

PINO TROGU – SAN FRANCISCO STATE UNIVERSITY, USA

LORENZO BOCCA – ARCHITETTO, SAN BASSANO (CREMONA)

L'OPERA VISIONARIA DI GIORGIO SCARPA TRA SCIENZA, DESIGN E DIDATTICA

GIOVEDÌ 22 OTTOBRE 2026, ORE 17.00

ISIA FAENZA / PALAZZO MAZZOLANI

CORSO GIUSEPPE MAZZINI 93, FAENZA

[go to last slide](#)

ARTISTA (INFLUENZE)



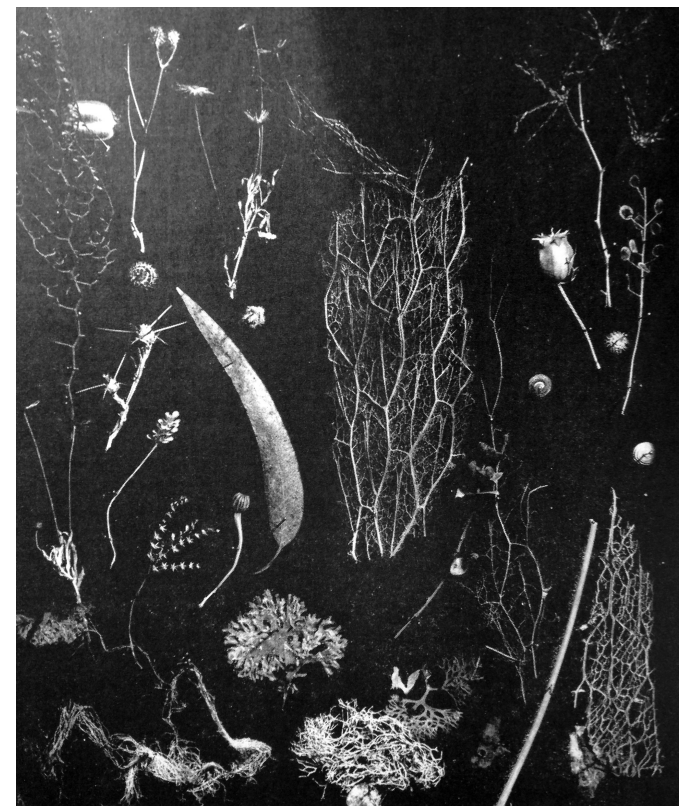
(12 ANNI)



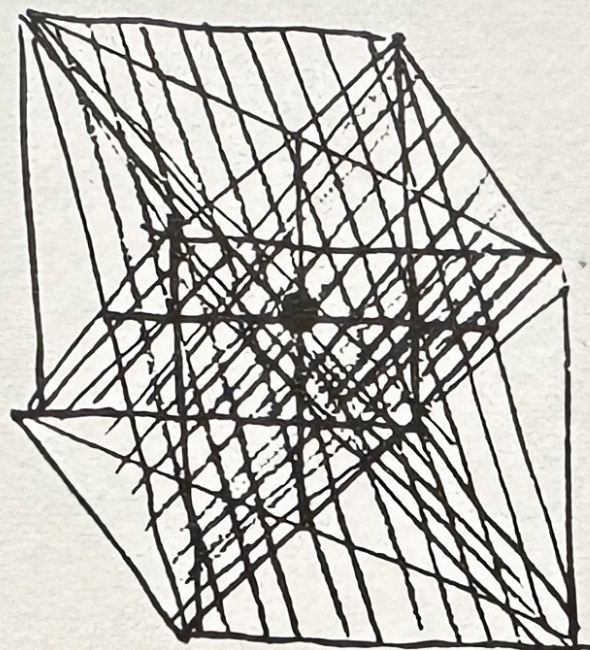


Teoria della forma e della figurazione Paul Klee

PAUL KLEE BAUHAUS, 1921–1931



Interno puro,
intimo del corpo



L'interno svolge la parte dominante.
L'intero ambito dell'interno
si designa con la parola “ contenuto ”

Paul Klee, *Teoria della forma e della figurazione*, Feltrinelli, 1959, p. 127
Titolo originale: *Das bildnerische Denken* (Benno Schwabe & Co., Basel, 1956)

