



*understand* point, line, plane  
*extrude* point, line, plane  
Perception structures natural and artificial  
observe natural and artificial  
test intrinsic & extrinsic forces  
built simple and complex structures

# POINT

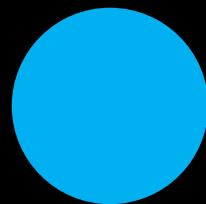
*'1. absolute sound of the point,*

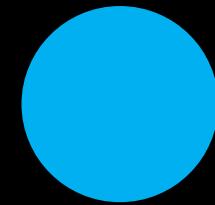
*2. sound of the given location in the  
basic plane.*

*This second sound, which in the case  
of the centric structure was almost  
silenced, again becomes distinct and  
transforms the sound of the point  
from the absolute to the relative.'*

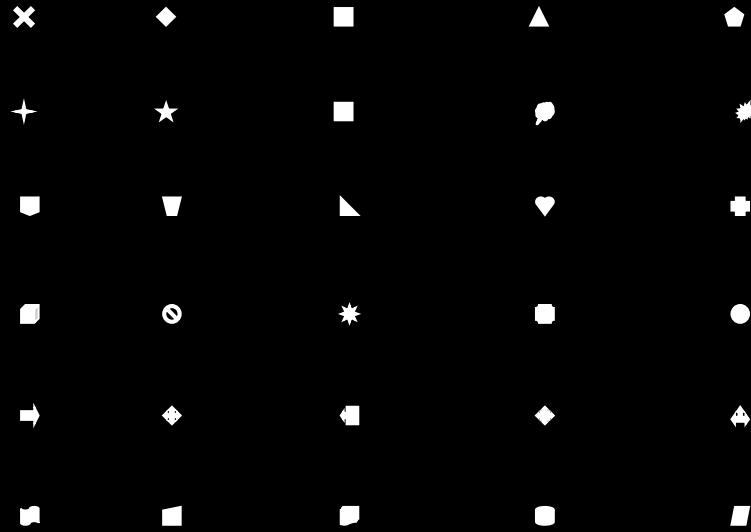
Point, line to plane, Kandinsky | 1926

[https://archive.org/stream/pointlinetoplane00kand/pointlinetoplane00kand\\_djvu.txt](https://archive.org/stream/pointlinetoplane00kand/pointlinetoplane00kand_djvu.txt)

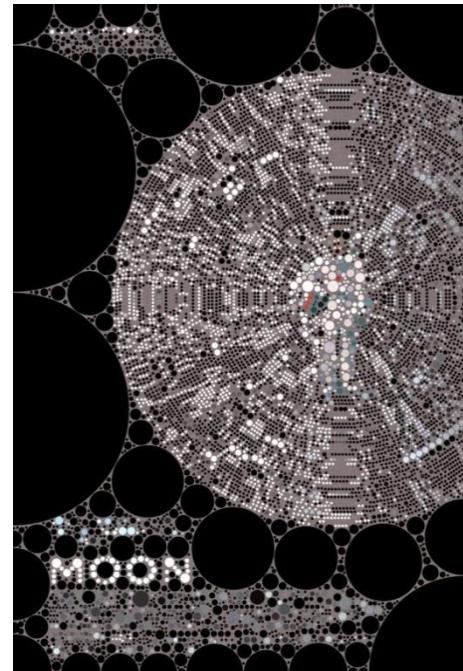
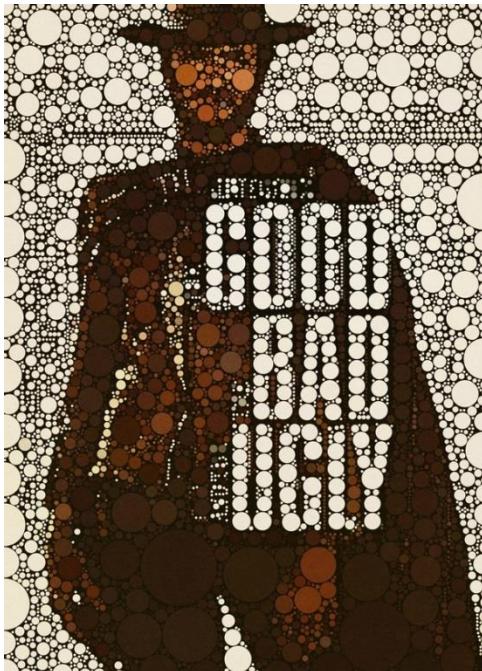




‘Thus we look upon the  
geometric point as the  
ultimate and most singular  
union of silence and speech’



*point  
circular  
shape  
abstract  
geometric*



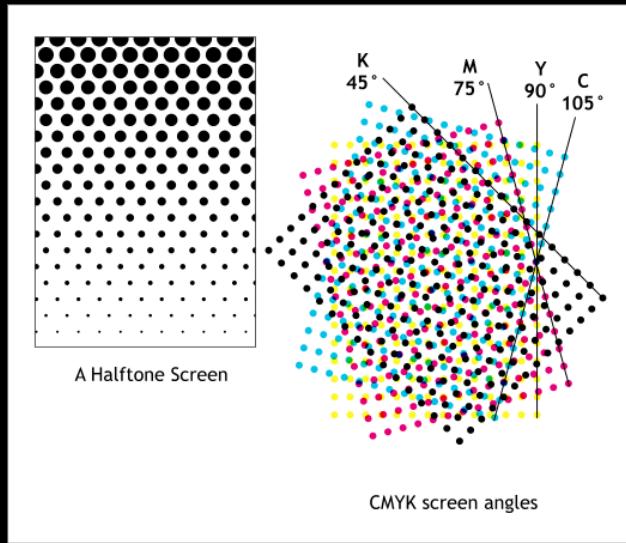
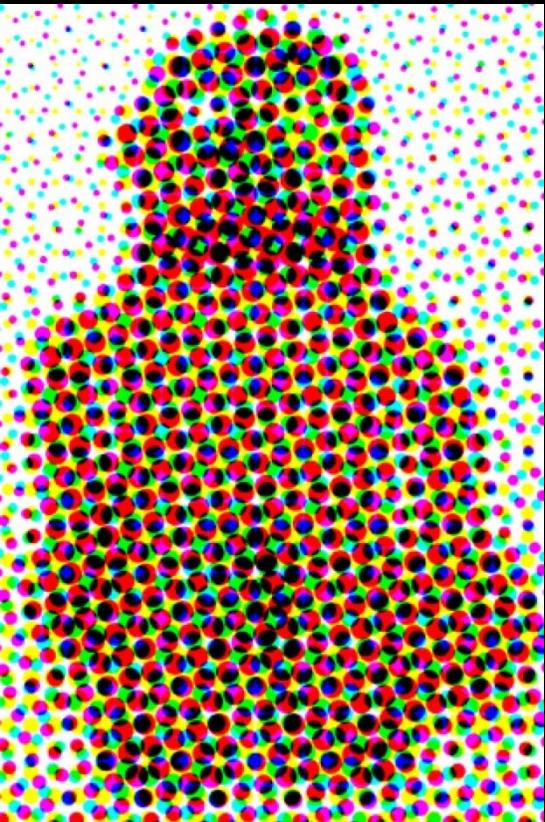
point

> Ennio Morricone | Ecstasy of Gold (The Good, the Bad, the Ugly)

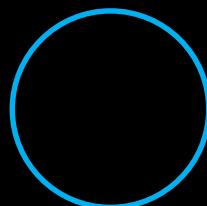
For the film Sergio Leone, 1966

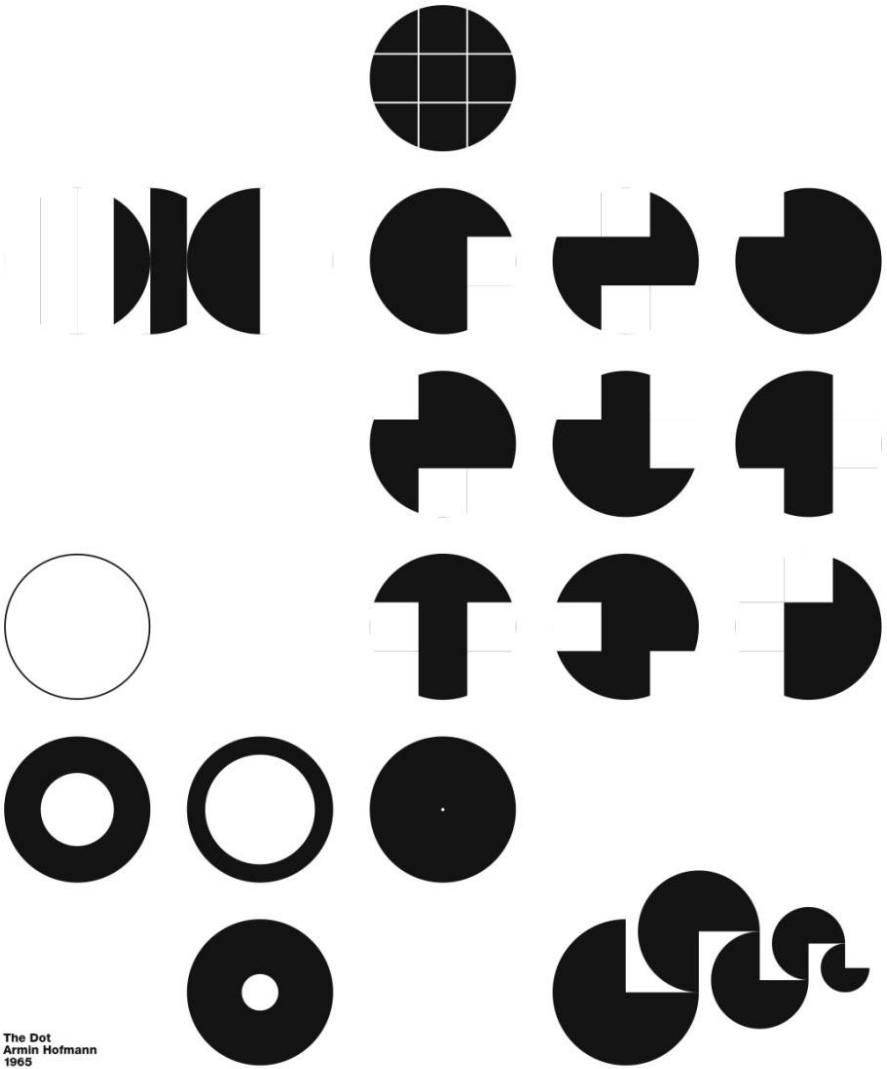
<https://www.youtube.com/watch?v=ZNGe7iK1O-4>

Point + color + CMYK



dimension





**The Dot**  
Armin Hofmann  
1965

The idea of a dot must be understood in a very broad sense. All small figures which have a centre and are presented in contrast to a larger area are being called shaped. And even if a dot expands, it still remains a dot.

A more increase in the size of an element is not enough to alter its essential character. We must be able to see the dot as a dot, no matter what the accessories of a particular environment. We can do this by giving large and small areas in which case the expansion and contraction of the dot is based on the colour value and its surface texture. But when it is focused to one point, of course, the dot is still a dot.

Because it is circumscribed, limited, and square-like and angular, the element is particularly adapted to demonstrating the most important principles of design. In the minor man-made element in the whole field of graphic art - it is mostly a building block of interaction.

It is also increasing from the technical point of view to have a dot as a basic element. When we work with transmittal to a printing surface, it is the dot which divides the dot emerge as such from its environment. What is the reason for this? At every stage of its appearance? It takes considerable time to find out the answer to this question. This is a question of the relationship between two elements.

There are two ways to increase the size of a dot. There are great potentials of producing tensions, the most marked tensions arise in the neighbourhood.

Exercise with dots - the most important graphic element - are particularly instructive when performed in graphic design. Especially in our day when the dot is used as a basic element, we can learn much from printing techniques, a great deal can be learned about the relationship between the dot and the surrounding space.

In the safe middle range the dot readily establishes a connection with its environment. The problem arises a particularity regarding the dot's behaviour. If the dot is displaced from the centre, the static equilibrium is lost. The dot begins to move.

If the dot is displaced from the centre, the static equilibrium is lost. The dot begins to move.

If we place the smaller dot in the center of a square, its forces begin to make themselves felt at once. There is a tension between the dots. Their sizes may be proportional to each other, otherwise too large a dot destroys too small a background or too large a background overpowers the small dot.

If the dot is displaced from the centre, the static equilibrium is lost. The dot begins to move. Above all, the symmetrical position of the background now becomes aggressive. It succeeds in attacking the dot from all sides. The dot is forced to the outer limits. The illusion of space might even be destroyed.

If we place another dot by the side of the first one, the dot background relationship, which was previously in only contact, now becomes secondary. The two dots are in contact with each other. The two forces are reciprocally engaged along a linear path.

If we place another dot by the side of the first one, the dot background relationship, which was previously in only contact, now becomes secondary. The two dots are in contact with each other. The two forces are reciprocally engaged along a linear path. Just as with the smallest dot, so in the case of the greatest spheres, for example, a dot which does not yet exist, yet, had enough strength to exert its influence.

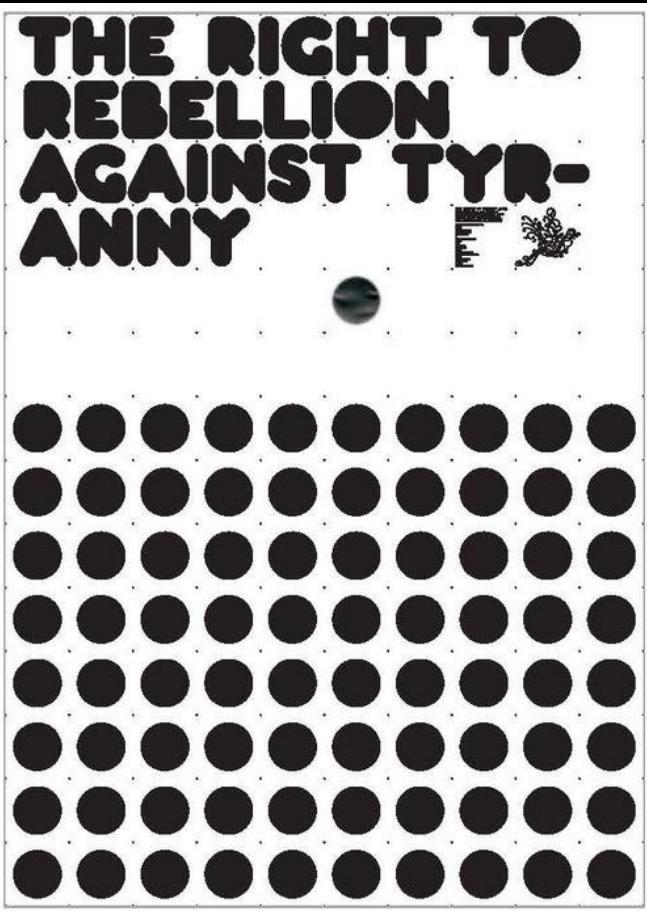
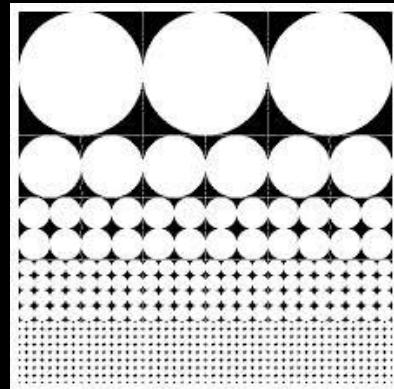
In technical applications, it is true, the reducing power of the absolute centre is of extreme importance. A great variety of forces, simple mixes of dots (dot patterns) and complex, three-dimensional, dynamic, meaning, variability in size, grey tone and colour, and in texture.

use with **other points**  
or **other elements**

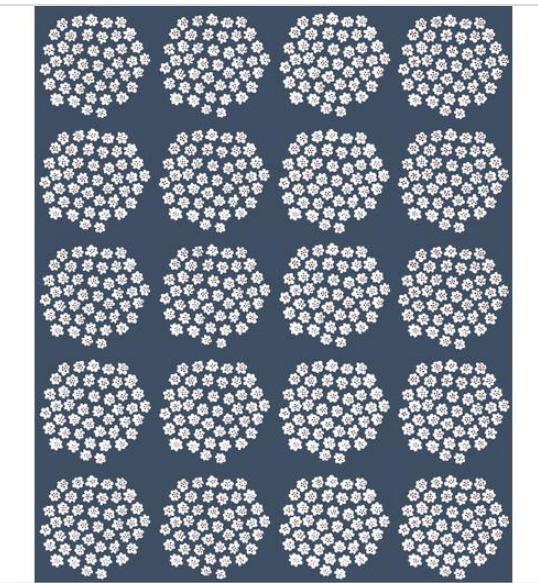
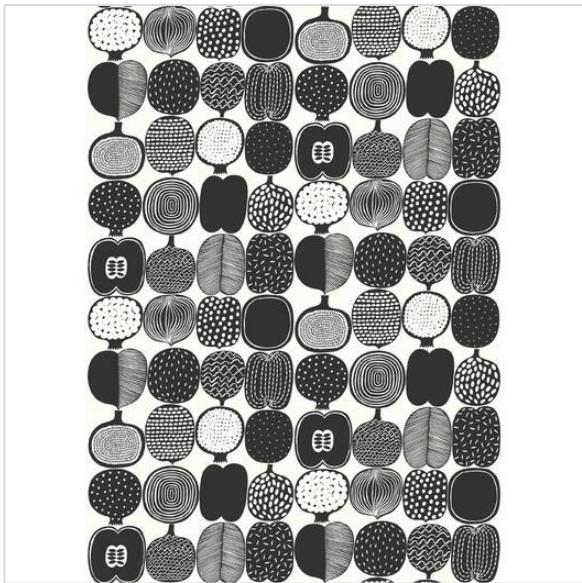
(no) dimensions  
repetition

*Graphic Design Manual:  
Principles and Practice*

*The dot  
Armin Hofmann  
1965*



Dimension |



*Marimekko*  
*Wallpaper*

## Point + color



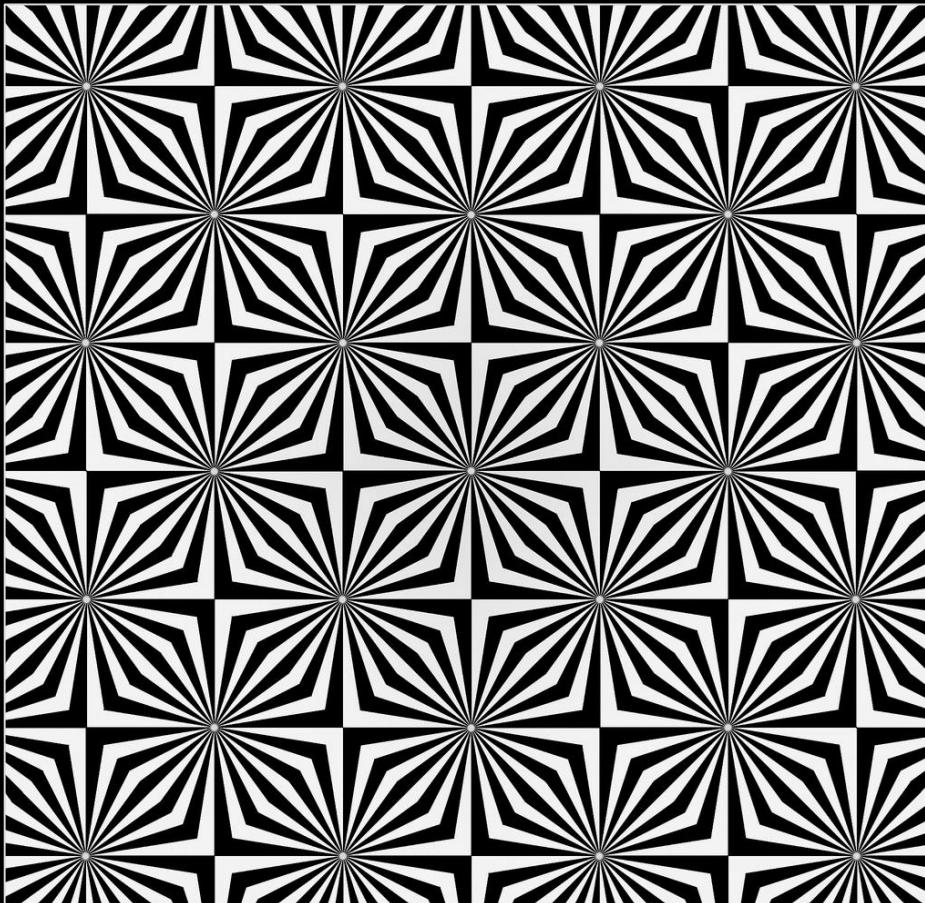
*dots* | 1969

**Victor Vasarely**  
(1908/1974) was a  
Hungarian painter and writer  
based in France, considered  
the "father of OP ART"

### THE RESPONSIVE EYE

....achieved with the opposition of  
identical structures that interact with  
each other, producing ... an optical  
effect





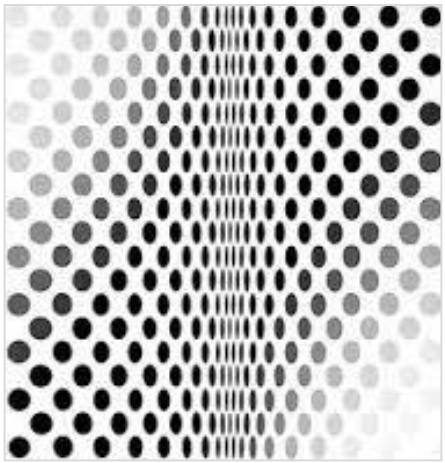
*Dots*

*Victor Vasarely*

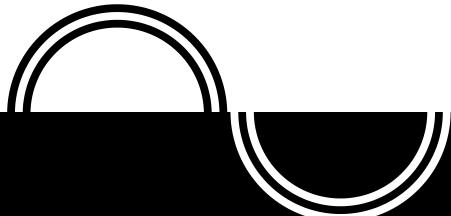
### **THE RESPONSIVE EYE**

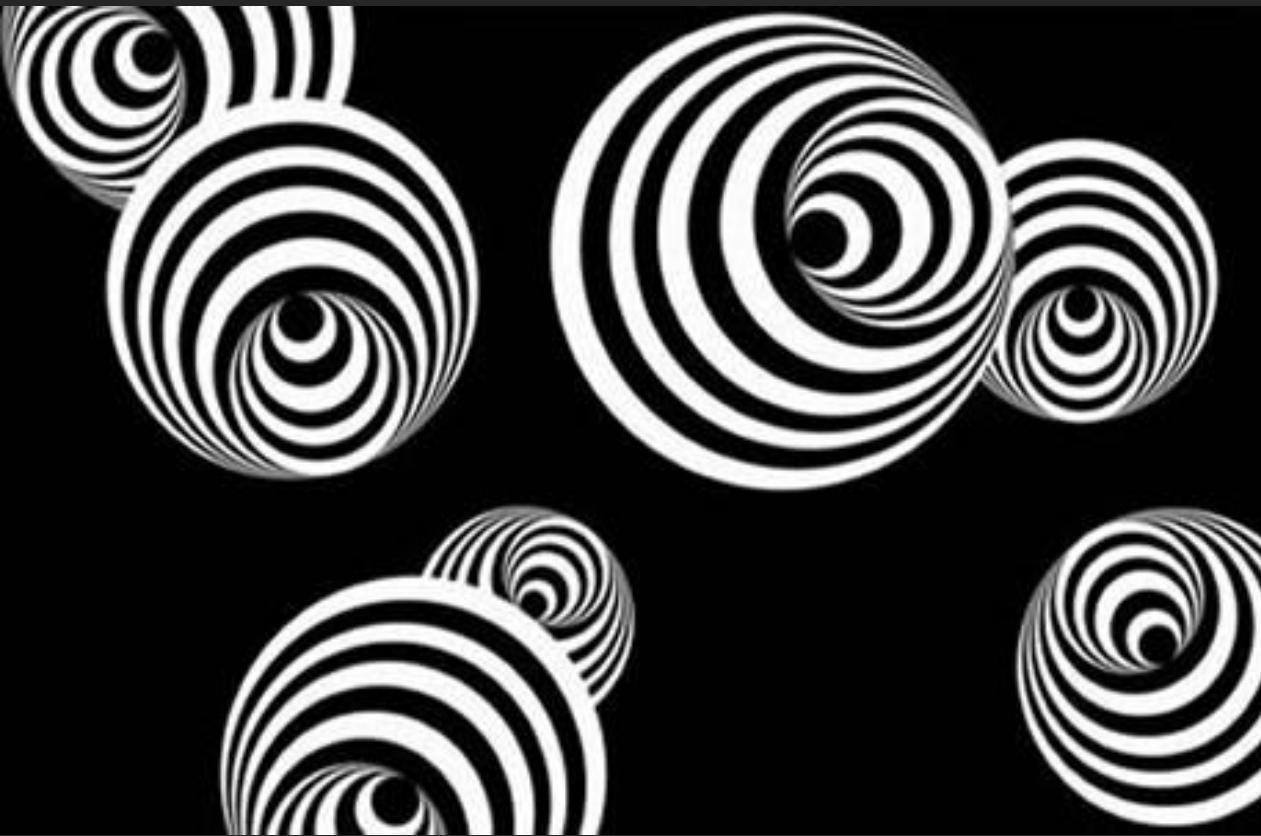
....The interaction of colors based on large contrasts (black and white) or the use of complementary colors





