Edwards, the Egyptian word for pyramid, "m(e)r," meant "place of ascension."[1046] To support his argument, he quoted utterance 267 of *The Pyramid Texts*: "'A staircase to heaven is laid to him (i.e. the king) so that he may climb up to heaven thereby.'"

The second concept is also closely linked with this idea of a *Jacob's Ladder*-like ascension: in response to the question of why the pharaoh was buried under the symbol of the sun god, Edwards inferred that the Pyramids were a solidification of the sun's crepuscular rays (Figures 277, 278):

> A remarkable spectacle may sometimes be seen in the late *afternoon* of a cloudy winter day at Giza. When standing on the road to Sakkara and gazing westwards at the Pyramid plateau, it is possible to see the sun's rays striking downwards through a gap in the clouds at about the same angle as the slope of the Great Pyramid. The impression made on the mind by the scene is that the immaterial prototype and the material replica are here ranged side by side.[1047]

Also cited by Tyng in "Geometric Extensions of Consciousness,"[1048] the English Egyptologist took further recourse in utterance 508 of *The Pyramid Texts*: "'Heaven hath strengthened for thee the rays of the sun in order that thou mayest lift thyself to heaven as the eye of Ra.'"[1049] Just as for Edwards the temptation to regard the Pyramids as a means of ascension seemed irresistible, it is plausible that for Kahn as well, in assignments devoted to the pursuit of learning and prayer the pyramidal form suggested the promotion of the human mind. Alongside, the Pyramids became an essential part of his theory encompassing the terminologies of "Silence" and "Light:"

> Silence and Light
> one can sense Silence as the desire to be
> to express
> The Pyramids seem to say 'let me tell
> of the desire that motivated being and the
> meeting with Nature in order to be'
> one can sense all Material as spent Light
> The mountains The streams The atmosphere and We
> Are of spent Light [...].[1050]

1045 Ibid., p. 237.

1046 Edwards further indicated that the hieroglyph for *r*, meaning "to go up," was a double stairway, while the hieroglyph for *m(e)r* was a triangle on a base. Ibid., p. 236.

1047 Ibid., p. 234.

1048 Cf. Tyng, "Geometric Extensions of Consciousness," p. 153.

1049 Already Pliny the Elder had suggested that the obelisks were given their particular form in resemblance to the luminary's rays. Cf. Pliny, *Natural History* (London: William Heinemann, 1971) XXXVI, § 14.

1050 Louis I. Kahn, "For the Pastels of Egypt," in Frank H. Goodyear Jr., (cur.), *The Travel Sketches of Louis I. Kahn* (Philadelphia: Pennsylvania Academy of the Fine Arts, 1978; from Notebooks of Louis I. Kahn, 1973) p. 49.

Fig. 277: Cheops' Pyramid, Cairo, Egypt, c. 2650 BC

Fig. 278: Crepuscular Rays.

Initially used in 1967, the differentiation between "Silence" and "Light" derives from Kahn's earlier mentioned thoughts on "Form and Design," or as he termed it, "Law and Rule" in 1961, "Belief and Means" in 1963, "Existence and Presence" in 1967, and "White Light and Black Shadow" in 1968. On the one hand, "Silence:" in Kahn's opinion this "wordless, soundless murmur"[1051] referred to that commonness, that psychic predisposition or "will to be" of which everybody singularly grasped a part, and which was brought to realization in an act of poetic revelation:

> By silence I don't mean quiet – but in the sense that Malraux calls his book *Silence* – I think it's *The Voices of Silence* – he means only the feeling you get when you pass the pyramids, you feel that they want to tell you how they were made. Not *how* they were made, but what made them *be*, which means what was the force that *caused* them to be made [...].[1052]

In other words, "Silence" denoted the incredible creative urge that allowed Gingko trees in Hiroshima to bloom forth after total destruction, while related to man it alluded to the immeasurable desire to express anew.[1053]

On the other hand, Kahn ascribed a gigantic power to "Light," as it was "the source of all being," including man, since "we – are made of light which has been spent." While "Silence" was pure and immaterial will for existence, "Light" made manifest the inscrutable desire to be and to express. Kahn noted that creation made him think of "two brothers," which dissolving their dichotomy met at a central threshold, the nexus of "Inspiration." There the creative spirit realized what was possible in the realm of the measurable. Kahn emphasized that as many meetings between the longing for expression and the means of implementation occurred "as there are people." He even argued,

> there must, in a way, almost be as many meetings as there are leaves on a tree, because I believe that sense must be in a tree or in a microbe equally as much as it is in every living creature.[1054]

Kahn's acknowledgment of "Light" as the *volcanic* source of all things present – with "outbursts," according to him "that are just giving itself to the making of material" – at least from a biological standpoint is wholly appropriate.[1055] During photosynthesis, which literally means "putting together with light," *autotrophic* organisms, i.e. plants, take up carbon dioxide, water and some other inorganic molecules from the air and

1051 Cf. Louis I. Kahn, "Architecture," (1972) in Latour, *Writings, Lectures, Interviews*, pp. 272-3.

1052 Louis I. Kahn interviewed by Patricia McLaughlin, "How'm I doing, Corbusier?," (December 1972) in ibid., pp. 308-9.

1053 Prown and Denavit, *Kahn in Conversation*, p. 58.

1054 Kahn, "1973: Brooklyn, New York," p. 96. Kahn's proposal for the Memorial to the Six Million Jewish Martyrs in New York (1966-72) consisting of nine transparent glass cubicles was a literal translation of this idea to petrify light.

1055 Prown and Denavit, op.cit., p. 59.

soil to transform them into oxygen, sugar, starch and other substances under exposure to solar radiation.[1056] Sunlight, in other words, is the eco-system's fuel, which, once changed by plants into the chemical power units of carbohydrates, is stored and transmitted to the animal that then expends and dissipates it as muscular force and heat. Overall, Kahn, with his belief that all material was spent light, seemed wholly aware of this process of *negentropy*, while Gaston Bachelard summarized: "Life is a fire."[1057]

Interestingly, at the time that Kahn made these statements, Dubin, his mechanical engineer, was spearheading research into energy conservation in buildings, and one of his main concerns was the *active* use of solar energy.[1058] Kahn kept a series of Dubin's reports in his files – one of them including an illustration of a "Flat-Plate Collector" (1972; Figure 279), an example of a building's *leaf*, so to speak – which indicated how architecture could function autotrophically, i.e. harness light to produce solar energy. In view of Kahn's constant effort to fuse the old with the new, it seems quite plausible that Dubin's considerations sooner or later would have found application in his work. Noticing the diminishing fuel reserves and the increasing energy consumption, the mechanical engineer saw

> compelling reasons for continued action to conserve energy, reduce waste, and invest our present resources wisely – including utilizing power to reduce pollution from existing practices, and to develop new clean energy sources for the future.[1059]

1056 In 2005, J. Thomas Beatty of the University of British Columbia and his colleagues encountered the green sulfur bacterium *GSB1*, which at a depth of 7875 feet in the Pacific Ocean off the coast of Mexico does not live off the light of the sun, but instead uses dim black body radiation given off by hydrothermal vents to activate its slow photosynthetic processes.

1057 Gaston Bachelard, *The Flame of a Candle* (Dallas: The Dallas Institute Publications, 1988; *La flamme d'une chandelle*, 1961) p. 45. Already Heraclitus had postulated (Fr.22): "All things change to fire, and fire exhausted falls back into things."

1058 Fitch predicted in 1948: "When we succeed in duplicating the physio-chemical process by which the simplest weed can convert and store energy in usable form, a Gordian knot in building design will have been cut." Fitch, *American Building: The Forces that Shape It*, p. 303. In fact, the first attempts to harness the energy of sunlight *actively* were Edward S. Morse's patent for a "Solar Wall" (1881) and Frank Walker's patent for a "Solar Collector" for heating water (1902). In 1938, MIT's *Solar Energy Research Project* was initiated under the lead of Vannevar Bush and Hoyt C. Hottel that resulted in the installment of Solarhouse I in 1939.