INSEGNANTE

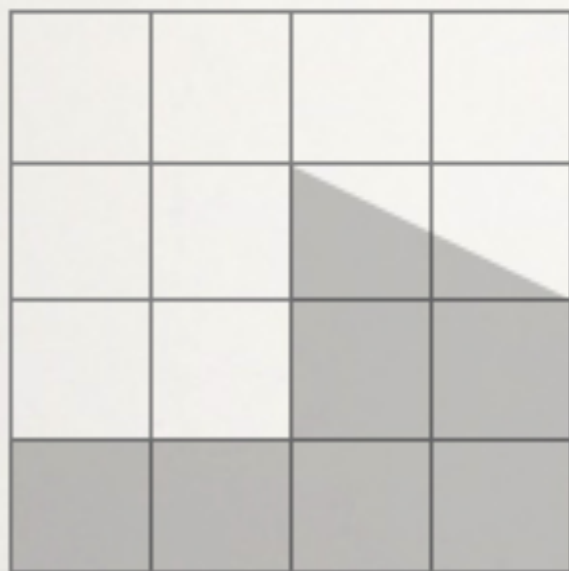
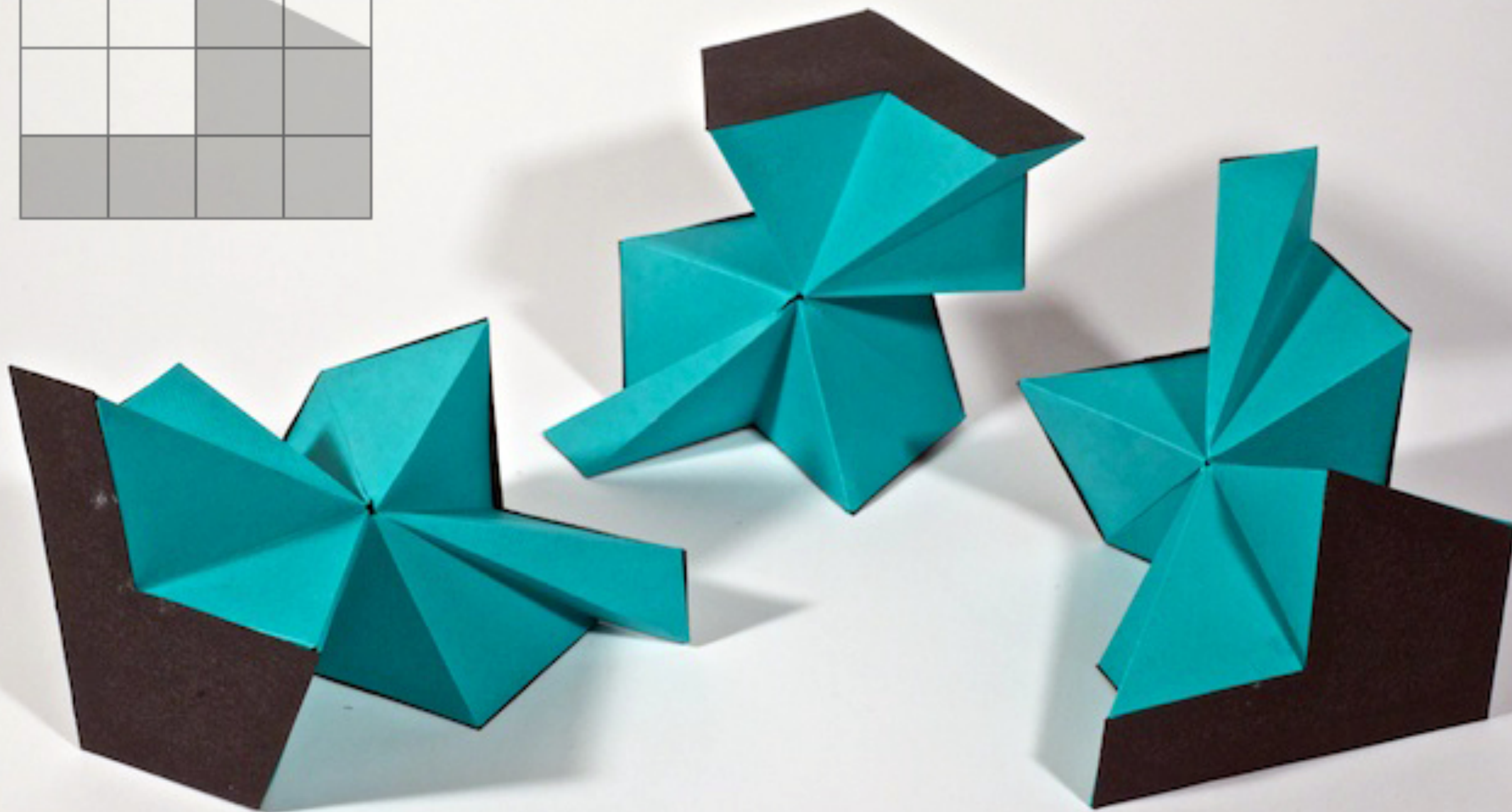
DISEGNO ARCHITETTONICO E GEOMETRIA
DESCRITTIVA – ISDA ORISTANO E FAENZA
(1962–1980–2002)