*Vasarely Fondation*





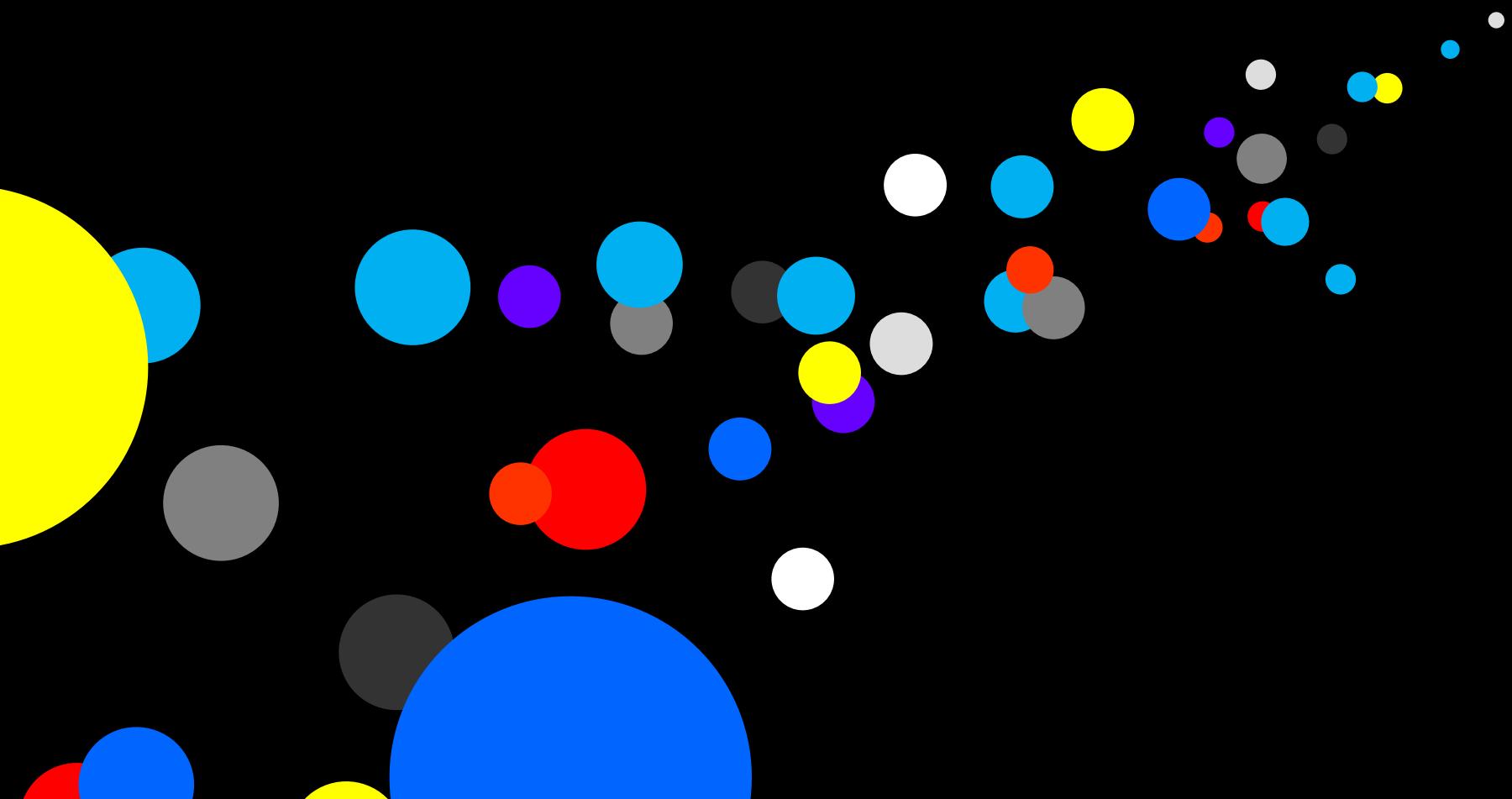
According to René HUYGHE, the period between 1950-60 (Black and White period), that definitively marks Vasarely's work, since by introducing for the first time the suggestion of movement without real movement, it creates a new relation between artist and spectator (**which ceases to be a passive element to begin to freely interpret the image in how many visual scenarios it can conceive**), developing and defining the basic elements of what will be known as Op Art a style and technique that will remain forever linked to its name.

*René HUYGHE . L'ART MODERNE ET LE MONDE. Volume 2.  
De 1920 A Nos Jours*



Point + color  
coloring

**1 + 1 + 1 + 1**





### Point + color

To end the intellectual and cultural emptiness generated by the mass design of industrial society was the proposal of Alessandro Mendini in creating the Proust armchair in 1978. The redesign was meant to end banality by applying bright and extravagant spot colors.

The re-reading of Alessandro Mendini translated Proust's maxim:

**'The true voyage of discovery is not to look for new landscapes, but to have new eyes.'**



point

expressiveness

expression

**1 + z + ⋆ + ○**





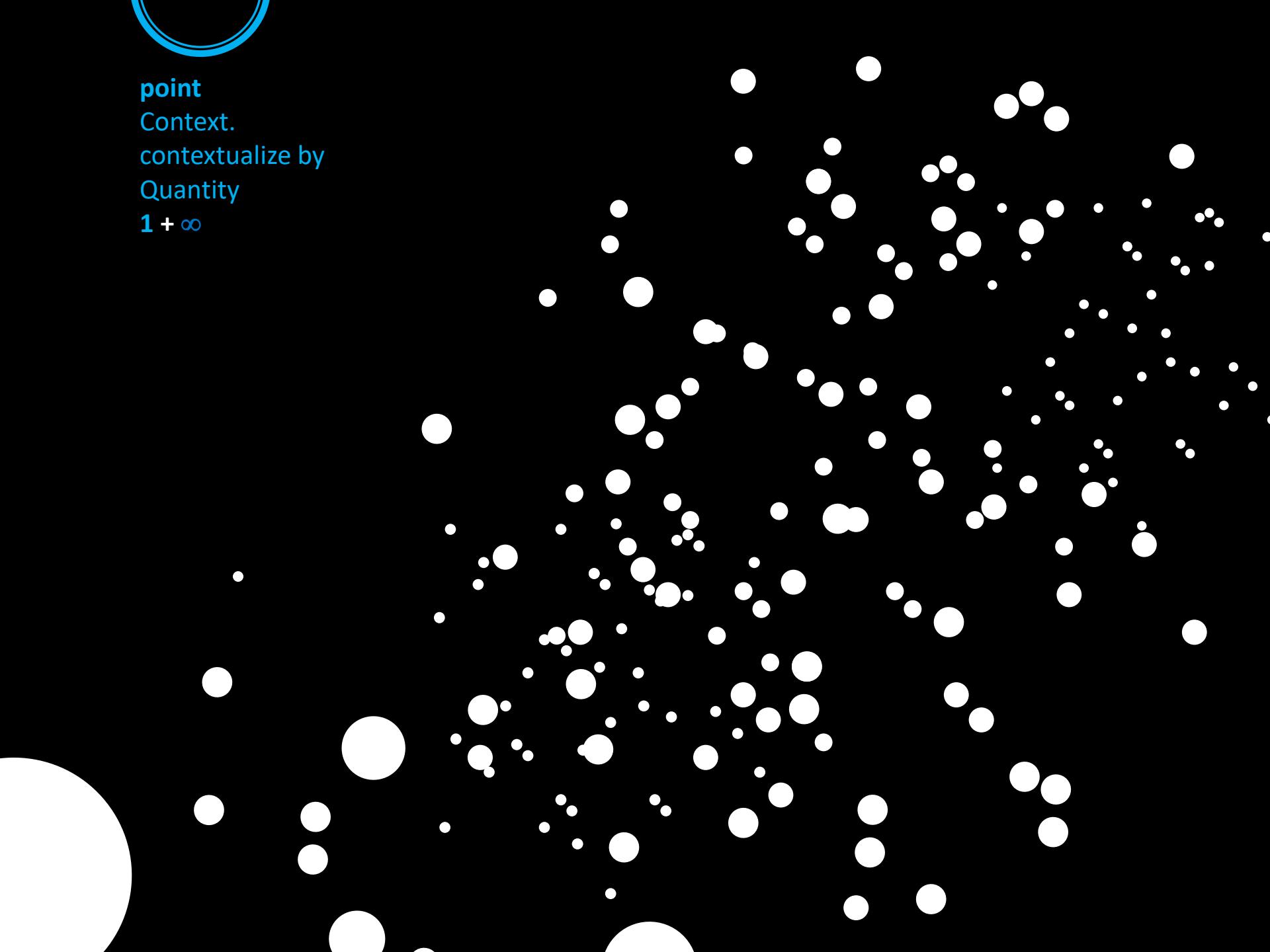
**point**

Context.

contextualize by

Quantity

$1 + \infty$





**point**

Line up . regular linear

**DISPOSITION**

**1 + 1 + 1 + 1**

- + - + - + -





**point**

Line up . **irregular** linear

**DISPOSITION**

**1 + 1 + 1 + 1**

**- + \_ + ^ + -**





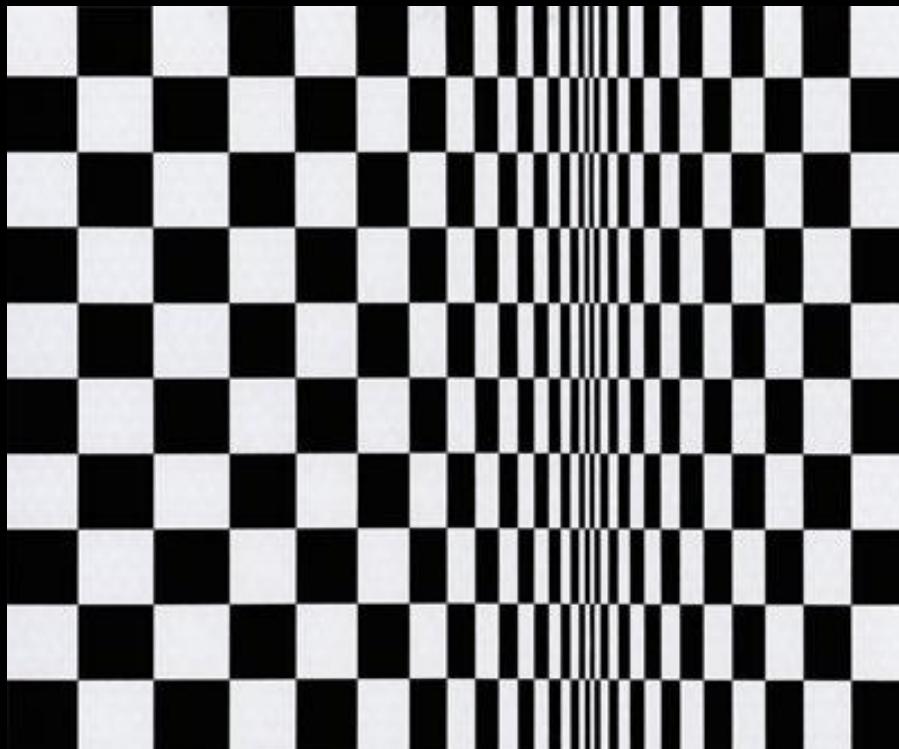
**point**

Line up . disposition

VARIABLE REGULAR LINEAR

**1 + 1 + 1 + 1**

| + || + ||| + ||||



**Bridget Riley**

*Movement in Squares*

1961



**point**

Line up . DISPOSITION

REGULAR STAIN

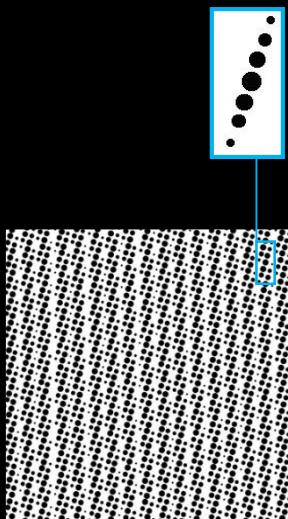
Pattern

Texture

Module

repetition

**1 (1+2+3+2+1)**



**Verner Panton**

during the 60s and 70s,  
interiors anchored in the  
context of radical use of  
color and experimental  
forms.





point

Disposition |condensed  
stain irregular

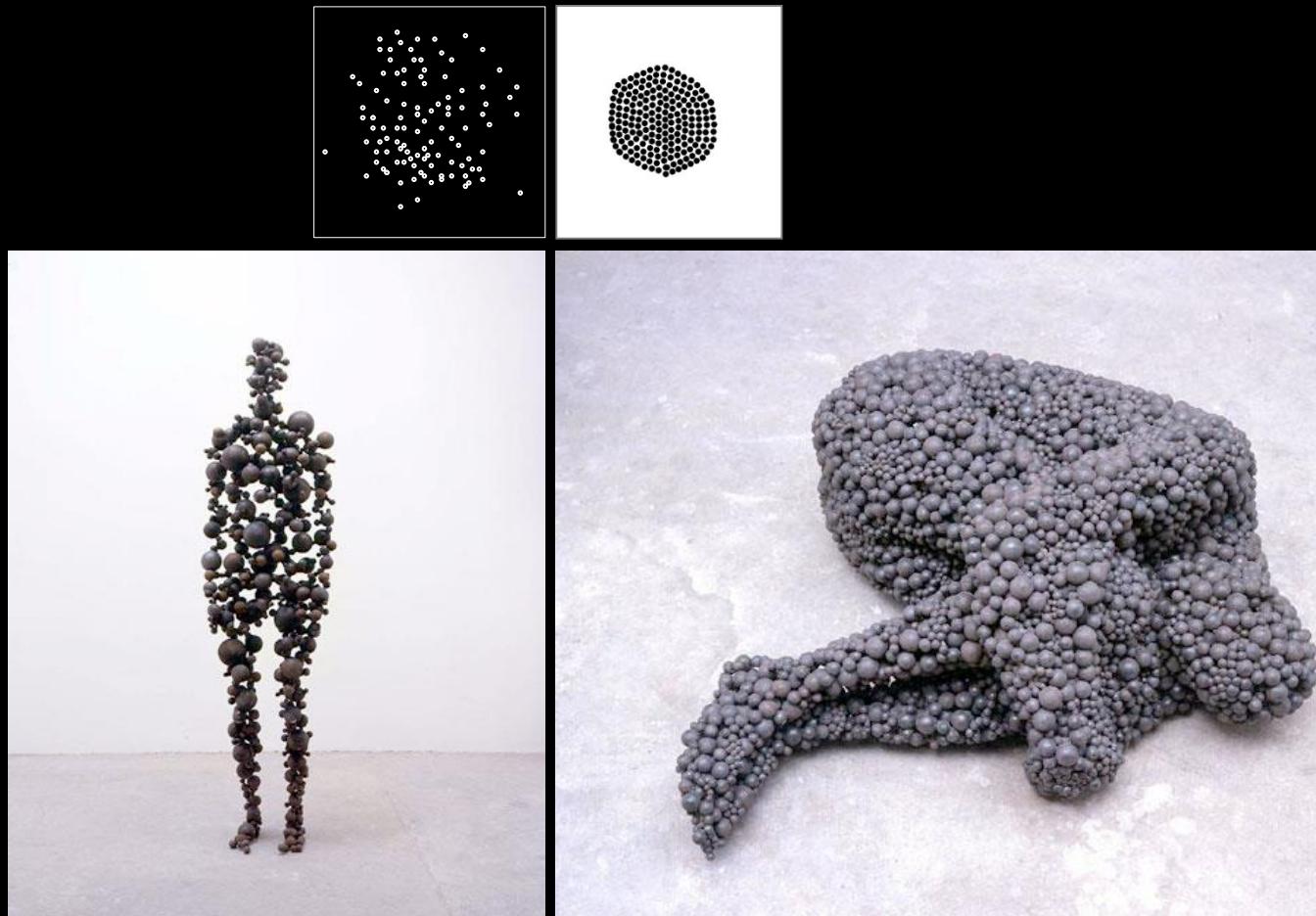
1 + 1 + 1 + 1

| + || + ||| + ||||

Anthony  
Gormely

*Here I am, this is me, this is the limit of my being, I am a body, but I am also a thought. I am a mass, but I am also a space. This is the realm of substance that aspires to the condition of light (and therefore has everything to do with dichotomy / time and particle / wave), but it is also a celebration of the possibility of being able to separate the subtle body of the brut body and somehow intuit an inner attitude or position from the externalized sign.*

on domain field (interview  
with Jorge Mulder)  
Calouste Gulbenkian  
Foundation, 2004, p.5





**point**

disposition

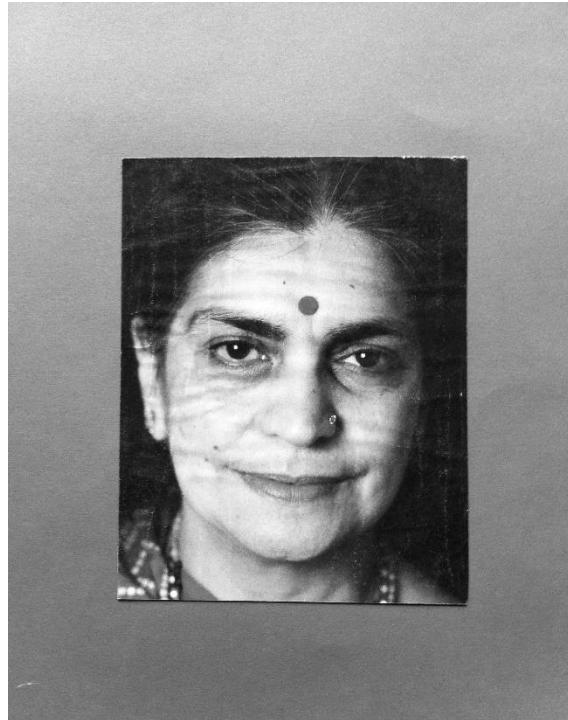
SATURATION

**dispersed**

**Concentrated**

**1 + 1 + 1 + 1**

**| + || + ||| + ||||**



### **J. Casimiro da Costa**

replicate a picture and working  
with points, it's a long  
process...a persistent working  
progress | ink black pen



point

disposition

SATURATION

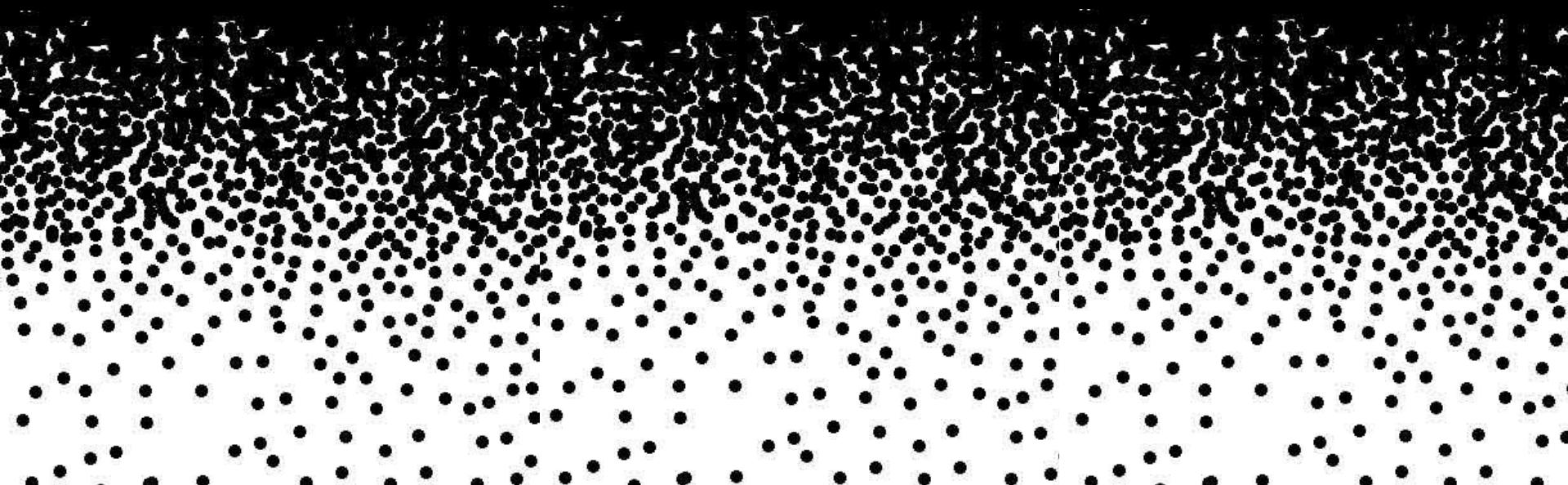
Tonality

1+1+1+1

11+11+11+11

111+111+111+111

1111+1111+1111+1111





**point**

disposition

SATURATION

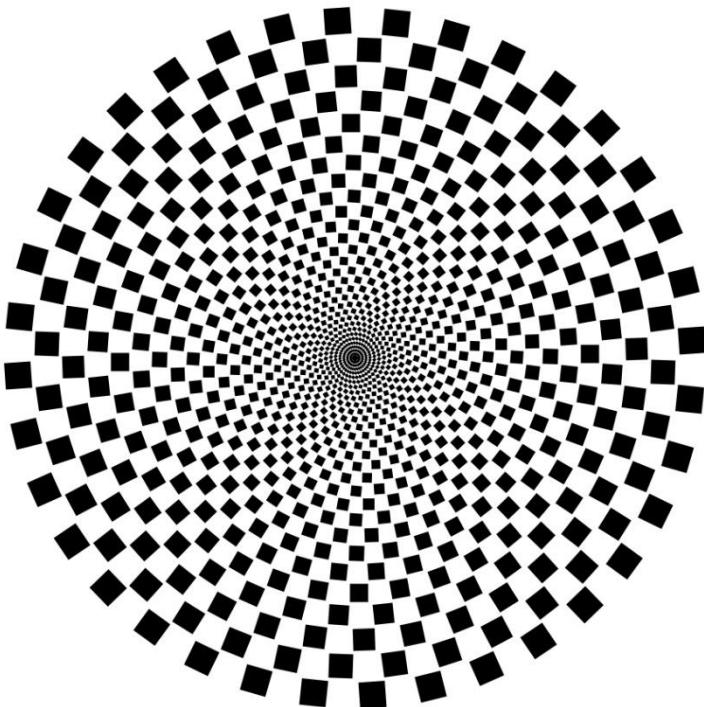
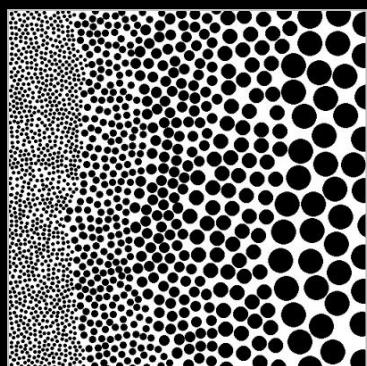
Tonality + **DIMENSION**

**1+1+1+1**

**11+11+11+11**

**111+111+111+111**

**1111+1111+1111+1111**





**point**

disposition

SATURATION

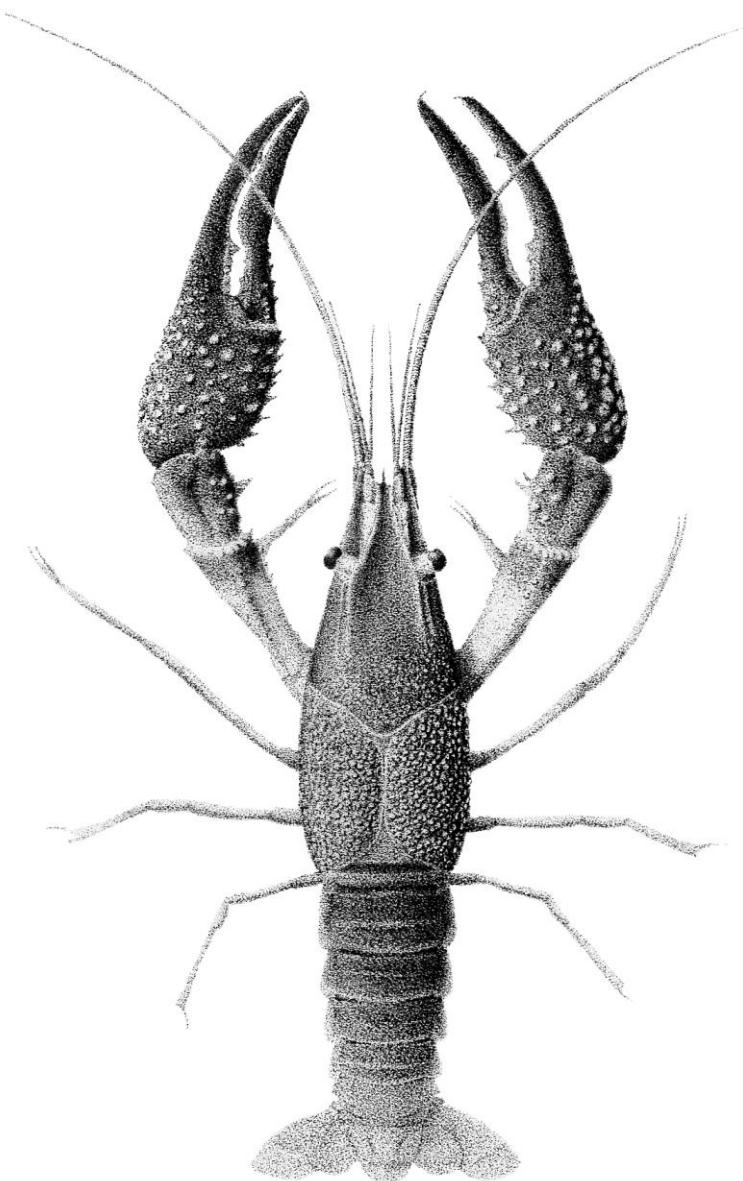
Tonality + **DIMENSION EXPRESSION**

**1+1+1+1**

**11+11+11+11**

**111+111+111+111**

**1111+1111+1111+1111**



## Point + color

Michel Eugène Chevreul (chemical)  
Gobelins tapestries, Paris

In investigating the apparent lack of vivacity of certain paints, Chevreul concluded that the problem was not in the colors, but in the tones that were arranged around him. The colors influenced each other.

