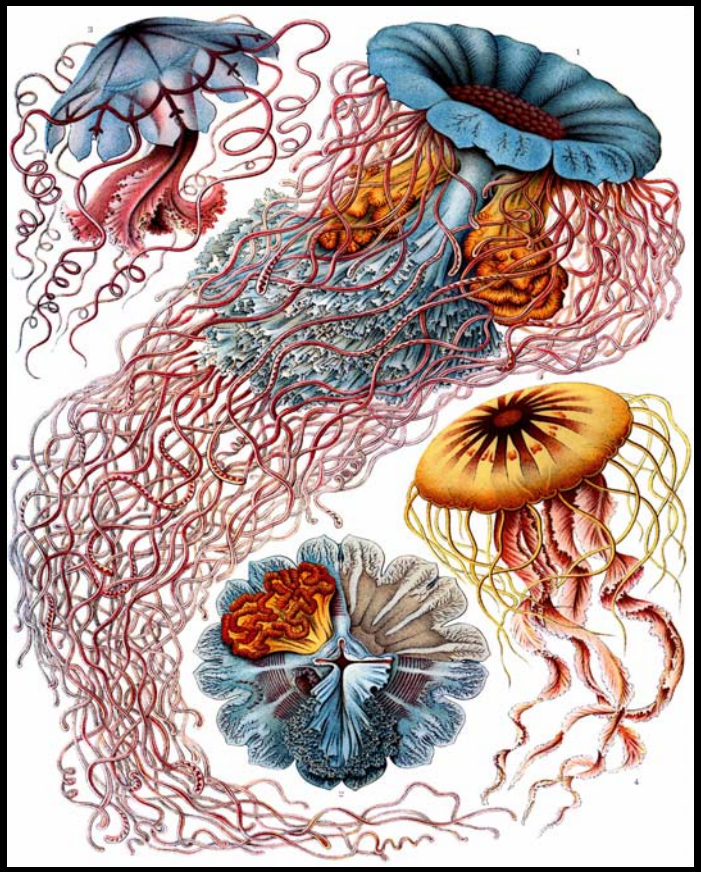
HUAS 6312-501
(87225)
From Bauhaus to Biohaus:
Biology and Cybernetics in Modern and Contemporary Art, Architecture, and Design
Fall 2016
Dr. Charissa N. Terranova

Tuesday August 30
Biocentrism, Art, and Design: Raoul Francé and the Seeds of Bioconstructivism at the Bauhaus



Ernst Haeckel, Jellyfish
from *Art Forms in Nature* (1899)

Raoul Heinreich Francé (1874-1943)
birth name: Rudolf Heinrich Franze

"Die Pflanze als Erfinder" (The Plant as an Inventor), by Raoul Heinrich Francé, Kosmos, Stuttgart, 1920. It is a popular-scientific version of a more hefty volume -- "Die Technischen Leistungen der Pflanzen" (The Technical Achievements of Plants), Veit & Cie., Leipzig, 1919.

Raoul Francé, *Germs of Mind in Plants,* 1905 [*Das Sinnesleben der Pflanzen*]

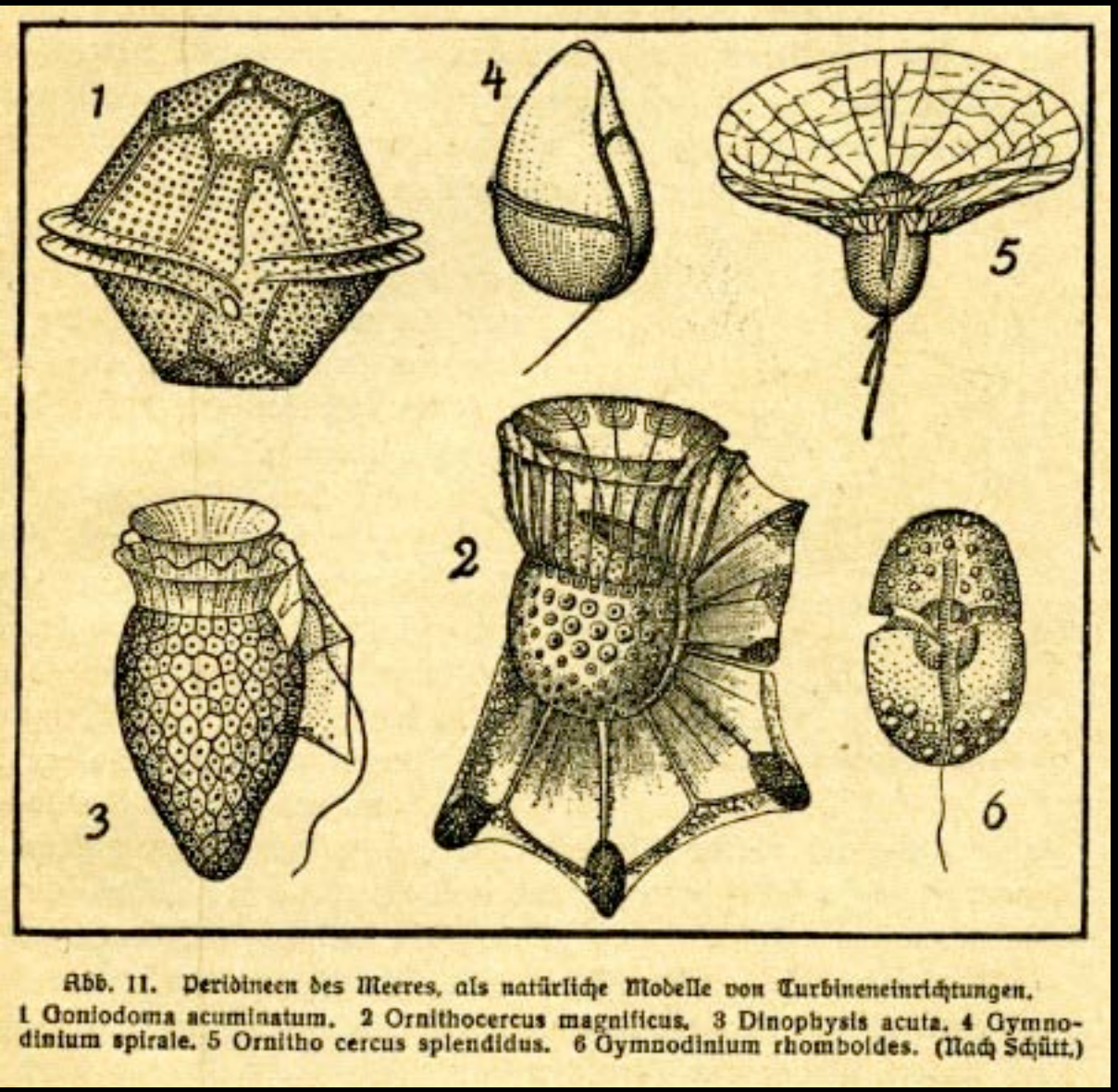


Abb. 11. Peridineen des Meeres, als natürliche Modelle von Turbineneinrichtungen. 1 Goniodoma acuminatum. 2 Ornithocercus magnificus. 3 Dinophysis acuta. 4 Gymnodinium spirale. 5 Ornitho cercus splendidus. 6 Gymnodinium rhomboides. (Nach Schütt.)

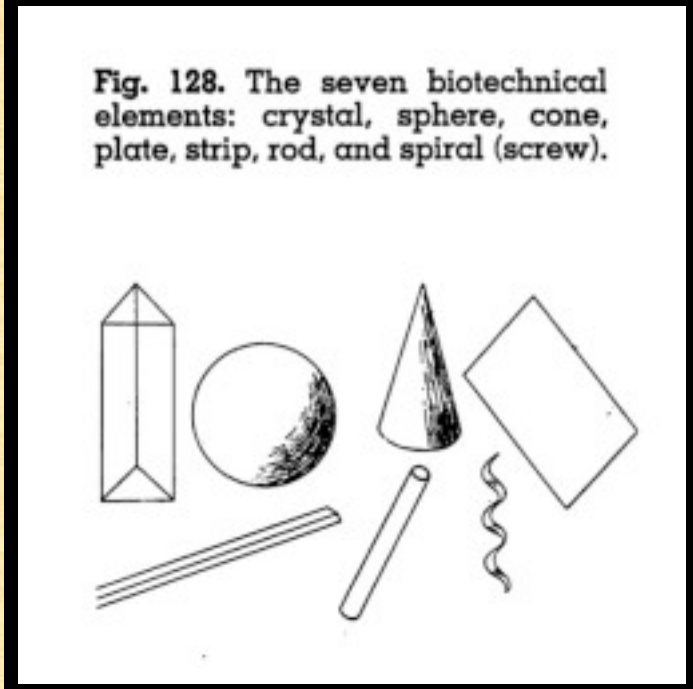
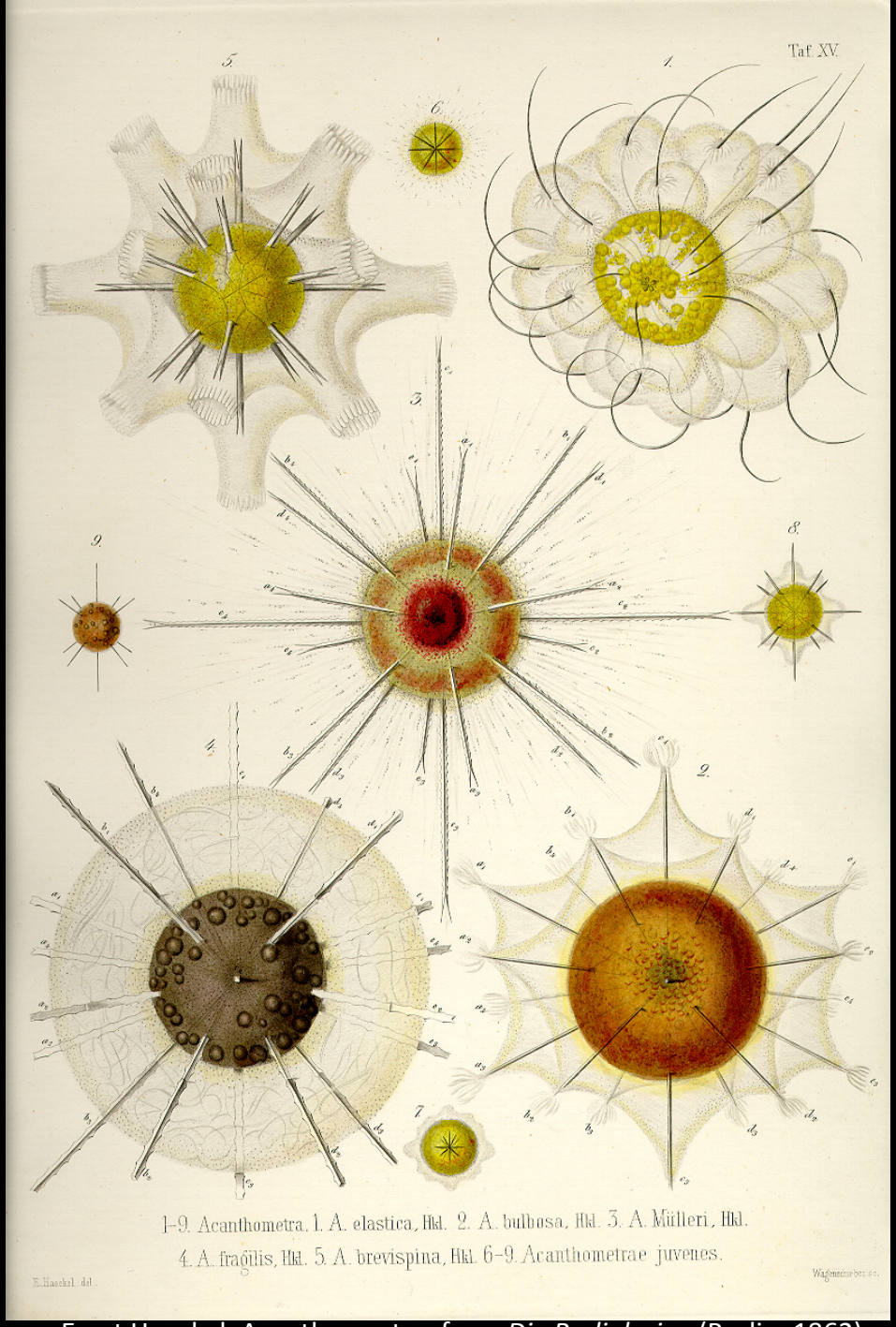


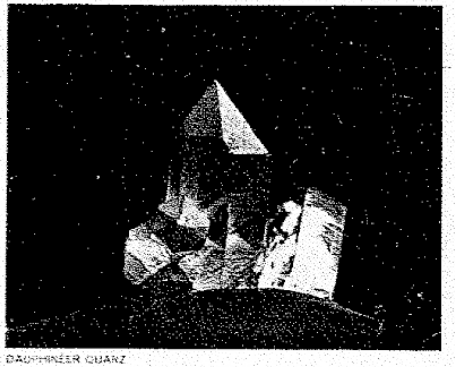
Fig. 128. The seven biotechnical elements: crystal, sphere, cone, plate, strip, rod, and spiral (screw).

single-celled organisms interpreted as highly efficient turbines



Ernst Haeckel, Acanthrometra, from *Die Radiolarien* (Berlin, 1862)

R. H. FRANCE



DAUPHINÉER QUARZ

+

KRISTALL
cristal

KUGEL
sphère

FLÄCHE
étendue

STAB
barre

BAND
ruban

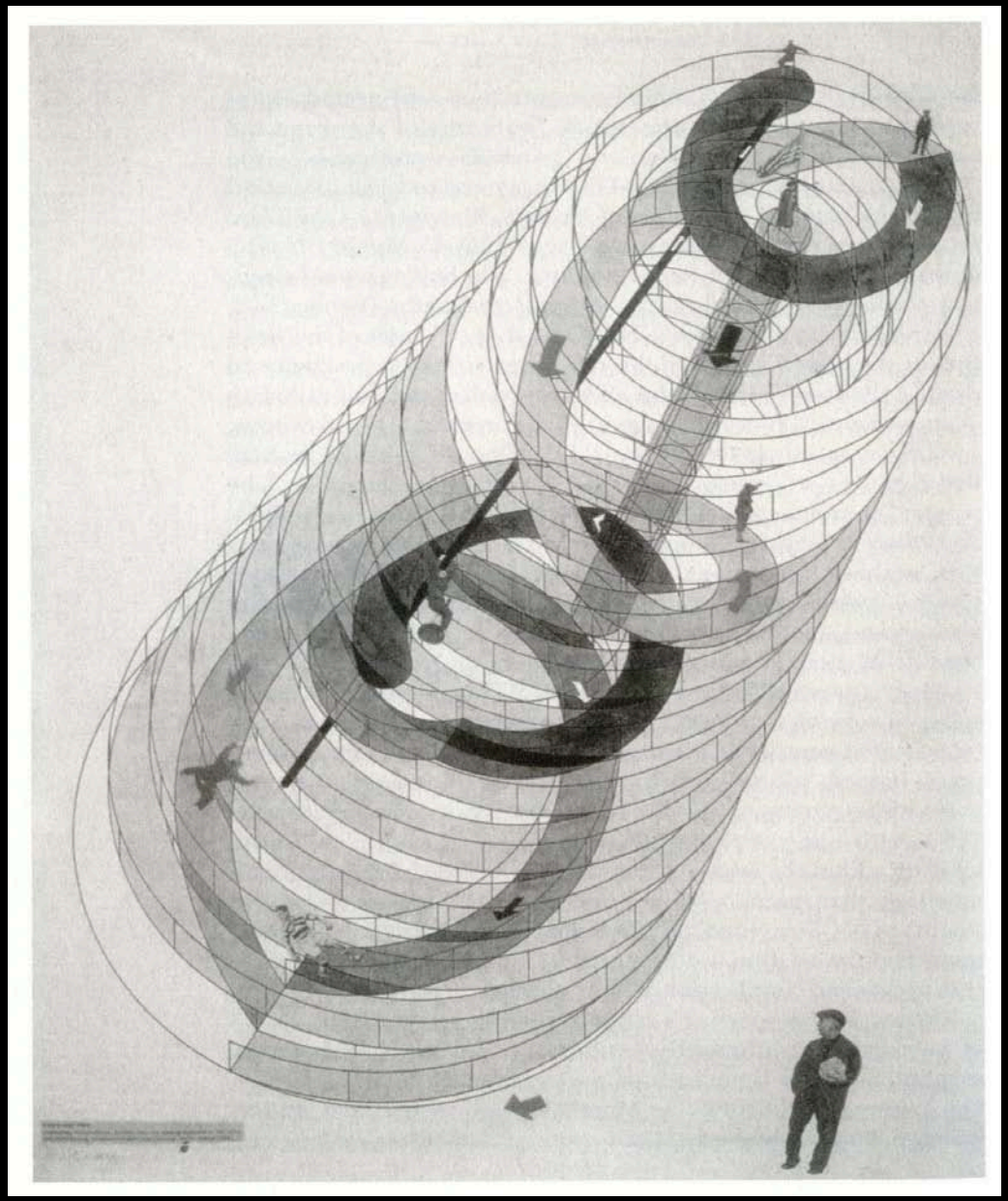
SCHRAUBE
spirale

KEGEL
cône

DAS SIND DIE GRUNDLEGENDEN TECHNISCHEN FORMEN DER GANZEN WELT. SIE GENÜGEN SÄMTLICHEN VORGÄNGEN DES GESAMTEN WELTPROZESSES, UM SIE ZU IHREM OPTIMUM ZU GELEITEN. ALLES, WAS IST, SIND WOHL KOMBINATIONEN DIESER SIEBEN URFORMEN.
SIE SIND DAS GANZE UM UND AUF
DER ARCHITEKTUR
DER MASCHINENELEMENTE
DER KRISTALLOGRAPHIE UND CHEMIE
DER GEOGRAPHIE UND ASTRONOMIE
DER KUNST
JEDER TECHNIK
JA DER GANZEN WELT.