1059 Fred S. Dubin, "Energy Conservation Through Buildings Design and a Wiser Use of Electricity," paper prepared for presentation at *The Annual Conference of the American Public Power Association*, San Francisco, 26 June 1972, 030.II.A.44.30, LIKC. Dubin recognized that during the last 20 years total energy consumption had tripled, while architecture, due to its dependence upon wasteful mechanical systems instead of exploiting the non-mechanical energies endowed by nature, was responsible for over a third of all energy use in the United States. Cf. Richard G. Stein, "Architecture and Energy," in *The Architectural Forum*, vol.139, no.1, July/August 1973, p. 43.

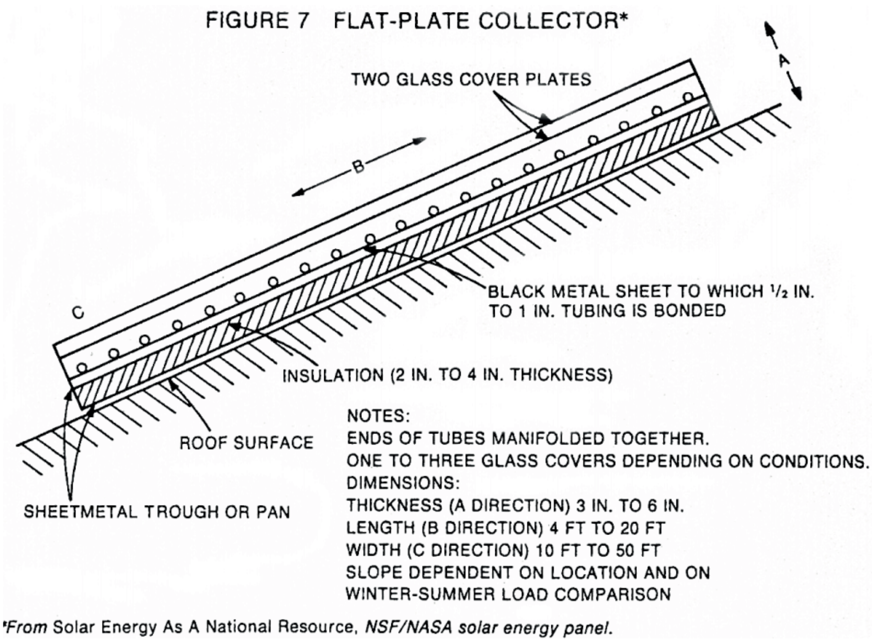

Fig. 279: Flat-Plate Collector, in "Solar Energy As A National Resource," 1972.

In planning the erection of a seven-story test building in New Hampshire, which would have been the first larger scale commercial edifice to use solar energy,[1060] Dubin's goal was to produce the "optimum building,"[1061] which largely self-sustained would save 85% each year of the energy used in the maintenance of a conventional structure. Inspired by NASA space-crafts, which recovered over half of their waste energy for their heating, ventilating and cooling systems, Dubin's "Total Energy System" would also recycle the building's wastes (water, heat and solid), manage artificial lightning more efficiently, acknowledge passive strategies of energy conservation, and take hold of renewable natural sources to produce electric power. His considerations coalesced in the Grassy Brook Village project in the mid 1970s, a new condominium community for southern Vermont, which was supposed to "combine waste management and solar energy systems to become an almost wholly self-sustaining habitat."[1062]

1060 Cf. Fred S. Dubin, "The Energy Picture: GSA's Energy Conservation Test Building – A Report," adapted from Dubin's testimony before the *Subcommittee on Energy of the House of Science and Astronautics Committee*, 12 June 1973, and published in *Actual Specifying Engineer*, August 1973, pp. 84-92. 030.II.A.44.30, LIKC.
1061 Ibid.
1062 Fred S. Dubin, "Energy for Architects," in *Architecture Plus*, July 1973, 030.II.A.44.30, LIKC. Notably, besides the appliance of solar energy, additional electricity should be provided by methane

Besides such pragmatic considerations, in the final years of his life Kahn also developed an increasingly mystical understanding of light as a supernatural radiance. In 1970, in a series of sketches with appended descriptions that he prepared for the symposium "On the Future of Art" at the Guggenheim Museum in New York, Kahn redefined "Silence" as "unlumnious Light," while "Light" was transformed into "Light luminous." Hence, from the alluring abyss of "Silence" an extrasensory, lightless light shone forth, which as a vivifying elixir and *lux et sol intelligibilis* preceded the benign power of the sun.[1063] More constant and eternal than the latter with its daily fluctuations, this enigmatic *light upon light* alluded to the realm from which was drawn the will to create anew. Similarly, in Hindu mythology Brahman shone forth from a world without light:

> There the sun does not shine, nor the moon and stars; there lightning does not shine, of this common fire need we speak! Him alone, as he shines, do all things reflect; this whole world radiates with his light.[1064]

When planning the Hurva Synagogue, Kahn sensed that "[t]he light of a candle plays an important part in Judaism."[1065] Recalling the *ner tamid* or "Eternal Light," which as a reminder of the always-lit lantern of the Temple burns above the ark, the Judeo-Christian religion, in general, is replete with passages that place the Lord in luminary guises. Appearing to Moses on Mount Horeb (Exodus 3:1-4) in the form of a fire blazing out of a bush that was not consumed, in *Genesis*, light is created on the first day, yet the sun does not appear until the fourth. When John declares (1 John 1:5), "God is light, and in him is no darkness at all," he alludes to a supernatural light that shines as much by day as by night.[1066]

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gas from sewage digestion and a windmill. According to Stein, the University of Pennsylvania also conducted experiments with the desire to design a building that was as independent of outside utilities and energy sources as possible. Cf. Stein, op.cit., p. 57.

1063 In Christianity a strict separation is made between *lumen*, the body of light, and *lux*, its spiritual reality.

1064 Olivelle, *Upanisads*, Katha Upanisad 5.15. As in the Egyptian differentiation between the sun god and its radiant force *Ka*, in the Vedas numerous hymns are dedicated to *Surya*, the sun, and *Savitr*, its impeller and active principle. Kahn's concept of two separately illuminated worlds also brings to mind the "allegory of the cave" as expounded in Plato's *Republic*.

1065 Ronner, Jhaveri and Vasella, *Complete Work* (1987), p. 365.

1066 In contrast to the monotheistic Aten worship of the sun as an object, the Judeo-Christian Providence was regarded as a spiritual light, unfading and impervious. While *light* symbolizes God, the *sun* is the symbol of Christ. Hans Sedlmayr compared the Blessed Virgin Mary, who carries the sun within her womb, with a church imbued with light. Cf. Sedlmayr, *Das Licht in seinen künstlerischen Manifestationen* (Mittenwald: Mäander Kunstverlag, 1979; 1960) pp. 39-41.