"Law of simultaneous color contrast".

Complementary colors are always harmonious with each other, and mutually exalted.

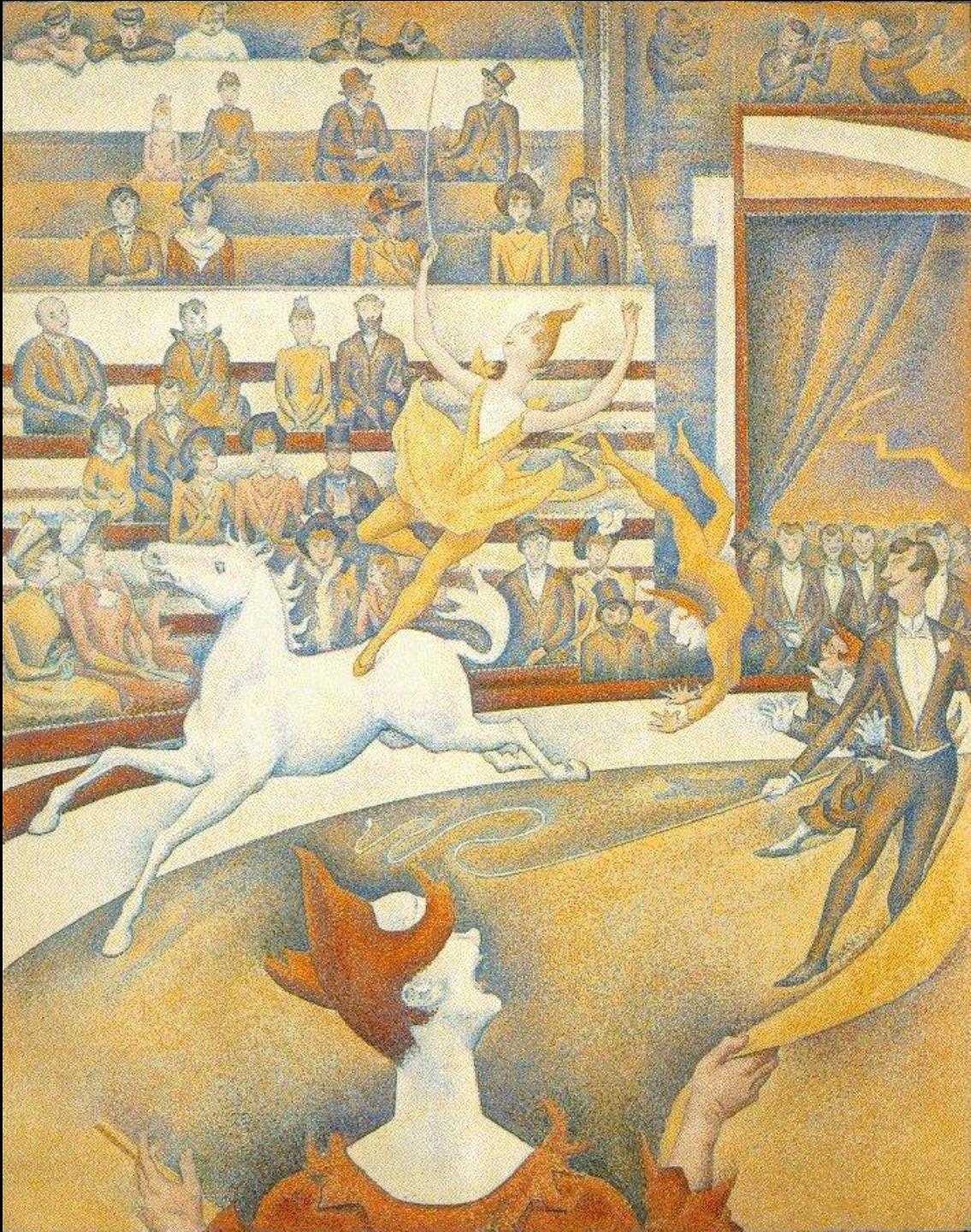
Georges SEURAT

*Le Cirque*

oil s. screen

1891

Neopointillism



## Point + color

Georges SEURAT

pioneer of the pointillist movement  
(taught by Signac) Also: Divisionism.

### pointillism

a technique of painting in which small spots or dots of color cause, by juxtaposition, an optical mixture in the eyes of the observer (image), tonal decomposition

by means of tiny brushstrokes clearly separated, even with the unarmed eye. The colors are separated in their components, so that instead of being mixed as pigments are applied to the screen directly by juxtaposition

Georges SEURAT

*La Baignade*

oil s. screen

1891

Neopontotillism



## Point + color + animation

Dots

By Norman McLaren | 1940

An experimental film in which both sound and visuals were created entirely by Norman McLaren drawing directly upon the film with ordinary pen and ink.

animation  
masterpieces

<https://vimeo.com/32645760>



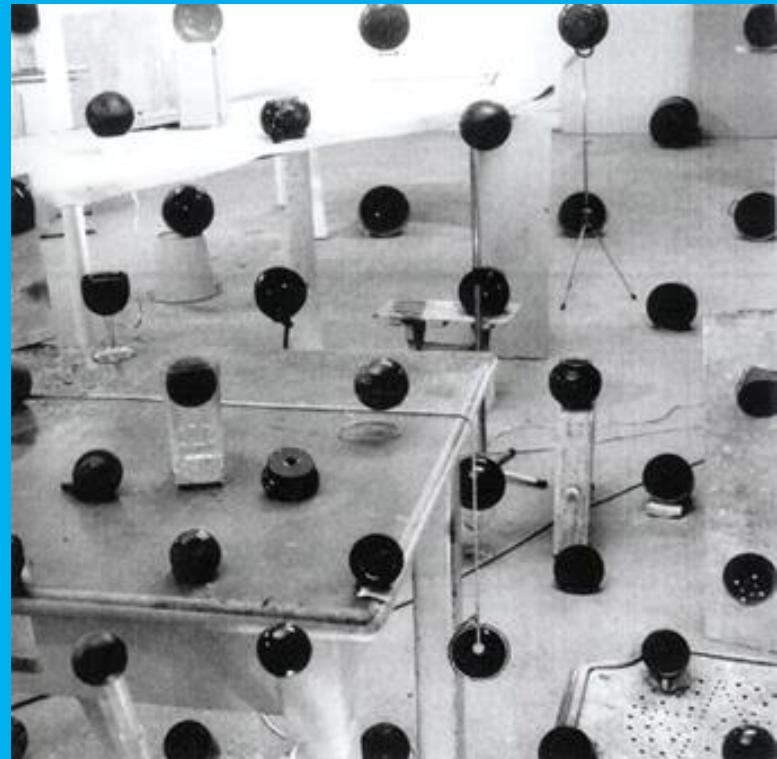
## Point + photography

By Bernard Voïta | Sans titre (1988)

installation contained in the quotidian objects that surround him – coffee cups, hoses, chairs, lamps and paint. Daily life paraphernalia as perceptual containers of domesticity and humanity... Expressions, curiosity, ingenuity transform photography in a new perception of space + points

<http://www.artefake.com/Bernard-VOITA.html>

<http://www.typetoken.net>



## Point + color + movement (Kinetic) + balance

'mobiles' Calder's light sculptures  
cutout shapes derived their movement from the air current

"Among all the artistic 'innovations' that came about after the Great War, Calder's line was so distant from any established formula, that there was a need to invent a new name for his forms in motion: 'mobiles'. He called them mobiles. In their treatment of gravity, disturbed by gentle movements, they give the feeling that "they carry pleasures peculiar to themselves, which are quite unlike the pleasures of scratching," to quote Plato in his *Philebus*.

"they seem to 'cry their own particular pleasures. A light breeze, an electric motor, or both combined in the action of an electric fan, can set in motion a series of weights, counterweights, and levers that draw unpredictable arabesques in the air, producing a lasting feeling of surprise. Once color and sound join the party, the symphony is complete and all our senses are called to follow the invisible score. Pure *Joie de vivre*, Calder's art is the sublimation of a tree in the wind."

Marcel Duchamp, about  
"Alexander Calder," Collection of the Société Anonyme  
(New Haven: Yale, 1950)

<http://www.calder.org/life/historic-films> with John Cage Music  
<https://vimeo.com/159040106>



**missing**

# line

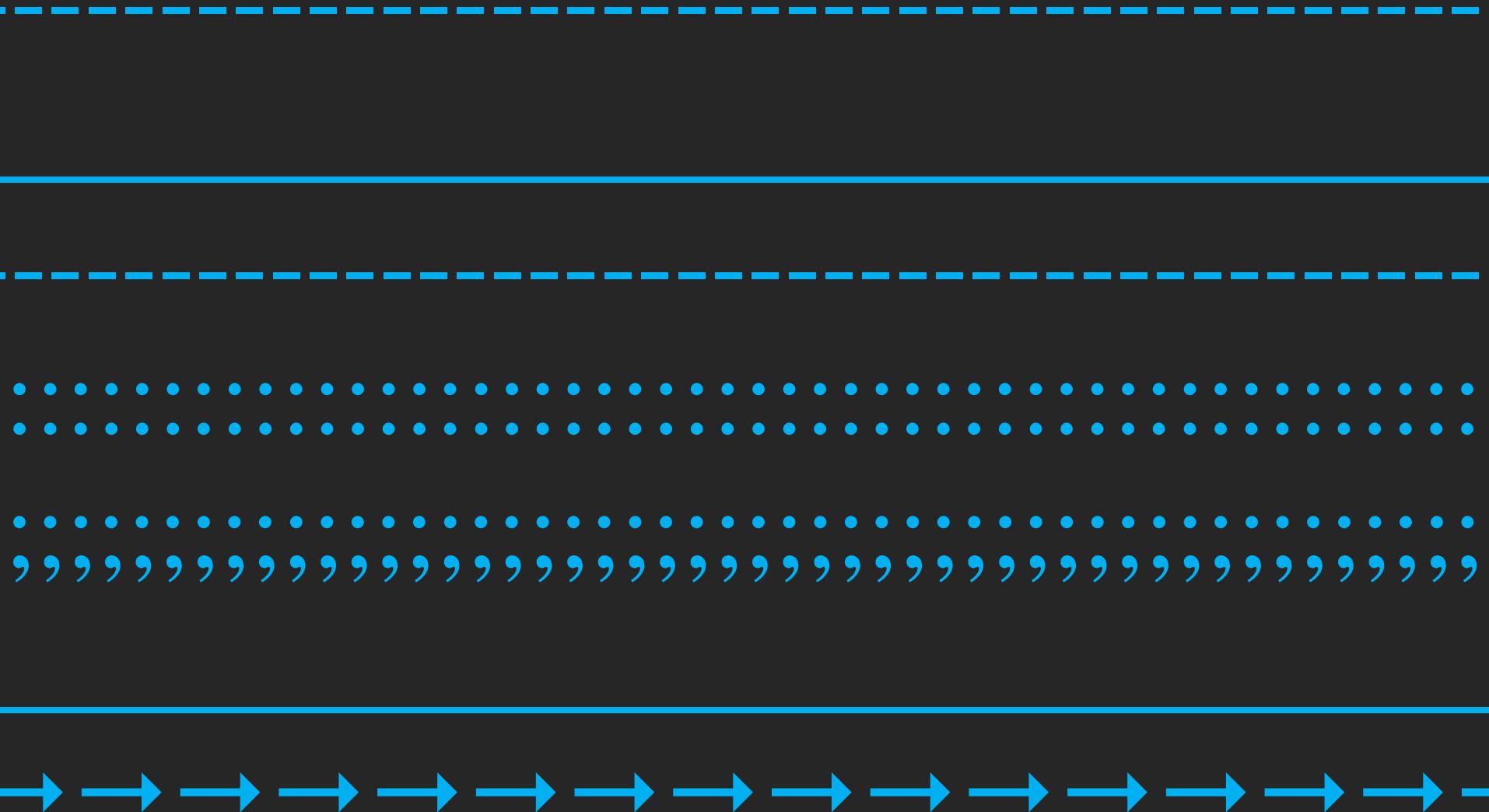
*'The geometric line is an invisible being. It is the path of the moving point, so it's your own product. It was born from the movement, annihilation of the supreme immobility of the point. Here we make a leap from the static to the dynamic. The line is therefore the greatest contrast of the original element of the painting which is the point.'*



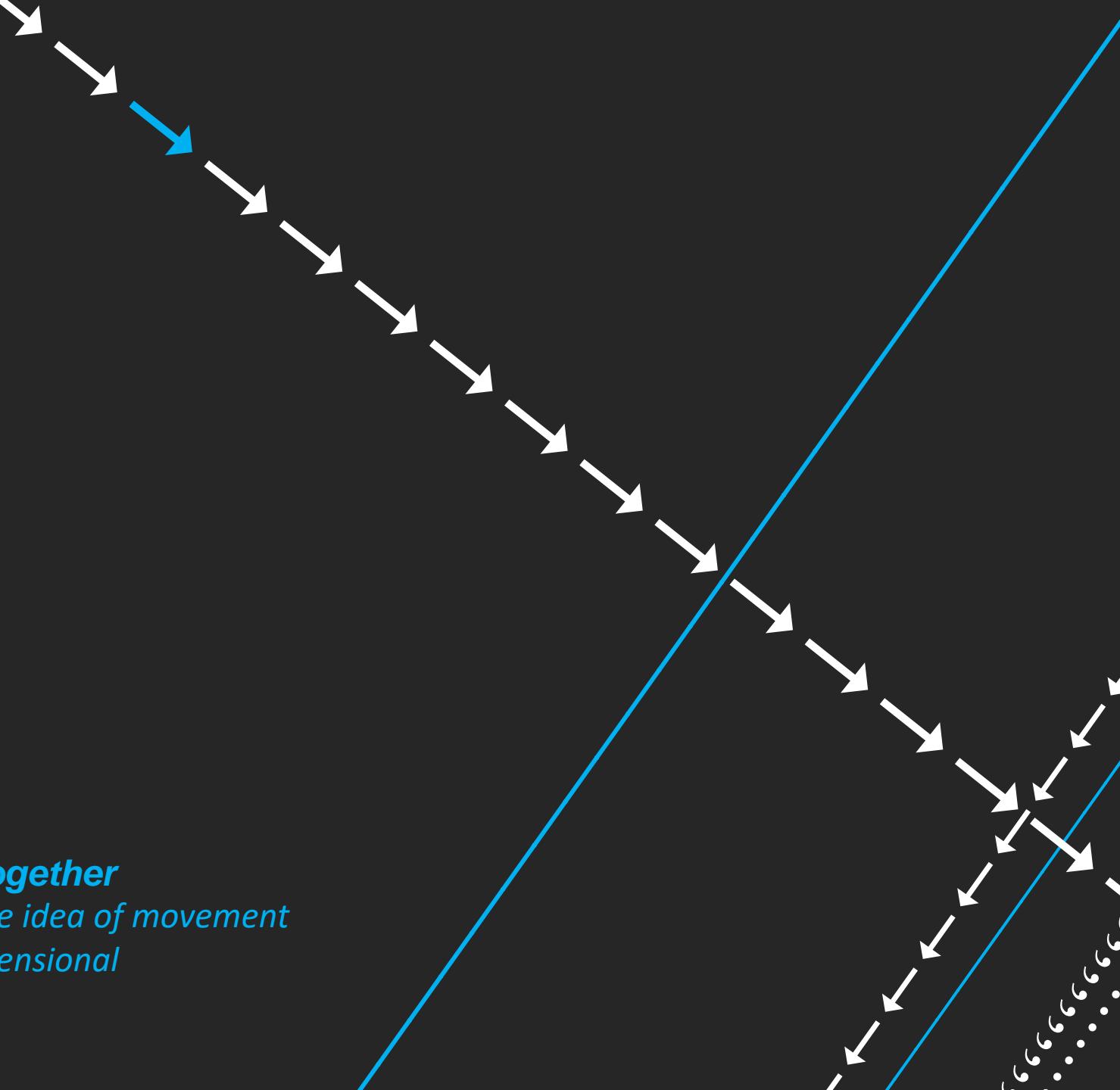
*'The outer forces that transform the point in line can be of very different natures. The diversity of lines depends on the number of these forces and their combinations, creating tension and direction'.*

Point, line to plane, Kandinsky | 1926

[https://archive.org/stream/pointlinetoplane00kand/pointlinetoplane00kand\\_djvu.txt](https://archive.org/stream/pointlinetoplane00kand/pointlinetoplane00kand_djvu.txt)



line



**single + together**  
*produces the idea of movement*  
*it's one-dimensional*

lineee

**line**

**Shape**

- - -

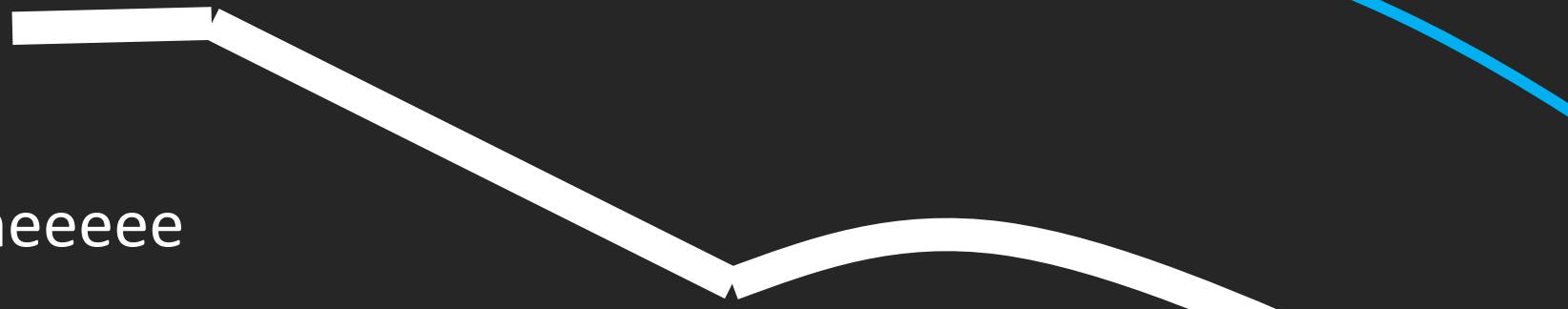
^ ^ ^

~ ~ ~

~ ^ \_ ^

STRAIGHT  
BROKEN  
CURVE  
MISCELLANEOUS

lineeeee

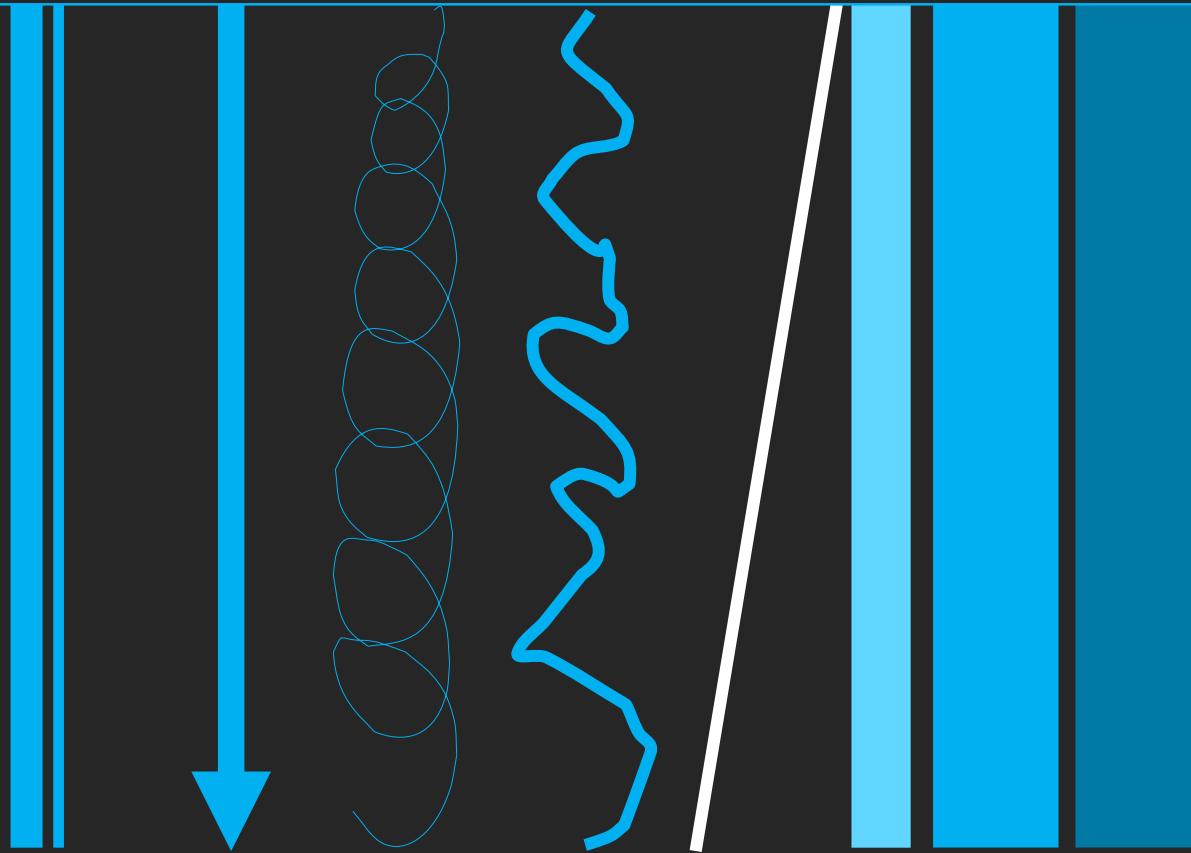


# Line Dimension Length

width  
Thickness  
volume  
Reading + direction  
Ascending + tension  
Regular  
tonality

## Disposition in relation to space.

# Vertical. Horizontal. Diagonal



## expressivity | expression



## Line + steel

*'The body always resounds its parts, its faults, its pains, to the point of being reduced and confused with them, the body is a reservoir of energies of attraction and repulsion in constant dramatic play, capable of representing all the characters , until the point of identifying with them and consuming themselves with them (...)'*

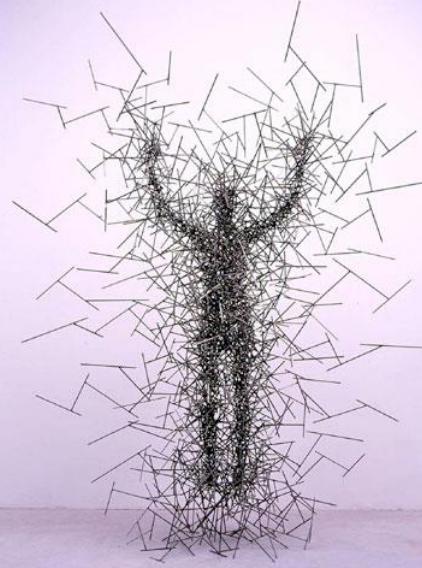
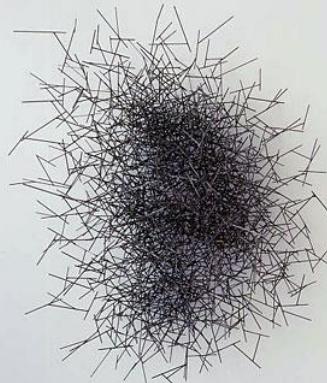
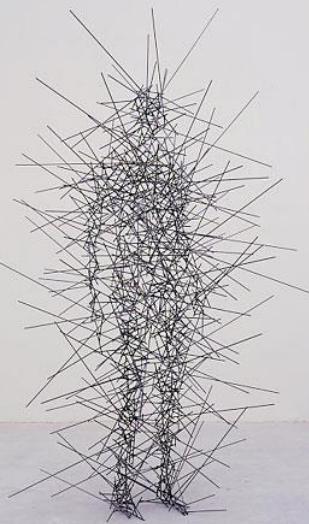
in Mass and Empathy