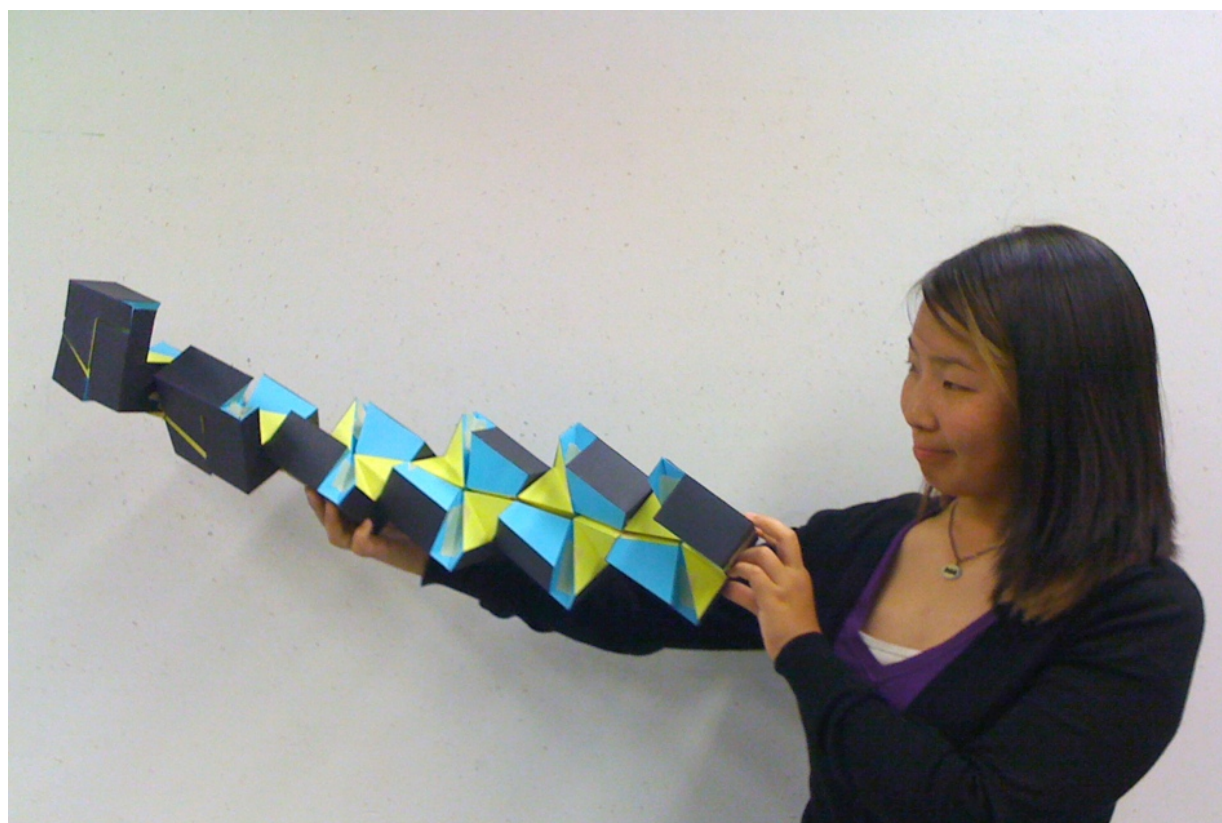
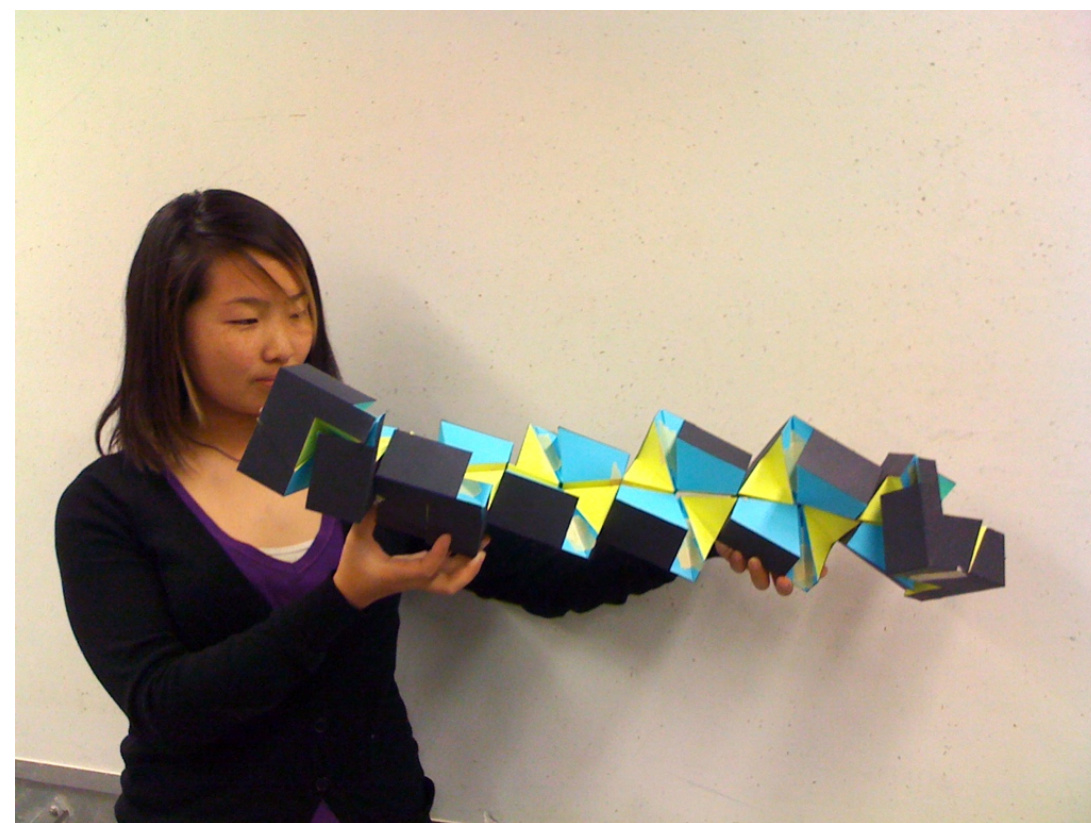
TEORIA DELLA PERCEZIONE (ISIA FAENZA)
(1980–2008)

ISTITUTO D'ARTE ORISTANO, C.1975



PROGETTO: SEZIONE DI UN CUBO





**CATENA CHIUSA A 24 MODULI
FLORENCE YUEN
SAN FRANCISCO STATE UNIVERSITY
2012**

NATURA

MODELLI BIONICI:

RICCIO MARINO & DNA



LANTERNA DI ARISTOTELE

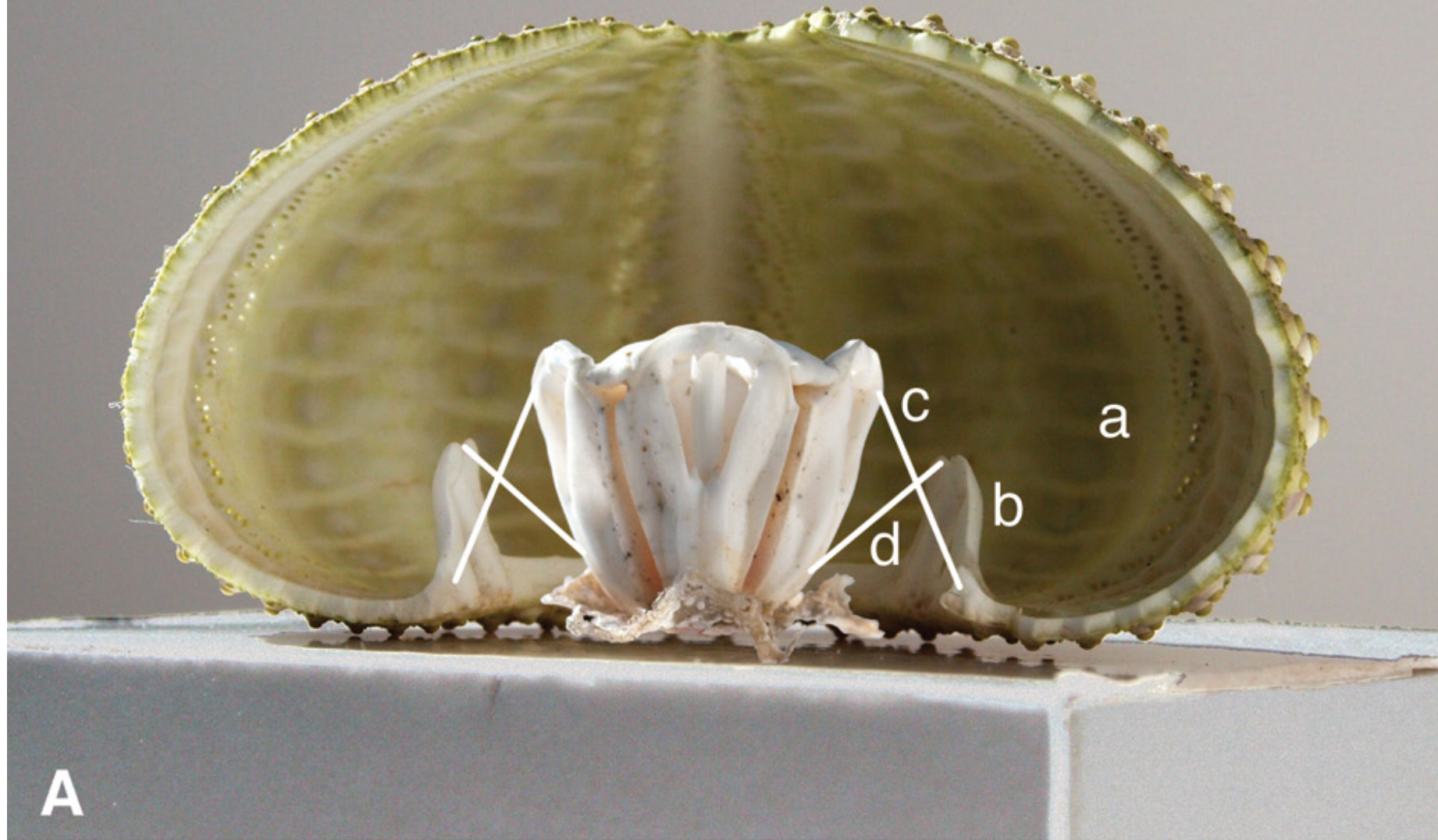
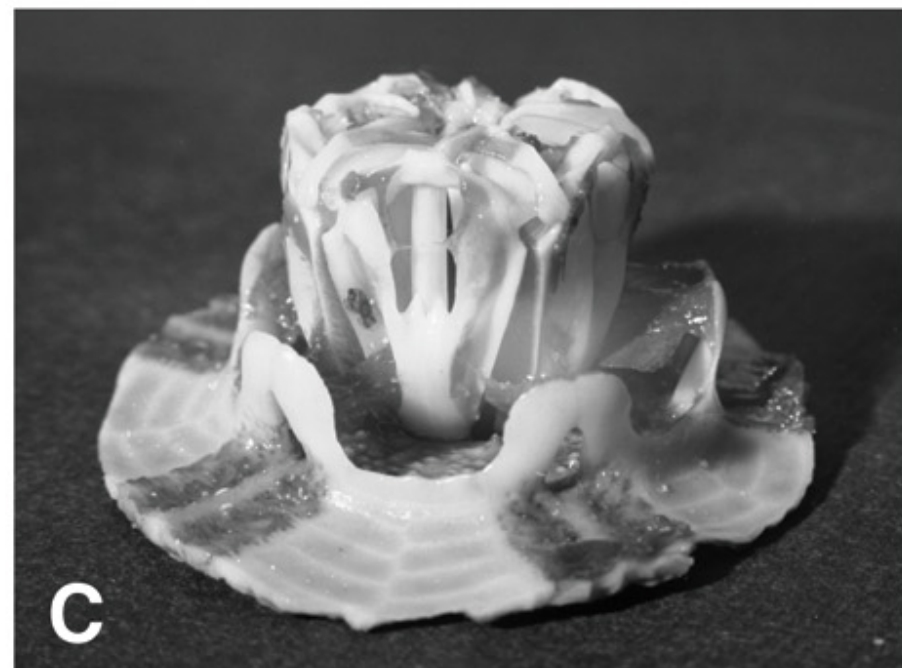