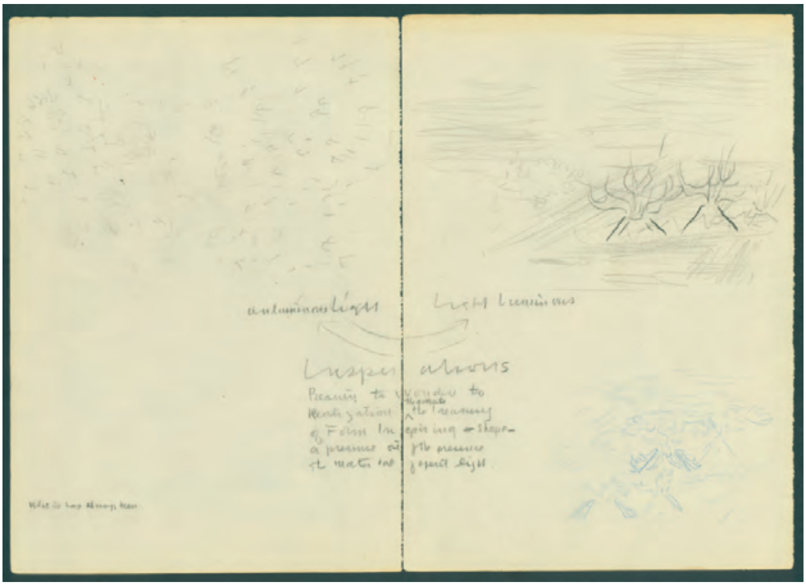

Fig. 280: Louis I. Kahn, "unluminous Light – Light luminous," c. 1969.

In the illustrations and sketches that accompanied Kahn's theory of "unluminous Light" and "Light luminous,"[1067] (Figure 280) he delineated the material form of light as a burning fire. He explained:

> Light as a prevalence of the luminous which I cannot conceive as being material. But entering a wild dance of flames which spent itself and became material.[1068]

In the *Zohar*, alternatively called "The Book of Radiance," it reads that at the beginning of time, "[w]ithin the most hidden recess a dark flame issued from the mystery of eyn sof, the Infinite, like a fog forming in the unformed [...]."[1069] Additionally, it recommended that, "he who cares to pierce into the mystery of the holy unity of God should consider the flame as it rises from a burning coal or candle."[1070] In the

1067 Cf. Prown and Denavit, *Kahn in Conversation*, p. 34. In the Meyerson sketchbook from c. 1969 it reads: "unluminous Light - Light luminous / Inspirations / Beauty to Wonder to / Realization. The door to the Treasury / of Form inspiring – Shape – / a presence out of the presence / The material of spent light / What is has always been"
1068 Kahn, "Architecture," p. 273.
1069 Scholem, *Zohar*, p. 27.
1070 Ibid., p. 38. (1) The flame arises from a corporeal basis. (2) As it touches the wick it is at times black, blue or white. (3) Above shimmers the actual white flame. (4) "Only just perceptible above the white light and encompassing it," is yet another illuminating veil of almost invisible vibration and purest radiance.

alchemical tradition, as Bachelard explained, the flame uprising against gravity transmutes base materials into the higher essence of pure light.[1071]

The credo that whatever is seen in the sensible world is merely a reflection of the light from another world, is similarly upheld in Sufism, and especially in its Illuminist school, the *Ishraquiyyah*, founded by Suhrawardi in the 12th century.[1072] Some of its basic doctrines were comprised in an undated manuscript by Ardalan entitled "Color in Safavid Architecture: The Metamorphic Diffusion of Light," which Kahn kept in his files.[1073] Dealing with the metaphysical expression of the Absolute within the transient world of the phenomenal forms, Nardalan clarified at the outset:

> But this light is not to be confused with physical light (such as the sun or fire) as we know it in the phenomenal world, for it is considered too weak and too defined to be 'essence'. Rather the Sufi sees through his 'eye of spiritual vision' (*ayn al-basirah*) the overwhelming light the Divine (*al-Nur*) as the true concept of light and all others are dim analogies within this created world.

Indicating that there existed seven spiritual stages, symbolized by different graduations of the light's intensity, he underlined that it is

> the mandate of creative man to symbolically suggest through his works that brilliant, yet 'hidden' world, and thus, the fundamental darkness of this world is turned into apparent light, but only to serve as a symbol for the absolute world of light.

The Iranian architect, in tune with Kahn's demand for a depersonalized expression, concluded:

> This spiritual journey spirals through the world of multiplicity of objects and colors toward an ultimate union, the final stage of which is signaled in some metaphysical systems by a luminous black light in which there is a total annihilation or death (*fana*) of all images, all colors, all sensations, and most important, an annihilation of one's very self. Nothing exists of the self, there is not even the awareness of there being nothing. […] There is simply light.

1071 "Fire receives its real existence only at the conclusion of the process of becoming light, when, through the agonies of the flame, it has been freed of all its materiality." Bachelard, *The Flame of a Candle*, p. 43. "Then fire is dematerialized; it loses its reality; it becomes pure spirit." Bachelard, *The Psychoanalysis of Fire*, p. 104.

1072 Basic to Sufism's philosophy of Illumination was the interpretation of the concept of "Light upon Light" as stated in Surah 24:35 and inscribed in the dome of the Hagia Sophia in Istanbul (Anthemius of Tralles and Isodorus of Miletus, 532-62 AD): "Allah is the Light of the heavens and the earth. The parable of His Light is as if there were a Niche and within it a Lamp: the Lamp enclosed in Glass: the glass as it were a brilliant star: lit from a blessed Tree, an Olive, neither of the east nor of the West, whose Oil is well-nigh Luminous, though fire scarce touched it: Light upon Light!"

1073 Cf. Nadar Ardalan, "Colour in Safavid Architecture: The Metamorphic Diffusion of Light," n.d., 030.II.A.44.14, LIKC. The transcript was published in *Iranian Studies*, vol.7, no.1, 1974, pp. 164-78. Notably, in September 1970, Kahn had lectured at the *First International Congress of Architects* in Isfahan.

That Kahn was in general aware of the Gnostic's journey from the *world of shadows* to the blissful realm of *lightless light* becomes apparent in a statement he made in 1967 quoting the 13th century Persian Sufi poet Jalalu'l-Din Rumi: "'Look without, look without, Priestess, and see the wonders God has made.' The Priestess answered, 'Look within and see God.'"[1074]

At the same time, the visionary poetry of Dante Alighieri and William Blake also caught Kahn's attention.[1075] In Dante's *Divine Comedy* (1308-21) one ascended through the nine heavenly spheres of the *Paradiso* to issue forth into the Empyrean with its exalted radiance,

> Into that heaven of purest light composed –
> Light intellectual, with love transfused;
> Love of true good, transfused throughout with joy;
> Joy that surpasses every sweet delight.[1076]

In 1973, Kahn realized as well that

> joy itself must have been the impelling force that was there before we were there. That somehow joy was in every ingredient of our making. That which was the ooze, you see, without any kind of shape or direction. There must have been this force of joy, which prevailed everywhere within the context that was reaching out to express. Somehow that word joy became the most unmeasurable word. It was the essence of creativity, the force of creativity.[1077]

This idea of an inner radiance of *joy* to propel all human and natural activity was also at the heart of Tagore's writings. Describing the "illumination of joy,"[1078] the Bengali philosopher inferred:

> As in the world of art, so in the spiritual world, our soul waits for its freedom from the ego to reach that disinterested joy which is the source and goal of creation.[1079]

Kahn speculated that after the first human sense of touch, sight entered and with it the "realization of beauty," "the total harmony that you feel without knowing,

1074 Kahn, "Space and the Inspirations," p. 15. A couple of years later, referring to the same poem, Kahn added: "In other words, what man had made is very, very manifestation of God." Kahn, "Silence and Light," p. 449.
1075 Cf. Kahn, "How'm I doing, Corbusier?," p. 305.
1076 Dante Alighieri, *The Divine Comedy* (New York: Pantheon Books, 1948; 1308-21) Canto 30.
1077 Kahn, "1973: Brooklyn, New York," p. 90.
1078 Rabindranath Tagore, *The Religion of Man* (Rhinebeck: Monkfish, 2004; 1931) p. xii.
1079 Ibid., p. 153. Heidegger in his analysis of the serene joy pervasive in Friedrich Hölderlin's poetry, noted: "To write poetry means to exist in that joy, which preserves in words the mystery of proximity to the Most Joyous." Cf. Martin Heidegger, "Remembrance of the Poet," in Heidegger, *Existence and Being* (Washington: Regnery Gateway Company, 1949) p. 281.

without choice – just simply beauty itself […].”[1080] Then followed “Wonder,” a sense of astonishment or a first response to the visceral, “the record of the odyssey of our making through the billions.”[1081] Only then, “Realization” through knowledge was attained, implying that via the consultation of the laws of nature – the order of earth, the order of water, the order of air, the order of light – one perceived “that something has a certain nature,”[1082] a specific logical predisposition, a unique “will to be”. This moment of “Inspiration” and poetic disclosure of a world “yet not made,” when the entheal joy to express intersected at a threshold with what was viable in the universe, indicated the opening of “the gate to the Treasury of Form,” where driven by the spirit of “unluminous Light” one produced “a presence out of the presence.” Only then, the mind’s illuminations became corporeal, i.e. “the material of spent light,” and through the manifestation of earth metamorphosed from a state of “Existence” into Being. Emitting in silent whispers the joy of its creation, the artistic artifact awakened the world and provoked novel ascents on the ladder of beauty.