Ce sont les formes techniques fondamentales de l'univers. Elles suffisent à toutes les opérations de la formation du monde pour les conduire à leur développement extrême. Tout ce qui est, est combinaison de ces sept formes primitives. C'est sur elles que reposent toute l'architecture, les éléments de la mechanique, la cristallographie, la chimie, la géographie, l'astronomie, l'art, toute téchnique et le monde entier.

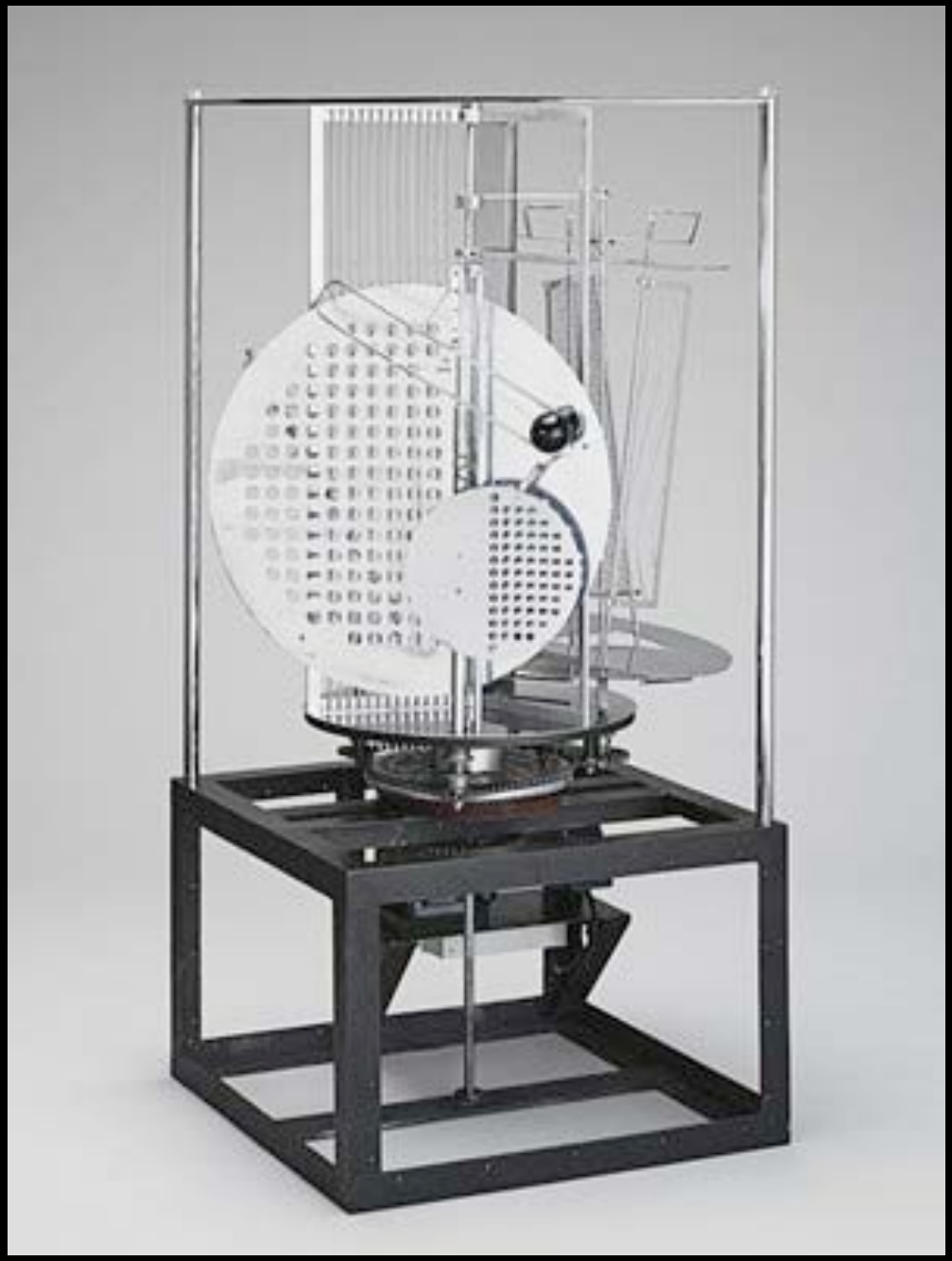
Page from *Merz* no.8/9 (April/June 1924) edited by Kurt Schwitters and El Lissitzky titled *Nasci*



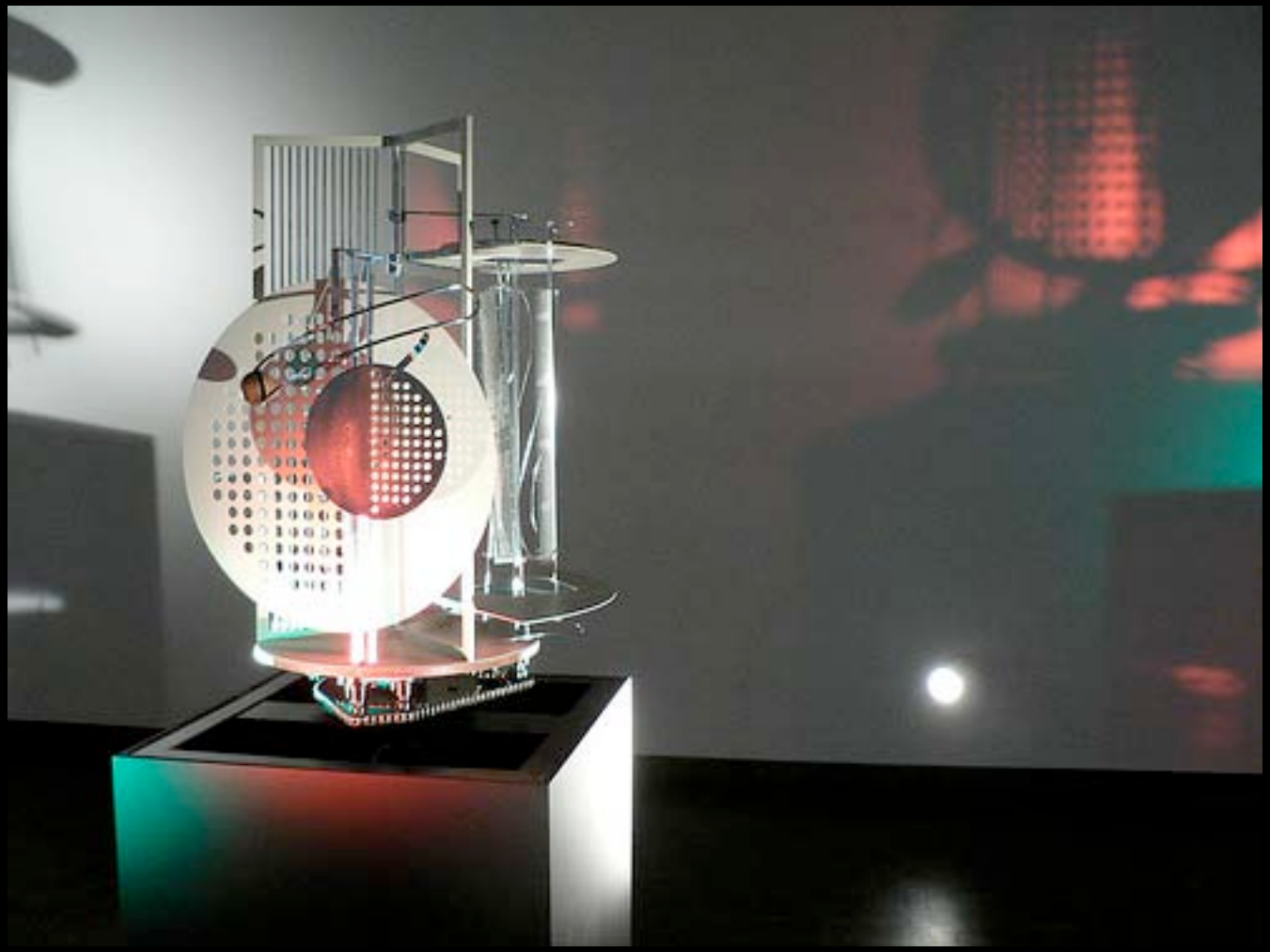
László Moholy-Nagy and István Sebök, “Kinetic-Constructive System: Structure with Movement Track for Play and Conveyance,” 1922

Vladimir Tatlin, Maquette of “The Monument to the Third International,” 1919

Friedrich Schumann’s tachistoscope c. 1900



Laszlo Moholy-Nagy, Light-Space Modulator, 1923-30

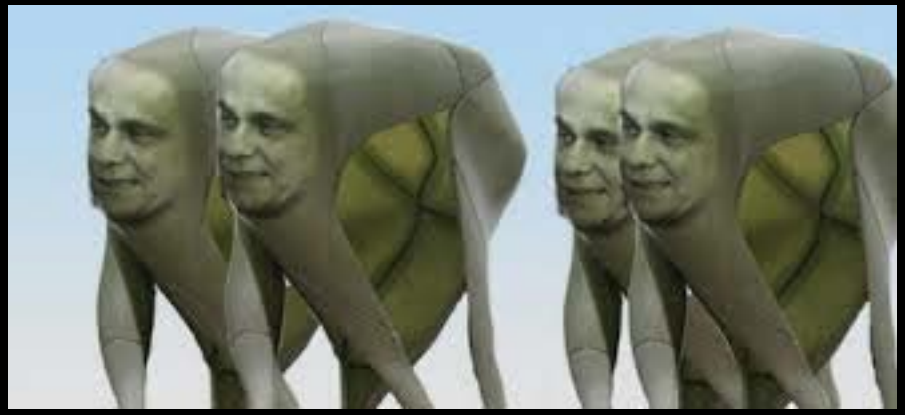


Laszlo Moholy-Nagy, Light-Space Modulator, 1923-30
https://www.youtube.com/watch?v=QYNO3DLIZe0

Lars Spuybroek, b.1959 Rotterdam

NOX

http://www.nox-art-architecture.com



D-tower (2001 - 2003), located in Doetinchem (NL) is an interactive sculpture and building by NOX/Lars Spuybroek and Q.S. Serafijn, co-developed with V2_
http://v2.nl/archive/works/d-tower

Left- Frei Otto [1925-2015] German architect-engineer; right-International and Universal Exposition or Expo 67, 1967, Montreal, Canada

Otto is known for tensile structures. Think here of the roof of a tent, where a piece of fabric hangs between two points in tension, versus a cabin, where the beams are in compression instead.

Frei Otto, Hall at the International Garden Exhibition, 1963, Hamburg, Germany.

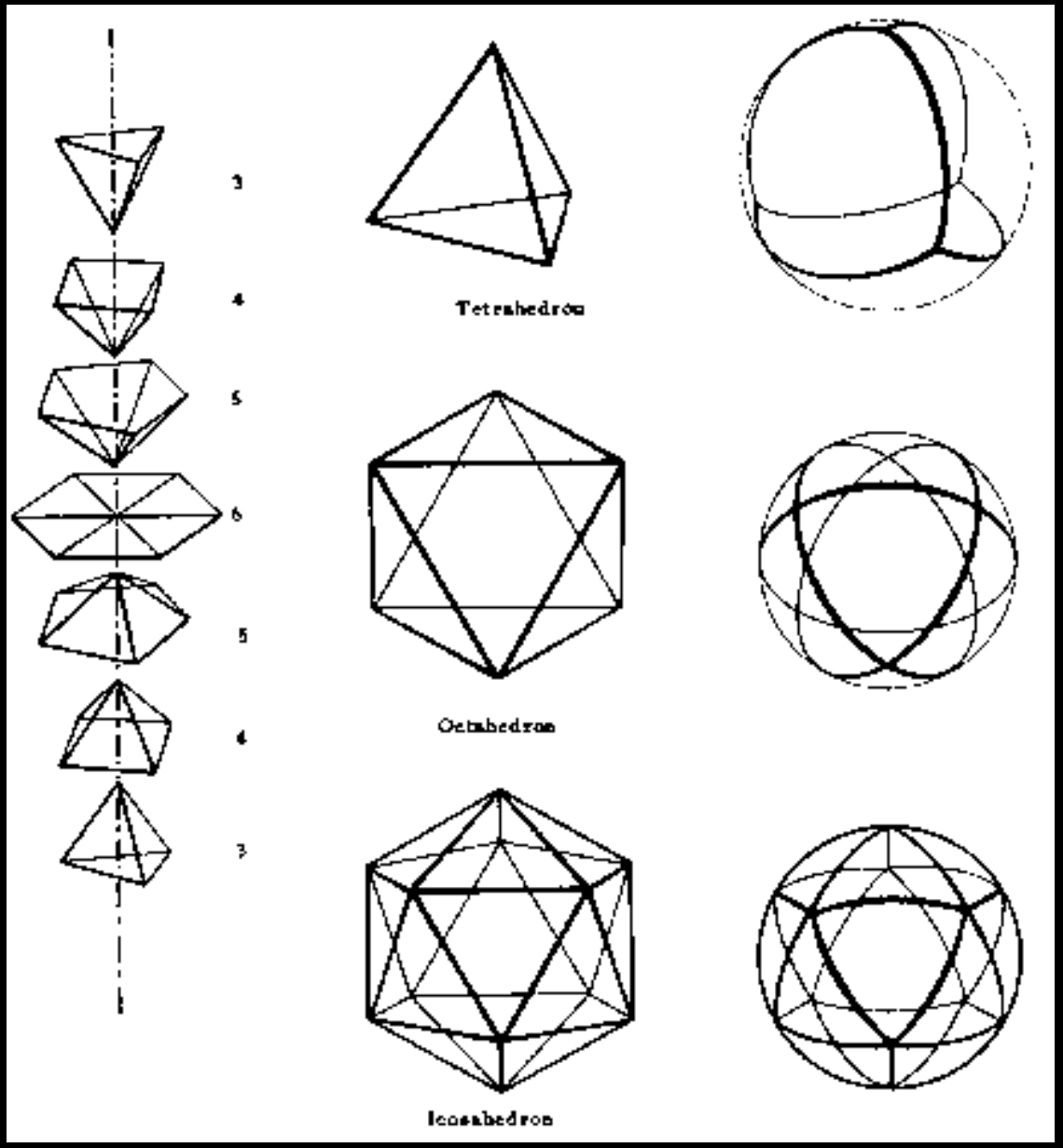
Frei Otto, Entrance Arch at the Federal Garden Exhibition, 1957, Cologne, Germany

Frei Otto, International and Universal Exposition or Expo 67, 1967, Montreal, Canada

Frei Otto, *Aviary in the Munich Zoo at Hellabrunn, 1979-1980, Munich (Hellabrunn), Germany*

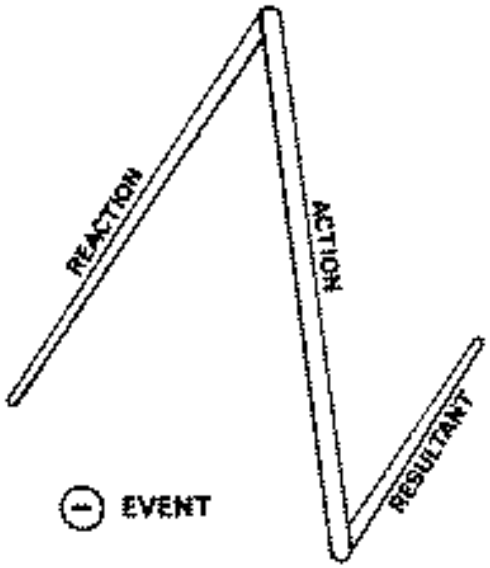
Richard Buckminster "Bucky" Fuller [1895-1983]

Tensegrity, **tensional integrity** or **floating compression**, is a structural principle based on the use of isolated components in compression inside a net of continuous tension, in such a way that the compressed members (usually bars or struts) do not touch each other and the prestressed tensioned members (usually cables or tendons) delineate the system spatially. The term *tensegrity* was coined by Buckminster Fuller in the 1960s as a portmanteau of "tensional integrity".