Photo: Giorgio Cireddu



Faenza, c. 1980

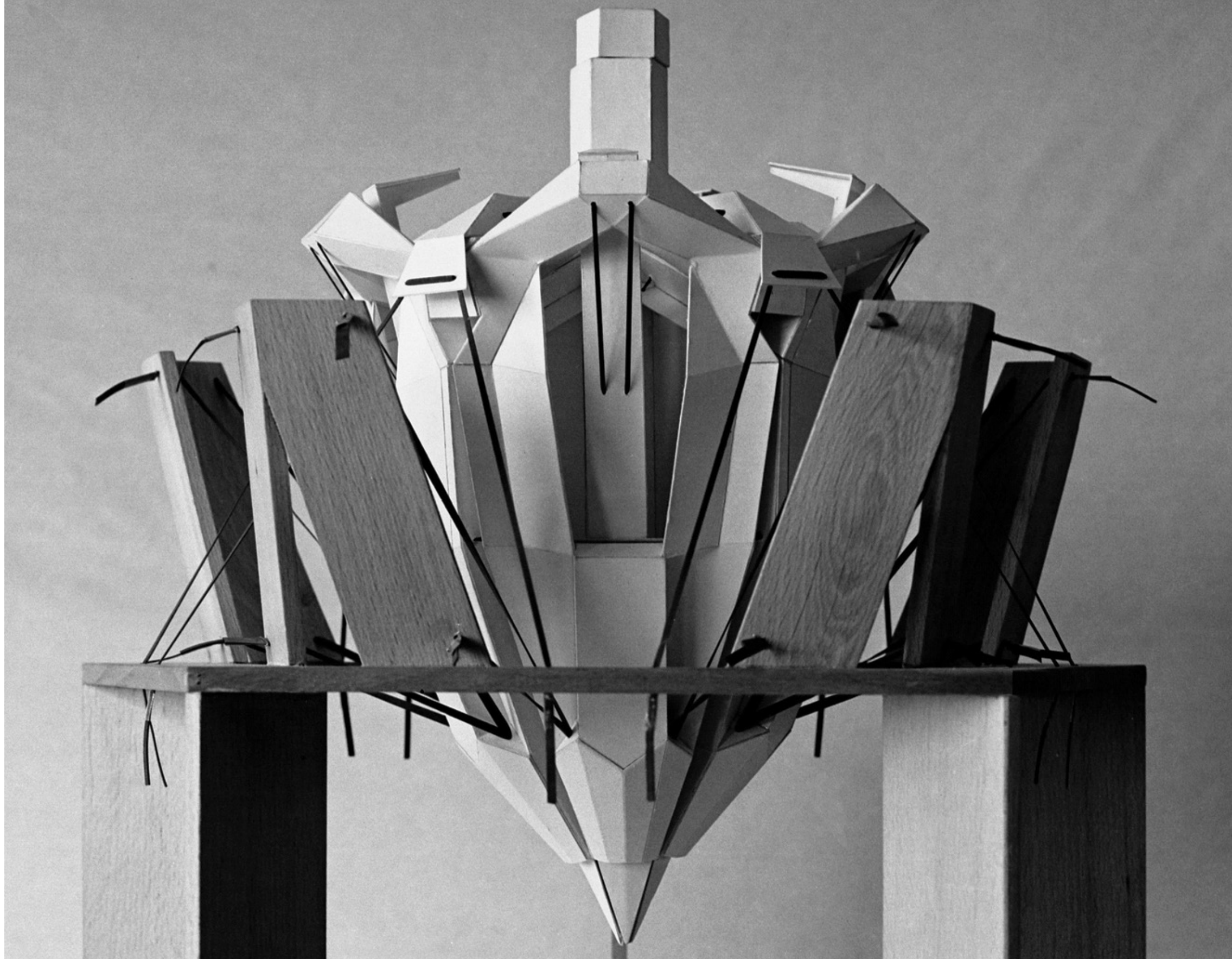