1080 Kahn, op.cit., p. 91.
1081 Ibid.
1082 Ibid., p. 92. “Everything is really just a matter of a kind of seed that you put into it.” Prown and Denavit, *Kahn in Conversation*, p. 45.

Epilogue: Domestication Of The Elements

Remembering Kahn's words that the design of the Salk Institute was being developed out of "a respect and understanding of the nature of nature," and that he was becoming increasingly "conscious of the architecture of water, the architecture of air, the architecture of light,"[1083] the statement marks an important moment in the evolution of Kahn's thinking. When he speaks about the "nature of nature," one cannot help but be reminded of the humanist tradition of thought that sees the generative principle in nature, *natura naturans*, as complementary to a natured nature, *natura naturata*. The first of the two Renaissance concepts, natura naturans, can be said to have played a dominant role at the beginning of Kahn's mature phase. More than anything he had designed before that date, the Yale Art Gallery and in particular its tetrahedral ceiling defined architecture as based on mathematics and geometry – i.e., following the Platonic tradition, on *nature itself*. While this attunement to the elements as *form* would remain dominant in Kahn's work through the geometrical and organizational rigor applied, the experiential reality of the natura naturata began to assume a comparable significance by the early 1960s with such works as the Salk Institute, the National Assembly Building in Dkaha, or the Kimbell Art Museum. In these projects, Kahn's more strictly abstract viewpoint was supplemented with a more empirical understanding, where in direct encounter with the world the natural elements were treated as what they actually are — sensually perceivable phenomena, material substances and physical energies that ought to be activated in both a poetical and geo-physical sense. Of course, such concerns had not been wholly absent even in Kahn's most Platonic projects: in the City Tower, for instance, it is important to stress the relevance Kahn attributed to the wind's destabilizing influence, accentuating in passing his parallel focus upon the elements not only as form, but also as *force*.

This elemental shift of focus was influenced from different directions – the general acknowledgment that architecture had to be more than a deterministic affair after the Second World War , the wide-spread influx of Eastern and primitive modes of thinking, the raising of the issue of *Man and the Environment* upon the architectural agenda, the heightening awareness that the *land* formed an essential part of the well-grounded project, and, at least in retrospect by Van Eyck, who had already on a panel at the 10th C.I.A.M. congress in Dubrovnik quoted Dylan Thomas: "Four elements and five senses, and man a spirit in love."[1084] Having personally experienced the elementary in the desert, where "[l]ack of water makes both water and everything that is not water clearer,"[1085] on the front cover of the "Day and Night" issue of *Forum* in December 1959 –

1083 Kahn, "Law and Rule in Architecture;" lecture held at the R.I.B.A. in London, 14 March 1962, 030.II.A.53.4, LIKC.

1084 Aldo van Eyck, "Nagele Grid for CIAM 10," (1956) in Ligtelijn and Strauven, *Collected Articles and Other Writings*, p. 196.

1085 Aldo van Eyck, "Note on the Experience of the Elementary in the Desert," (handwritten note, probably 1951) in ibid., p. 85.

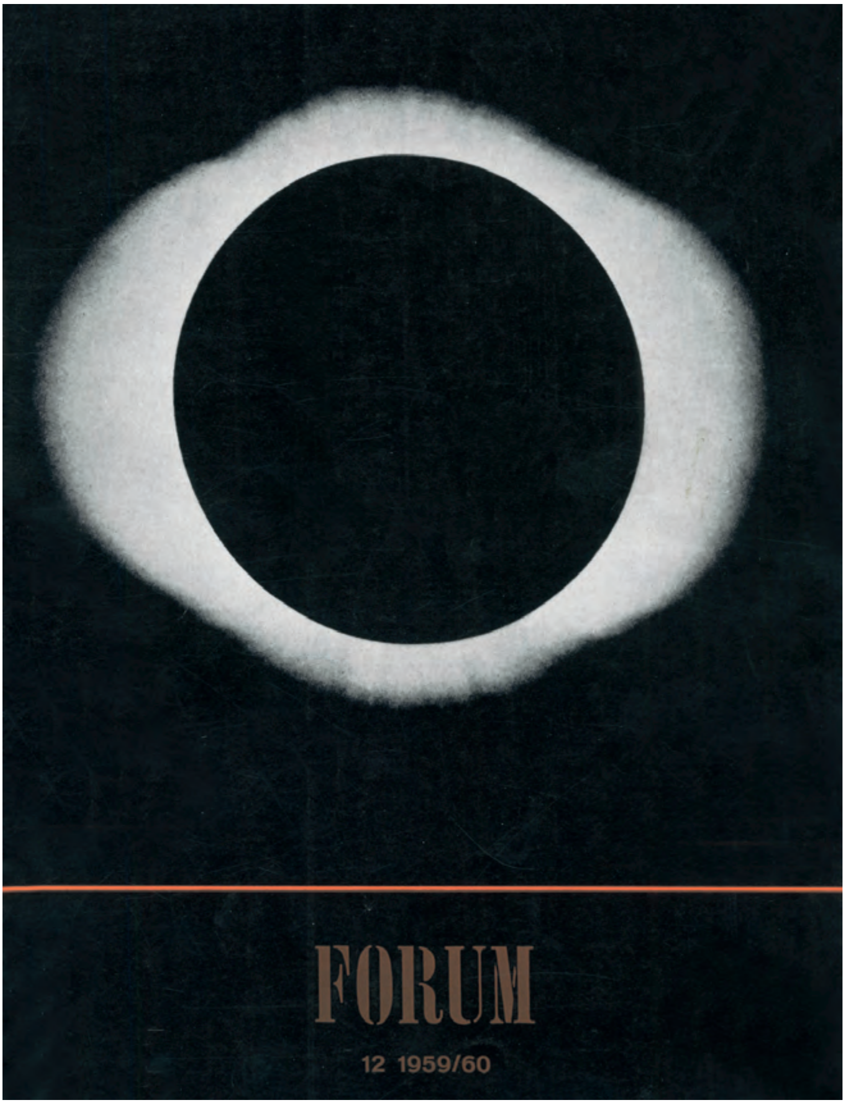

Fig. 281: *Forum*, "Day and Night," 1959-60.

released just after the C.I.A.M. meeting in Otterlo – he put a solar eclipse (Figure 281), this "simultaneous perception of the sun and moon," while the contents tried to look at the contemporary city in the light of the natural cycles.[1086] Figuring on the cover

1086 "The things that are familiar take on a new face: summer and winter, sun, rain, wind, moon, storm, ice and snow, light and dark." Aldo van Eyck, "The CIAM City and the Natural Cycles," (proposal, late 1959) in ibid., p. 279. Cf. *Forum*, no.12, 1959-60.

of a later number on the Pueblos was an abstract, cosmological drawing by Knpobo (Cradle Flower; Figure 282), which was described on an adjacent illustration:

> from the elements we receive
> what we need so that we may live
> from mother earth our sustenance
> from the air our breath
> from water cleanliness and the quenching of our thirst
> from fire warmth to dispel coldness
> from the seasons the clouds that bring snow
> and rain to ensure our survival

Van Eyck demanded to treat rain, storm, spring or sunshine as the "materials of architecture," and instead of leveling their differences by means of technology, the natural phenomena "should be gratefully embraced and allowed to 'enter'."[1087] Just as for Kahn, this was not sufficient, though, since it lacked the "positive" activation of nature:

> The time has come to conceive the places we live in, in the light of the positive potential hidden in the natural cycles. [...] Elimination is not creation. Involving nature positively in a city means a positive expression of the natural cycles (not just taking them into account): the seasons, the elements, the weather – constant and constantly changing.[1088]

Like Van Eyck, Kahn had learnt to understand this positive elemental potential during his many travels to parts of the world where the impact of 20th-century technology was negligible, but a psycho-physical affinity to the cosmic order was still immediate. Kahn was enthusiastic about the efforts of the simple builders that had no choice but spiritually cope and physically adapt to the natural cycles which, when architecturally articulated could give rise to details and forms explaining a whole way of life. To think from such an elementary perspective enabled the reclamation of the archaic grounds of architecture that powerfully asserted human order in universal chaos.[1089] In that sense, nature was an essential counterpart to Kahn's work, which, reciprocally engaged, activated the latter, while it was also itself raised to a higher level of consciousness in man's perception through it.

Kahn's "reverence for the elements – for water, for light, for air — a deep reverence for the animal world and the green world," and the recognition of the elements as

1087 Aldo van Eyck, "The Snow Image Again," in *Via*, no.1, 1968, p. 117.
1088 Aldo van Eyck, "Day and Night," (draft, late 1959) in Ligtelijn and Strauven, op.cit., pp. 287-8.
1089 Kenneth Frampton noted that he remains "transfixed by Vittorio Gregotti's aphorism that architecture does not begin with the primitive hut but with the marking of ground in order to establish a human cosmos as opposed to the chaos of the universe." Kenneth Frampton interviewed by the author, "Cosmos vs. Chaos," in Josep Lluís Mateo and Florian Sauter, (eds.), *Earth Water Air Fire: The Four Elements and Architecture* (New York: Actar, 2014) p. 16.

Fig. 282: *Forum*, “Pueblo,” 1962.

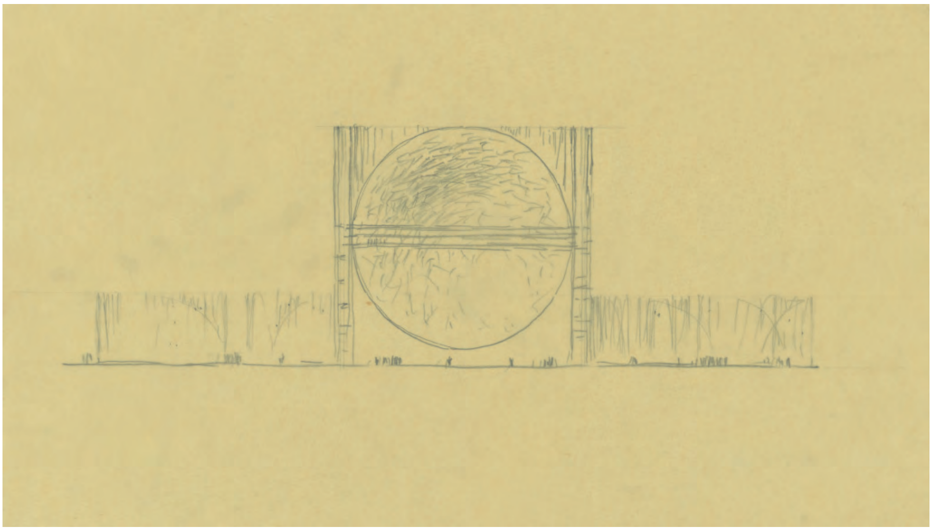

Fig. 283: Louis I. Kahn, General Motors Exhibit, World Fair, New York City, New York, 1964.

"simple everlasting presences that should constantly talk to you,"[1090] found direct incorporation in his proposal for the General Motors Exhibit at New York's World Fair (1964). Between November 1960 and February 1961, Kahn developed two schemes. The first, an immense spherical space within a cubic volume (Figure 283), was based on Boullée's Cenotaph for Isaac Newton of 1784 (Figures 284). However, the Revolutionary Architect's spherical space was a ready afflatus for Kahn not only in terms of form and sublime scale, but also with regard to its conceptual aim of enforcing an existential encounter with nature.

In Boullée's proposal, during daytime the scintillating stars should shine forth through slits in the dome of the firmament to brighten the dark inside, while during the night an armillary sphere with a streaming sun, the ecliptic and the rotation of the earth and the moon should illuminate the immense vacuum of the spherical space with Newton's sarcophagus at the gravitational center.[1091] What remained constant was the void, which expressed the scientist's essentially empty cosmos; only a small part of it filled by matter and all interrelated by the forces of attraction. What changed was the *mise-en-scène* of the universe: during the night, an abstract, artificially lit and heliocentric planetary model that underlined the mathematical properties of absolute time and space; by day, a more physical, naturally illuminated and geocentric vision of a miniature cosmos that highlighted Newton's empirical working methods and

1090 Kahn, "A Discussion recorded in Mr. Kahn's Philadelphia Office in February 1961," p. 10.
1091 Cf. Rosenau, *Boullée's Treatise on Architecture*, p. 19.