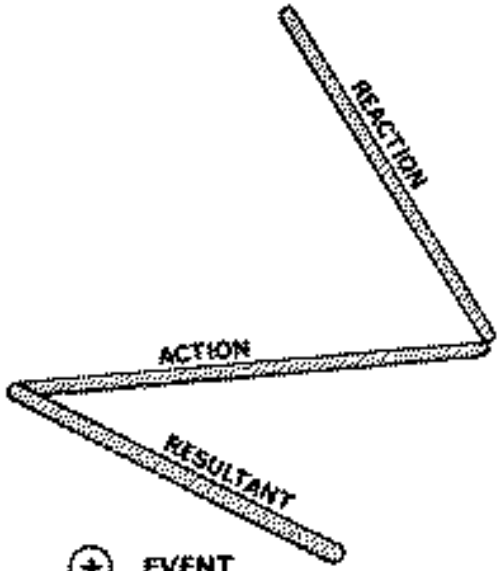


The Three Basic Structural Systems in Nature with Three, Four or Five Triangles at Each Vertex: Tetrahedron, Octahedron, Icosahedron

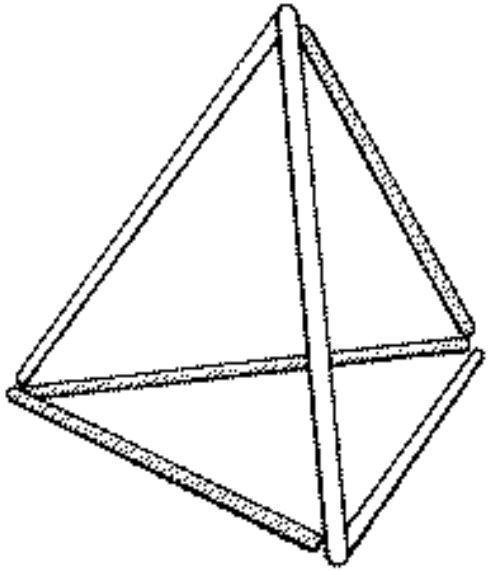
A TRIANGLE IS A SPIRAL
AND IS ONE ENERGY EVENT



⊖ EVENT



⊕ EVENT



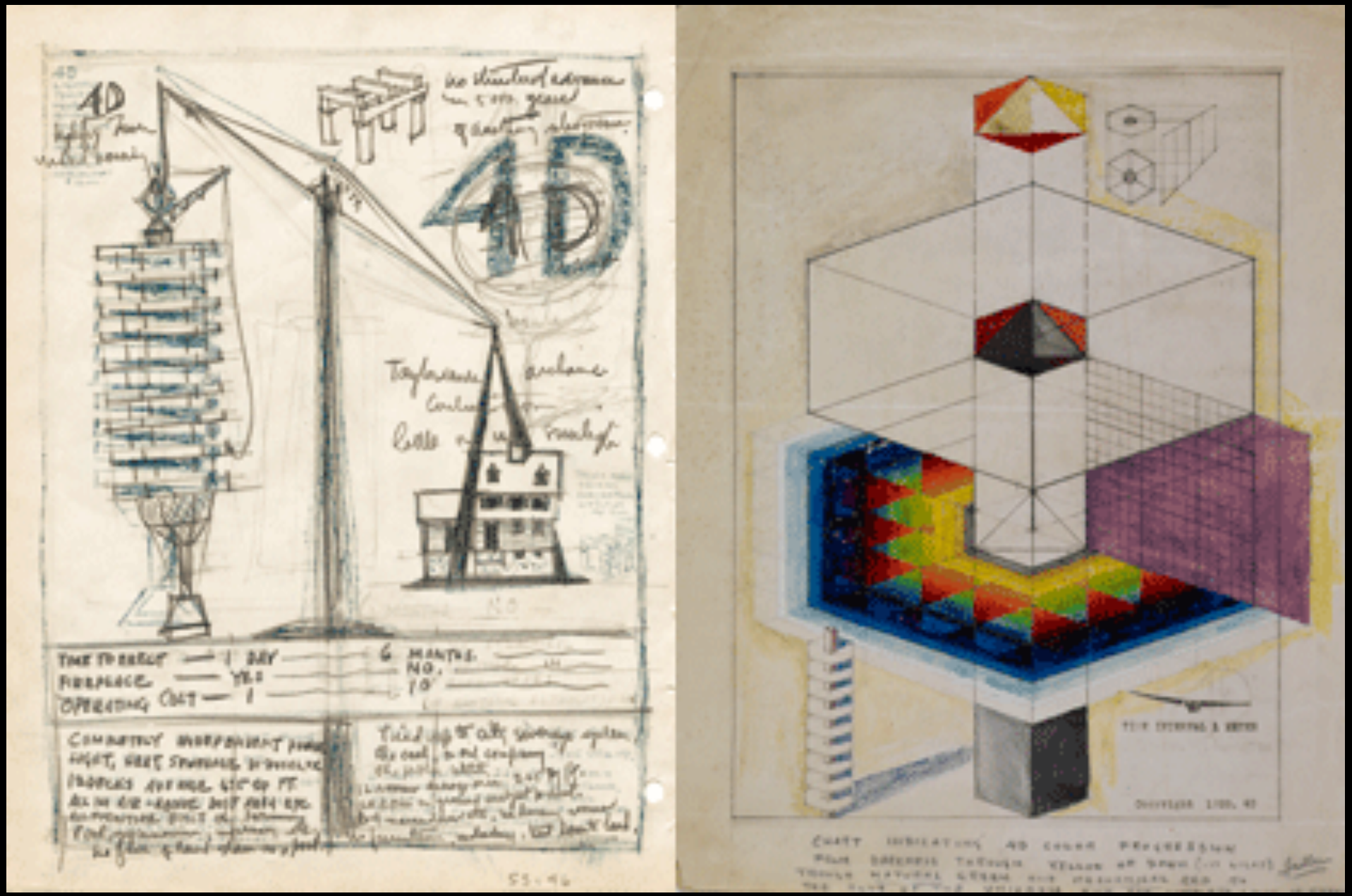
ONE POSITIVE + ONE NEGATIVE EVENT

= **TETRAHEDRON**

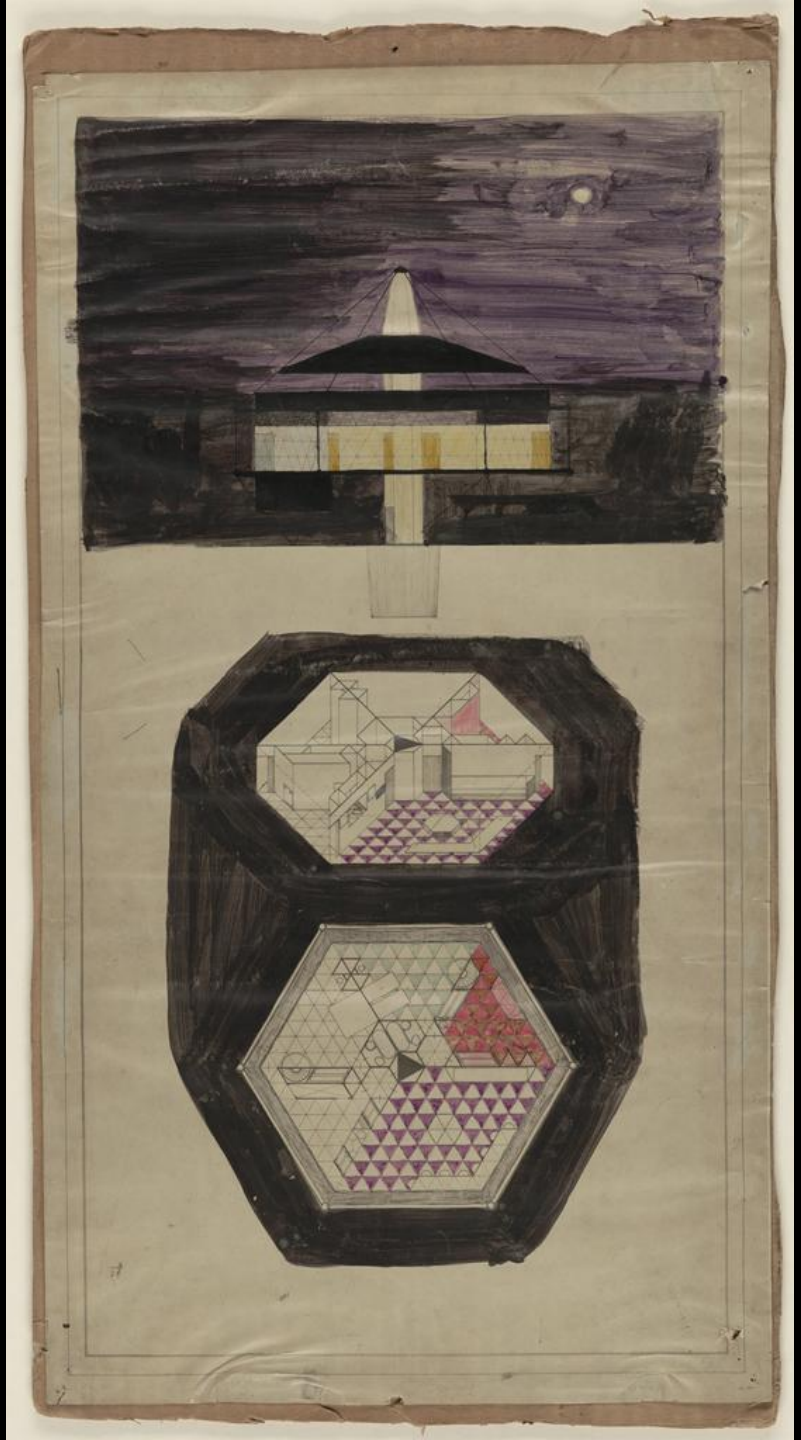
DYMAXION

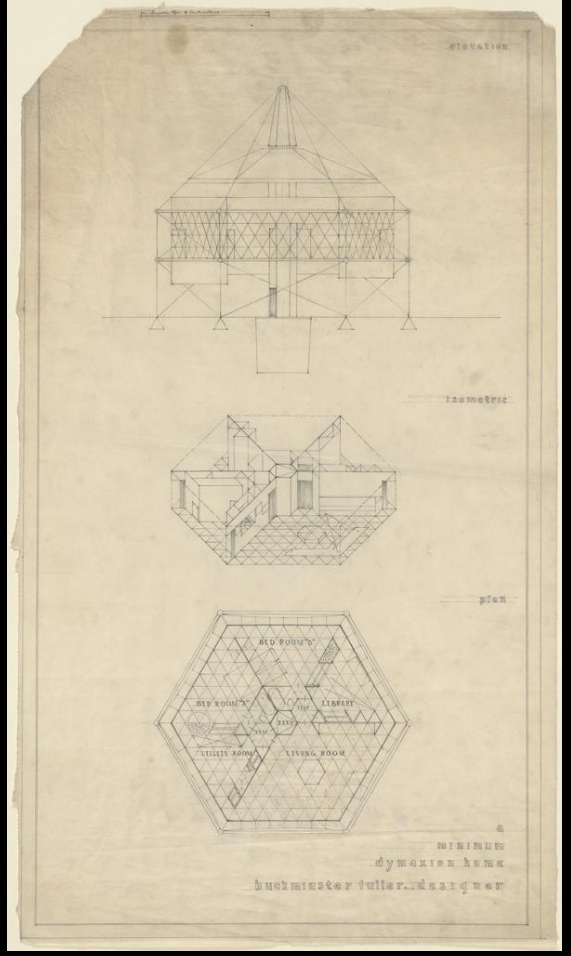
DYnamic -- **MAX**imum - tens**IONDYMAXION**

DYnamic -- **MAX**imum - tens**ION**

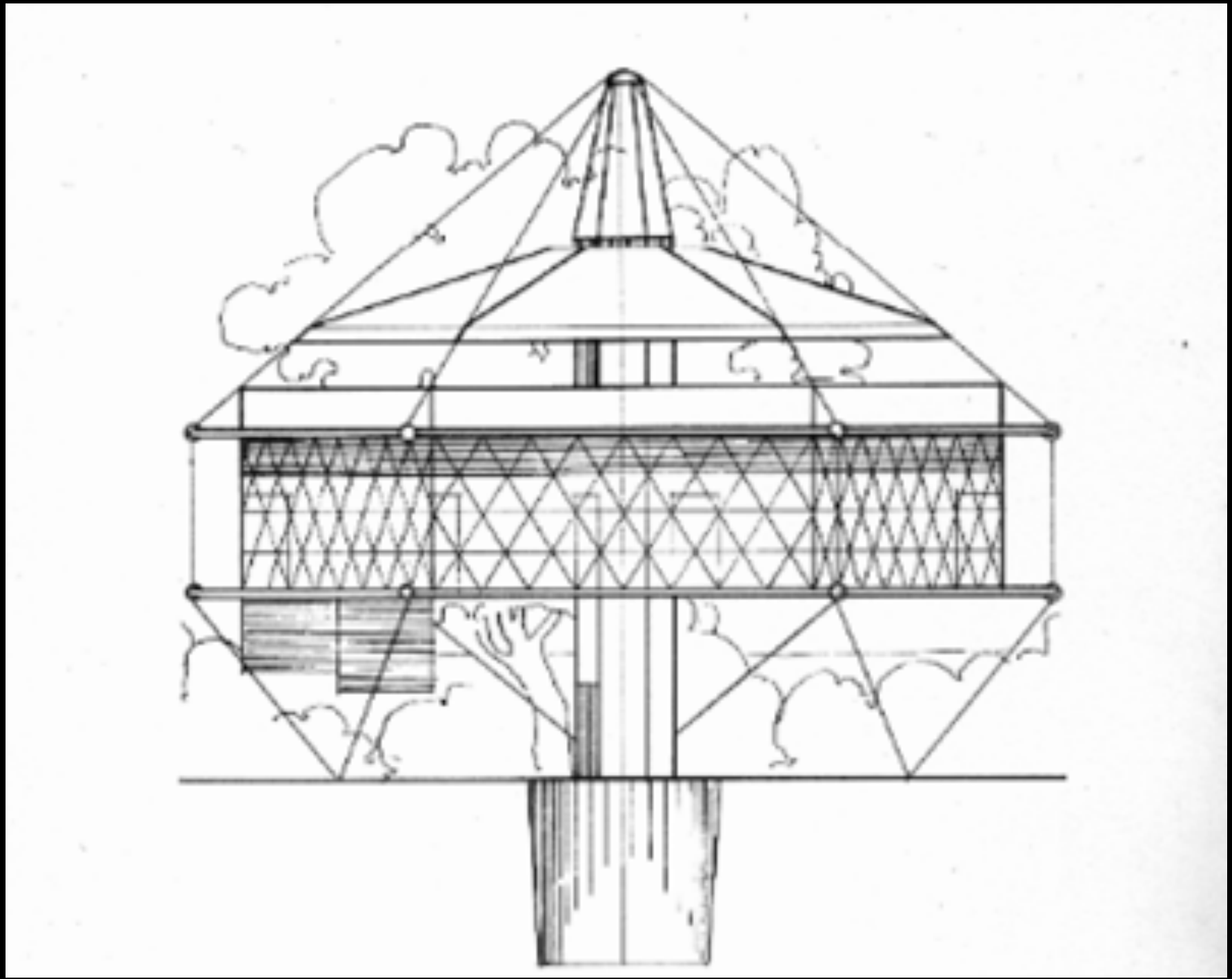


Buckminster Fuller, 4D Tower: Time Interval 1 Meter, 1928 / Comparison of Lightful Houses and Traditional Homes, 1928