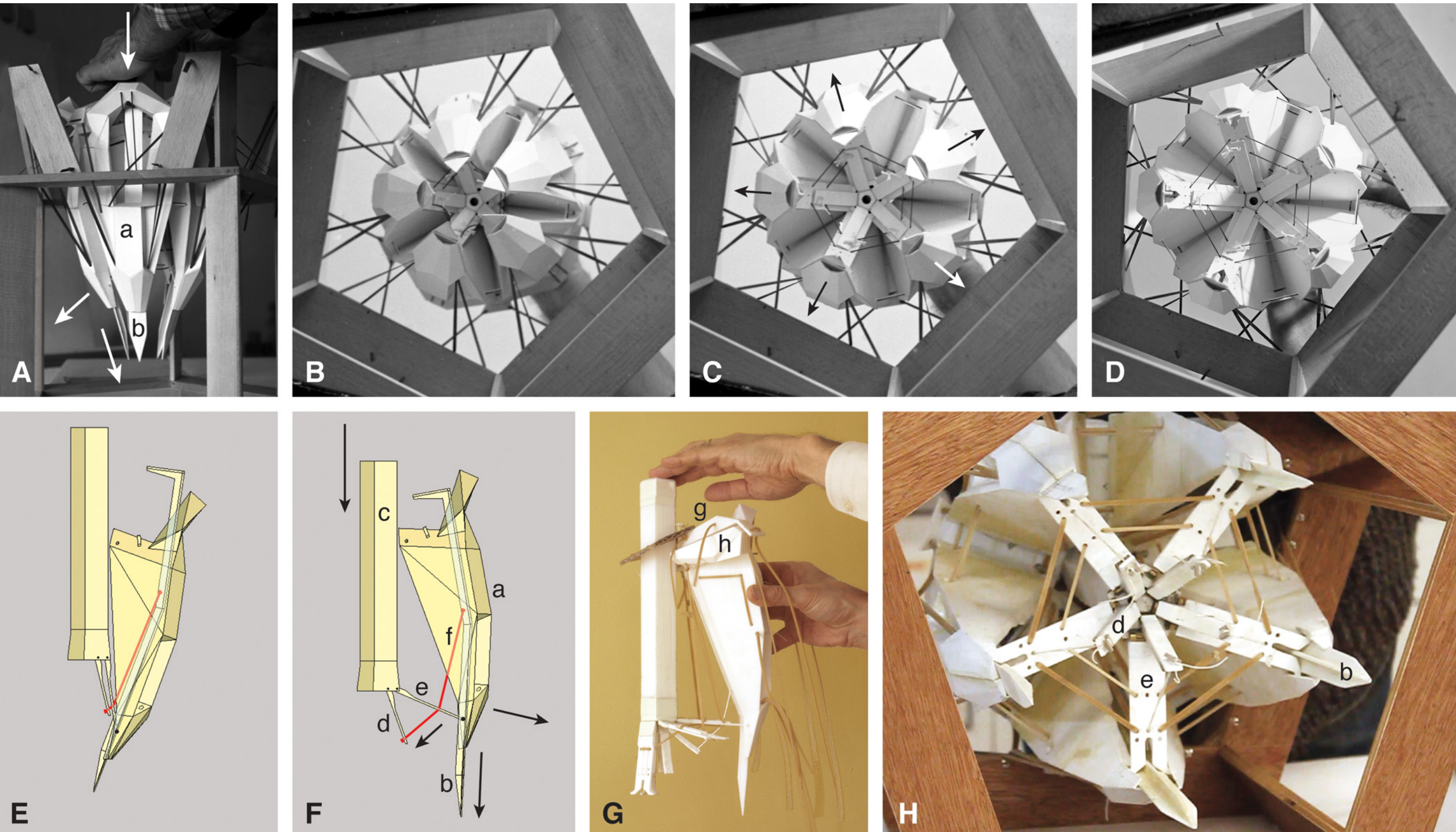
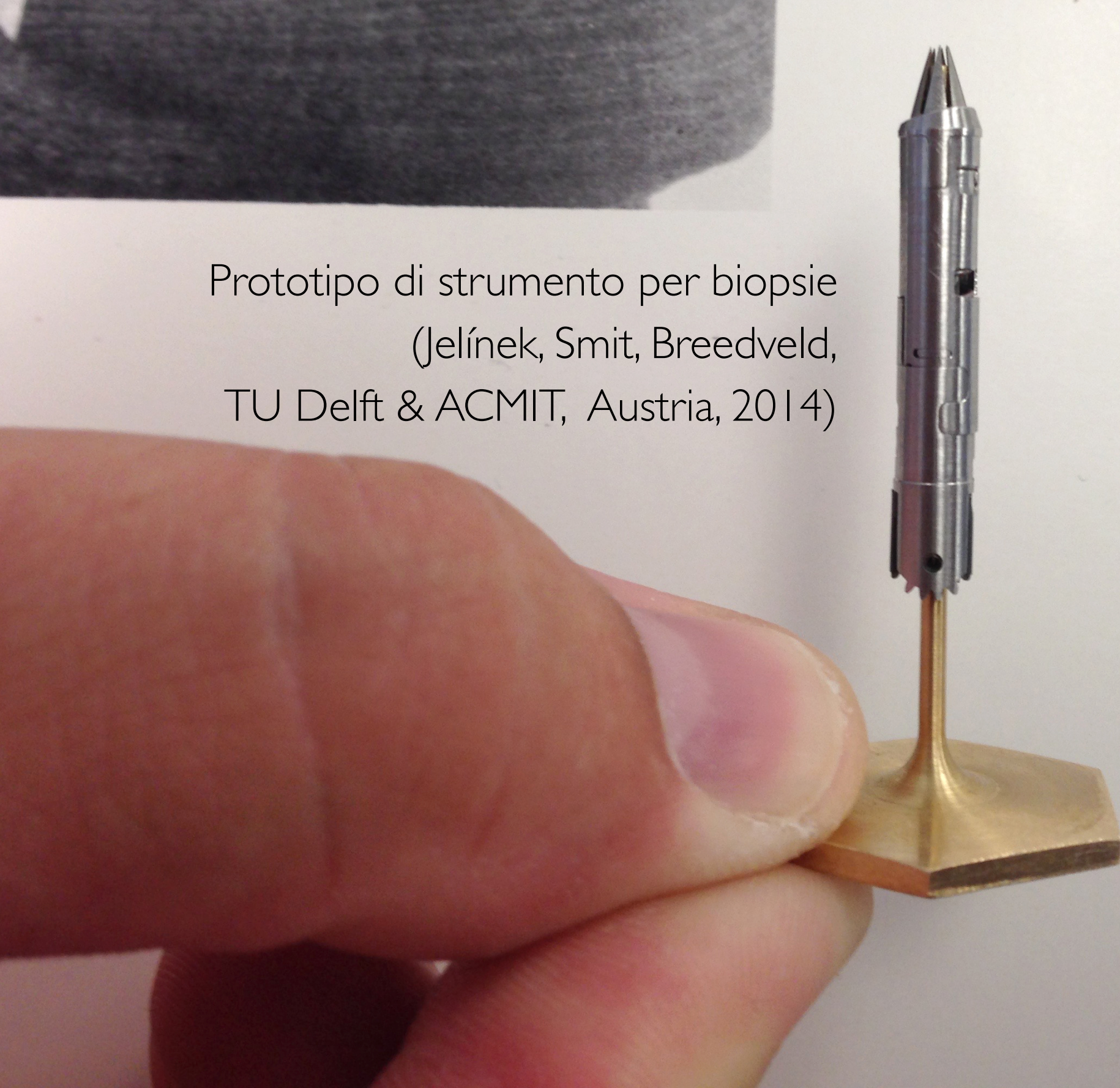