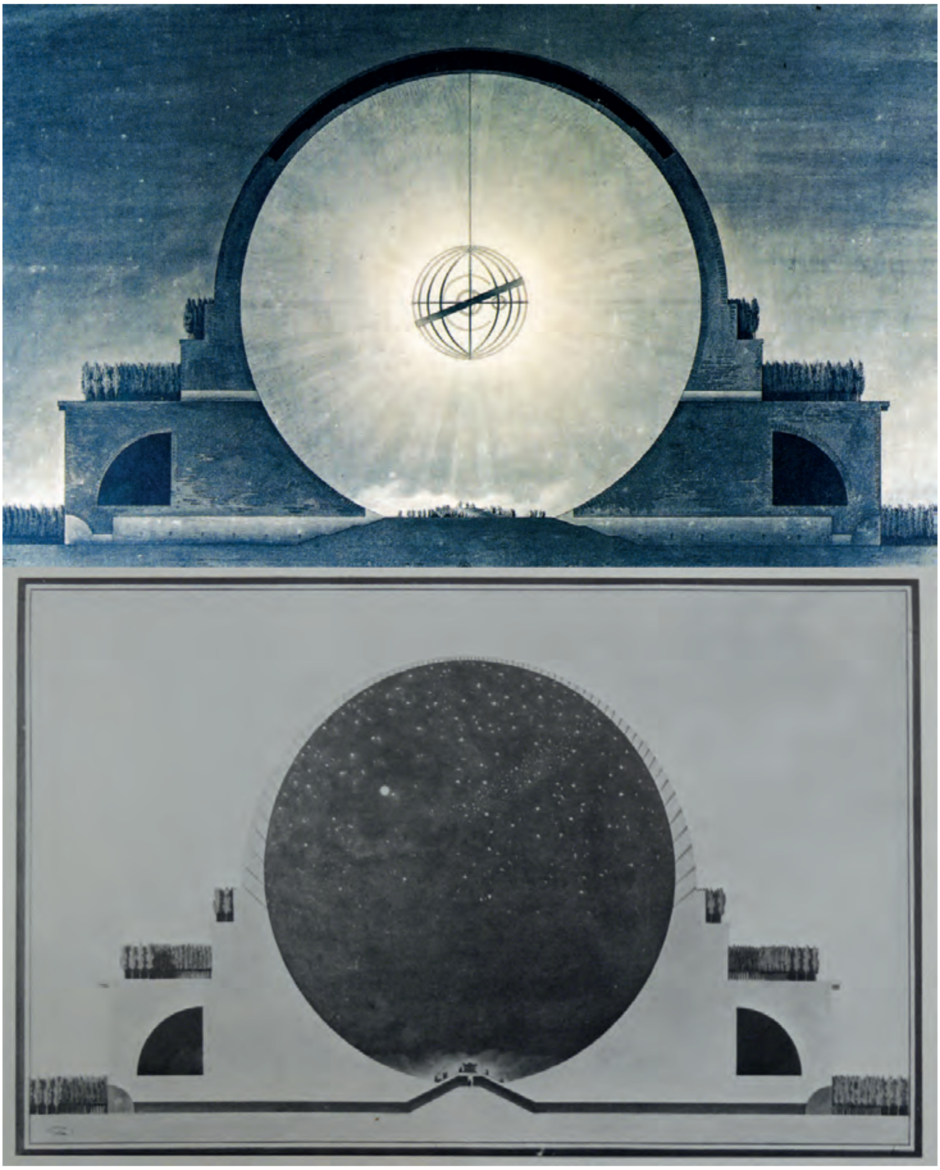

Fig. 284: Étienne-Louis Boullée, *Cenotaph for Isaac Newton*, 1784.

man's *de facto* experience of being-in-the-world.[1092] To recognize and accept this dualism, "to be able to see man as a disappearing nothingness in cosmic space, and at the same time as the cognitive and symbolical center of the latter," according to Titus Burckhardt, "quite exceeds the capacity of the majority."[1093]

Interestingly, the same year that Boullée conceived Newton's *heavenly* resting place, the Montgolfier brothers had broken off man's earthly vessels when flying off in a first *aérostat*. Light as air was also Kahn's second and final proposal consisting of seven inflated pavilions (Figure 285). Although it is easier to ascertain their curvilinear shape of megalomaniac size that paid tribute to the Baths of Caracalla than it is to establish what content they should harbor, a number of sketches, a short note on these, "[Len] Lye film – [Hayden] Planetarium New York – Nature geographic," besides several sheets of memos by Pattison indicate that Kahn, too, sought to present the *forces of life*, the "wonder about the world," in both an abstract and a physical manner.[1094] Alluding to the fact that "when you see a beautiful thing in nature you feel alive,"[1095] Kahn imagined his air-filled tent-structures to shelter a wavy promenade that encircled several brewing-pot-like excavations (Figure 286). Each of these bowls was filled with a separate element (Kahn mentioned "Light," "Air," "Water," and "Life" with the "green world" and the "animal world") and pronounced its distinctive features — for instance, water and its change of form in relation to temperature and motion, or, as Pattison suggested in one of her storyboard-like notes:

> The Amazon — water gives life — makes plants grow — (the silent view of water); rain an envelopment in a relentless rainstorm (water + sound); water as a force — (the water wheel) — a great expanse of ocean; the lake — the pond; the fountains of Rome — Villa Lante, the geyser, waterfall — Granada Alhambra; the canal ... the oasis, snow, the great dam.[1096]

Similarly polyvalent should be the staging of light and its changing "moods" within one of the other *elemental greenhouses*: "Rainbow, Sun & Shadow, Color

1092 Cf. Adolf Max Vogt, *Boullées Newton-Denkmal* (Basel: Birkhäuser, 1968) pp. 267–72. While the heliocentric day version was rather a monument to Copernicus, the night scheme related directly to Newton's experiments in light refraction, where single rays had entered a dark chamber in order to be broken in a prismatic body.

1093 Titus Burckhardt, *Alchemy: Science of the Cosmos, Science of the Soul* (London: Stuart & Watkins, 1967; 1960) p. 53.

1094 Cf. Kahn's notes and Pattison's memos, 030.II.A.32.48, LIKC. The author is indebted to Jochen Eisenbrand and Stanislaus von Moos for sharing their information on the General Motors Exhibit. Kahn also kept a newspaper clipping (1961) of the "Unisphere," the alleged symbol of the 1964 World Fair in his files, which epitomized the underlying theme of "Man's Achievement on a Shrinking Globe in an Expanding Universe."

1095 Ibid.

1096 Ibid.

Fig. 285 : Louis I. Kahn, General Motors Exhibit, World Fair, New York City, New York, 1964.

Fig. 286: Louis I. Kahn, General Motors Exhibit, World Fair, New York City, New York, 1964.

of Objects in Sun … Darkness, Sunless Spaces, Sunny Spaces, Candle Light, Sun Light,”[1097] and

> moonlight … the poets write moonlight is the sunlight in the darkness; the moon is the embassy of the sun; the moonlight is the light of the sun in its shadow … the window (man’s desire for light) — “The Pantheon” — the dome with its oculus;

or of air:

> a turbulent sky, a tornado, center of a hurricane — shows substance of air; clouds, the sky — a wheat field in Kansas — the sense of air; the windmill (Holland, Spain); San Marco: air as space … the feeling of breathing deeper in a large space; air as related to a square — the city square; relation of buildings to each other — a sense of space; a place to breathe.[1098]

This was the “Nature geographic” part, illustrated by Kahn in forceful color patterns, all characterized by a nebulous quality of pure, primordial energy that recalled the infancy of the universe and the beginning of life on earth (Figure 287).

Notably, in the entrance pavilion, visible in its section (Figure 288), Kahn placed at the bottom center a projector — a modern-day armillary sphere — as it also had been used in the Hayden Planetarium.[1099] (Figure 289) Not intended solely for didactic purposes (which were widespread in America at the time as a consequence of the moon-race), Kahn’s galactic screenings might have expressed a more personal and artistic approach to the elements. This, at least, may be concluded from the last of his references — “Len Lye film.”[1100] Starting with “A Color Box” from 1935 (Figure 290), the New York-based artist from New Zealand had created vibrant assemblages of simple textures and forms — not unlike Kahn’s enigmatic color patterns — which were directly painted, stenciled or scratched onto the celluloid and brought to perplexing new life once the frames were set in motion. In contrast to such an abstract screening of nature, Kahn in his major works of the 1960s had targeted water, earth, light, and air, on a more direct and concrete basis, though, that enabled a quiet albeit fundamental meditation on how in the beginning one might have confronted the world with amazement and expressed with joy its dazzling beauty. Literally taking hold of Boullée’s suggestion that it was the architect’s foremost task to make nature present, Kahn conceived his buildings as monochrome and porous backdrops that staged the poetical disclosure

1097 Ibid.
1098 Ibid.
1099 In Kahn’s section, visitors were placed at the periphery of the pavilion and surrounded a reflective surface (possibly water) in the middle, which turned the existent half into an imaginary full sphere.
1100 Kahn’s possible audio-visual performance brings to mind Le Corbusier’s *Poème électronique* in the Philips Pavilion at the 1958 World Fair in Brussels, and Charles and Ray Eames’s projection *Glimpses of the USA* in Buckminster Fuller’s geodesic dome at the 1959 World Fair in Moscow.

Fig. 287: Louis I. Kahn, General Motors Exhibit, World Fair, New York City, New York, 1964.