Buckminster Fuller, Dymaxion House/Dymaxion Living Machine, 1927-1929



Buckminster Fuller, Dymaxion Car, 1933

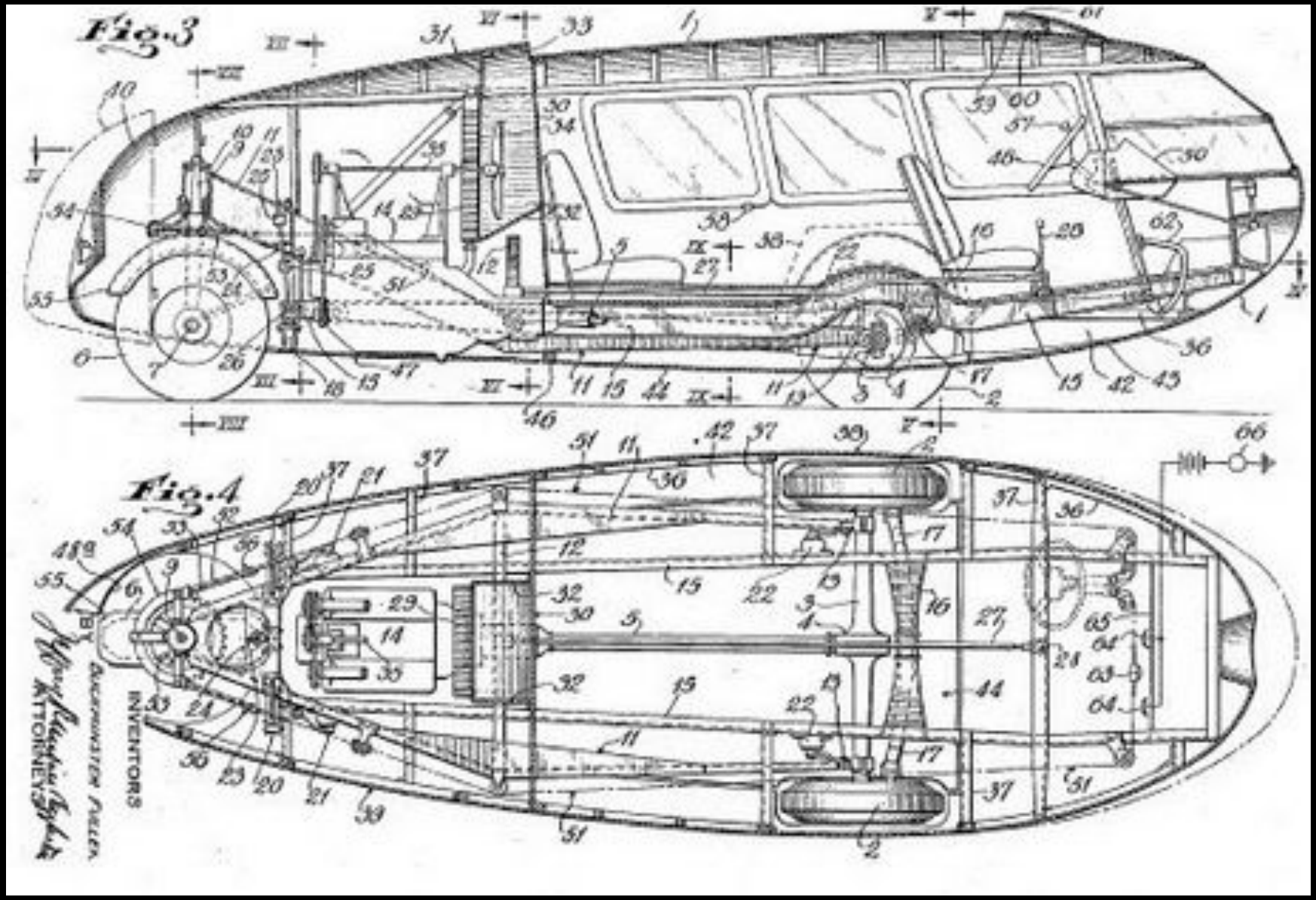
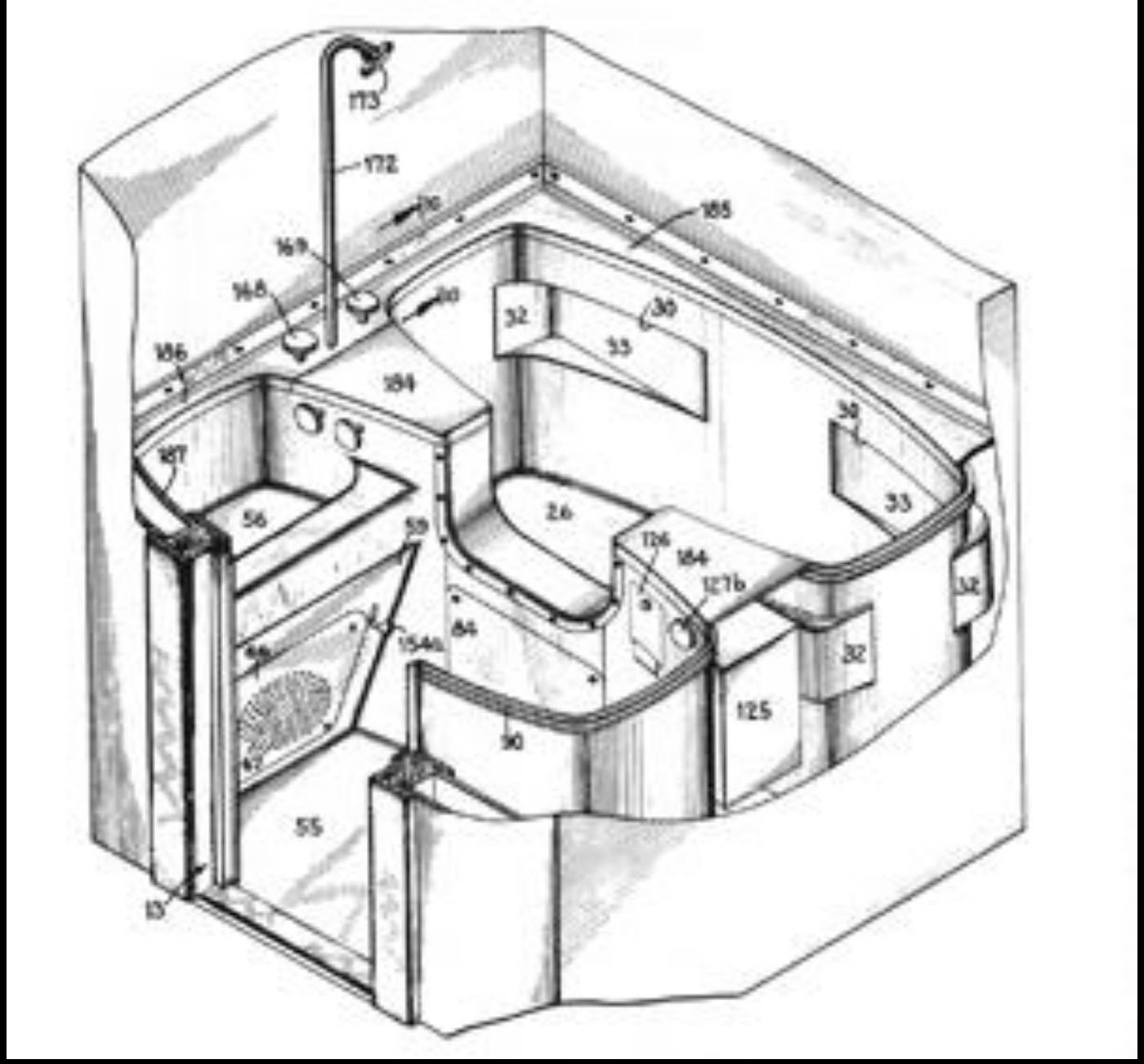


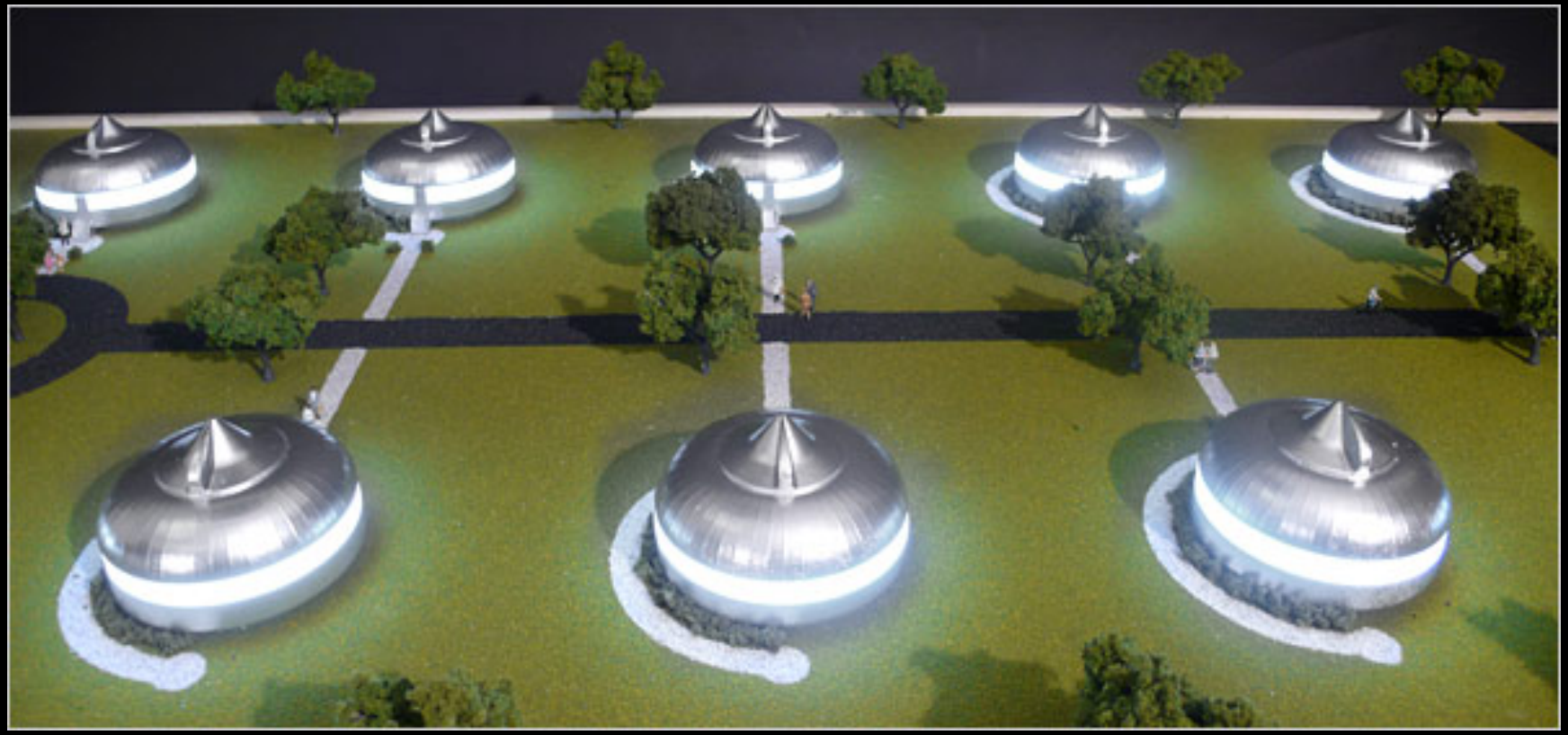
Fig. 3
Fig. 4
INVENTORS
ATTORNEY

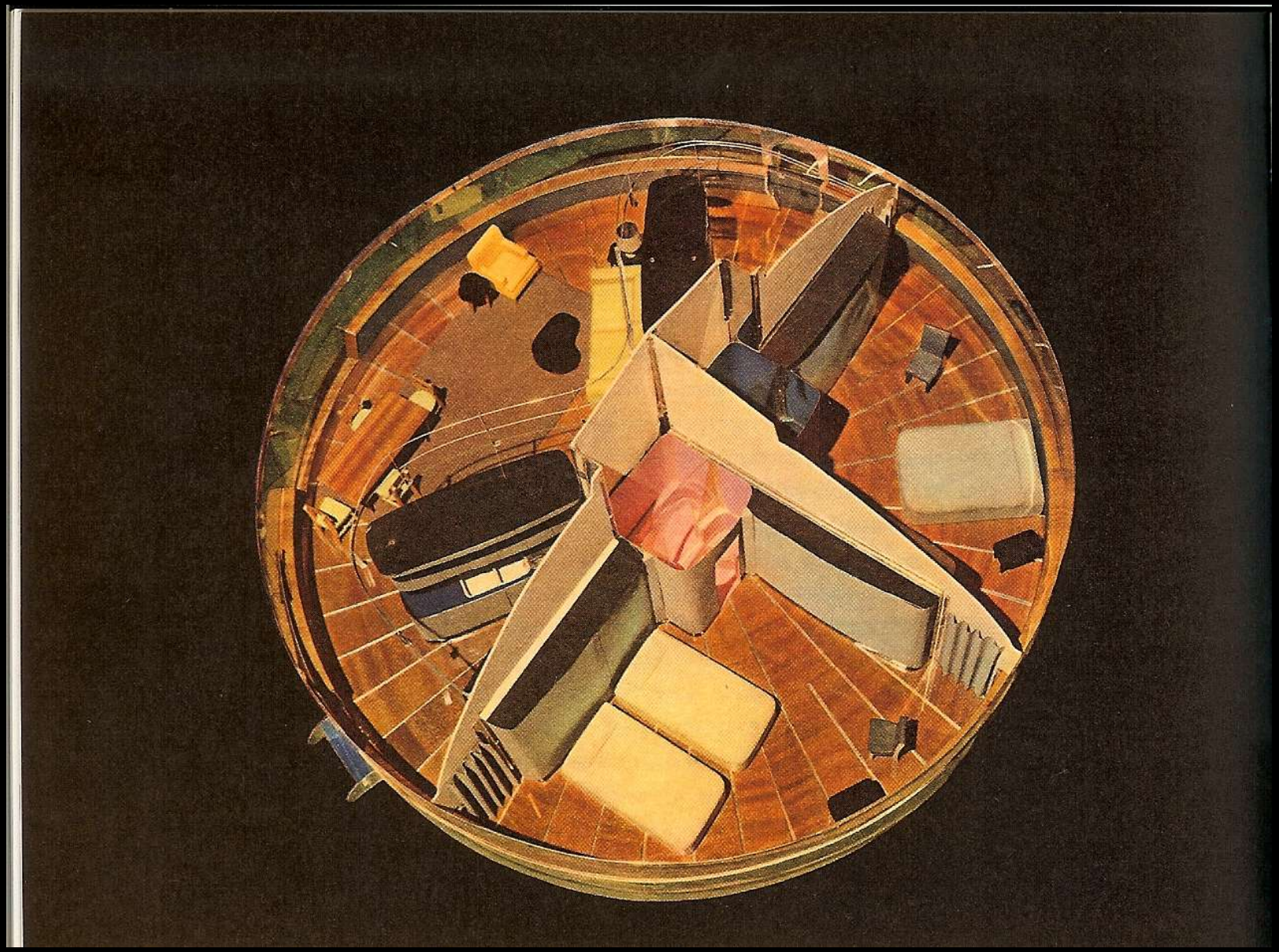


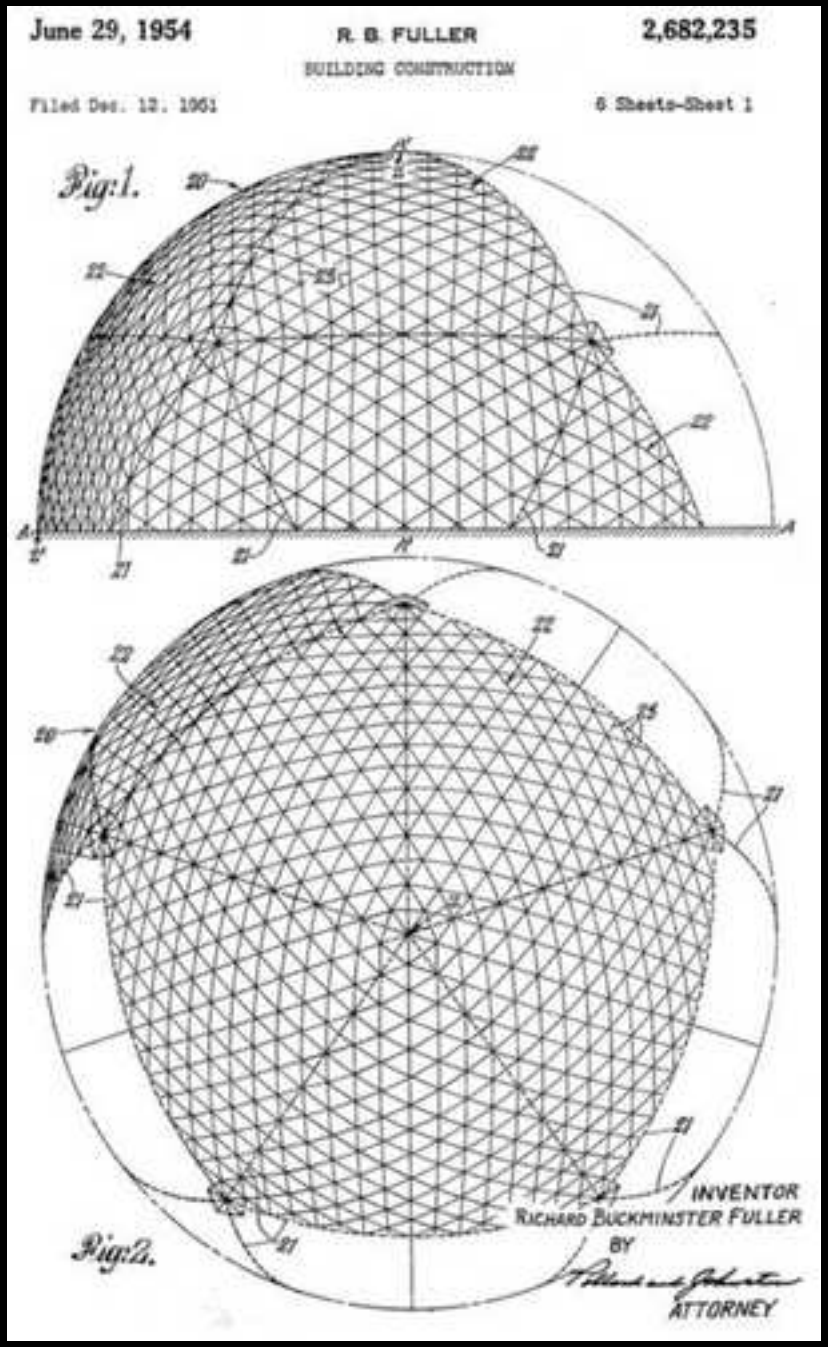
Buckminster Fuller, Dymaxion Bathroom, 1937

Buckminster Fuller, Building Construction – Dymaxion Deployment Unit, United States Patent Office no. 2,343,764, filed March 21, 1941, serial no. 384,509, granted March 7, 1944