**Antony Gormley**

Fundaçao Calouste Gulbenkian

2004

Maria Filomena Mulder





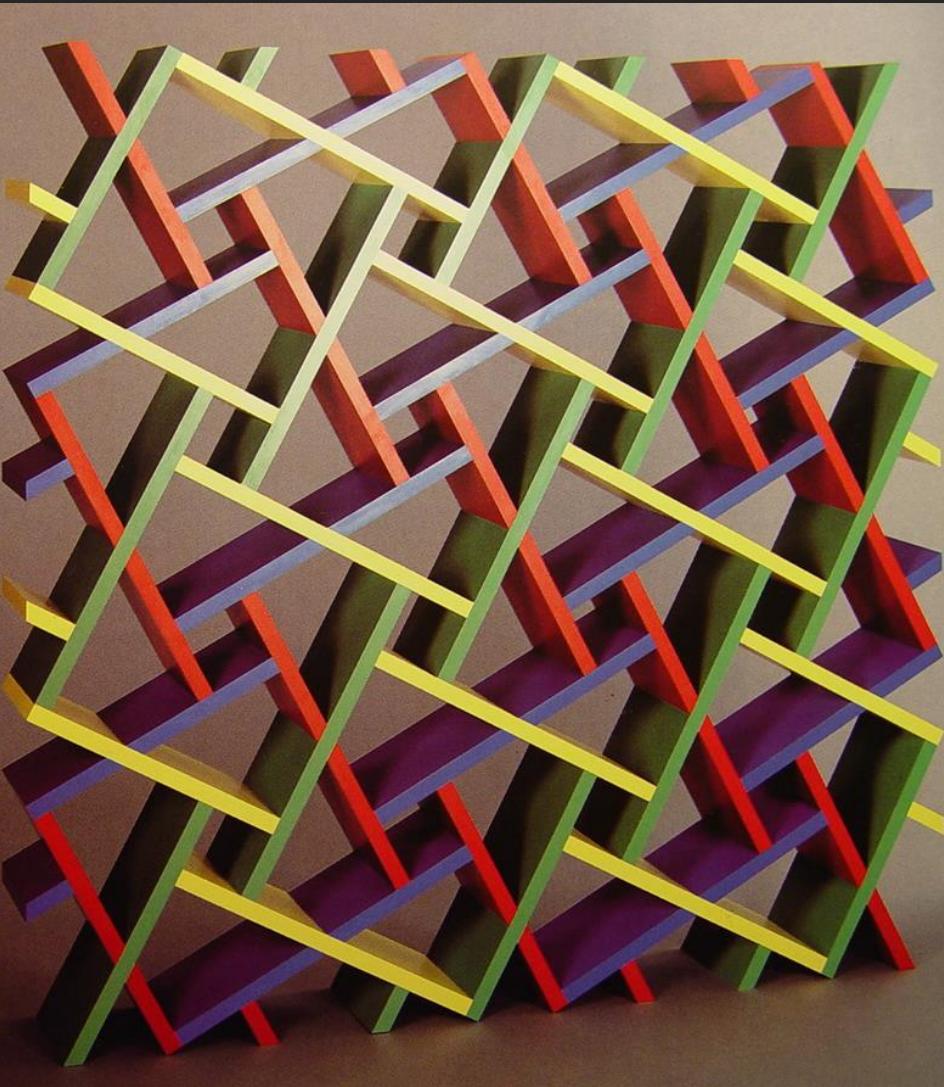
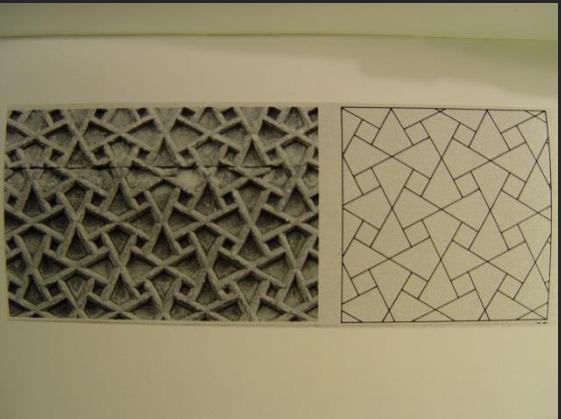
Line + mimicry  
**VASARELY**  
Zebras





## Line + shelf

Shigeru Uchida  
design japan  
bookshelf



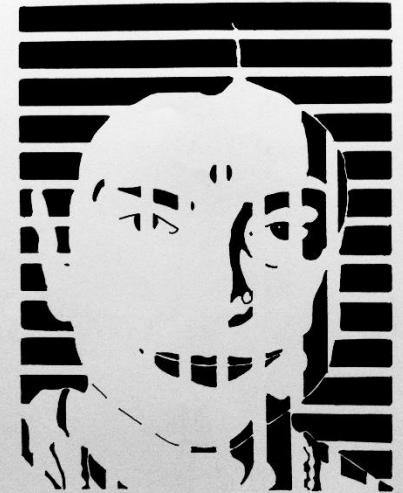
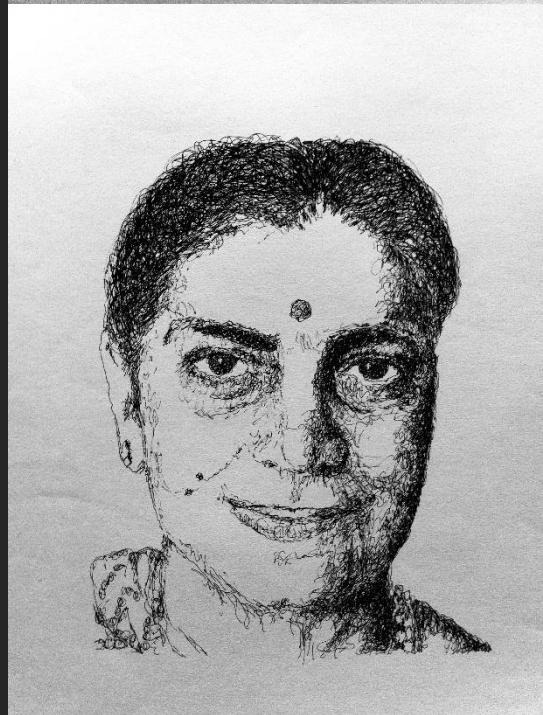
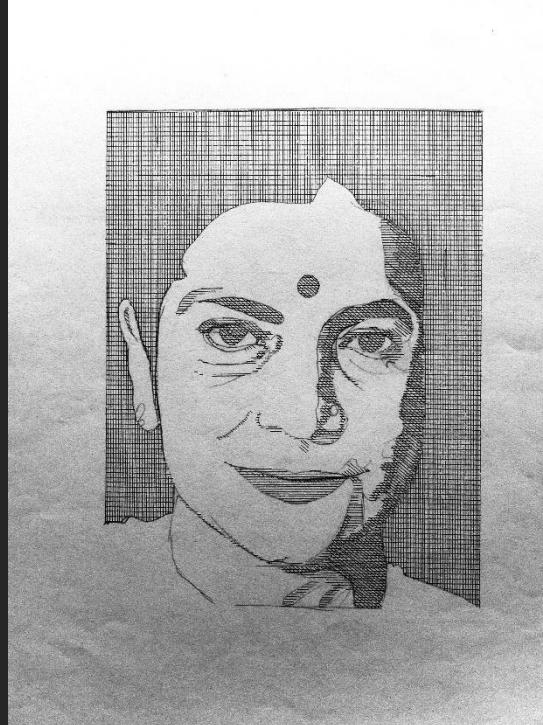


## Line

disposition  
dispersed  
Concentrated  
**Irregular**  
Regular  
Vertical  
Horizontal

### J. Casimiro da Costa

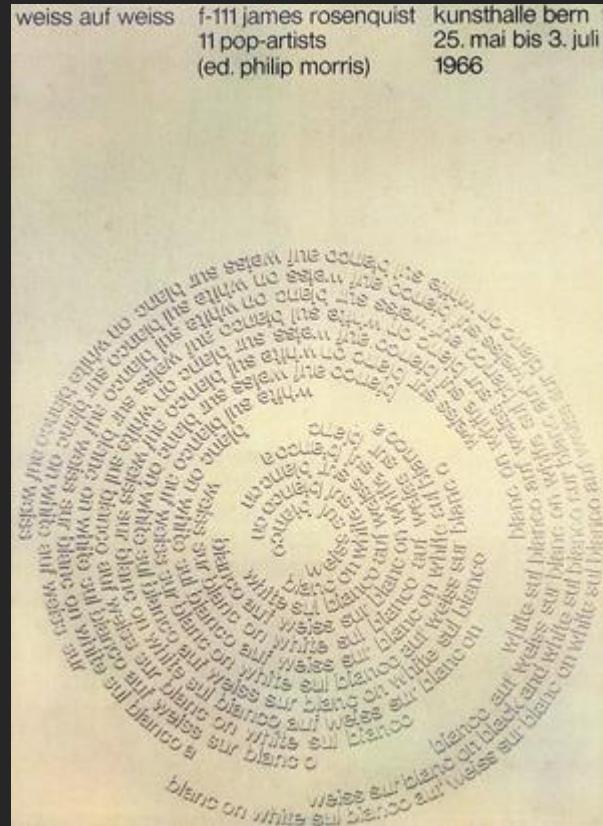
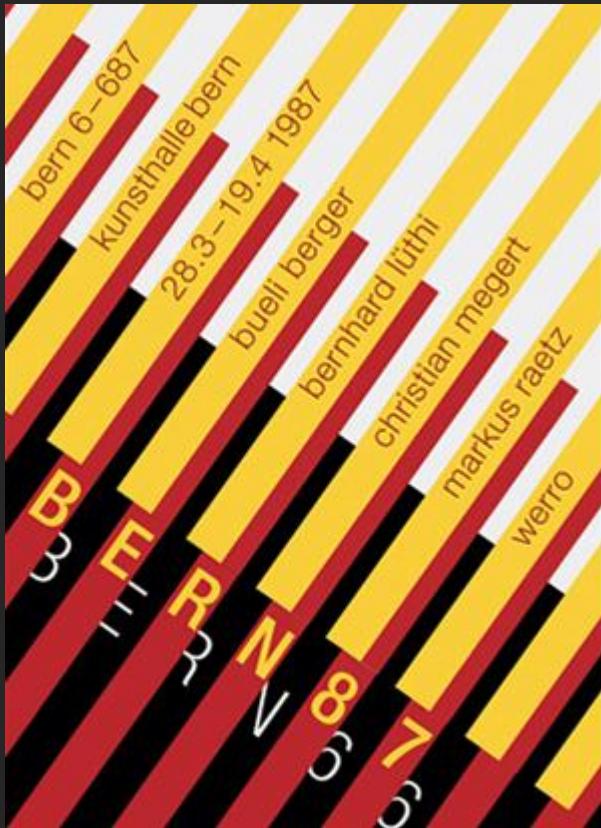
replicate a picture and working  
with points, it's a long  
process...a persistent working  
progress | ink black pen



# Line

Peter Megert

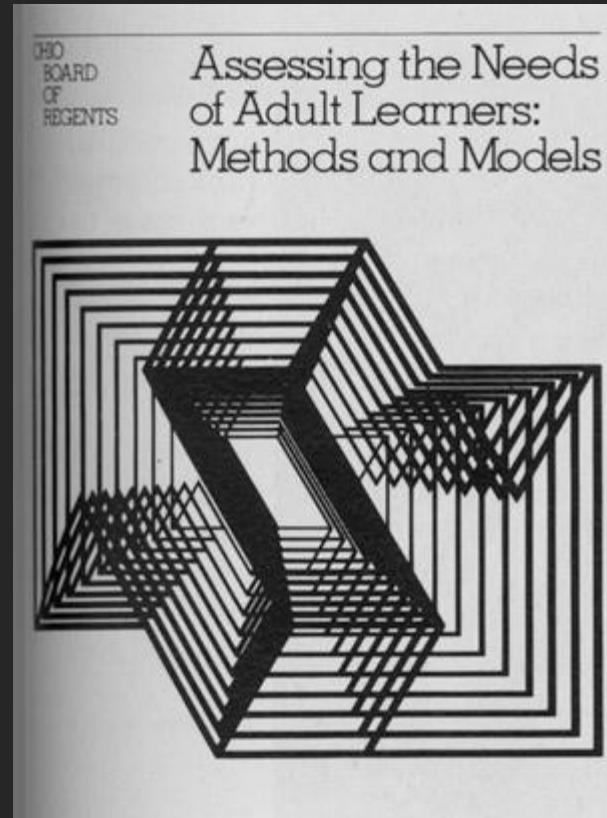
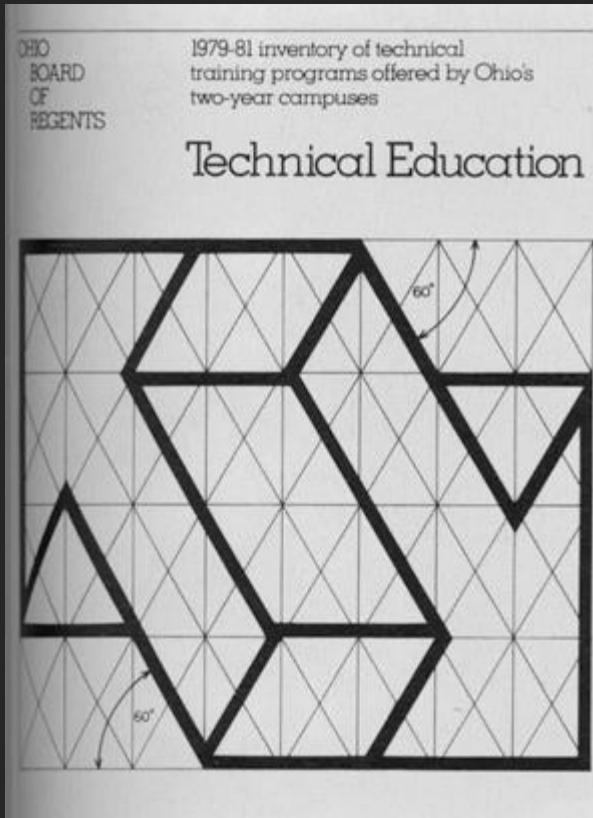
swiss design, typography  
Berne, Switzerland.



# Line

Peter Megert

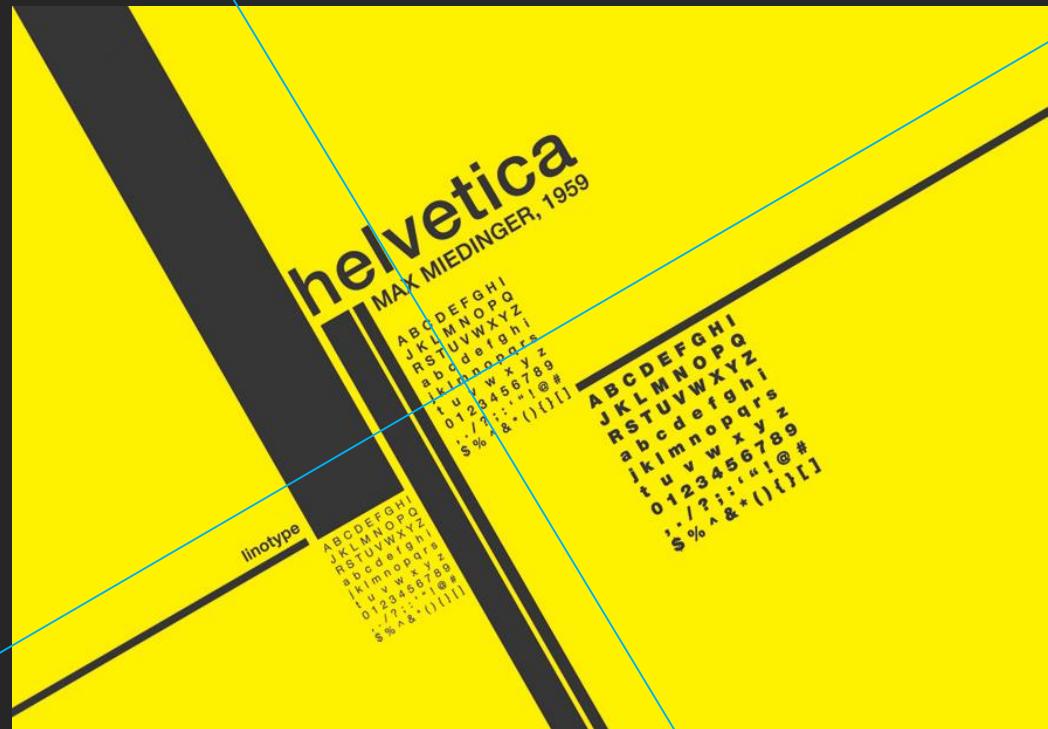
swiss design, typography  
Berne, Switzerland.





## Line

Helvetica | 1959  
Max Miedinger  
Swiss typographic legacy



Line

Helvetica | 1960

film

[mhttps://www.youtube.com/watch?v=chXbq2tTlI0y](https://www.youtube.com/watch?v=chXbq2tTlI0y)

I went to  
see Helvetica  
and all I got  
was this  
beautiful  
typographic  
poster.

**HELVETICA**

A documentary film  
by Gary Hustwit

Rochester Institute  
of Technology  
Webb Auditorium  
11 May 2007  
Friday 17:00

**FILM Q & A**

Hosted by  
Erich Lehman  
School of Print Media

**FEATURING**  
Gary Hustwit  
Director of Helvetica

Charles Bigelow  
School of Print Media

Ryan Clifford  
School of Design

Heinz Klinkon  
School of Design

**SPONSORS**

School of Print Media  
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## Line

### F.H.K Henrion

Henrion Design Associates, focusing in corporate identity, poster exhibitions, packaging, magazine and book design.  
notable work:

KLM (Dutch airline)

Title: Design Coordination and Corporate Image by FHK Henrion and Alan Parkin  
1967



## Line + animation 1

*Lignes verticales / Lines vertical*

**Norman McLaren | 1960**

Film expérimental

Normand McLaren and Evelyn Lambart.

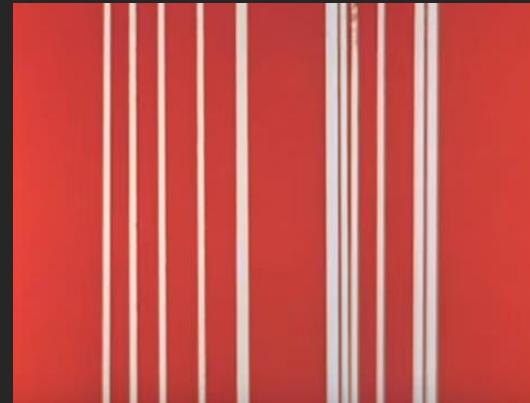
soundtrack composed

by **Maurice Blackburn**

animation

**Masterpieces**

<https://www.youtube.com/watch?v=LnbaVAYULUU>



## Line + animation 2

*Tragic story with happy ending*

is a Portuguese animated short film

**Regina Pessoa | 2007**

soundtrack composed by

**Normand Roger.**

2007.

animation

**Masterpieces**

<https://www.youtube.com/watch?v=NY9UrvKS4ug&t=68s>



## Line + Kinetic and Op Art + movement

Sculpture, *Pénétrables*

*Jesus Rafael Soto*

1957

Venezuela

*'In Jesus Rafael Soto's work, this interim perspective on the abstract object, or 'non-form', as a play of spaces and sensations, emphasizes the work of art as practice, as participatory intervention. Thus, the observer leaves his or her frontal place to be part of the experience of that same space. Perception, according to the same author, leaves (...) from the inside and not from the front: there are no spectators anymore: there are only participants. The Pénétrables with its constant movement of the image from the movement of the spectator, translates a kineticism into the apparent mobility of a world: Soto's revision is adapted to the principle according to which, thanks to the two-dimensionality of the planes, can transform the visual point of the eye that no longer addresses a single dominant point (as in the classical perspective), but one that encompasses the whole of the work without being fixed on a particular optical reference center.'*

CCC

Costa, Carlos Casimiro da (2004) - Engenhar, o engenho: a razão prática duma engenharia inversa: a interpretação da cultura do design em culturas periféricas. Porto: FEUP.

<https://ipb-pt.academia.edu/CarlosCasimirodaCosta>





## Line

Mikkel Koser | o k d e l u x e

### United Nations Climate Change Conference

*The software control panel allows for many different configurations. It can save 10 preferred settings and has the ability to animate between them to tailor the evolving animation.*

<http://www.okdeluxe.co.uk/cop15/>

<http://www.shiftcontrol.dk>

<http://openframeworks.cc/>

The software control panel allows for many different configurations. It can save 10 preferred settings and has the ability to animate between them to tailor the evolving animation.



# step for a break

Ron Carmel and Kyle Gabler | 2006-09

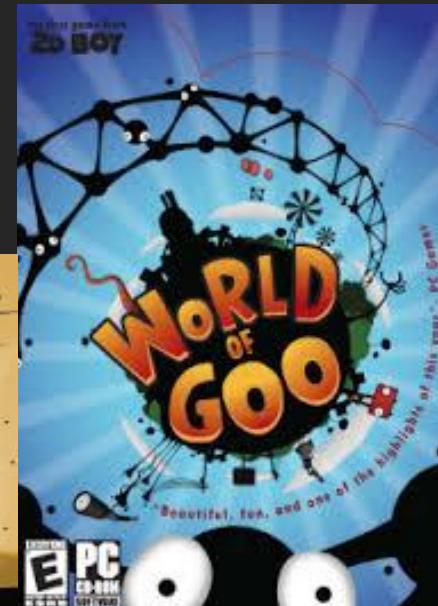
World of Goo  
puzzle video game  
developed and published  
by independent game developer **2D Boy**

*the player must use the goo balls to construct bridges, towers,  
and other structures to **overcome gravity** and various terrain  
difficulties such as chasms, hills, spikes, windmills, or cliffs.*

soundtrack by Kyle Gabler

released in 2009

<http://2dboy.com/games.php>



**missing**

**missing**

- Mesh
- Anem0na  
malusinh0s



# AAAA

Structure Concepts . 2d

Book 's

**Munari, Buckminster, Leonardo, Pierce...**



## Exploration

Describe the activities/ inquiries/probes/tests the target group performs in the exercise:

### ***Students:***

**2d**

**draw and think**

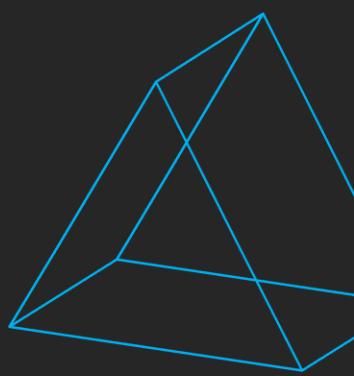
A. create a triangle dimension . Draw and observe elements from nature.

AA. create a triangle dimension . generate triangles structures and modules . Drawing

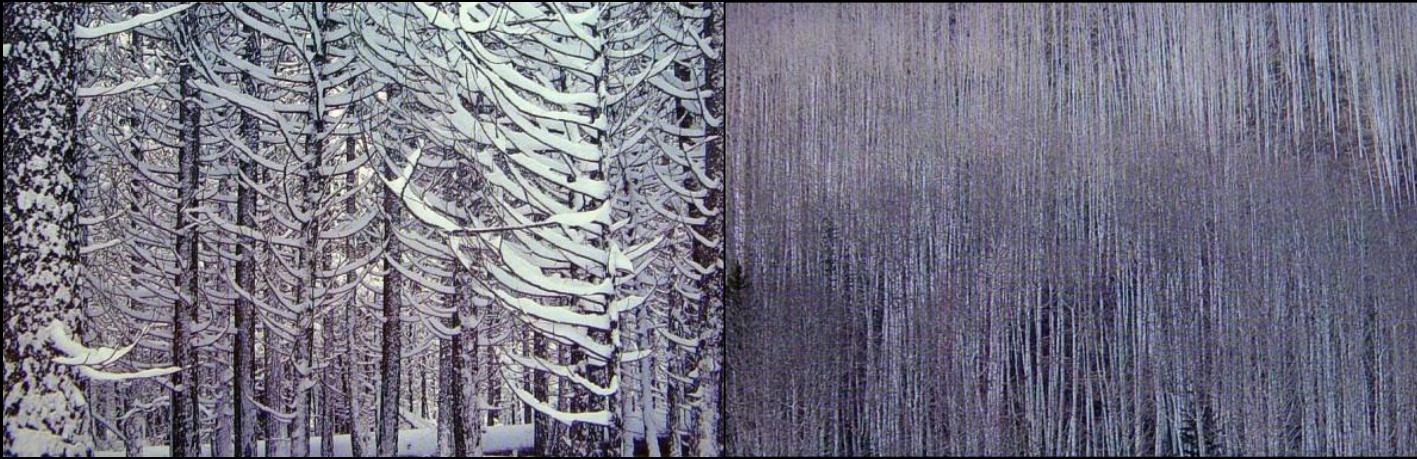
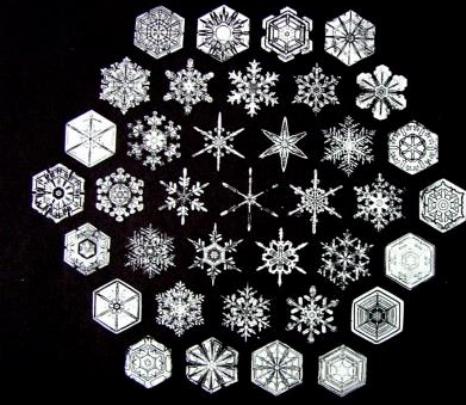
AAA. Transfer patterns drawing to 2d software. Create position.