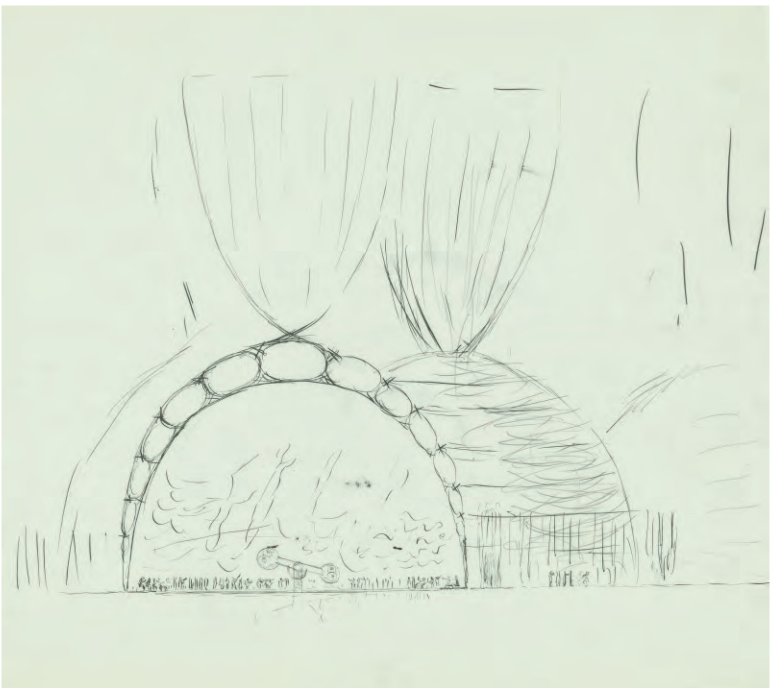

Fig. 288: Louis I. Kahn, General Motors Exhibit, World Fair, New York City, New York, 1964.

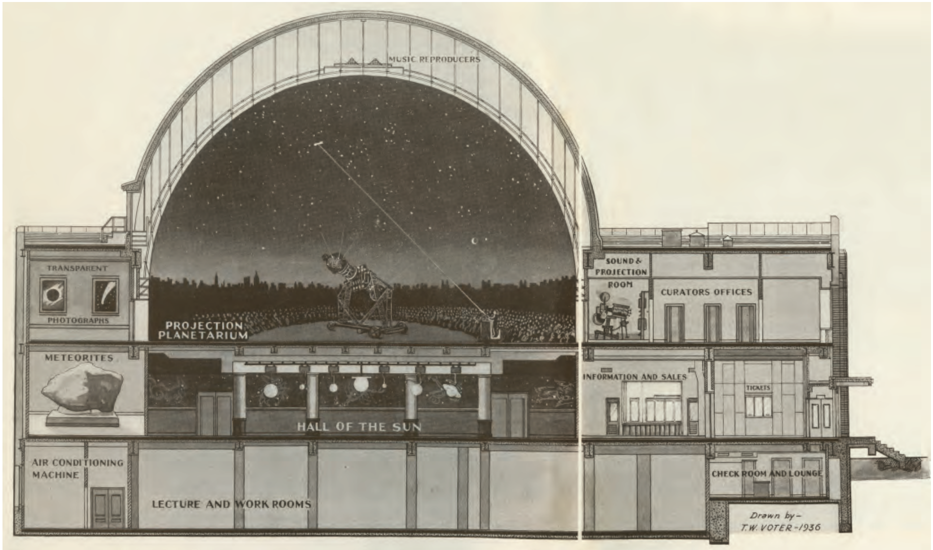

Fig. 289: Hayden Planetarium, New York City, New York, 1937.

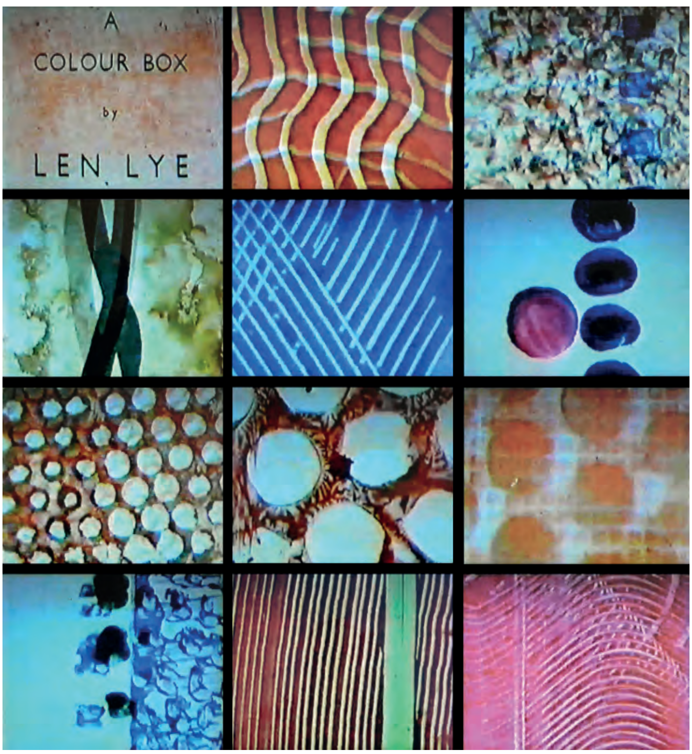

Fig. 290: Clippings from Len Lye, *A Color Box*, 1935.

of the world. This deliberate activation of nature brought to light the most perplexing sentiments and luscious bounties of the days and seasons.

Historically, the elemental tetrad established by the Pre-Socratics ceased to be the root of everything existing only during the Enlightenment's chemical restructuring of the universe.[1101] Nonetheless, in terms of their physical presence, the canonical elements remain at the forefront of our encounter with the world. Even in our *post-natural age*, water, to take one example, and not hydrogen and two pieces of oxygen, is characteristic of our worldly perception, and as Bachelard, notably a former physics and chemistry teacher, showed in his seminal studies on elemental poetics, of our "imaginative experience," as well.[1102] For Pérez-Gómez, at the core of the crisis of modern science stood the problem that "[t]he poetical content of reality, the *à priori* of the world, which is the ultimate frame of reference for any truly meaningful architecture, is hidden beneath a thick layer of formal explanations."[1103]

Overall, the natural elements represent the familiar states that matter can adopt: earth, all solids (carbon) – the land; water, all fluids (hydrogen) – the sea; air, all gases (oxygen) – the sky, and fire, all forms of energy (nitrogen) – the sun. To embrace them means to confront the world like early humankind, to return to an atavistic sense of rootedness, and to accept them in all their eerie beauty and existential rage (Figure 291). Yet, to stay with Bachelard, "[a] person who sets a fire, who activates fire, magnifies but also controls and regulates the forces of the world."[1104] Architecturally speaking, to tame the flame means to house it. This kind of *domestication* may occur with all the elements and is articulated through the building's orientation and contextual interrelation, spatial and volumetric composition, choice of materials and constructive detail. Replacing the *domination* of the elements, as David Macauley in *Elemental Philosophy* (2010) suggests, their domestication implies control, but also *caring*.[1105] Once thoughtfully harbored, they can become positive-poetic measures to concretize man's experience of being-in-the-world.

1101 Cf. David Macauley, *Elemental Philosophy: Earth, Air, Fire, and Water as Environmental Ideas* (Albany: State University of New York Press, 2010). Thales' student Anaximander of Miletus argued that the four perennial elements transformed through the agency of the opposite principles (*archai*) of hot (*thermon*) and cold (*psychron*), dry (*hyron*) and moist (*xeron*); both pairs relying for recognition on the primary sense of touch. Aristotle's matrix of elemental metamorphoses was based upon these same qualities, whereas each element stood in relation to two and in opposition to one element (earth, dry and cold vs. air, hot and moist; fire, hot and dry vs. water, moist and cold).

1102 Burckhardt agreed that "[t]he four elements are simply the primary, and most general, qualities by means of which the amorphous and purely quantitative substance of all bodies first reveals itself in differentiated form," before adding: "These elements are not the chemical constituents of things, but are the qualitative determinants of 'matter' as such, so that, instead of speaking of earth, water, air, and fire, one can also speak of matter's solid, liquid, aerial, or igneous mode of existence." Burckhardt, op.cit., pp. 42-66.