Buckminster Fuller, Wichita House, 1944







Buckminster Fuller, Geodesic Dome, 1950 (invented/Montreal dome being built at right)

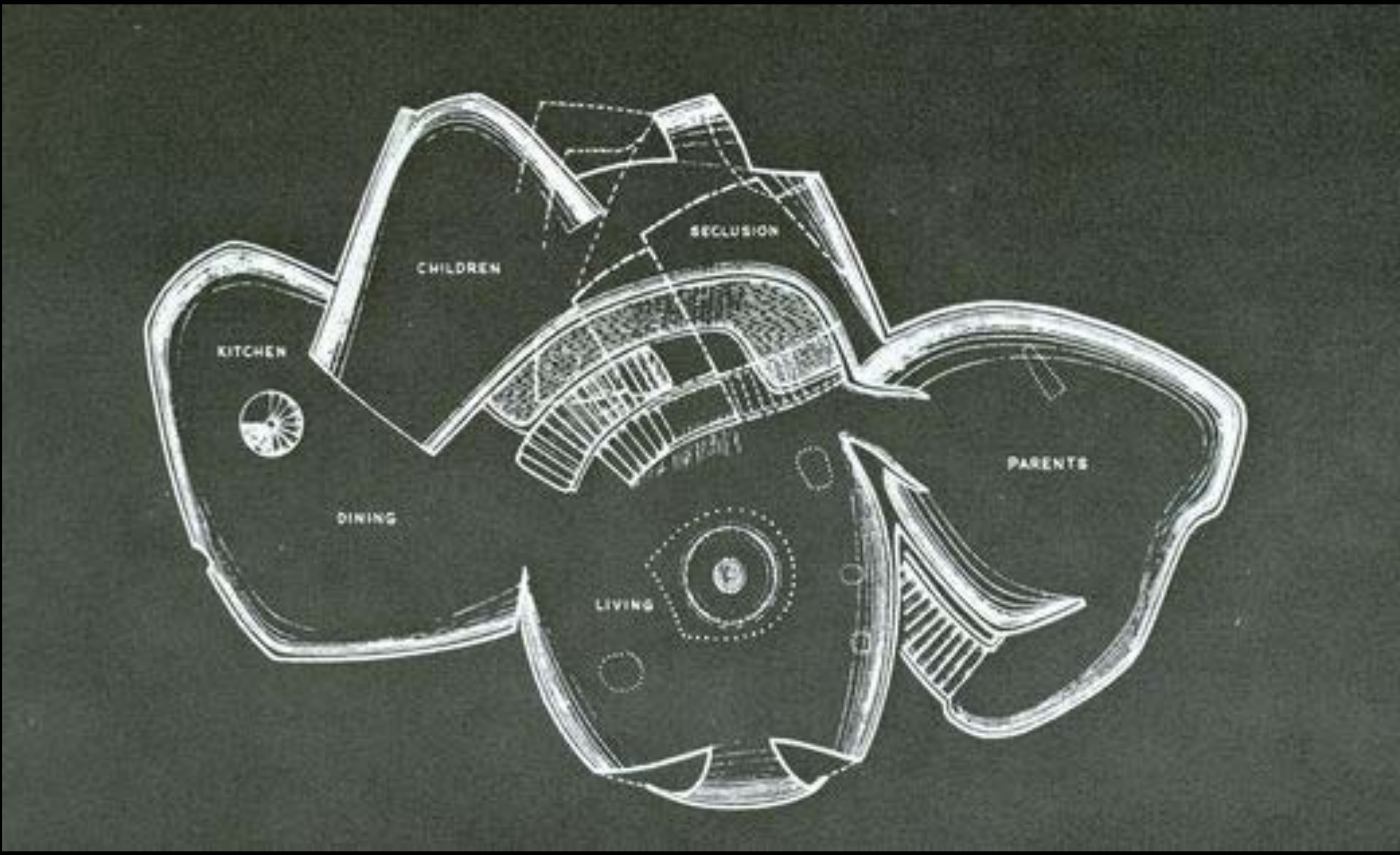
Northland Center, Detroit, Michigan, 1954

Accordion Truss, Northland Center, Detroit, Michigan, 1954

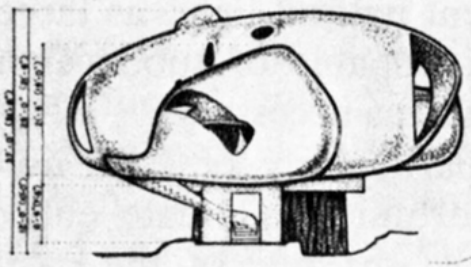
Frederick John Kiesler [1890-1965]

Frederick Kiesler. Endless House. Project, 1950–60

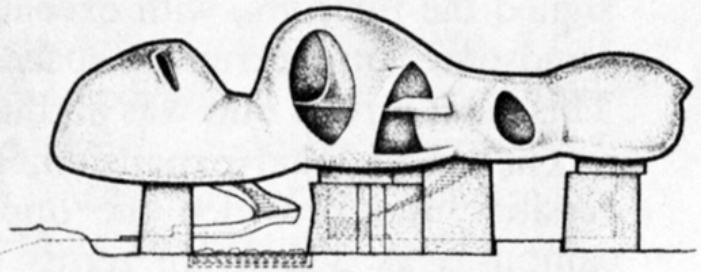
spirals, infinity, and eternity


CHILDREN
SECLUSION
KITCHEN
PARENTS
DINING
LIVING

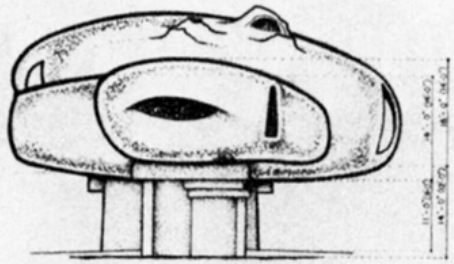
PLANS AND ELEVATIONS



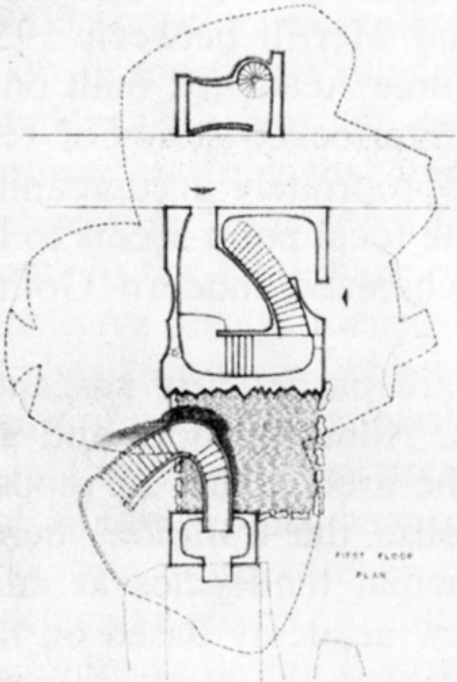
NORTH ELEVATION



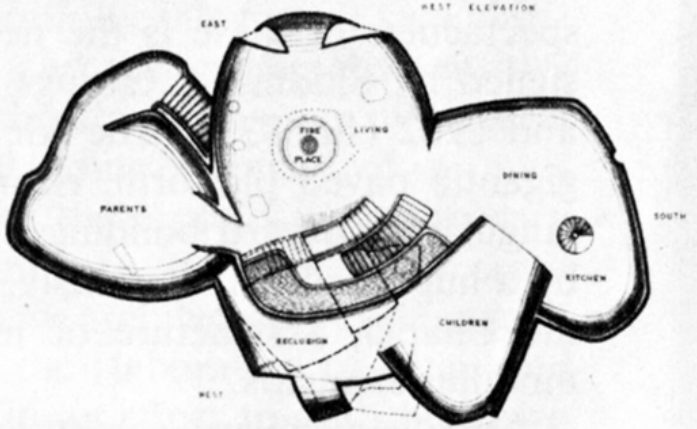
WEST ELEVATION



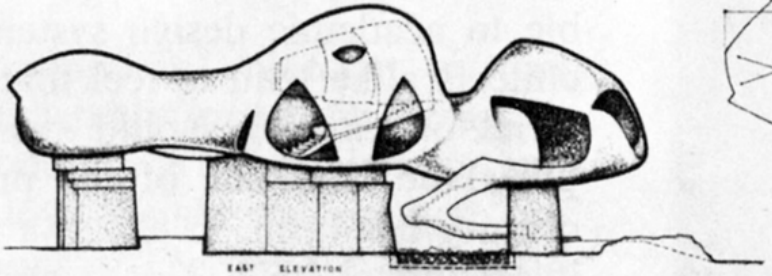
SOUTH ELEVATION



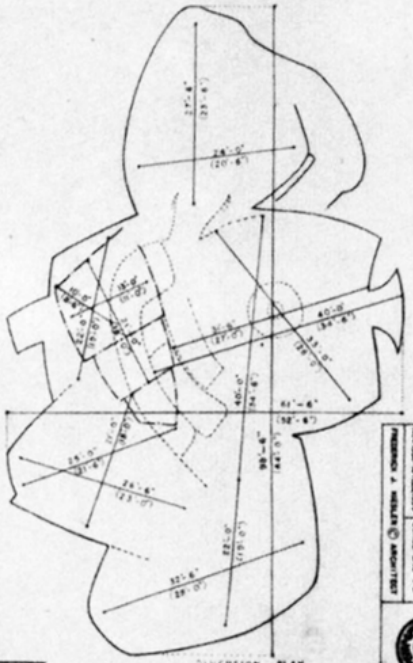
FIRST FLOOR PLAN



SECOND FLOOR PLAN



EAST ELEVATION



DIMENSION PLAN

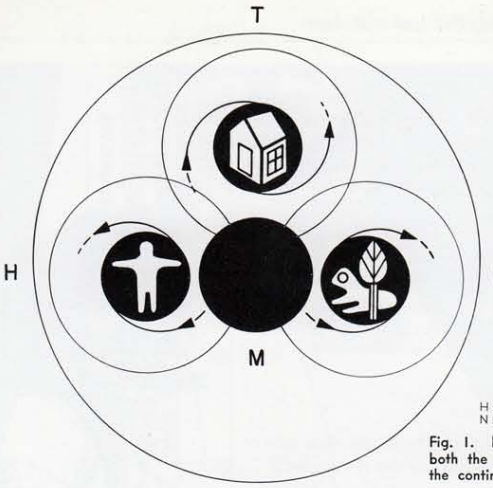
PLANS FOR ENGLISH HOUSE

ON CORREALISM AND BIOTECHNIQUE

DEFINITION AND TEST OF A NEW APPROACH TO BUILDING DESIGN

by **FREDERICK J. KIESLER**

Director, Laboratory of Design-Correlation
Columbia School of Architecture



H = Human environment
N = Natural environment
T = Technological environment
M = Man—Heredity

Fig. 1. Man = heredity + environment. This diagram expresses both the continual action of the total environment on man and the continual interaction of its constituent parts on one another.

In this paper* I propose to show that the perennial** crisis in architectural history is due to the perennial lack of a science dealing with the fundamental laws which seem to govern *man as a nucleus of forces;* that until we develop and apply such a science to the field of building design, it will continue to exist as a series of disparate, overspecialized, and unevenly distributed products; and that only such a new science can eliminate the arbitrary divisions of architecture into: Art, Technology, and Economy, and make architecture a socially constructive factor in man's daily activities.

Today we face the task of formulating the *general* laws of the foundations that underly the many specialized sciences, not in terms of metaphysics (such as religion or philosophy) but in terms of work-energies; and the *specific* task of formulating those that govern building design. But the two are intimately related and we in the building field cannot solve our special problems without comprehension of the foundations of such part-sciences, e.g. physics, chemistry, biology, etc. Thus, it would seem imperative that we summarize some of the concepts of modern science and investigate their validity for our specific problem.

Concepts of sciences and the building designer

Man is born in evolution of hereditary trends. He is the nucleus of forces which act upon him, and upon which he acts. Forces are energies. We assume, with contemporary science, that they are of an electromagnetic nature. The interrelation of organic and inorganic matter is a mutual bombardment of energies which have two characteristics: those of integration and those of disintegration.

By means of gravitation, electricity generates energy into solids of visible matter. This is integration. By magnetism and radiation, electricity degenerates energy into tenuous, invisible matter. This is disintegration.

If this general principle of anabolic and catabolic energies were the sole principle of existence, we would have a static, unchanging world. But these two forces (positive and negative) interchange through physico-chemical reactions, one force striving always for a preponderance over the other. In this way *variations* are constantly created; and in this process of creation, new nuclear concepts and new environments are in continual formation.

Reality and form

The mutual biological interdependence of organisms is, in the final analysis, the result of the primary demands of all creatures: proper food, habitat, reproduction, defense against inimical forces. Life is an expression of the cooperation, jostling, and strife of individual with individual, and of species with species, for these primary needs.

*In an earlier manuscript of Mr. Kiesler's ("From Architecture to Life," for Brewer, Warren and Putnam, 1930) the groundwork of this paper was laid; it was first read in approximately its present form at a Symposium on Science and Design held by the Alumnæ Associaition of the Massachusetts Institute of Technology, June 6, 1938; this is its first appearance in print.—Ed.

**See Index.

The visible result of these activating forces is usually called *matter* and constitutes what is commonly understood as reality. The reason for this superficial interpretation of reality lies in the limitation of man's senses in relation to the forces of the universe. For matter is only one of the expressions of Reality, and not reality itself. If matter alone were reality, life would be static.

What we call "forms," whether they are natural or artificial, are only the visible trading posts of integrating and disintegrating forces mutating at low rates of speed. Reality consists of these two categories of forces which inter-act constantly in visible and invisible configurations (Fig. 2). *This exchange of inter-acting forces I call* CO-REALITY, *and the science of the laws of interrelationships,* CORREALISM. *The term "correalism" expresses the dynamics of continual interaction between man and his natural and technological environments.*

Natural, social, and technological heredity

Biology has divided these forces into two main categories: Heredity and Environment. Man had to evolve a method for dealing with the effects of these overwhelming forces upon himself. For this purpose he created technological environment to help him in his physical survival even within the short span of the age-potential of his own species. This is made more difficult because man is biologically unfit to transmit his experiences to his offspring: each child has to begin anew its adaptations to nature. In short: contrary to prevailing belief, acquired traits and habits of parents can not be transmuted into the make-up of body cells and, by way of procreation, given to their children.*

By providing unchangeable genes within the germ-cells *Nature* has safeguarded herself from man interfering fundamentally with her aims, whatever they may be. This "sealed order" of the germ cell contains nature's will which man can influence *during his own life-time, but not beyond that.* This places a deep responsibility upon those who "design" technological environment, because the restriction of its application to only *one* life-span makes it so much more needed as part of man's defense-mechanism. It appears, then, that the only human experiences that can be inherited by children are those of customs and habits by way of: training and education, thus "social heredity" is the only tool man can rely upon. Just as all living organisms are generated through their own species from a long chain of generations, so do ideologies or man-made objects generate from a long line of older ideologies or objects of similar functions. Thus a contemporary chair, for instance, is the product of many generations of other tools for man to rest his body in fatigue. This is heredity in technology transmitted through education.

What is technological environment?

When the biologist speaks of environment, he invariably means the geographical and animal environment. This definition is perhaps accurate for all creatures except man. For man alone has developed a third environment: a *technological* one which has been his steady companion from his very inception. This technological environment, from "shirts to shelter," has become one of the constituent parts of his total environment. Thus, the classification of environment becomes three- instead of two-fold, as in Fig. 1:

1. natural environment
2. human environment
3. technological environment

*The part of Darwin's theory which stated that *"acquired characteristics are inheritable"* has been disproven. (August Weissmann, 1880.) Thomas H. Morgan: ". . . the belief in the inheritance of acquired characteristics is not based on scientific evidence but on the very human desire to pass on one's acquisitions to one's children."