AAAA. Explore natural tints . transfer modules and patterns to textil through printing , direct drawing or lab serigraphy

(example: T-shirts)



between 2d | 3d



# step A

- Struggle for pleasure
- The forest

Wim Mertens |

<https://www.youtube.com/watch?v=lO2LDx8lagc>

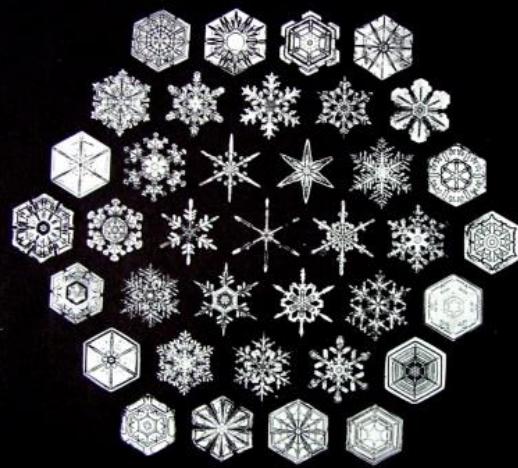
The Cure | 1992

<https://www.youtube.com/watch?v=hnVldyHRcjU>

# Path to nature

**nature** creates shapes and structures according to the requirements of use,... through **minimum energy consumption**, resulting in a diagram of forces interacting through a particular sense in which the action of force or energy tends to fulfill the conditions of use by at least effort. This is, ... forces that result from this administrative question of nature applied in the idea,... that with the maximum of **diversity of forms** through the **minimum of invention..**

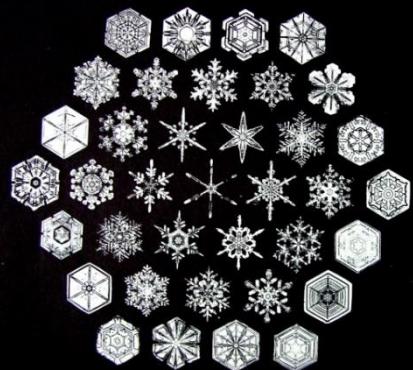
Leonardo, Fuller, Pierce, Munari



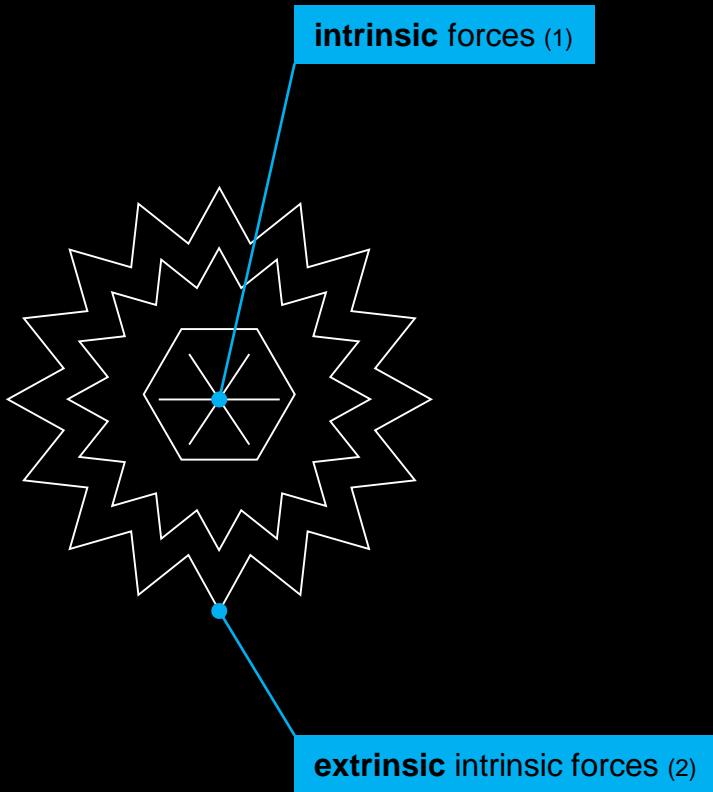
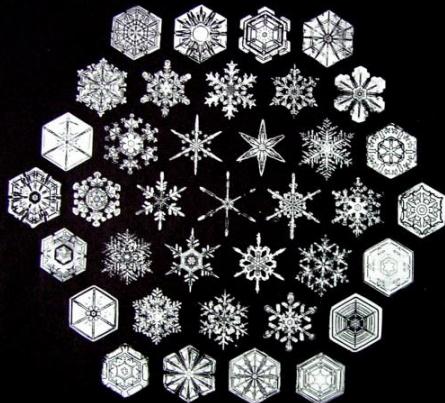
# Path from nature to artificial

In a **design principle**, we can consider and compare a molecular structure with a building system or an object, which is responsible for the actions and the forces that interact, placing above all the possibility of generating and fulfilling needs for man by means of change, adaptation and diversity, ...in an attitude where the use of natural resources must be questioned, minimized and, as such....**conservative**.

# Artificial concepts through mimicry



# path A . nature | concepts



According to Pierce...*a force can be considered as any factor that can act from the inside out or vice versa, determining any form. The shape of any structure is determined by the interaction of two fundamental classes of forces:*

- (1) **intrinsic** forces
- (2) **extrinsic** forces

**'Intrinsic forces are those that regulate and manage any system of structures, that is, the internal properties of a system that governs its combinations and their possible performance. In the case of the image of snowflakes is its molecular structure which results in the character and nature of its variety of texture that determine the shape and its intrinsic strength'.**

Pierce



# nature . concepts

*Structure in Nature is a Strategy  
for Design*

1980

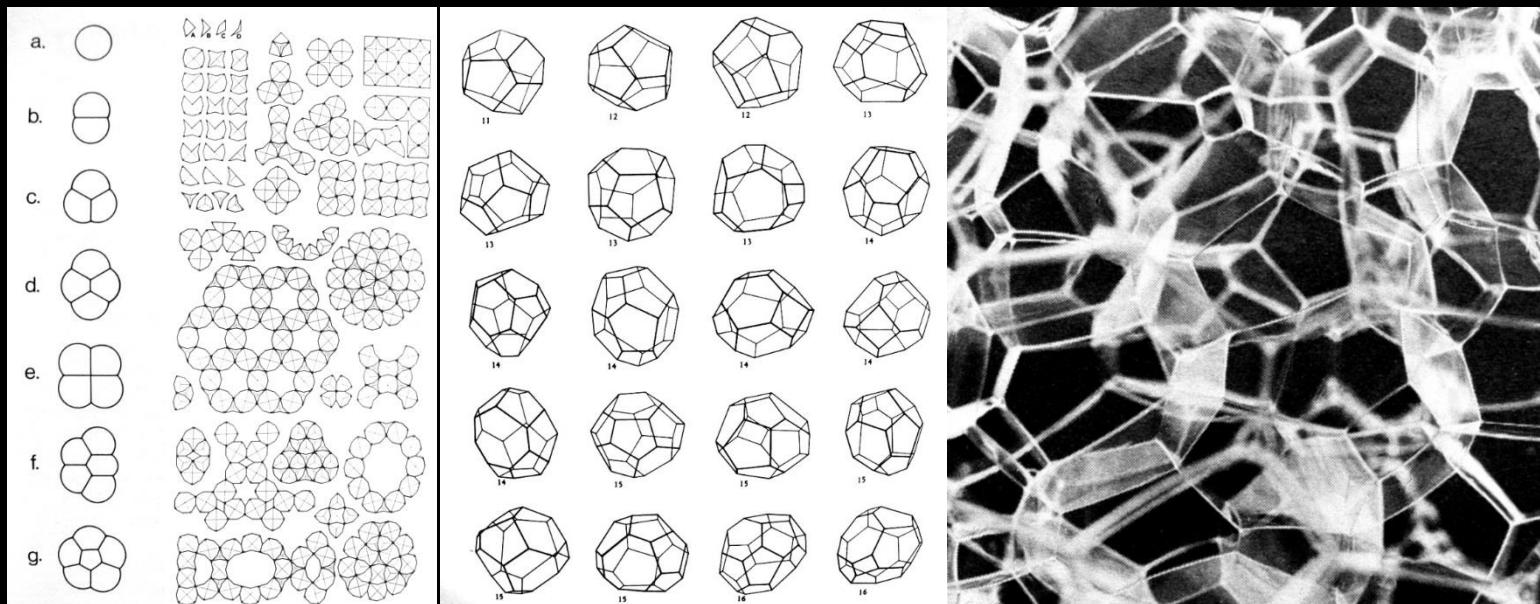
by Peter Pearce

<http://www.pjpearcedesign.com/>

## According to Pierce

The interaction of intrinsic and extrinsic forces to produce in nature is relatively understandable in the case of inanimate crystals, as interactions tend to be dominated by phenomena of psychology and geometry, the process is much more complex and evasive as the person examines its biological form and its structure. The division between intrinsic and extrinsic forces is not always clear and tends to be **hierarchical**. That is to say, if we put on a scale a force can be considered extrinsic, but in a larger context, the same force can also

become intrinsic. This hierarchical phenomenon exists for inanimate and animate structures. For example, a given molecular structure may constitute an intrinsic system of forces that controls the choices of possible crystalline cells by shaping them when they are in association with other cells, and the environment formed by contiguous cells is an extrinsic force that determines which can take the shape of the cell. The **interaction** of the extrinsic force with the intrinsic force thus forces the molecule and determines the shapes of the cells in a given order.



**'extrinsic forces are those whose influence is external to any structural system. These are the corollary of several factors, especially environmental factors, which give rise to and allow combinations of forms, resulting in the properties of a system of structures. For example if we speak of our image of snowflakes the extrinsic forces are those that result from the environmental factors described above and interacts with body molecules and with the structure,... modifying it and synthesizing its form in a species of geometric hexagonal form...'**

Pierce

"the eye of a fly, a sunflower, a crystal of quartz, corn, a pine cone, a beehive are shapes modeled in four dimensions, considering that time is the fourth dimension.

I think that, for example, the alveolus that forms the hive at the beginning is not hexagonal, but cylindrical; the hexagonal shape arises from the compression that occurs when in a limited space the largest number of cylinders must be placed. Here the fourth

dimension may be the transformation of a round base module into a hexagonal base module. The same happens in the transformation of the plastic modules of the corn that assume a shape similar to the cube, whereas in the sunflower the seeds, due to their arrangement according to a logarithmic spiral, assume a form whose section is rhombic ... "

Bruno Munari

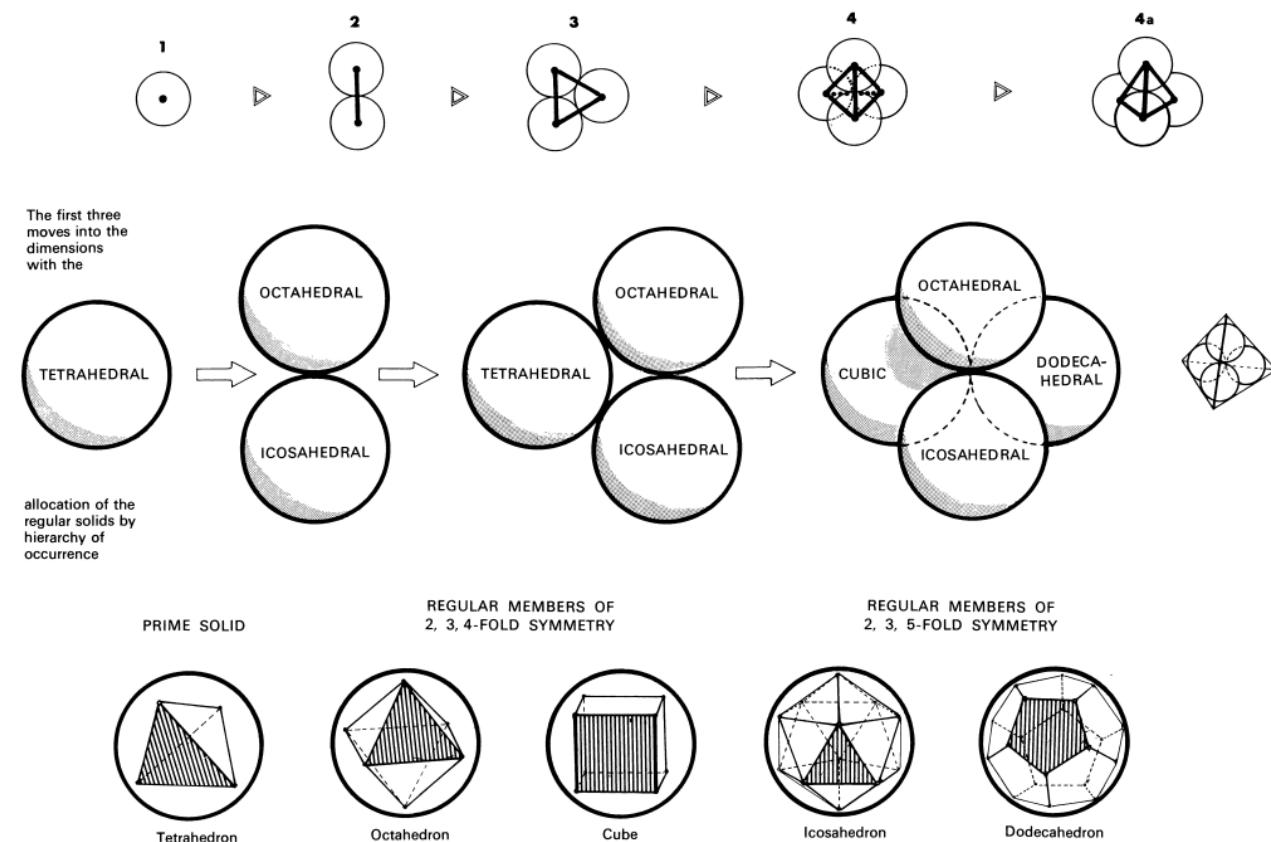


# concepts

Order in Space  
by Keith Critchlow  
1969

<https://archive.org/details/OrderInSpaceDesignSourceBookByKeithCritchlow>

If a point moves in an unchanging direction, from a starting position, a trace of its path describes a 'line' – the so-called first dimension, 1. Moving the 'line' in any other than the first direction describes a planar trace – the so-called second dimension, 2. The trace of the third change in direction describes a 'solid' – the so-called third dimension, 3.



# concepts

*Order in Space*  
by **Keith Critchlow**  
1969

<https://archive.org/details/OrderInSpaceDesignSourceBookByKeithCritchlow>

The top line of sketches is a visual reminder of the process adopted in establishing the three dimensions, starting from a point, 1, moving to the line, 2, the plane, 3, and thus to the prime solid, 4 and 4a, the **tetrahedron**.

It is possible to display the hierarchy between the five Platonic solids<sup>1</sup> by allocating to each a sphere and grouping them in accord with the pattern used to establish the three dimensions.

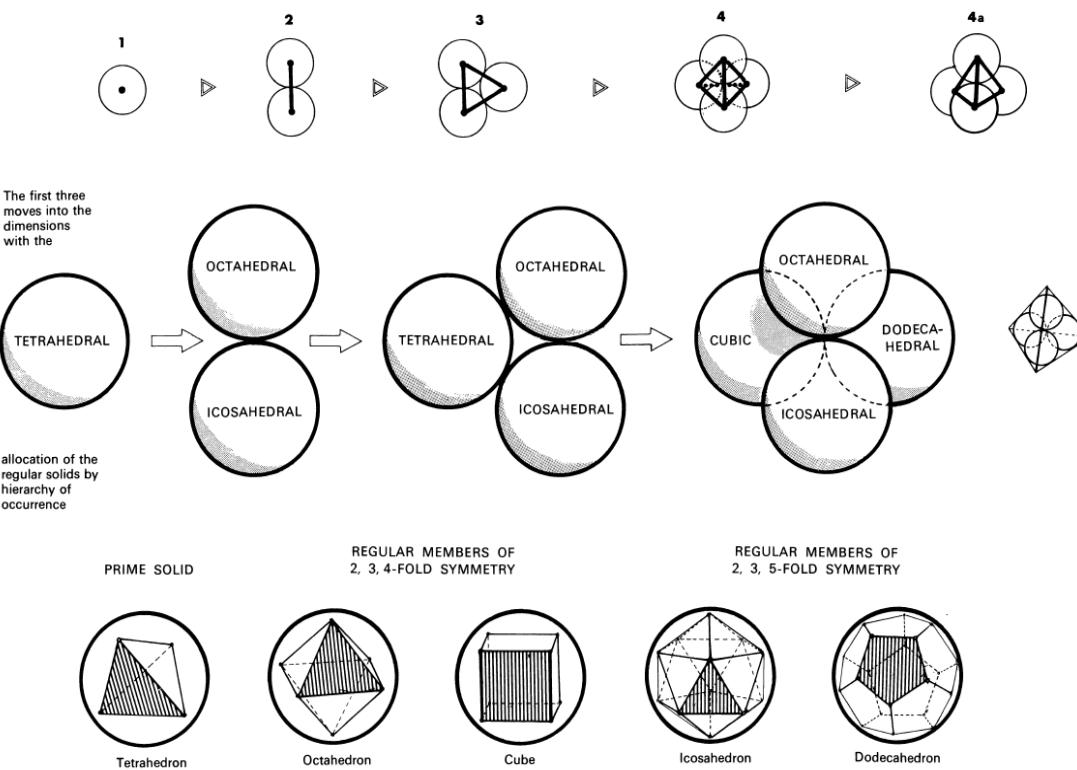
The apices of all the Platonic solids lie in the surface of a circumscribing or containing sphere, shown in the bottom line.

The first of the solids, the **tetrahedron**, is allocated to the first sphere, in the middle range of drawings. The next two spheres are allocated to the **octahedron** and the **icosahedron** as they are the prime representatives of the figures with 2, 3, 4 and 2, 3, 5-fold symmetry (p 11). Three spheres containing the three triangulated inherently structural Platonic figures are then grouped together. If the two pairs of spheres, containing the prime and secondary representatives of the 2, 3, 4 and 2, 3, 5-fold symmetries, i.e. octahedron and cube with icosahedron and dodecahedron, are placed in close packing, the relationship

between the four spheres provides the **tetrahedron**, completing the cycle and establishing it once again as the master or 'over' solid – indicated in the small diagram at the end of this range.

The prime and secondary representatives of the 2, 3, 4-fold symmetrical figures, it should be noted, are duals, i.e. the lines joining the centre-point of the faces of one of the figures results in the other figure. Similarly the prime and secondary representatives of the 2, 3, 5-fold symmetrical figures are duals.

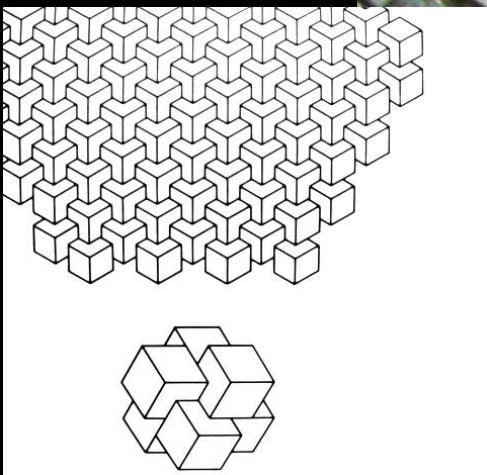
<sup>1</sup> Definition of a regular or Platonic solid: a convex polyhedron is said to be *regular* when its faces are regular and equal, and its vertices are all surrounded alike. If we denote the faces  $\{p\}$ , and those surrounding each vertex  $\{q\}$ , the polyhedron is described by  $\{p, q\}$ . We can examine the possible values of  $p$  and  $q$  thus: the solid angle at a vertex has  $q$  face-angles, each  $(1 - \frac{2}{p})\pi$ . These  $q$  angles must total less than  $2\pi$ , so we get  $1 - \frac{2}{p} < \frac{2}{q}$ . This gives us  $\frac{1}{p} + \frac{1}{q} > \frac{1}{2}$ , or  $(p-2)(q-2) < 4$ . Therefore  $\{p, q\}$  cannot have any other values than  $\{3, 3\}$ ,  $\{3, 4\}$ ,  $\{4, 3\}$ ,  $\{3, 5\}$  and  $\{5, 3\}$ , which are respectively the regular tetrahedron, octahedron, cube, icosahedron and dodecahedron. See H S M Coxeter, *Regular Polytopes*, 2nd ed, p 5 (Macmillan, London).





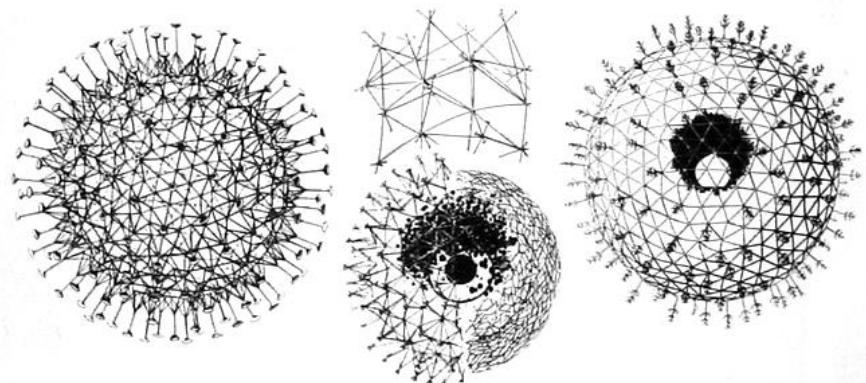
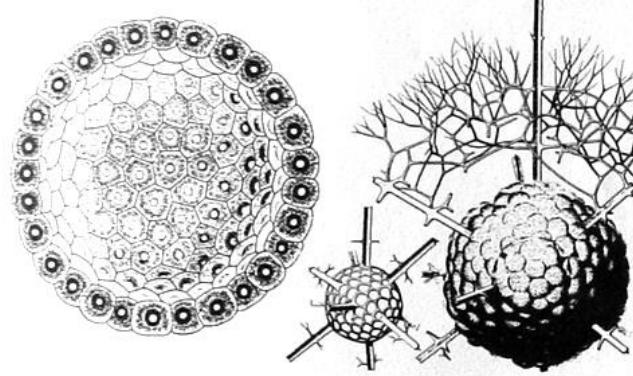
## Replication . abstraction

*Earth from Above*  
by Yann Arthus-Bertrand,  
1999





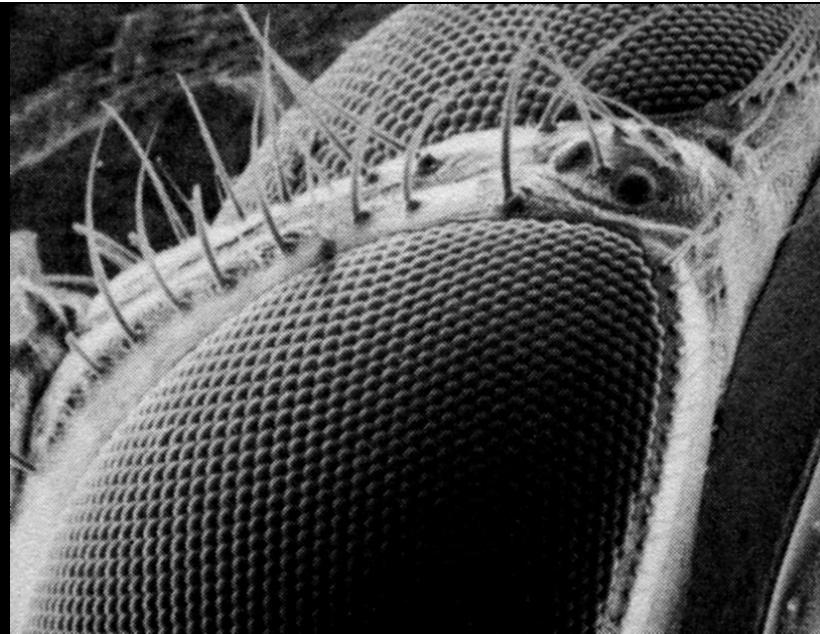
nature . abstraction . mesh . planar



organic

Relation with nature branches, plants,  
structures of high complexity.