Photo: Giorgio Cireddu



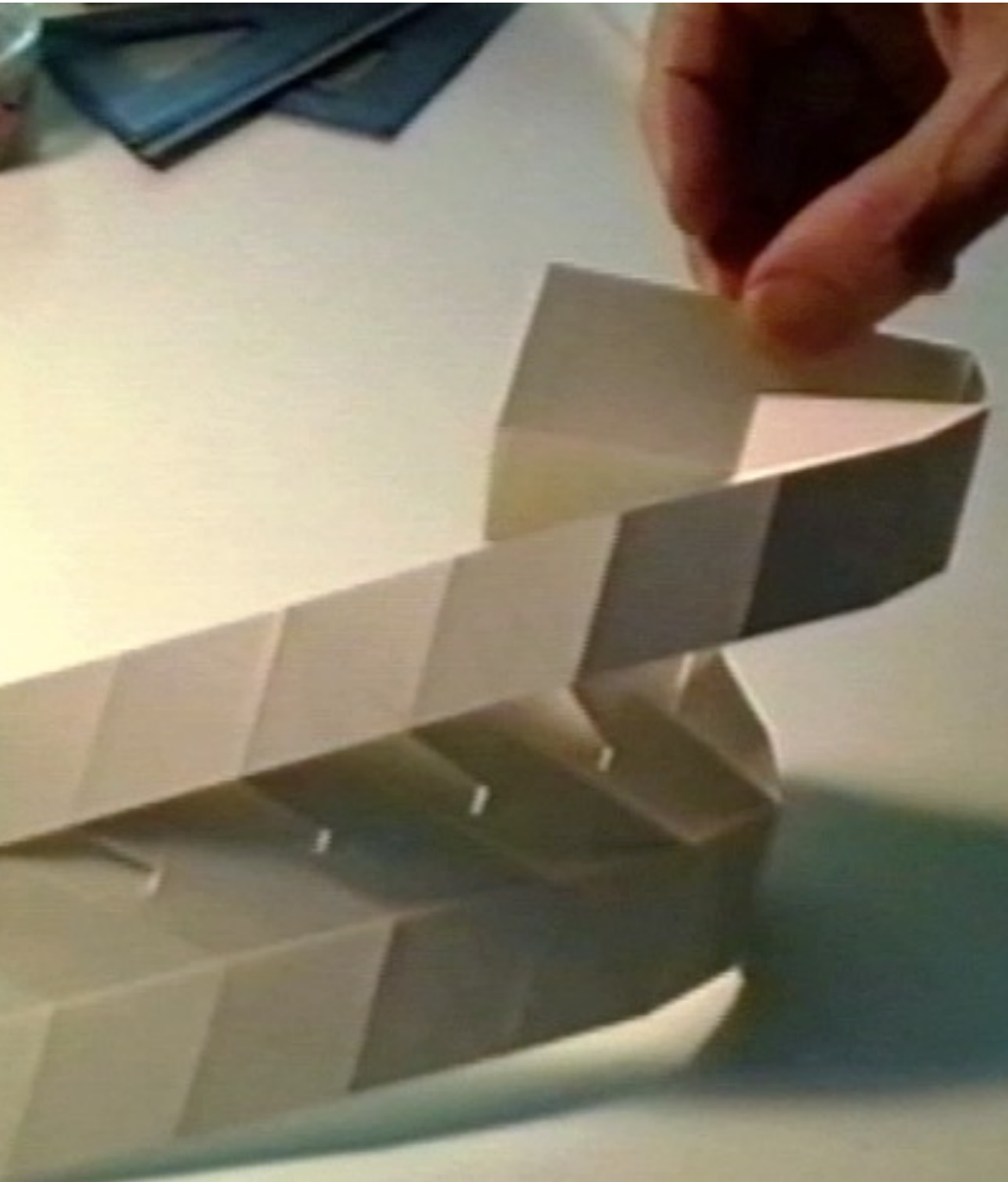
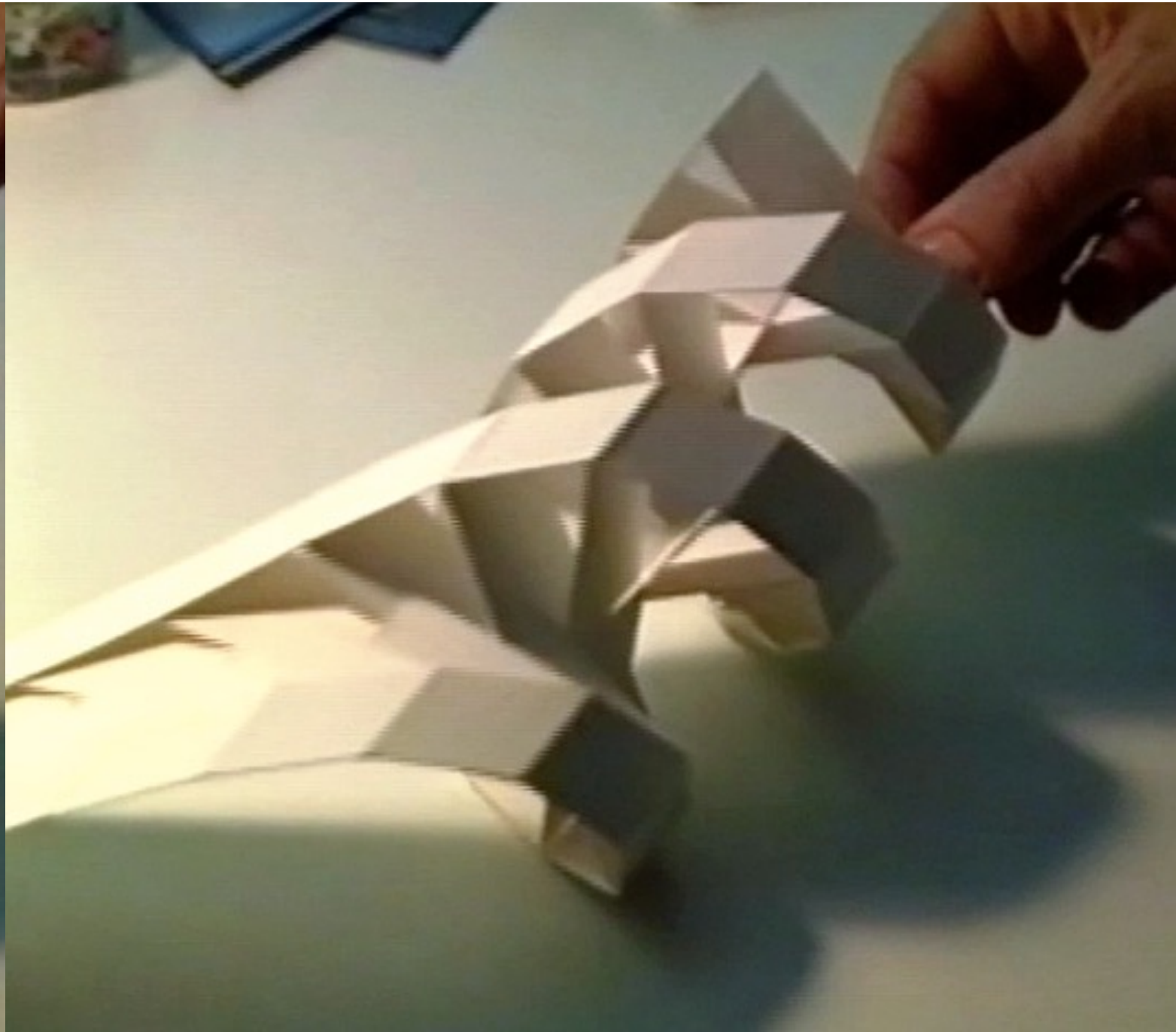
Trogu, replica della lanterna di Aristotele, 2015

Prototipo di strumento per biopsie
(Jelínek, Smit, Breedveld,
TU Delft & ACMIT, Austria, 2014)