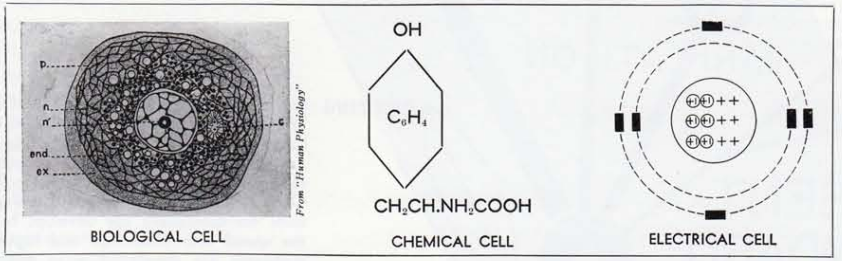
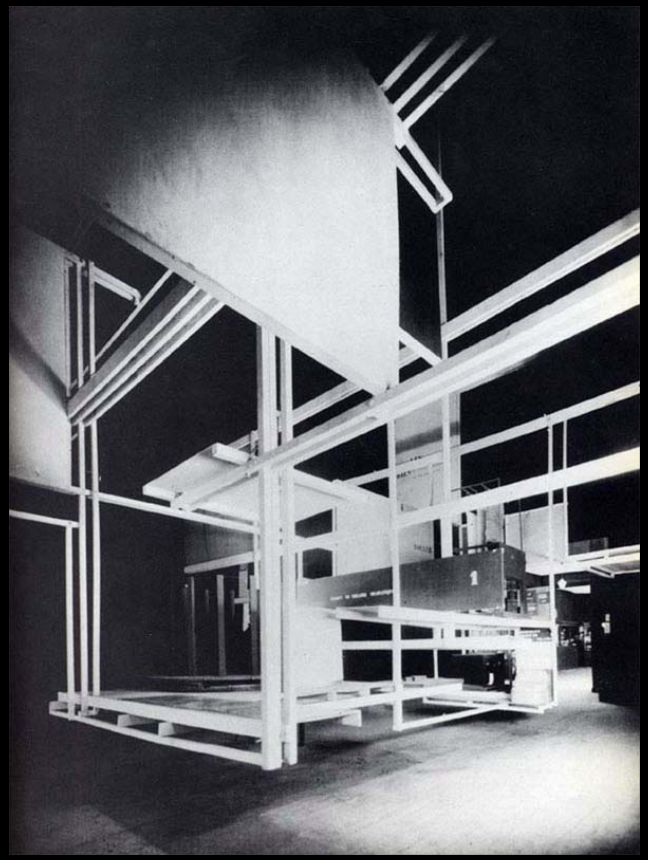


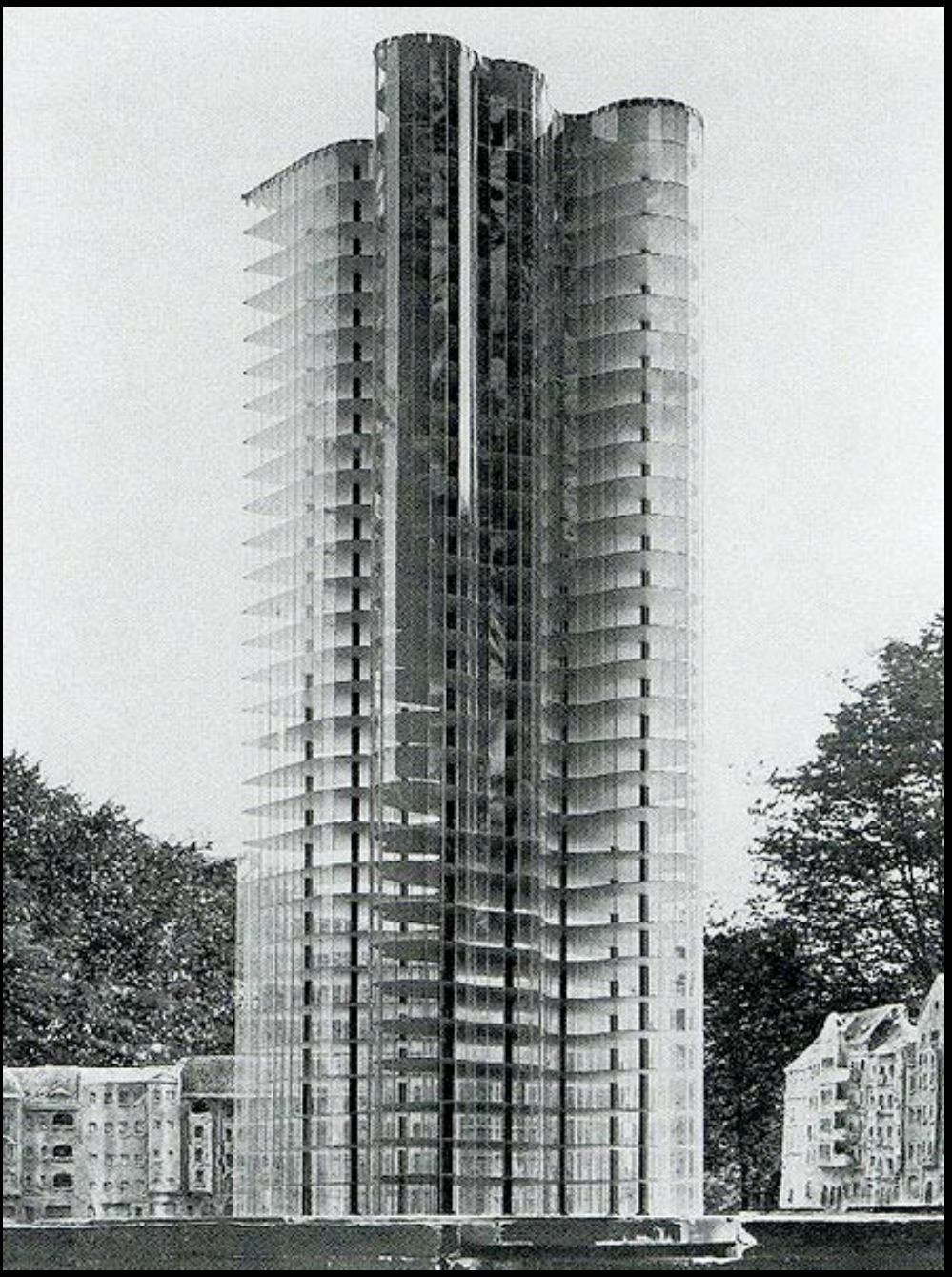
Fig. 2—The nuclear concept of production as expressed in three of the sciences. Note that though the forces involved are expressed in different terms, their basic organization is similar. Technological design must also be seen in the light of a nuclear concept.

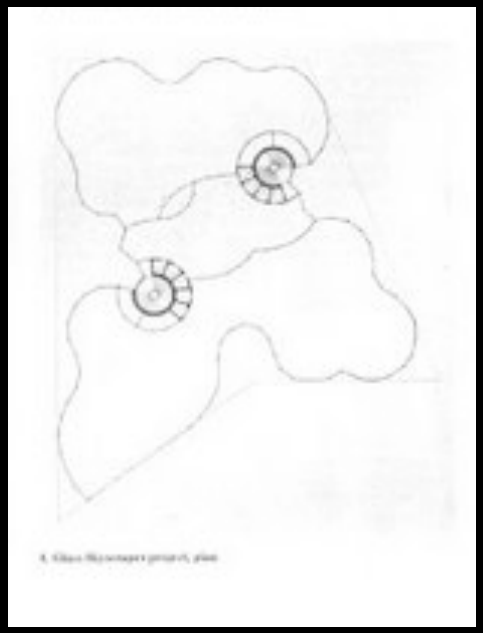


Frederick Kiesler, City in Space, Paris , 1925

Frederick Kiesler, Space House, 1933

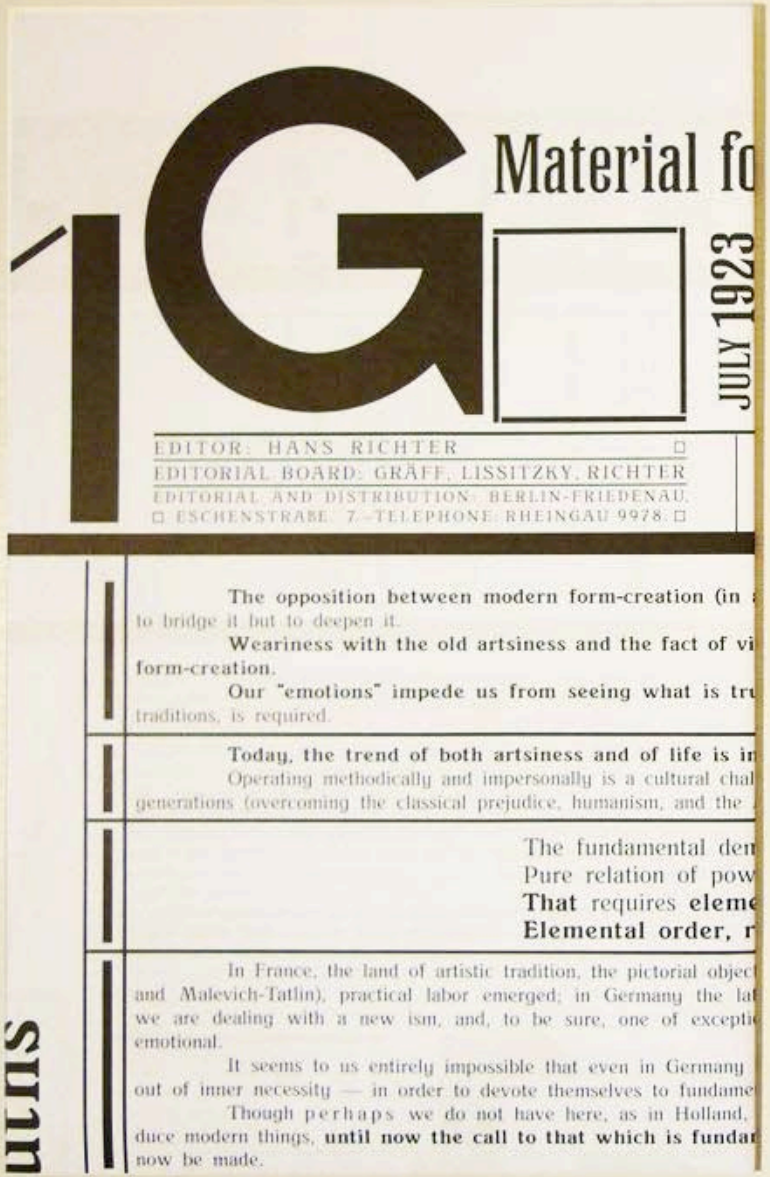
Ludwig Mies van der Rohe
[1886-1969]



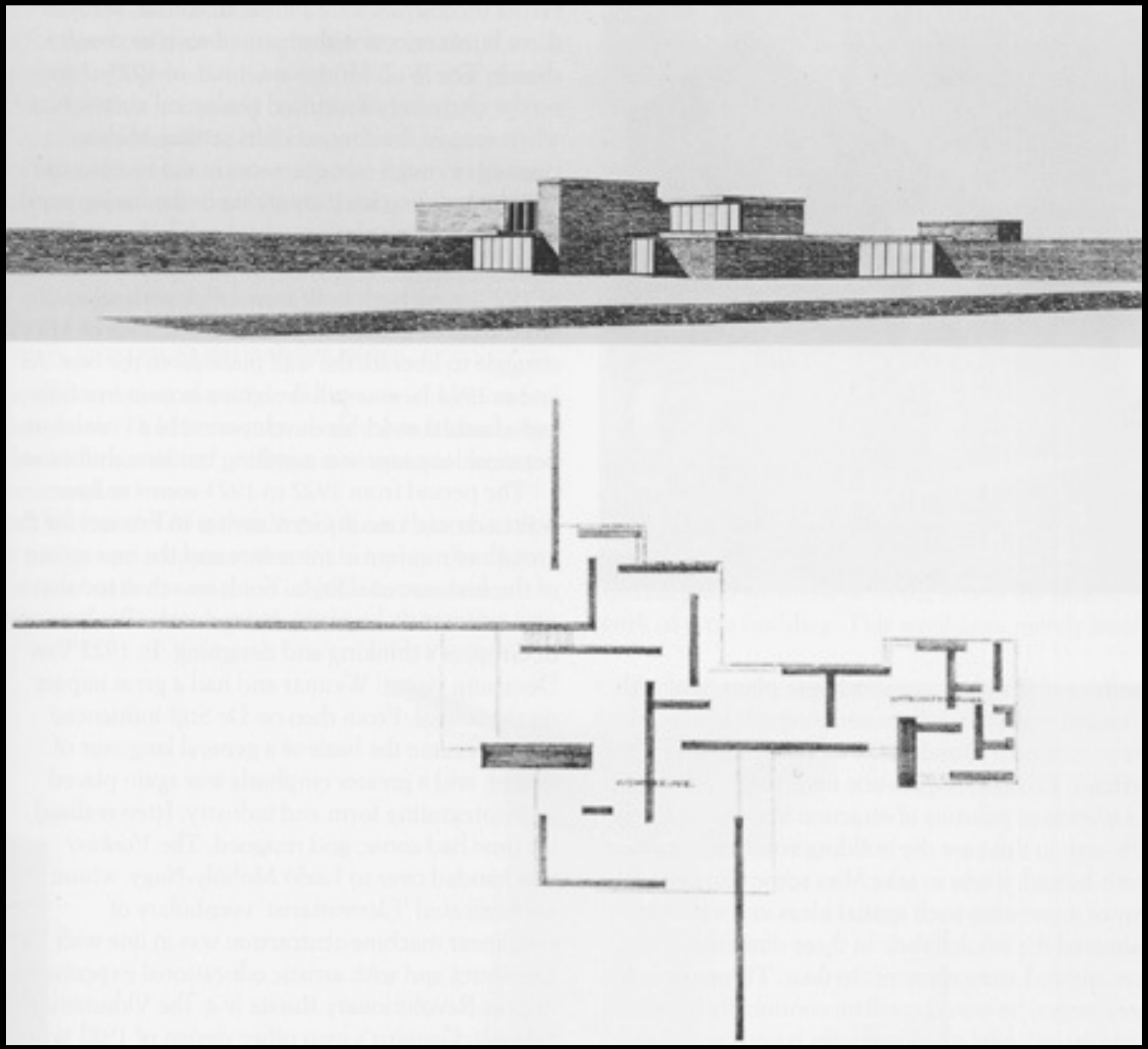


Mies van der Rohe, Model for a Glass Skyscraper, 1922

Mies van der Rohe, with Philip Johnson (interiors), Seagram Building New York, 1958