**B. Munari**





# BBBB

Structure Concepts 3d

Book 's

**Munari, Buckminster, Leonardo, Pierce...**



# Replication . abstraction . mesh . planar



## Dome, Montreal Expo

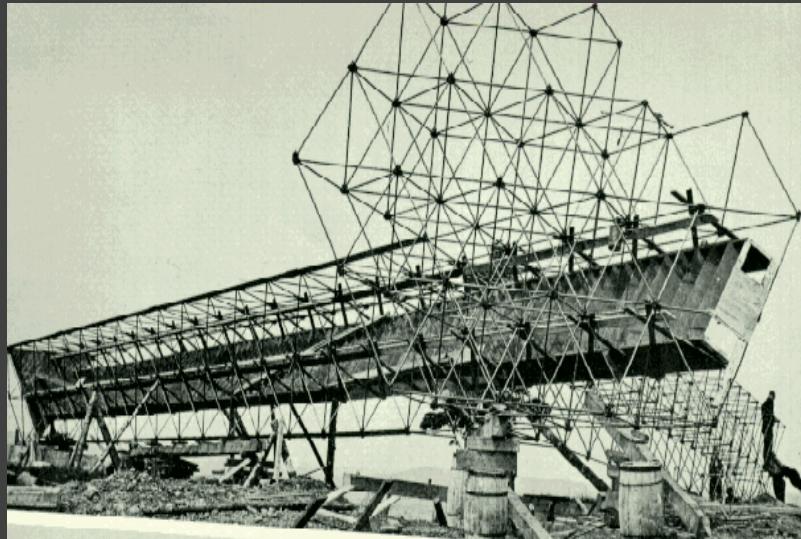
Buckminster **FULLER** | 1967

*Comprehensive design strategy. Phase  
II. Document*

5. World Resources Inventory  
Southern Illinois University  
Carbondale, Illinois U. S. A.

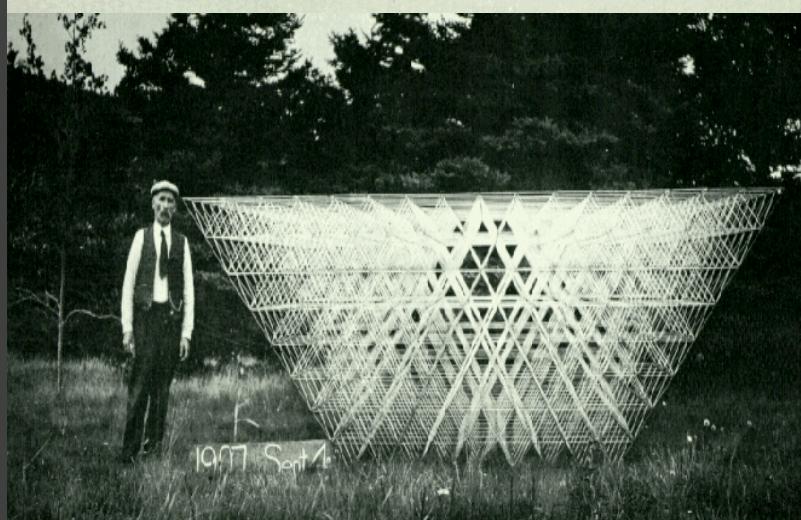
*das coisas nascem as  
coisas*

B. Munari



E

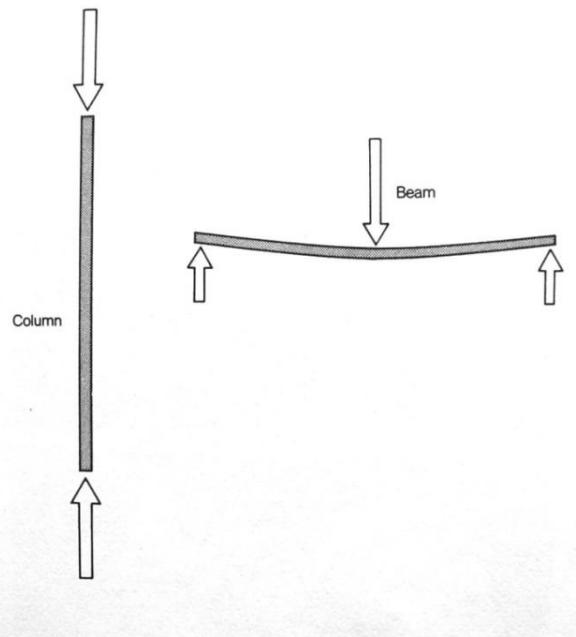
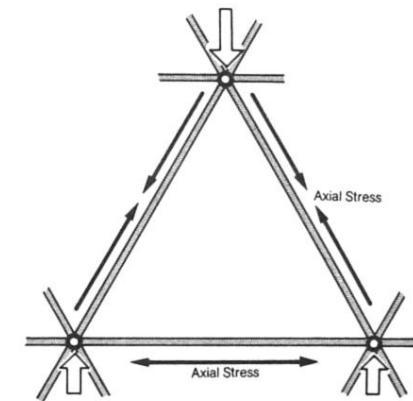
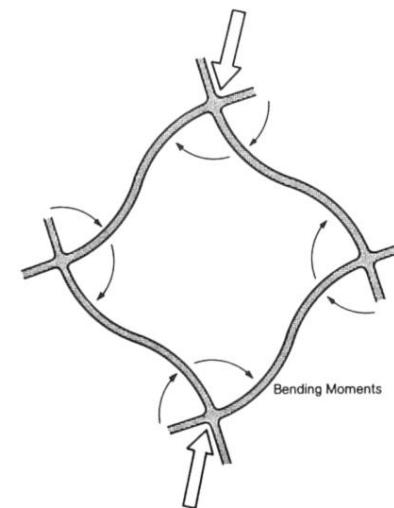
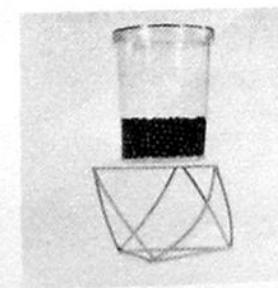
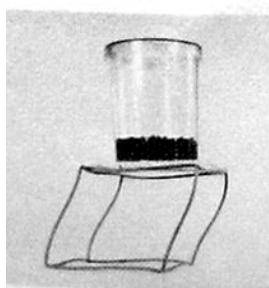
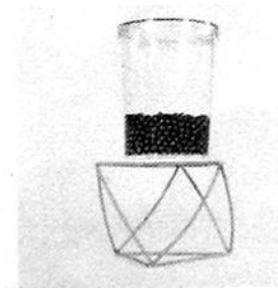
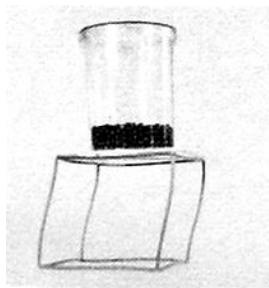
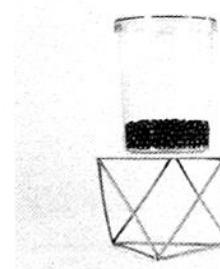
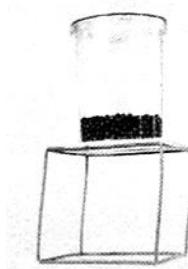
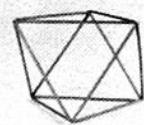
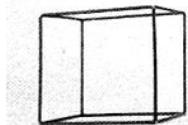
G . Bell – Torre de  
observação em tetraedros.

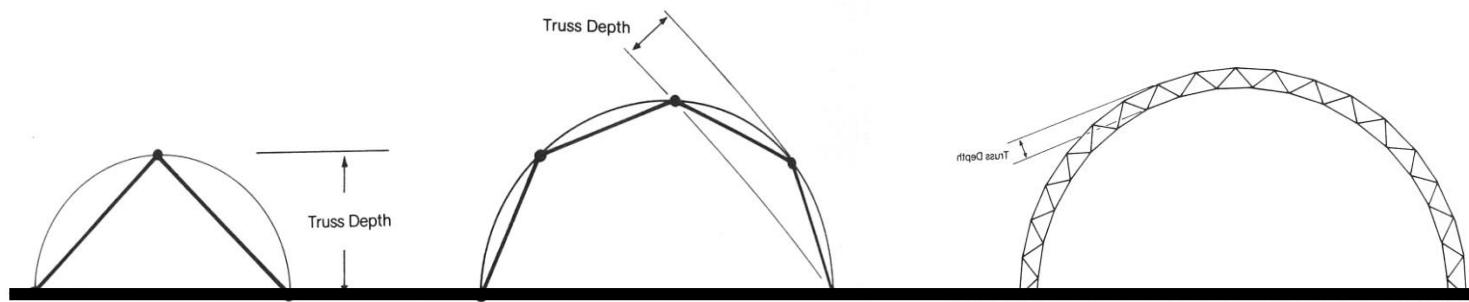
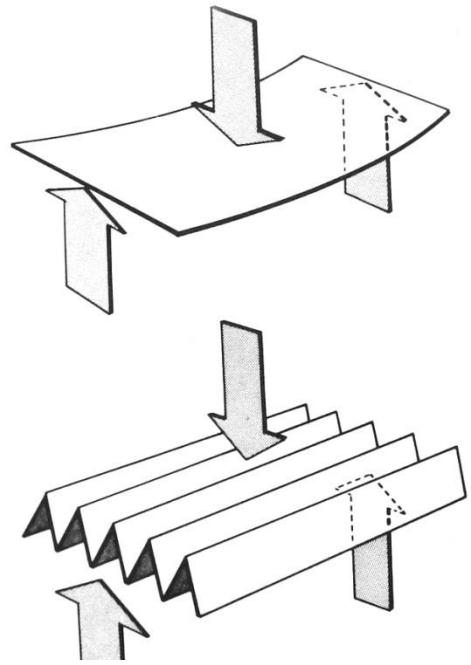


E

A . G . Bell – Pesquisas  
Espaciais – Estrutura Espacial  
Tridirecional construída com  
barras metálicas e conectores.

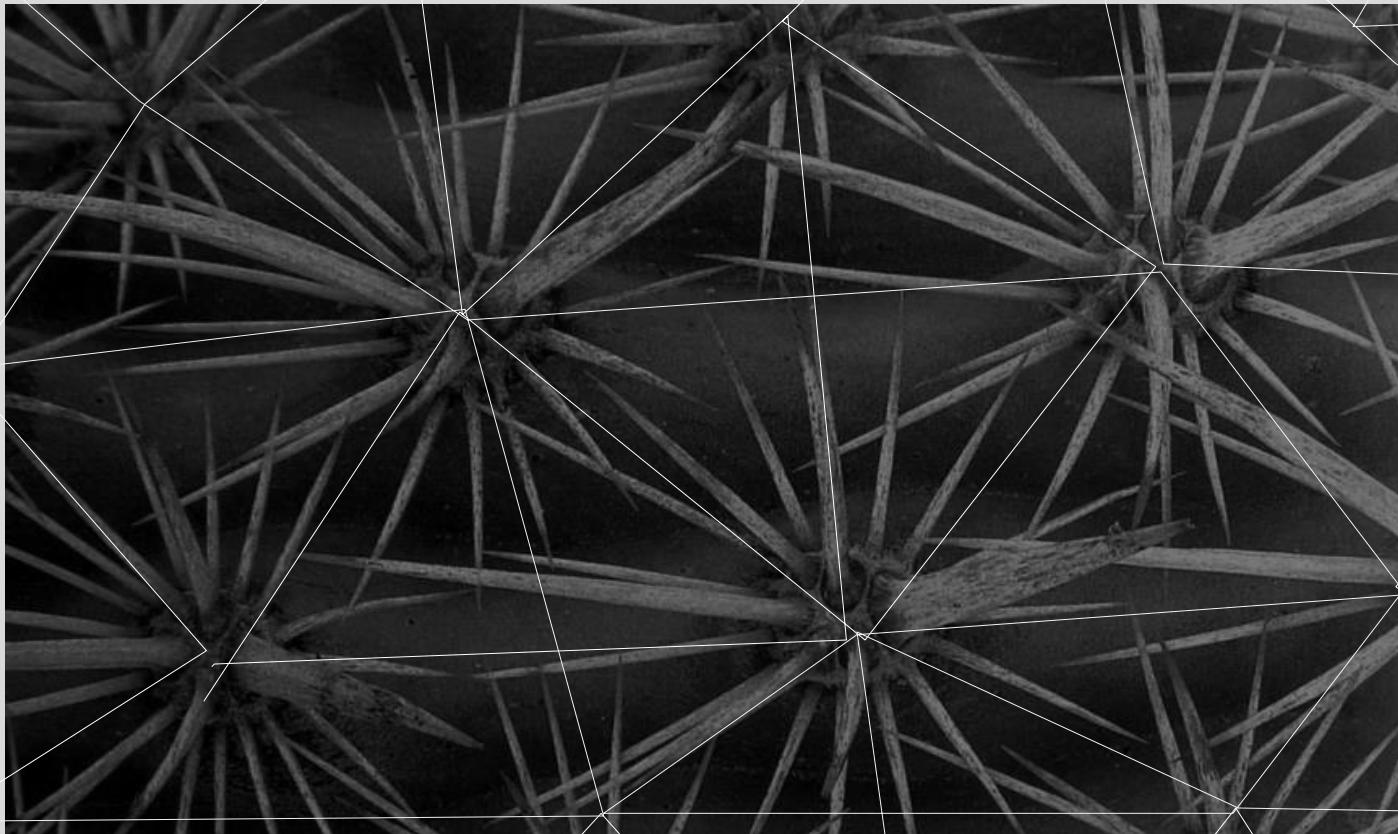
Structural Engineering

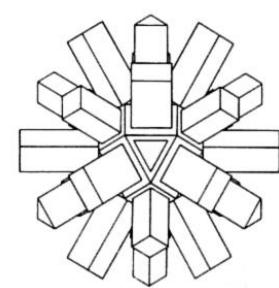
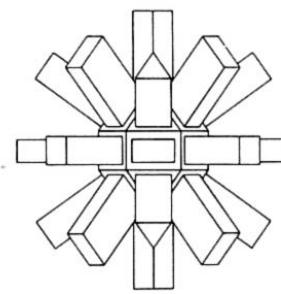
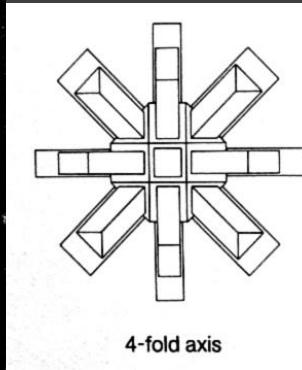
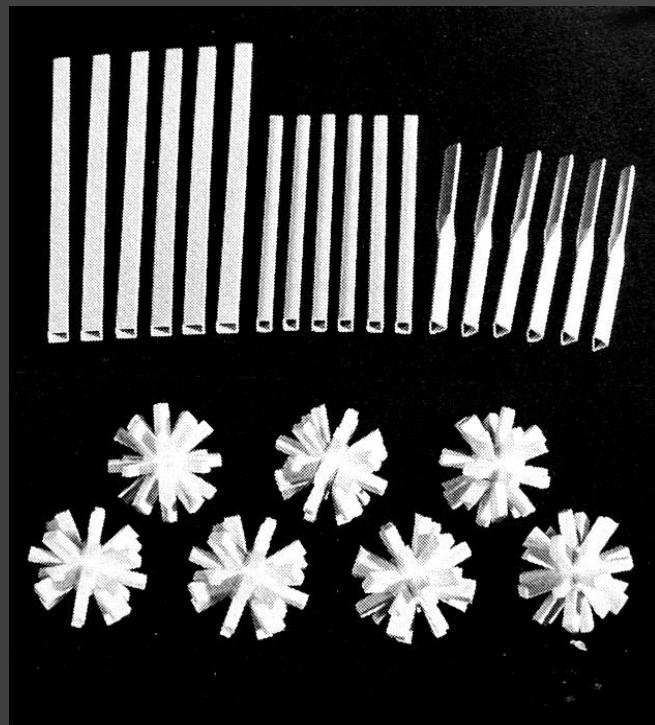


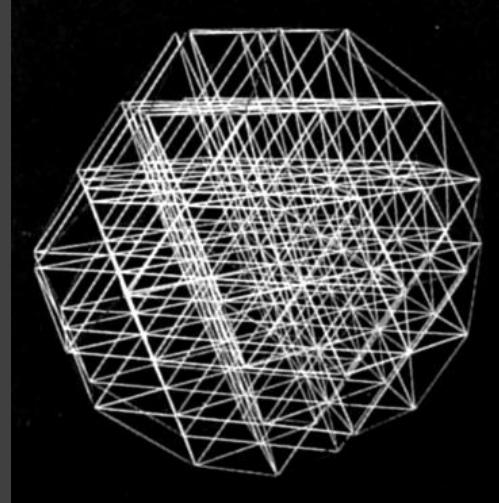
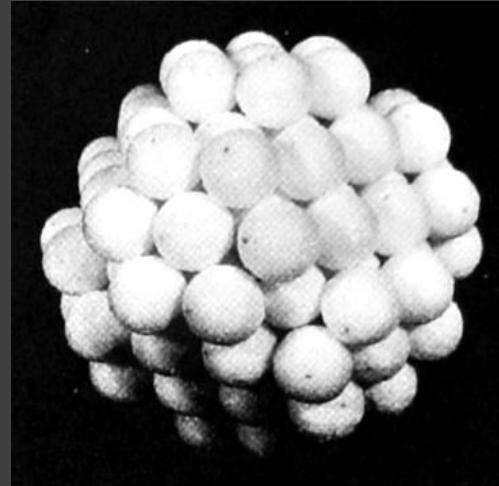
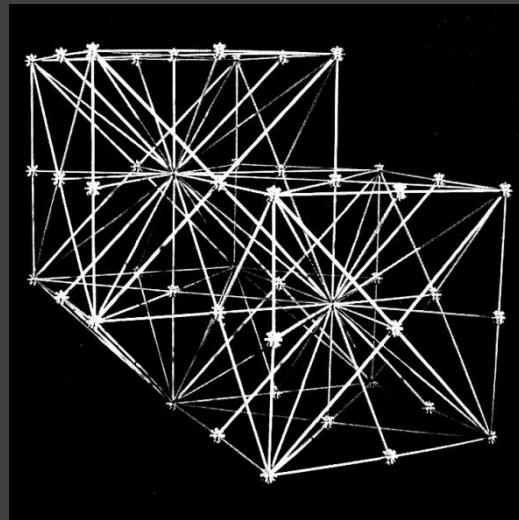
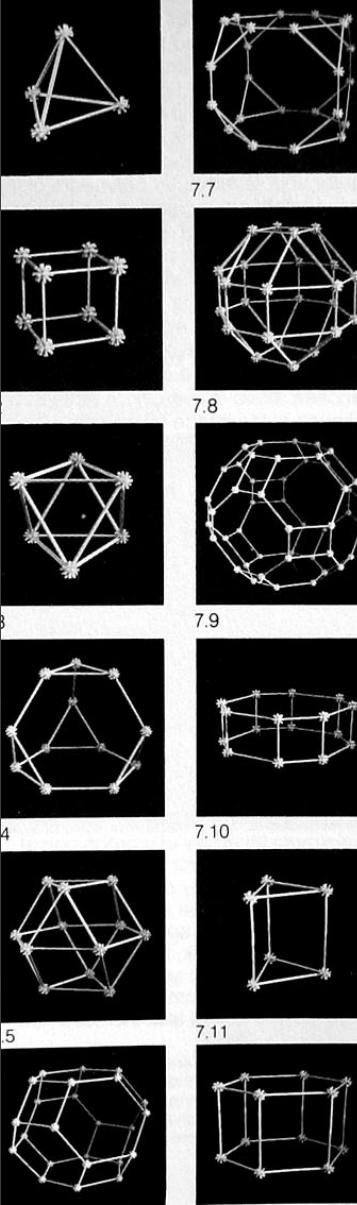




# Replication . Abstraction . 2d









## Exploration

Describe the activities/ inquiries/probes/tests the target group performs in the exercise:

### ***Students:***

BBBB. Create patterns through nature observation . deduce triangles in nature . Capacity to view abstraction.

B. Experimenting simple solids structure: from tetrahedron to decahedron structures (and more complex edron's).

Micro-scale 1 (Nasa Toy)

BB. Concepts regarding Lean design: building the essence of vertical (from Gothic to Gropius) . individual approach

Micro-scale 2(spaghetti and plasticine)

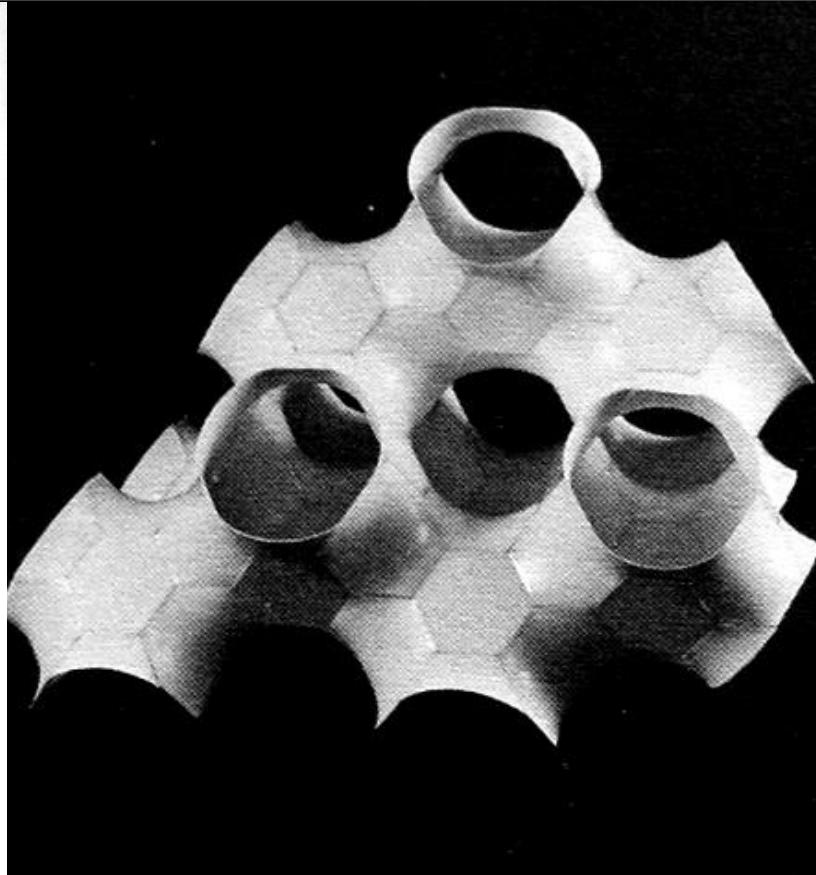
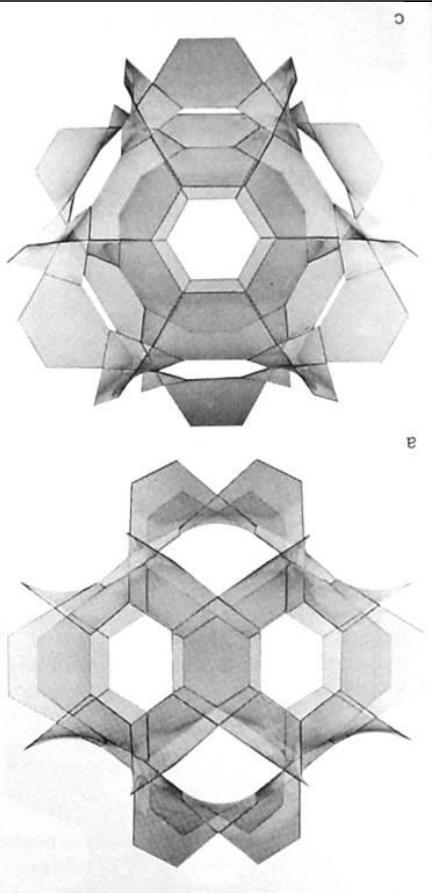
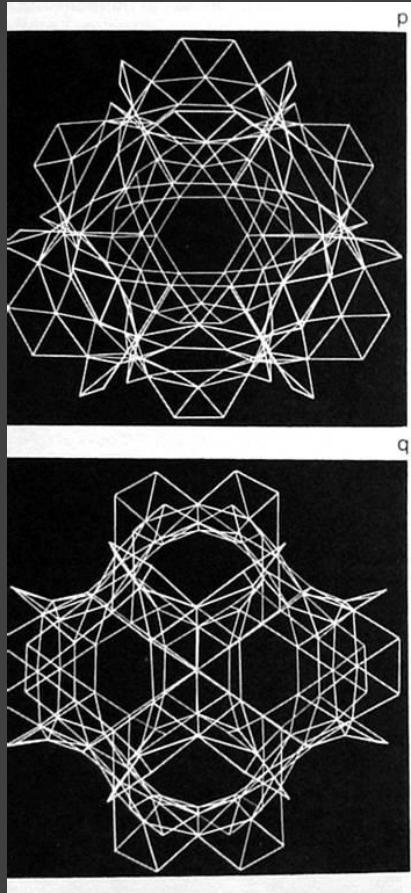
BBB. Tenso-structures: building bridges – Colective approach.