1103 Pérez-Gomez, *Architecture and The Crisis of Modern Science*, p. 6.

1104 Gaston Bachelard, *Fragments of a Poetics of Fire* (Dallas: The Dallas Institute Publications, 1988; *Fragments d'une Poétique du Feu*) p. 69.

1105 Macauley, *Elemental Philosophy*, p. 4.

Fig. 291: Coast of San Francisco, California.

Accordingly, just as the elements are real, architecture also addresses the real construction of the world and can holistically mobilize their powers. Emphasizing this argument, Tadao Ando pointed out that "architecture is the only conceivable form of expression to control light and wind not metaphorically but directly."[1106] The Architectonization of nature, for him, but also for Kahn, implied the immersion in an authentic spatial experience that was not insulated by the cocoon of modern comfort, but where weather mattered and was brought to surface. Van Eyck added, "we should not neutralize nature with the aid of technique and form, but intensify it.[1107] Once acknowledging the elements' "meaningfully uncomfortable" reality, they define basic characteristics of place, indicate the presence of certain materials, and act according to precise geophysical rules and rhythms. For Kahn, it was clear that the architect should give in and "[n]ever offend nature," since "[t]he only reason why it doesn't leak is because you respected nature."[1108]

Each natural element is related to a fundamental architectural correlate – earth to the *foundation*; water to the *roof*; air to the space-defining *wall*, and fire to the *energy*

1106 Tadao Ando interviewed by the author, "Earth Water Air Fire," in Mateo and Sauter, op.cit., p. 18.
1107 Van Eyck, "Day and Night," p. 88.
1108 Prown and Denavit, *Kahn in Conversation*, p. 61.

within and without.[1109] Acting as primal causes leading to *à posteriori* architectural effects, consciously expressed, they might turn every gutter into a happening and every one of its drops into a celestial song. At the same time, their distant echoes are transfixed in a building's materials, as Pallasmaa showed:

> Stone speaks of its distant geological origins, its durability and inherent permanence. Brick makes one think of earth and fire, gravity, and the ageless traditions of construction. Bronze evokes the extreme heat of its manufacture, the ancient processes of casting, and the passage of time as measured by its patina. Wood speaks of its two existences and timescales; its first life as a growing tree and the second as a human artifact made by the caring hand of a carpenter or cabinetmaker.[1110]

Zooming in on each (Figure 292), Aristotle's order by weight is still most comprehensible: earth, the heaviest, at the center; then water, heavier than air; and lastly fire, the lightest.[1111] In a permanent dialectic of struggle and cooperation, it is their *Janus*-faced character that makes them difficult to grasp: differentiated into male (*yang* – active; fire and air) and female (*yin* – passive; earth and water),[1112] there is a fundamental flux and antagonism to each that makes every statement and its opposite equally true in Heraclitean terms. With bivalent and ambiguous powers, the subtending earth can quake, a flood turn into a desert, a gust ignite a cyclone, and a match the burning forest. In constant exchange, their peculiarities blur into each other as one observes only their combined, synthetic actions.

Earth is the one element not identified specifically by a major Pre-Socratic thinker as a singular *arche*, yet Xenophanes of Colophon noted: "For all things come from the earth, and all things end by becoming earth." (Fr.27) Mother Earth (*terra mater*) not only gives birth to but also buries us in her caverns. Earth gives us a sense of above and below, of hard and soft; it is stable and characterized by the plumb line of gravitational vertigo. In accumulated horizontal layers, it keeps a stratified record of the sedimentary past; its top layer, the soil, is the seat of life.[1113]

1109 Notably, Gottfried Semper's derivation of the basic architectural elements – "hearth," "roof," "enclosure" and "mound" – in *The Four Elements of Architecture* (1851) was directly influenced by his study of the primitive hut displayed by the Caribbean island of Trinidad at the Great Exhibition in London.

1110 Pallasmaa, *The Embodied Image*, p. 48.

1111 In comparison, in Chinese mythology (Tung Chung-shu, 2nd century) five basic elements are arranged in circular order: *wood* is placed in the east and characterizes the chi (breath) of Spring; *fire* is in the south and represents Summer; *metal* is located in the west and stands for the chi of Autumn; *water* lies to the north and characterizes winter. In the center dwells *earth*, the other elements' source of nourishment.

1112 According to Burckhardt, "heaven" traditionally manifested "the active and masculine pole of existence." "Earth," in contrast, "under the influence of Heaven becomes pregnant, brings forth plants and nourishes all living creatures." Burckhardt, op.cit., p. 43.

1113 Soil stems from Latin *solium*, meaning "seat." Cf. Gaston Bachelard, *Earth and Reveries of Will: An Essay on the Imagination of Matter* (Dallas: The Dallas Institute Publications, 2002; *La terre et les rêveries de la volonté, essai sur l'imagination de la matière*, 1943) pp. 233-47.

Fig. 292: Earth, Water, Air and Fire.

Water, similarly receptive but more dynamic in its wavy meandering motion, is the only substance of the four that can take on three different physical states according to changing temperatures. Without color, taste or form, its main attributes are ceaseless change and constant flow. The spring of life, it strives to acquire horizontal balance. Water may combine with the others to form clay, fog or alcohol, but it can also dissolve, purify and extinguish them. A thermal moderator, its tranquil surfaces mirror the world with glimpses of the abyss below.

Air, this invisible but sensible thickness full of moving gases has no inside and outside. In this fragile abode of ours, the wind, the earth's breath, blows sideways against the vertical currents of convective heat exchange. Opposed to the resistance of earth, amorphous clouds float in the expanses of the sky.

Representative of the weather, air asserts the specificity of each context and fills space without matter.

In *fire*, an entity that lacks its own substance, nothing can live and thrive. The sun's radiance cyclically activates the universe with its energizing force. The vital anima of all things living, fire is the Promethean son of man: it transmutes, purifies and destructs matter. Ruled by chaotic Brownian motion on the small scale, the shining solitaires of the heavens move with clockwork-like precision along their interstellar paths. Without light's infinite malleability there is no definition of form.

Plato's addition of a fifth element representing space (*aether*) underlines that neither of the four others operates in spatial or temporary isolation, but to the contrary, they synergistically interact in a constant dialectic of struggle and cooperation.[1114] In space, they gather and wash into each other like watercolors to affect different situations with changing intensities. To think of them as singularities is pointless; like a blacksmith or potter who works holistically with them all,[1115] also the architect ought to consider them all at once and not one by one. Fused in a mist-like mellifluous way, they are the universal elixirs, which in a frenzied state of becoming ethereally coalesce. The elements, then, teach not a style, but a way of thinking: with elemental "four-thought"[1116] one ought to encompass both their inherent dangers and modes of domestication. As Kahn's mature works demonstrate it is a diaphanous architecture that may result; one of soft, blurred boundaries that makes intelligible and brings to presence the *elemental condition*. Articulating this timeless state, the American architect's diligent tectonic expressions not only invented anew, but transformed reality eternally.

1114 Transformable into each other, the crux of the question remains whether or not the four elements are, at root, merely different states of one substance or *prote hyle*. Ardalan explained: "Every jism or body consists of all four manifestations although only one predominates." Ardalan and Bakhtiar, *The Sense of Unity*, p. 58.

1115 The potter takes earth and mixes it with water to create clay – dried by air, it may solidify with fire. Transplanting such principles to architecture, ultra-stable kiln-like shelters result. Cf. Nader Khalili, *Racing Alone: A Visionary Architect's Quest for Houses Made with Earth and Fire* (San Francisco: Harper & Row, 1983).

1116 Macauley, *Elemental Philosophy*, p. 1.

Fig. II: Louis I. Kahn, National Capital of Bangladesh, Dhaka, 1962-83.

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