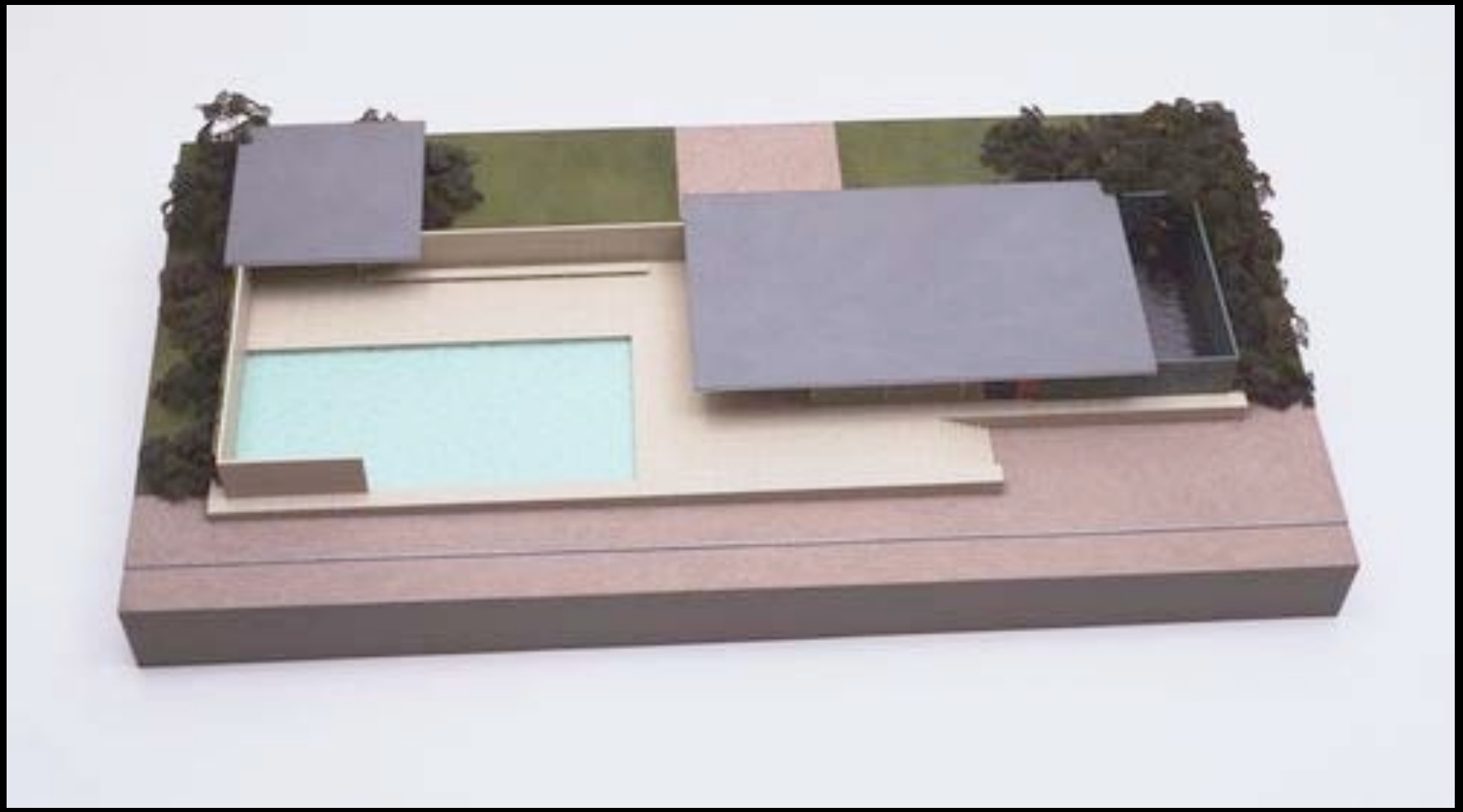


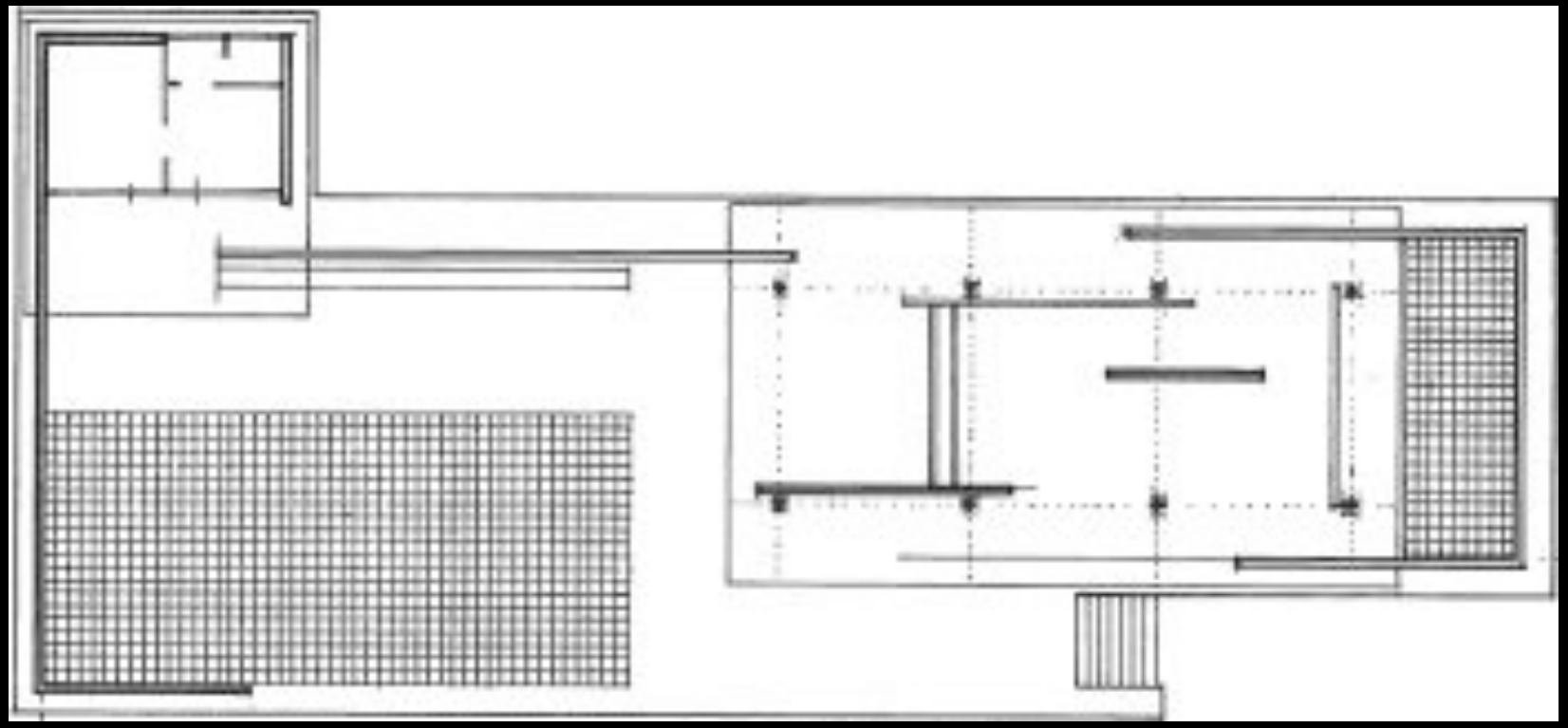
G: Material zur elementaren Gestaltung/ G: Material for Elementary Form (1923)

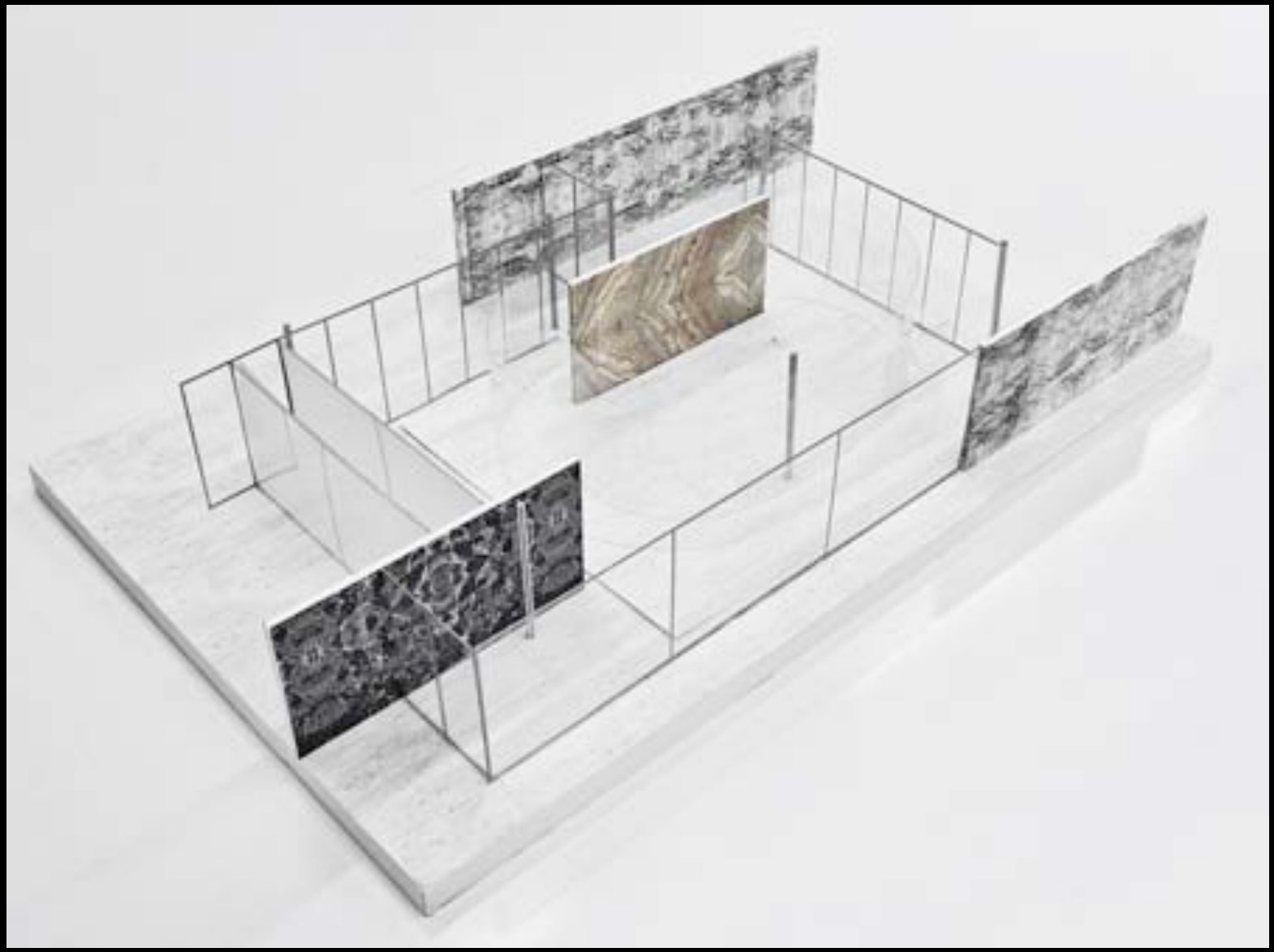


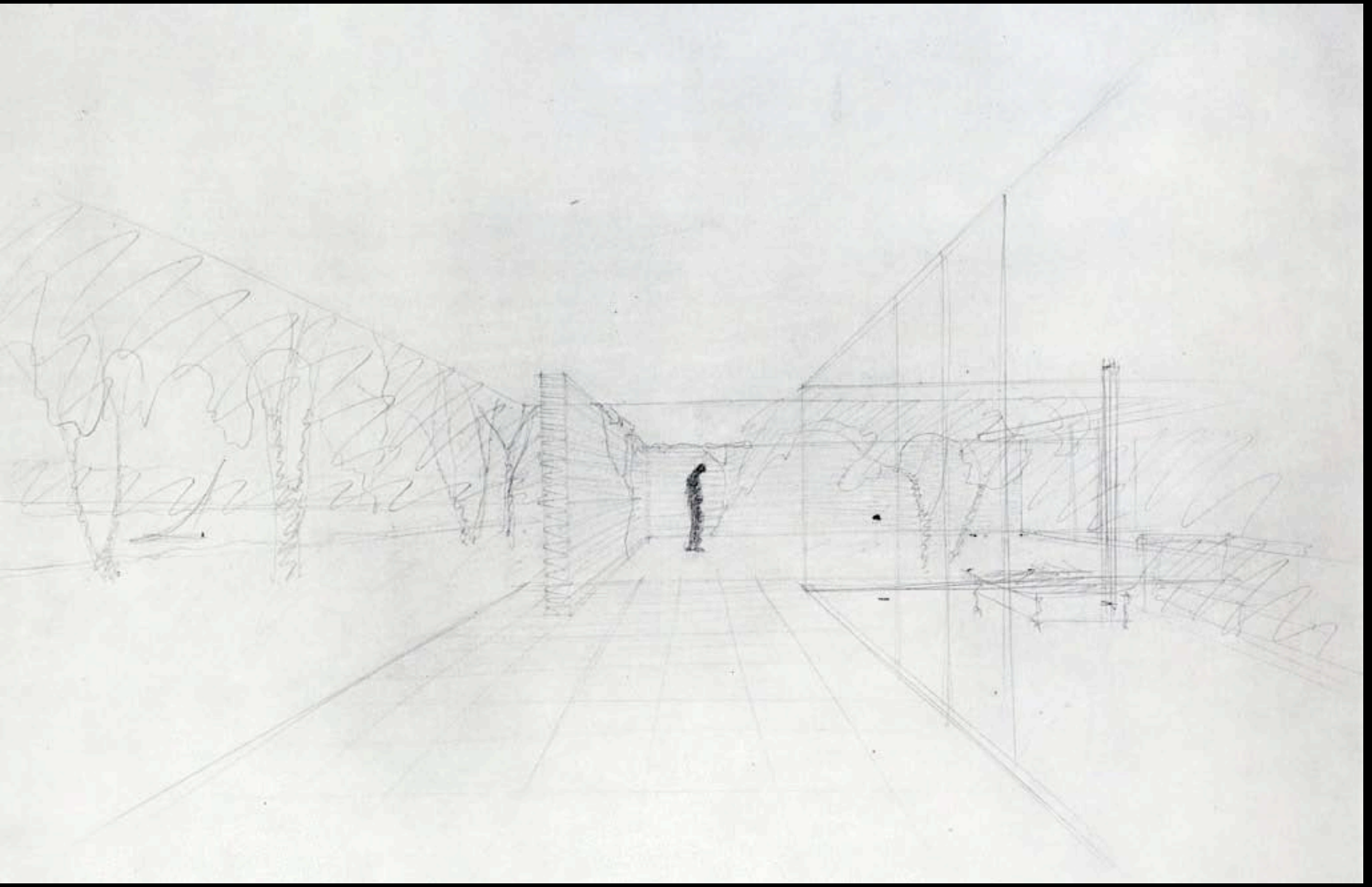
Mies van der Rohe, Project for a Brick Country House, 1923