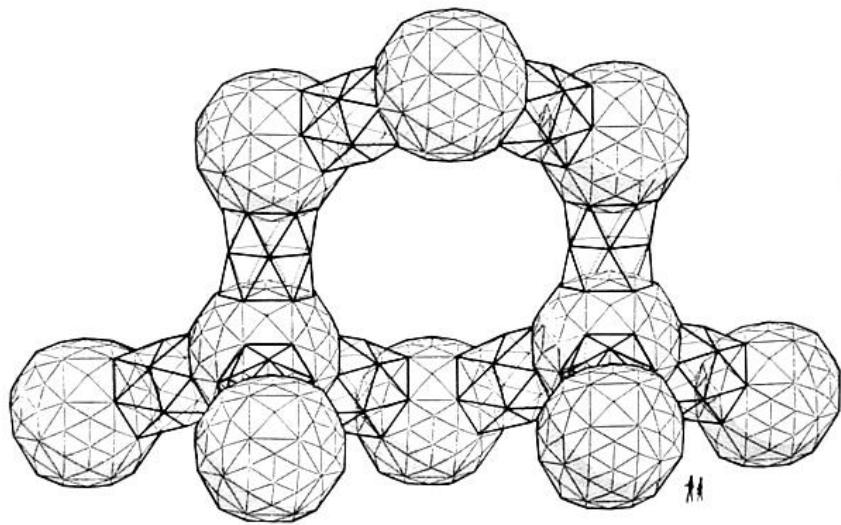
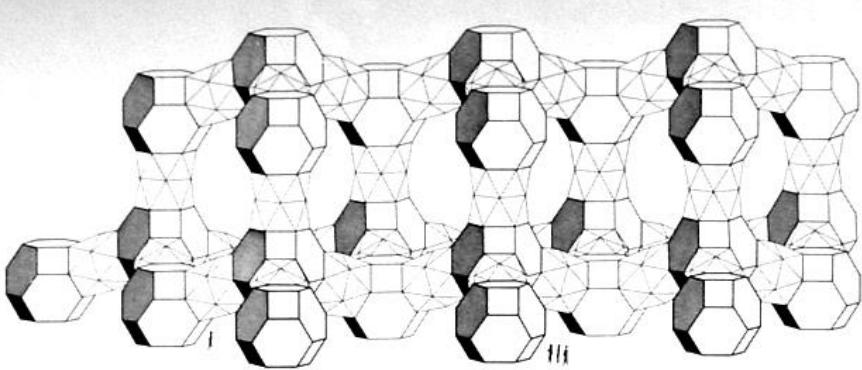
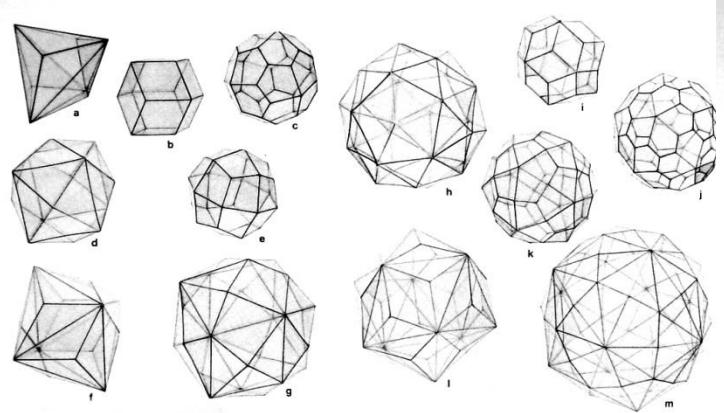
Meso-scale (tubes, wood, ...)

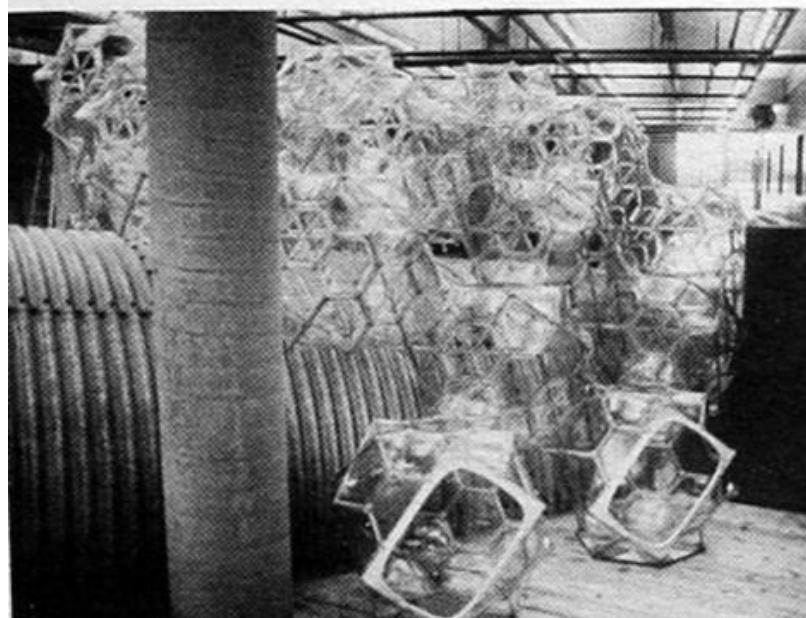
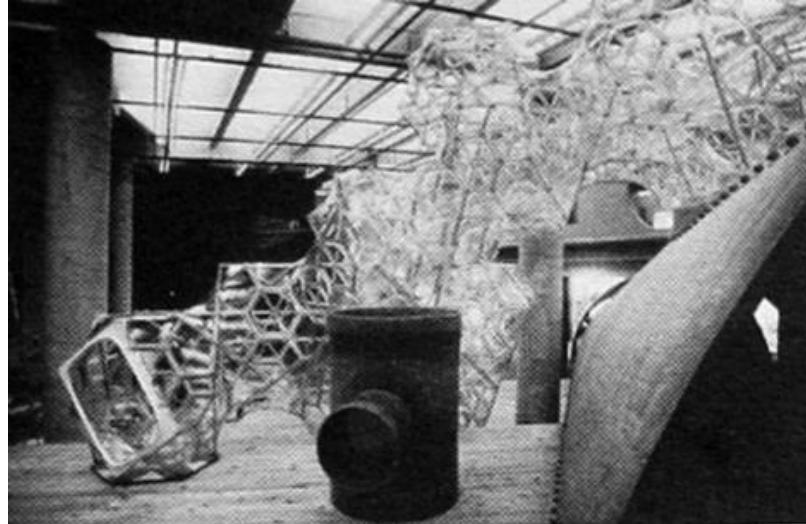
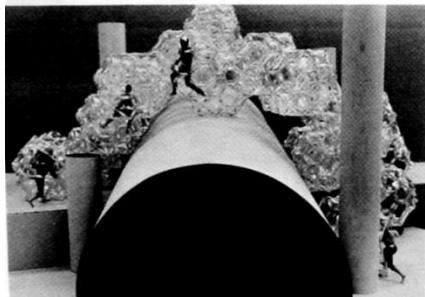
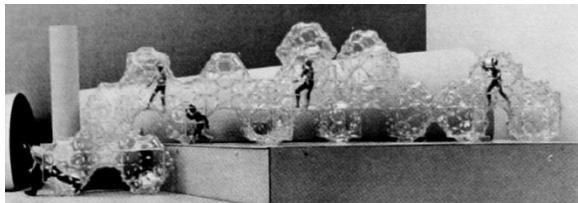
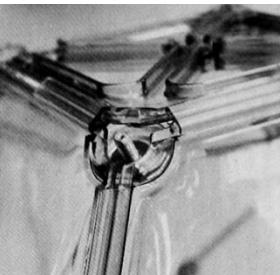
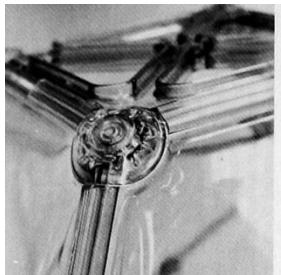
BBBB:From organized structures to chaos and reversible approach. Experiment

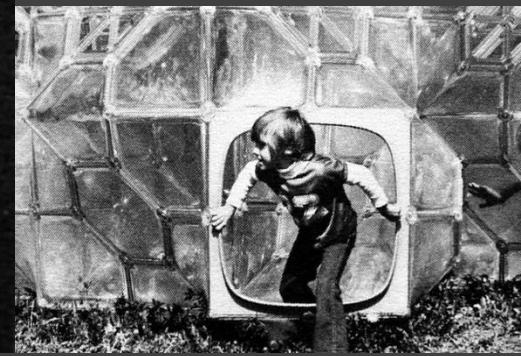
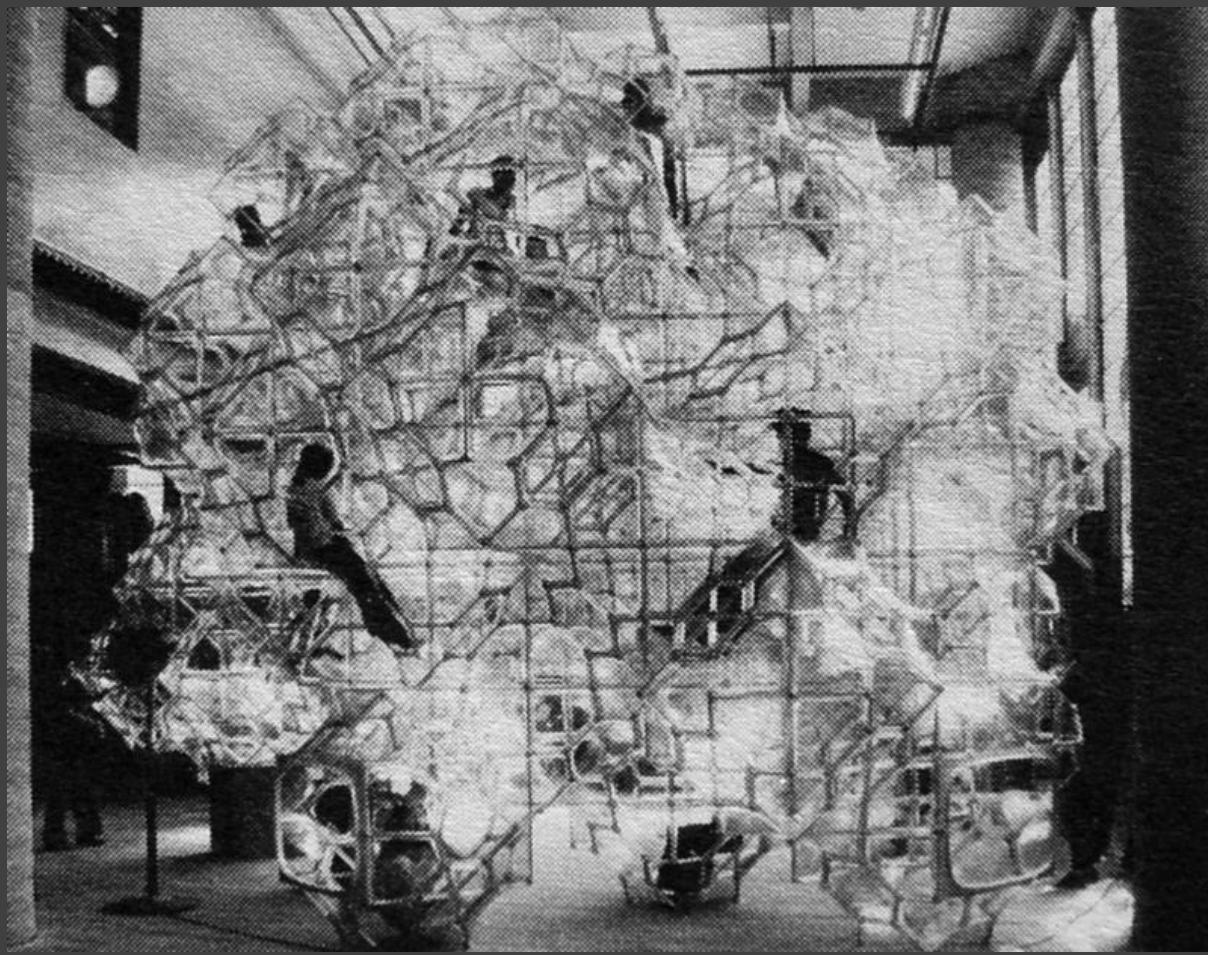
**BBBB+**

Participatory ccc&jc and 4 points structures activity in the limits











# Replication . Abstraction . Mesh . planar

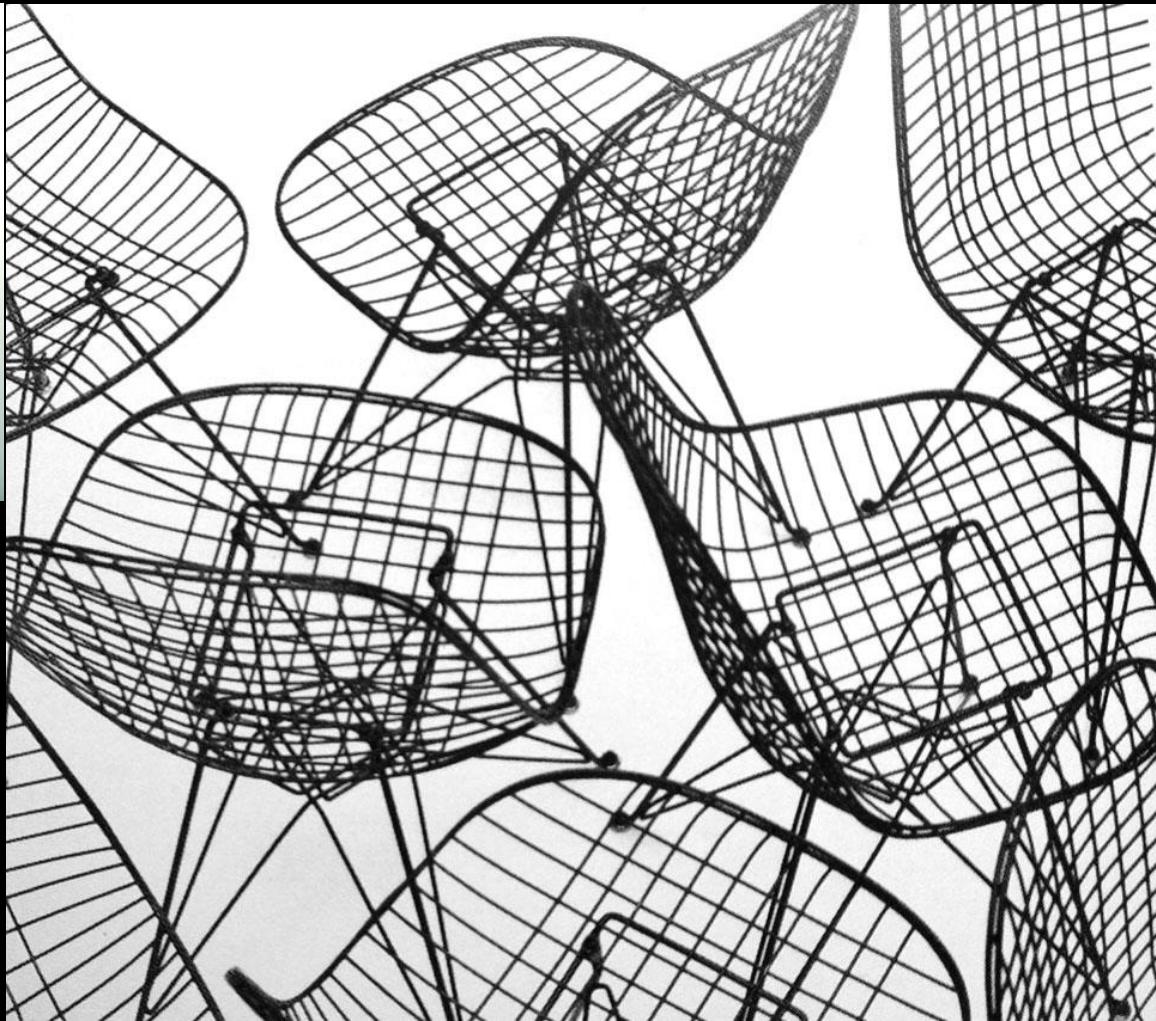


Harry Bertoia

1950-52

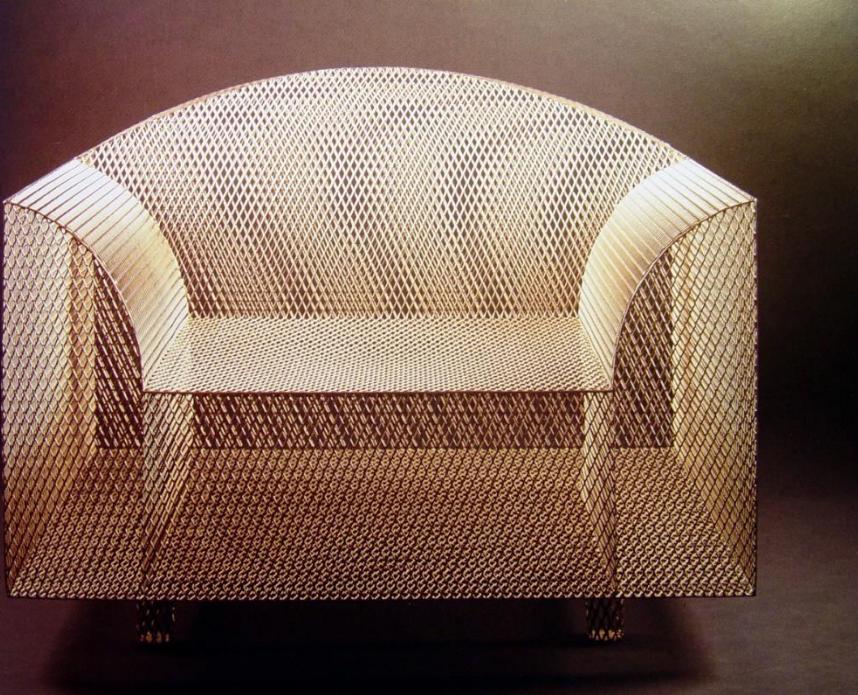
Armchair: Model no.421-1  
Vinyl, Steel, and polyurethane foam, fabric [cotton]  
77,5\*85,7\*69,7cm

Knoll Associates USA





# Replication . Abstraction . Mesh . planar



Shiro **Kuramata**

1986

ArmChair,  
*How High the Moon*

Nickel plated steel netting

72.4 \* 95 \* 81.8cm

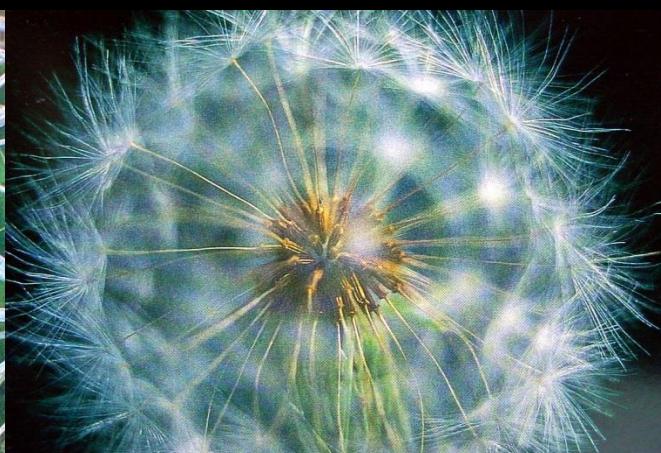
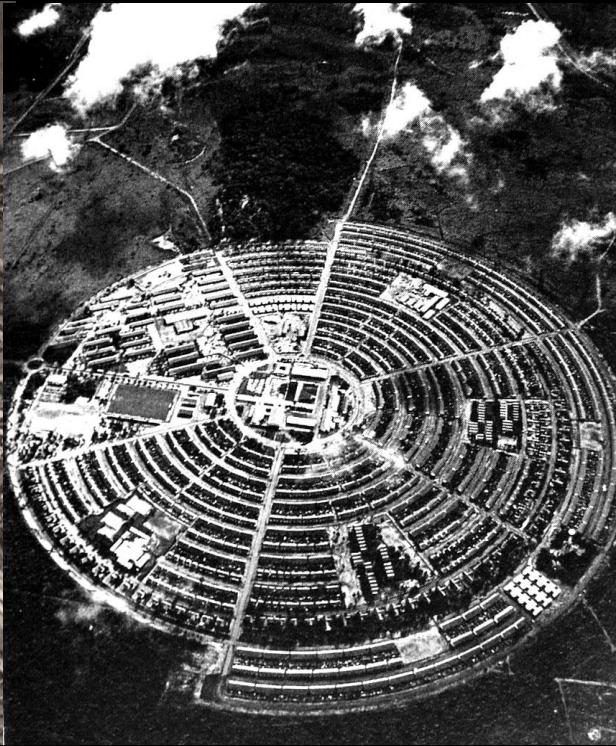
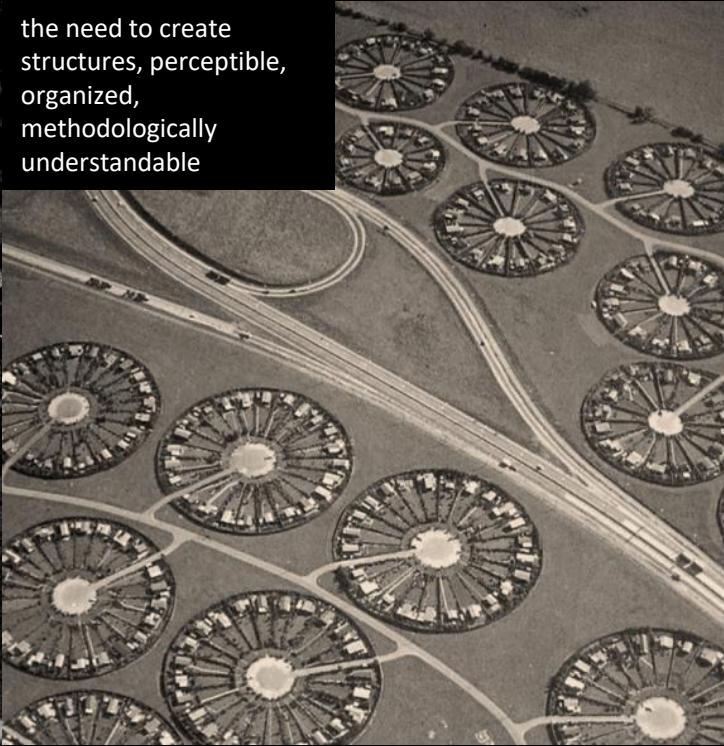
Transparency and structural lightness



# Men's . Replication . abstract organization



the need to create  
structures, perceptible,  
organized,  
methodologically  
understandable





# Replication . abstraction . 2d | 3d



## 1959, Frank Lloyd Wright, Guggenheim Museum's

The inverted ziggurat, the unconventional approach based around a series of intersected places. The gentle slope in a continuous ramp affords viewers the possibility to see work on several levels.