Mies van der Rohe, German Pavilion, World Exhibition, Barcelona, 1929



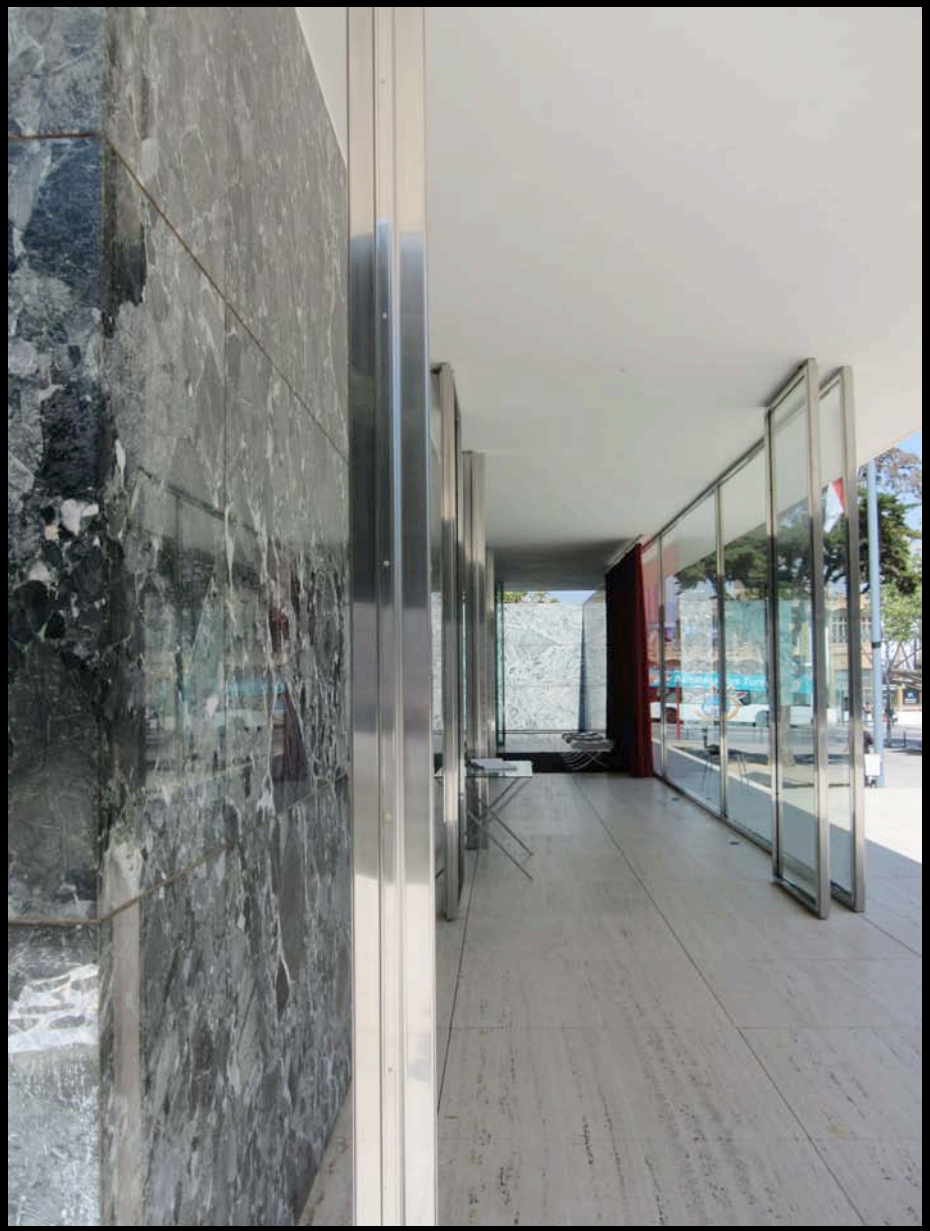


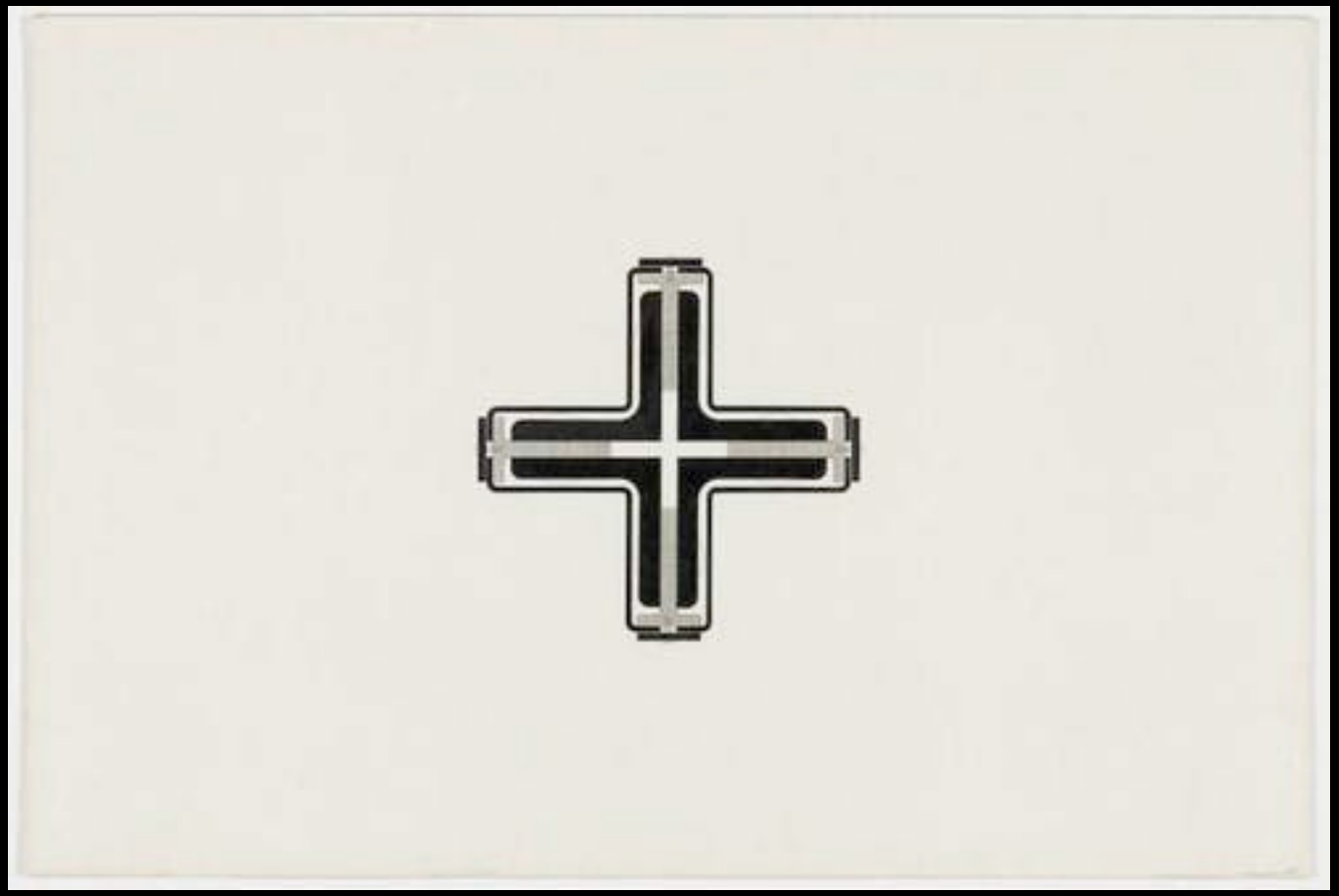




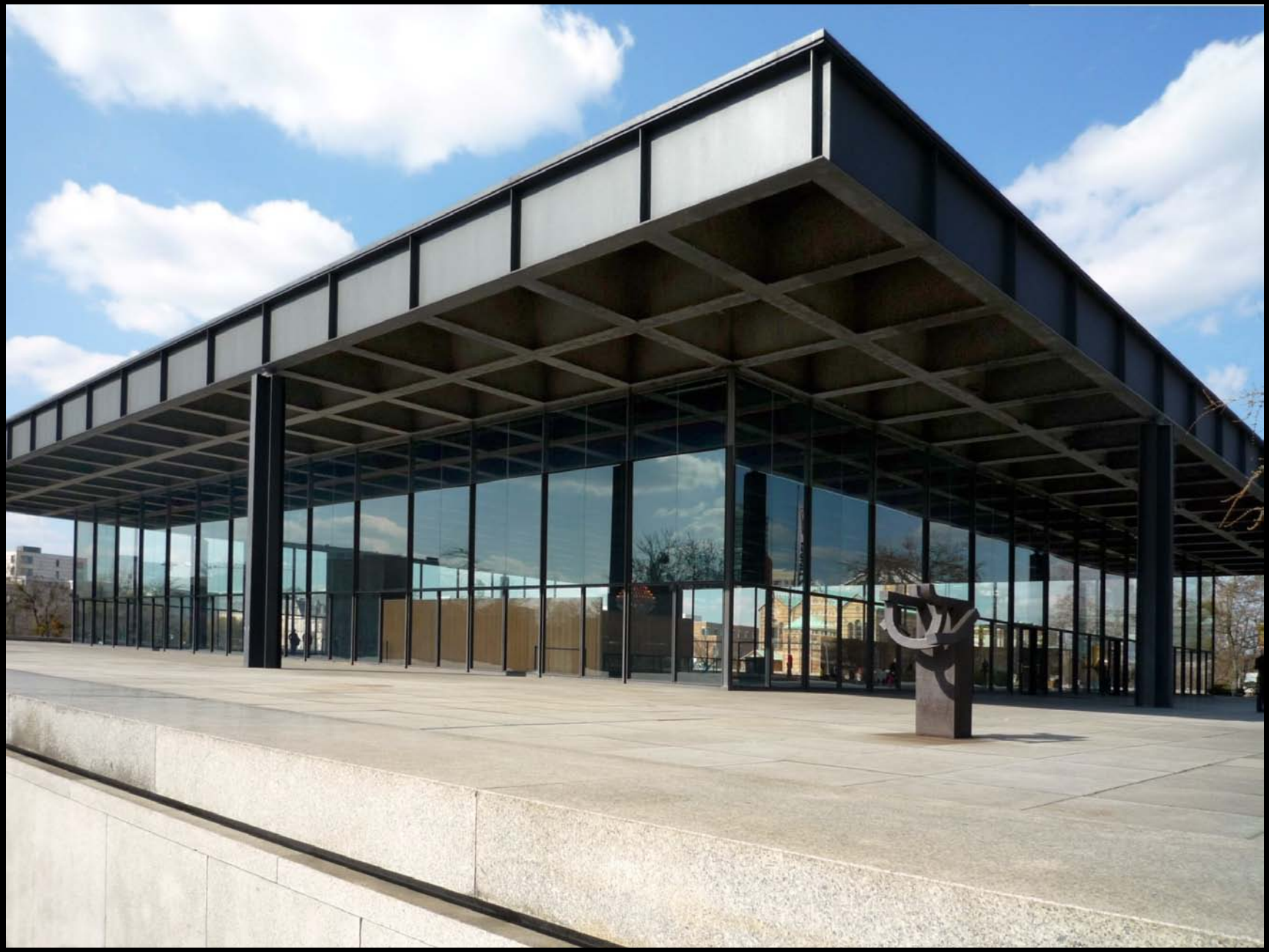
beinahe nichts – almost nothing

Barcelona Chair



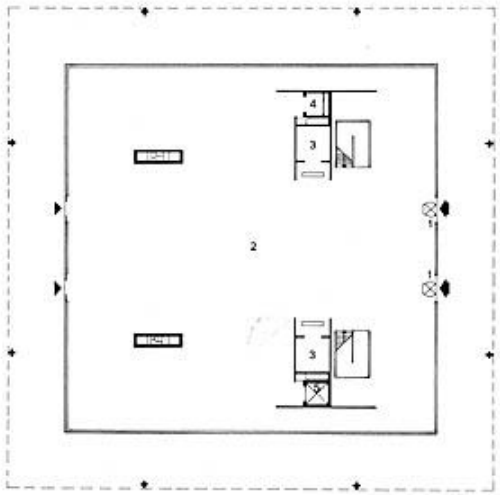


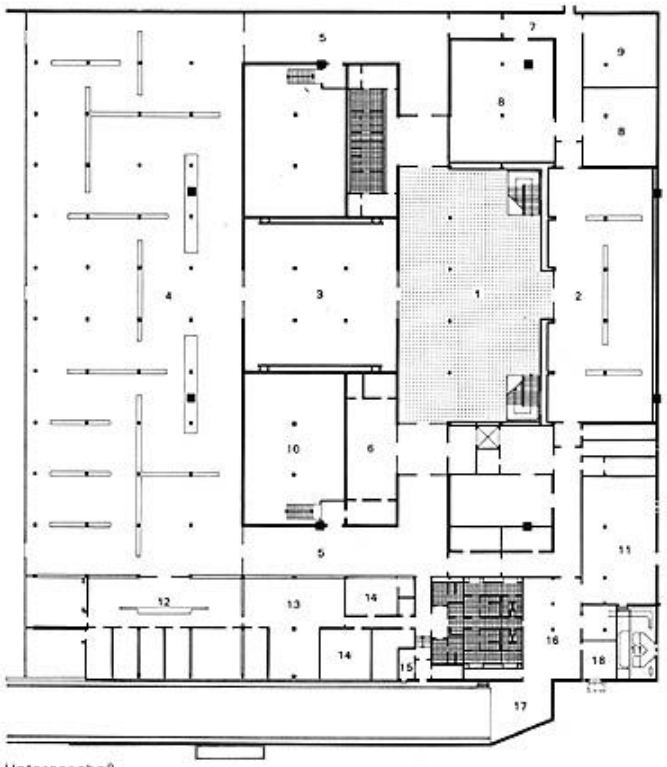
Horizontal Column Section



Ludwig Mies van der Rohe, Neue Nationalgalerie (New National Gallery), 1968

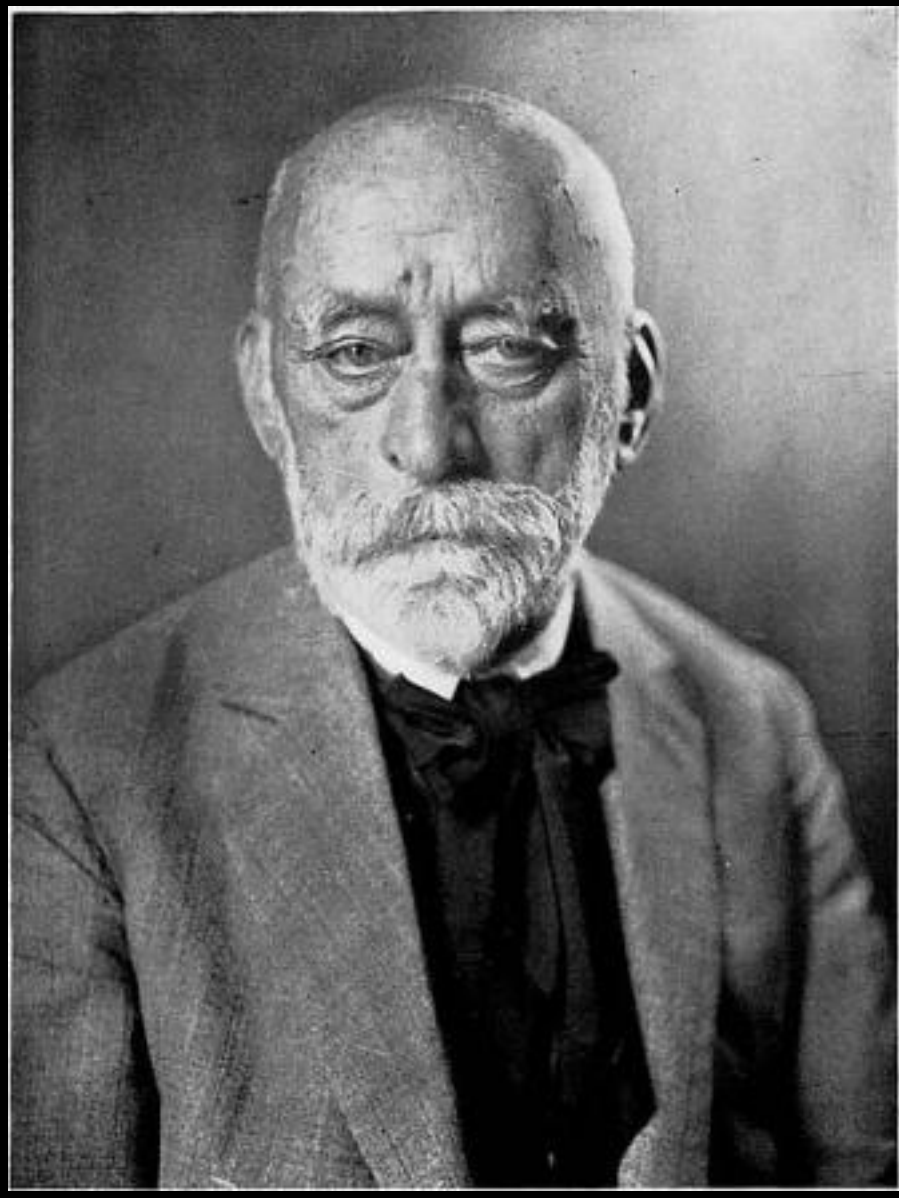
Ausstellung
1 Eingang
2 Ausstellungshalle
3 Garderobe
4 Putzraum
5 Aufzug





Untergeschoß
1 Treppenhalle
2 Graphisches Kabinett
3 Kleiner Raum
4 Großer Raum
5 Museumsgang
6 Restaurant
7 Depotgang
8 Depot
9 Heizzentrale
10 Maschinenraum
11 Trafostation
12 Direktion
13 Restaurationswerkstätten
14 Bibliothek
14 Hausmeister
15 Aufsichtspersonal
15 Portier
16 Verpackung
17 Laderampe
18 Ventilatorraum

Berlage chair inspired by
Egyptian Chairs, 1904



Hendrik Petrus Berlage [1856-1934]

Berlage chair inspired by Egyptian Chairs, 1904

Three-legged chair designed by Berlag,e, c. 1900

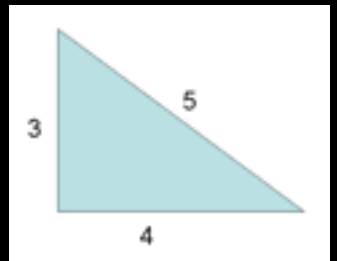
Hendrik Petrus Berlage, Stock Exchange, at Amsterdam, The Netherlands, 1897 to 1909

Designed according to a superimposed grid based on the Egyptian triangle*

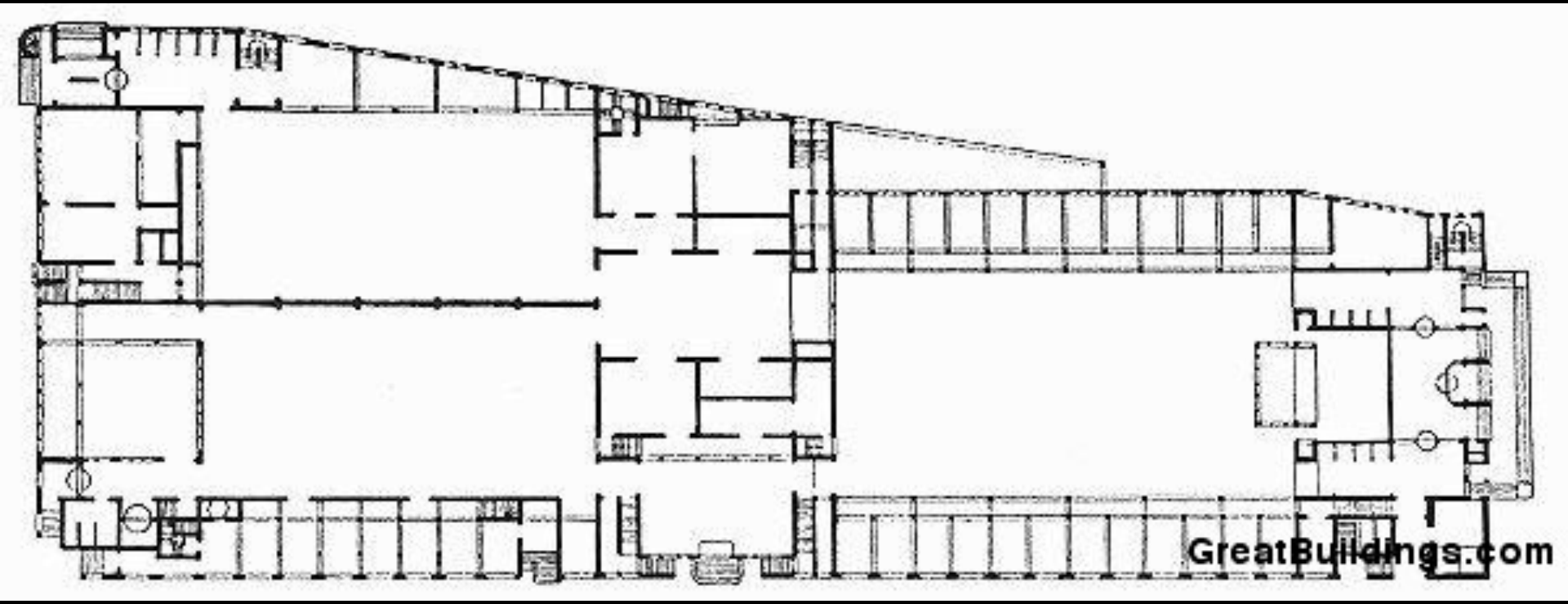
…the pleasing effect of simple numerical ratios has been appreciated in all epochs. Once again a model can be found in nature, for it is known that not only the proportions of the human body but also those of various animals can be expressed in simple numbers. The Stock Exchange building in Amsterdam… is entirely proportioned after the Egyptian triangle. It consists of a system of built-up pyramids with the ratio of 8: 5 and can therefore be compared with a group of natural crystals.
-- Berlage in Foundations and Developments

Piet Zwart and Hendrik Petrus Berlage, Breakfast Service, for Leerdam Glassworks
Pressed glass 1923–1924

*Egyptian triangle: The 3–4–5 triangle, fundamental to architecture and surveying because it enables a right angle to be constructed; right triangle where the sides are in the ratio of the integers 3:4:5




BEURS VAN BERLAGE



The Exchange building had three great halls housing the Commodity, Grain and Stock Markets, each of them surrounded by smaller offices and service areas. Above the main entrance is the conference room of the Chamber of Commerce. The most striking of the halls is the Commodities Market, 67 feet wide, with a gable roof of glass and iron supported by conspicuous, brightly colored parabolic iron beams. The long walls are turned into openwork screens by the broad arcades of the ground floor and the two galleries above. The stone capitals are remarkable: their faces lie flush with the brick walls above them, both units merging in their common structural function.

—from P. Singelenberg, G Schwartz, translator. H.P. Berlage: Art and Architecture in the Netherlands. p10-12.


BODIES
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