John Coltrane, *My Favorite Things* | 1961  
<https://www.youtube.com/watch?v=YHVarQbNAwU>

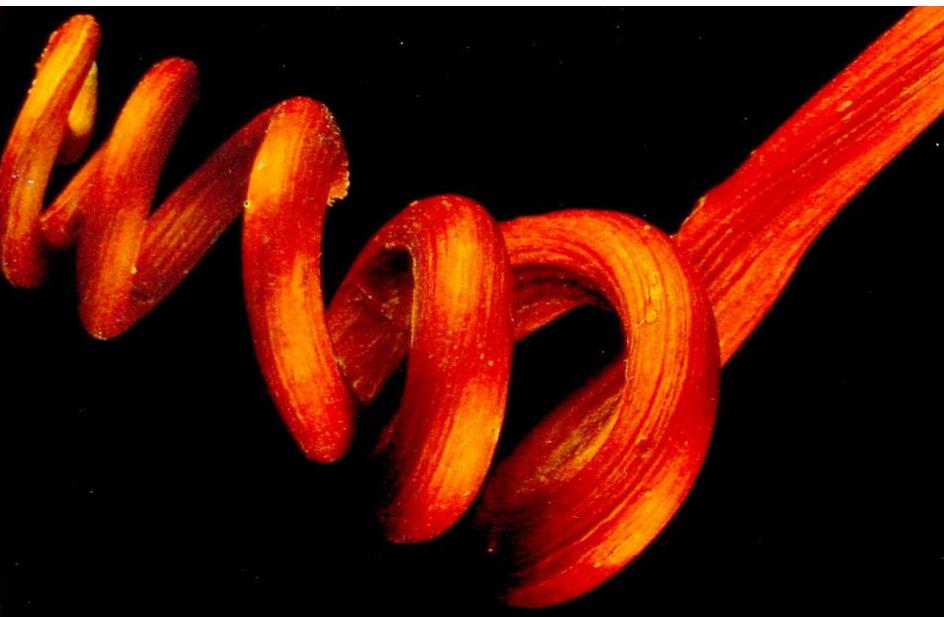




# Replication . abstraction . 2d | 3d

## Golden Ratio

its ubiquity and functionality  
in nature suggests  
its importance as a fundamental characteristic  
to men



## Minaret

**Great Mosque of Samarra**  
ninth-century located in Samarra,  
Iraq

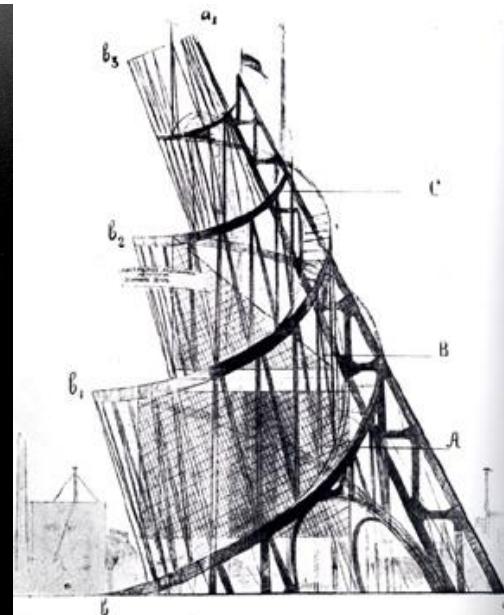
## HUMAN's Musics

film by Yann Arthus-Bertrand |  
Composed by Armand Amar, 2017  
<https://www.youtube.com/watch?v=uog4eCZTUX4>



## Tatlin

1920  
**Monument to the 3rd International,**  
drawing  
exhibited in 1920  
**Deconstructing Utopia: From**  
**Russian Constructivism**





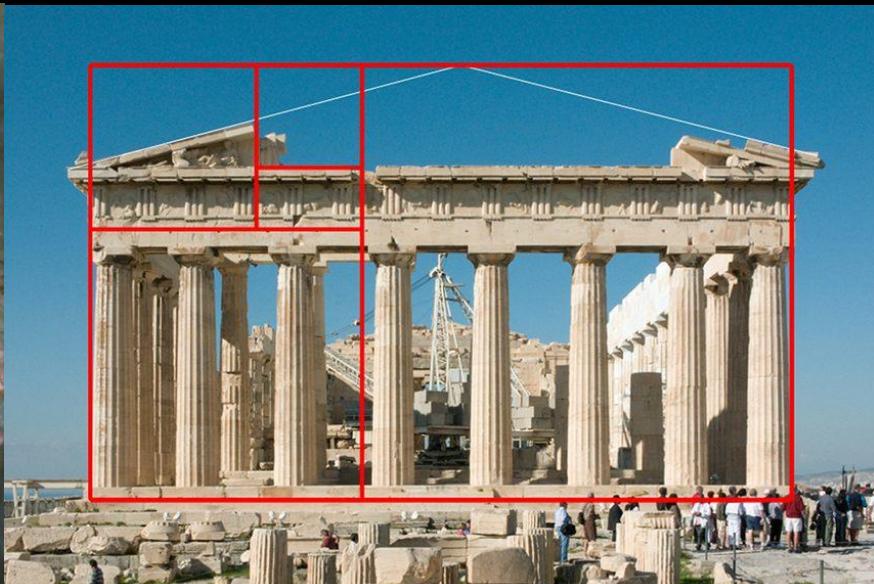
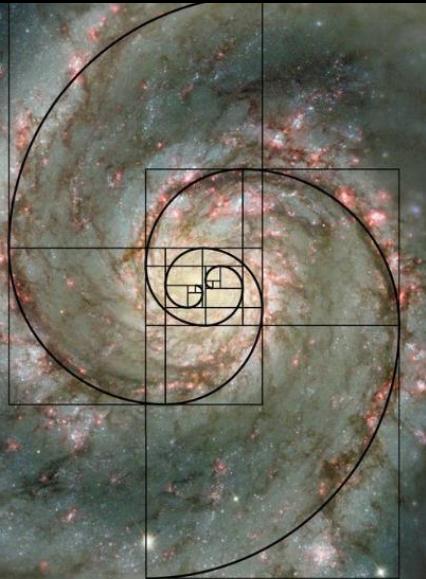
# Replication . abstraction . 2d | 3d

## Golden Ratio

its ubiquity and functionality  
in nature suggests  
its importance as a fundamental characteristic  
to men

### Fibonacci sequence:

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55 and so on forever



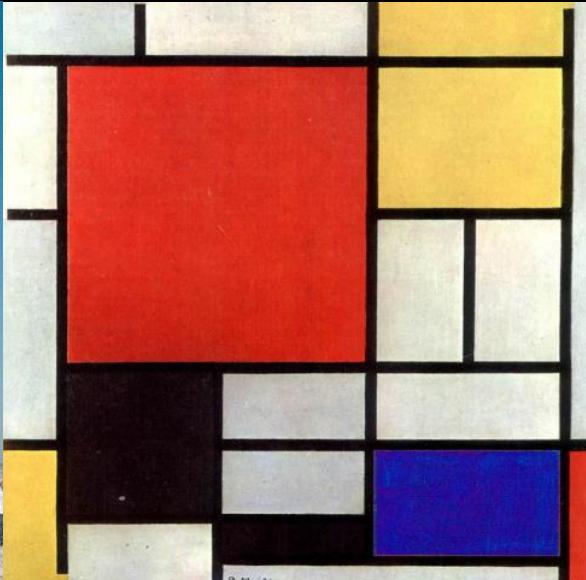
The golden ratio, hypothetical  
appears in many of the proportions in  
Greek temple **Acropolis**.  
**Athens | Greece**

Piet Mondrian | *Compositions in Red, Blue, and Yellow* . 1930.

Abstract style of work with vertical and horizontal lines, geometrical shapes, and primary colors, were the only shapes that express reality, nature and logic.

Mondrian shared Leonardo Da Vinci mathematician and art confluence. His paintings display the reoccurring golden rectangle.

**De Stijl | Netherlands**

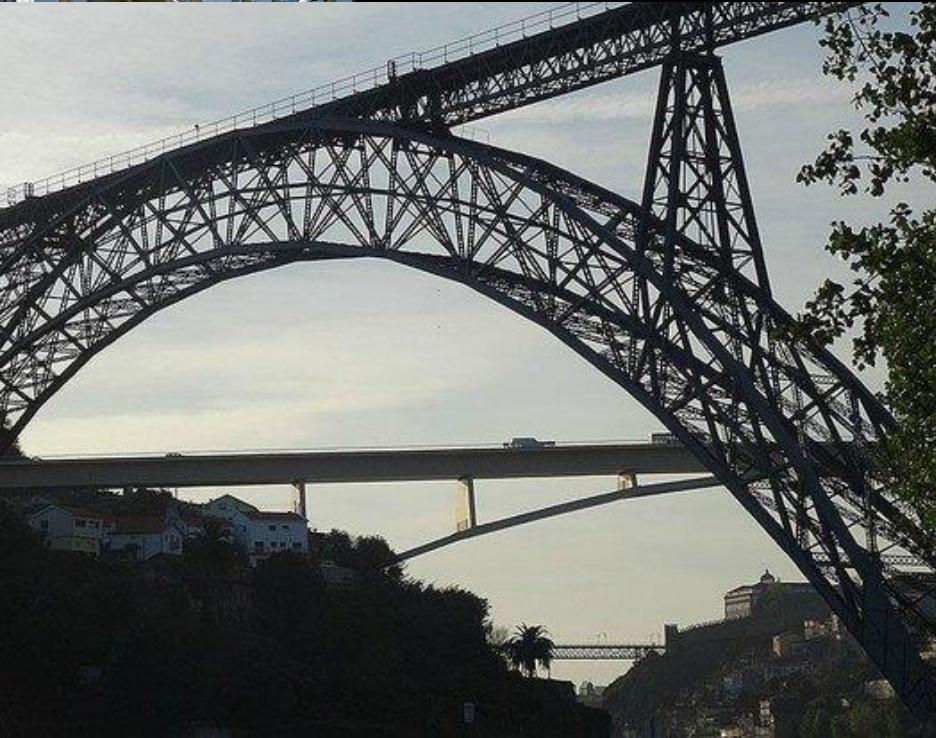




# Men . Replication . abstraction



tensor structure by  
**Gustave Eiffel**  
Porto  
Queen Maria Pia Railway | iron  
Bridge  
1877.



tensor structure  
**Frei Otto**  
Munich Olympic Park for the  
Olympics  
1972.





# Replication . abstraction

tensor structure  
Spider

Ccc . natural park montesinho



tensor structure  
Under tension, beneath the concrete anchors on both sides of the river, a steel structure is hidden beneath which lie rectangular blocks of granite from the region, which make the pedestrian walkway with steel rods that rise vertically, traversing the railing that accompanies the bridge. \_ Switzerland

tensor structure by  
**B. Munari**  
mostra Alta Tensione,  
Milano 1990  
<http://www.munart.org>



Marcel Breuer  
Club chair (model B3)  
1927–1928

*'my most extreme work . . . the least  
artistic, the most logical, the least  
'cozy' and the most mechanical'.*

Vassily chair in honor of VASSILY  
Kandinsky, start of production of  
tubular chairs, cylindrical profile.  
Bicycles + new technology and  
folding [twisting] of metal pipes





# Men . Replication . abstraction

**Tom Dixon**

Pylon Chair

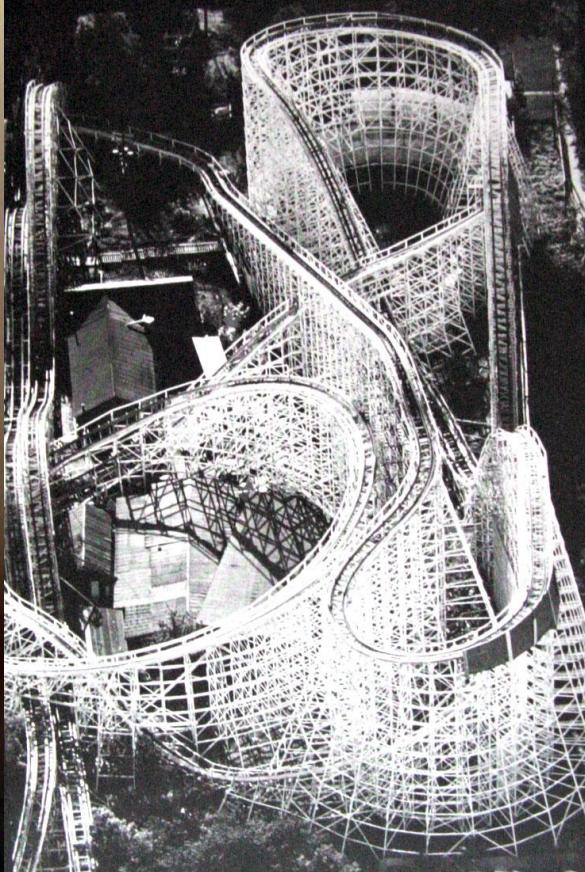
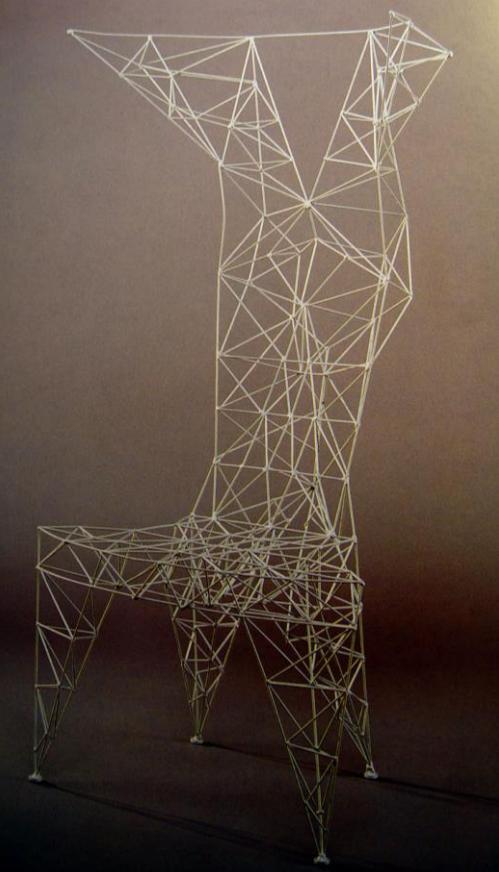
1991

Painted steel

126.5 \* 57.3 \* 55.5cm

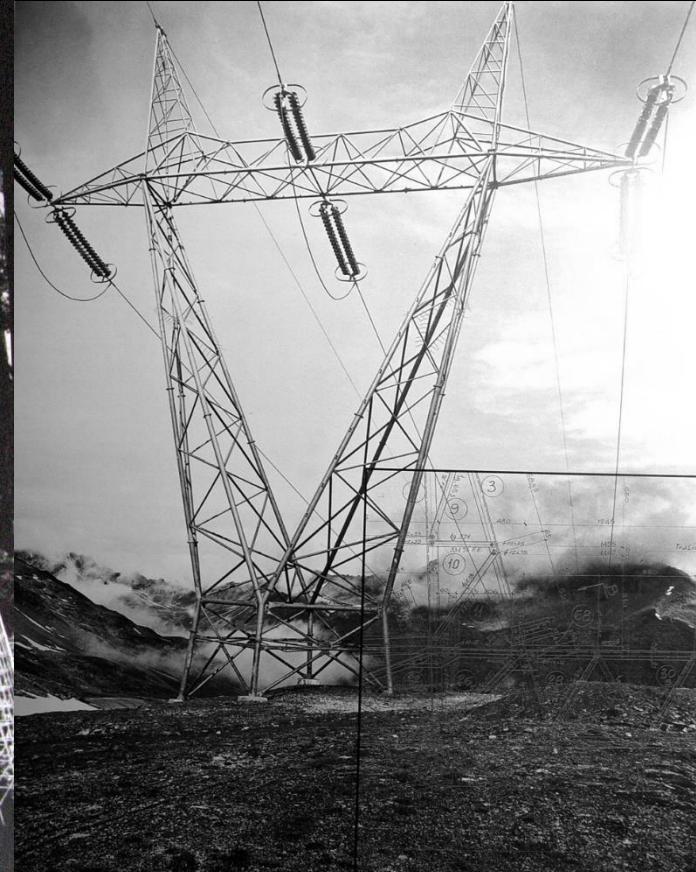
Capellini Italy

Dematerialization process



Complex structure of a  
Russian mountain.  
California

High voltage line  
Archive Edison



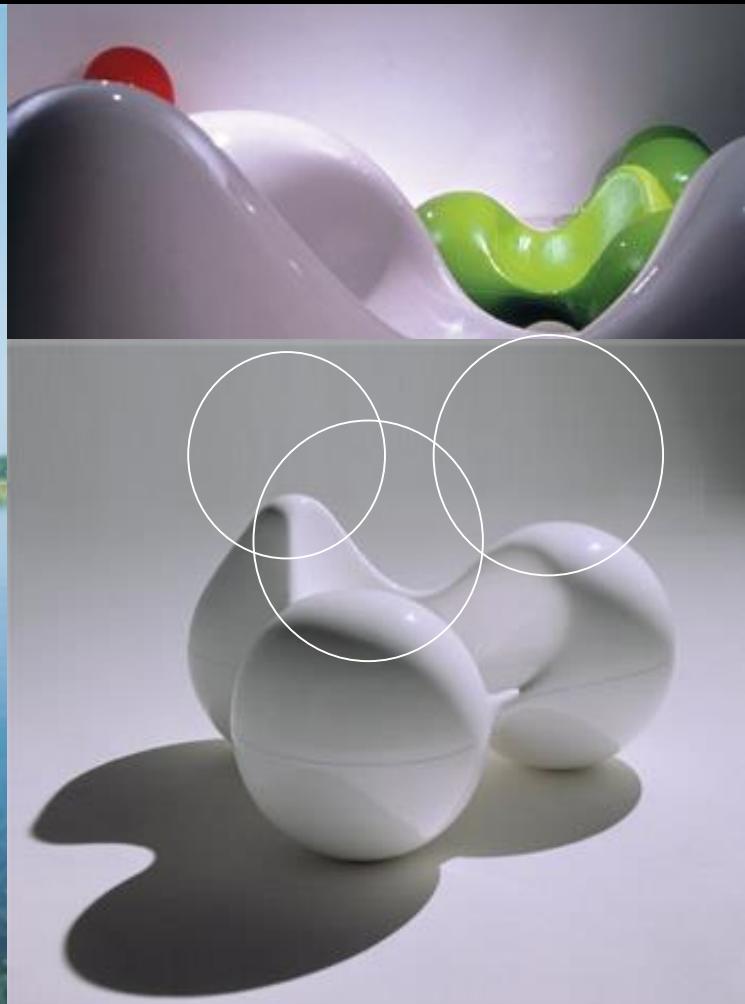


# Replication . Abstraction . 2d to 3d

E

Eero Aarnio (1971)

At the first sight the Tomato Chair looks complicated, but the second look shows an intelligent combination of 3 circles with same diameter, two of them being armrests, one stretched to a comfortable back, and even a fourth half circle up side down giving the chair a consequent seat.



Objectives: To develop a group work using materials with the aim of creating a complex structure in equilibrium [stability] that supports itself, by model or irregular systems ... [height-scale] ... [complexity] ... [stress-structures] ... [bridges] ... [tetrahedral-equilateral triangle] ...

"The formation of structures is an imitation of the constructive systems of nature, not the imitation of finished forms, without understanding the structure that determines them."

Materials:

Spaghetti, plasticine and other elements for your base, etc ...

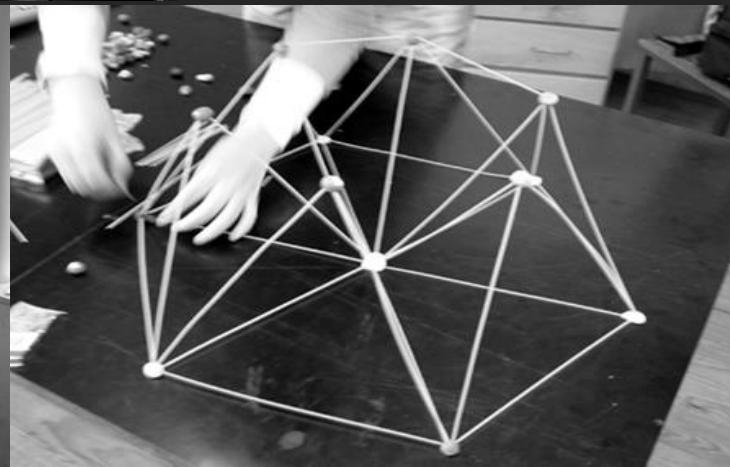
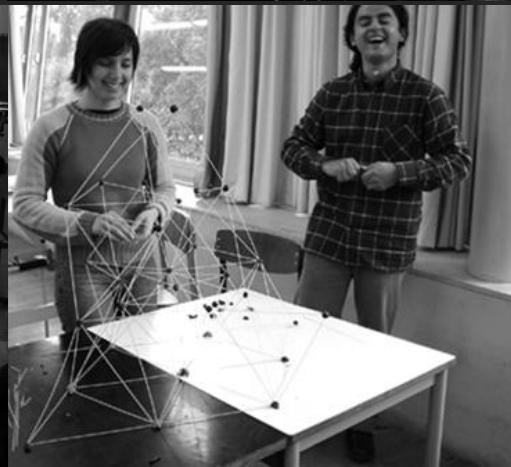
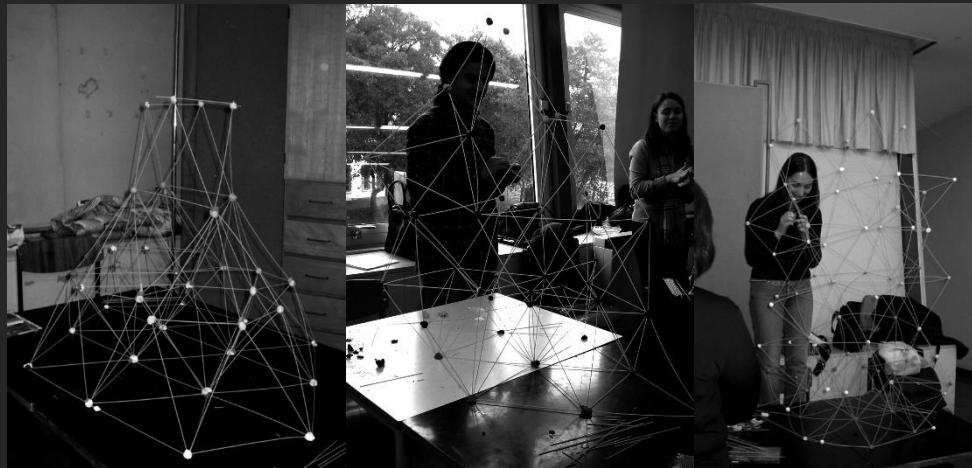
Evaluation :

Technical mastery of materials.  
Development and consistency in the structural and functional quality of the proposals.

Creativity and quality of the final structure.

Compliance with deadlines.

...





# Replication . Abstraction . Mesh . planar

From  
nature to  
Design  
STEM

As Guy Brett says about the magnificent work of Gego and Soto, it is suggested that the process is mainly established by doing and undoing and that in this intention the work crosses new cycles and new rhythms. In the rhythm of the lines one does not look for something new, just simplicity in the ways of looking.

It was these imbalances, these other modes of seeing that guided the creative process of the 4 Points (CCC + JC + Richard + Sara). On the one hand, the interventions were intended to be collaborative, a symbiosis between sculpture and image, forming an artistic manifestation one, free of conceptual boundaries, merging the re-creation of a space and three different visions.

On the other, the structures that the group produced abroad and their contamination imposed a virulent work, the strange organism would grow and live confined to that body. In response, the work should occupy and be occupied, block and pass, show and hide. The uneasiness of its lines would attenuate the internal dimension of monumentality. The spectator should be subtracted from the comfort of the space and be immersed in the work, build it up and give it meaning.

Carlos Costa (ccc) , Jacinta Costa Ricardo Gonçalves e Sara Botelho (**4pontos**).

12<sup>a</sup> edição do Imaginarius - Festival Internacional de Teatro e Rua  
Instalação – “Diga se faz favor”. Envolvente da Piscina Municipal de Santa Maria da Feira.  
Coautoria de Jacinta Costa, Sara Botelho e Ricardo Gonçalves (**4pontos**).  
Carlos Costa (ccc) , Jacinta Costa Ricardo Gonçalves e Sara Botelho (**4pontos**).



2014 | O Porto na Avenida - Ciclo de Fotografia. Instalação | Exposição – O Porto na Avenida. Praça da Liberdade, Porto.  
Entidade promotora: Edifício AXA, Câmara Municipal do Porto

Carlos Costa (ccc) , Jacinta Costa Ricardo Gonçalves e Sara Botelho (**4pontos**).



2014 | Escultura | Instalação  
“Fugas de um dó maior”.  
Local: Edifício AXA  
Entidade promotora: Edifício AXA, Câmara Municipal do Porto.

Carlos Costa (ccc) , Jacinta Costa Ricardo Gonçalves e Sara Botelho (**4pontos**).





# Replication . Abstraction . Mesh . planar

From  
nature to  
Design  
STEM

2011 | Exposição 'Elipse da duração' - Mostra de Artes  
do IPP  
Escultura | Instalação - "IPP PVC 1063 X 0,25 anos  
|2011|Instalação". Palacete Pinto Leite, Porto  
Carlos Costa (ccc) , Jacinta Costa Ricardo Gonçalves e  
Sara Botelho (4Pontos).



2013 | Exposição 'Outros Olhares'  
Escultura | Instalação - 'Outros Olhares'. Museu  
Municipal Abade Pedrosa, Santo Tirso  
Carlos Costa (ccc) , Jacinta Costa Ricardo Gonçalves e  
Sara Botelho (4Pontos).



2013 | Museu de Arte Contemporânea Graça Morais -  
Bragança  
Escultura | Instalação "Sarilho".  
Carlos Costa (ccc) , Jacinta Costa Ricardo Gonçalves e  
Sara Botelho (4Pontos).