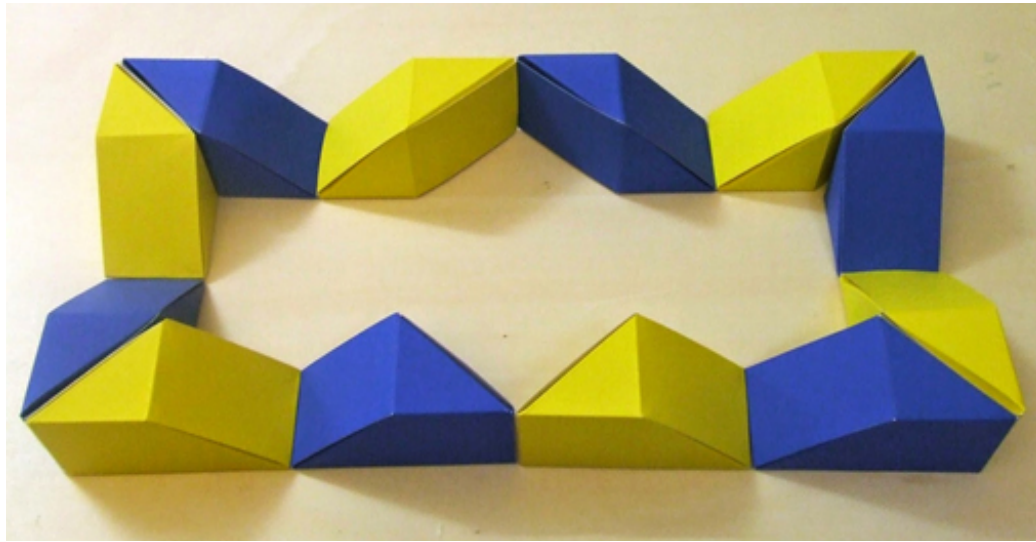
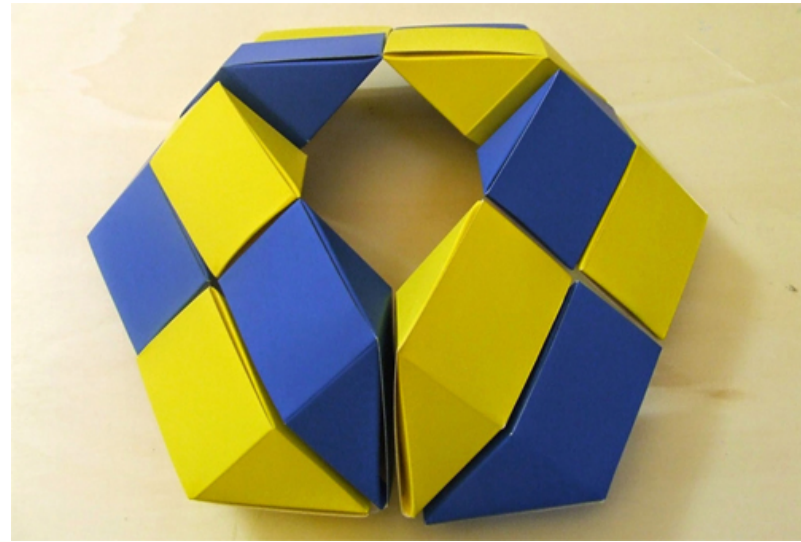
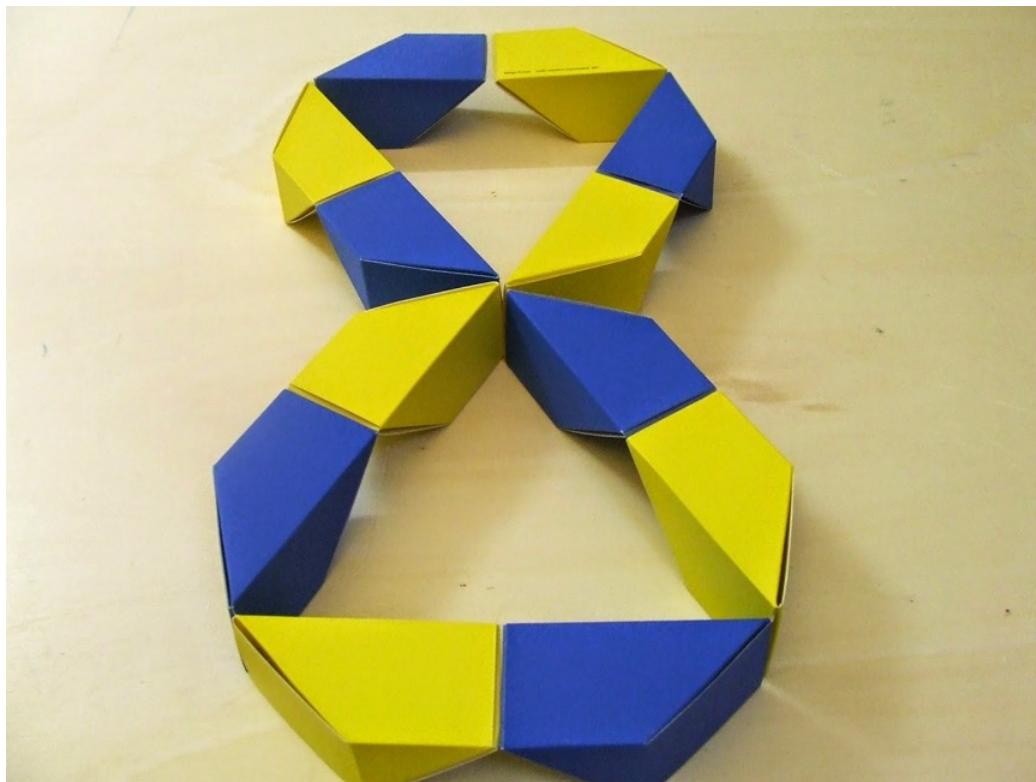
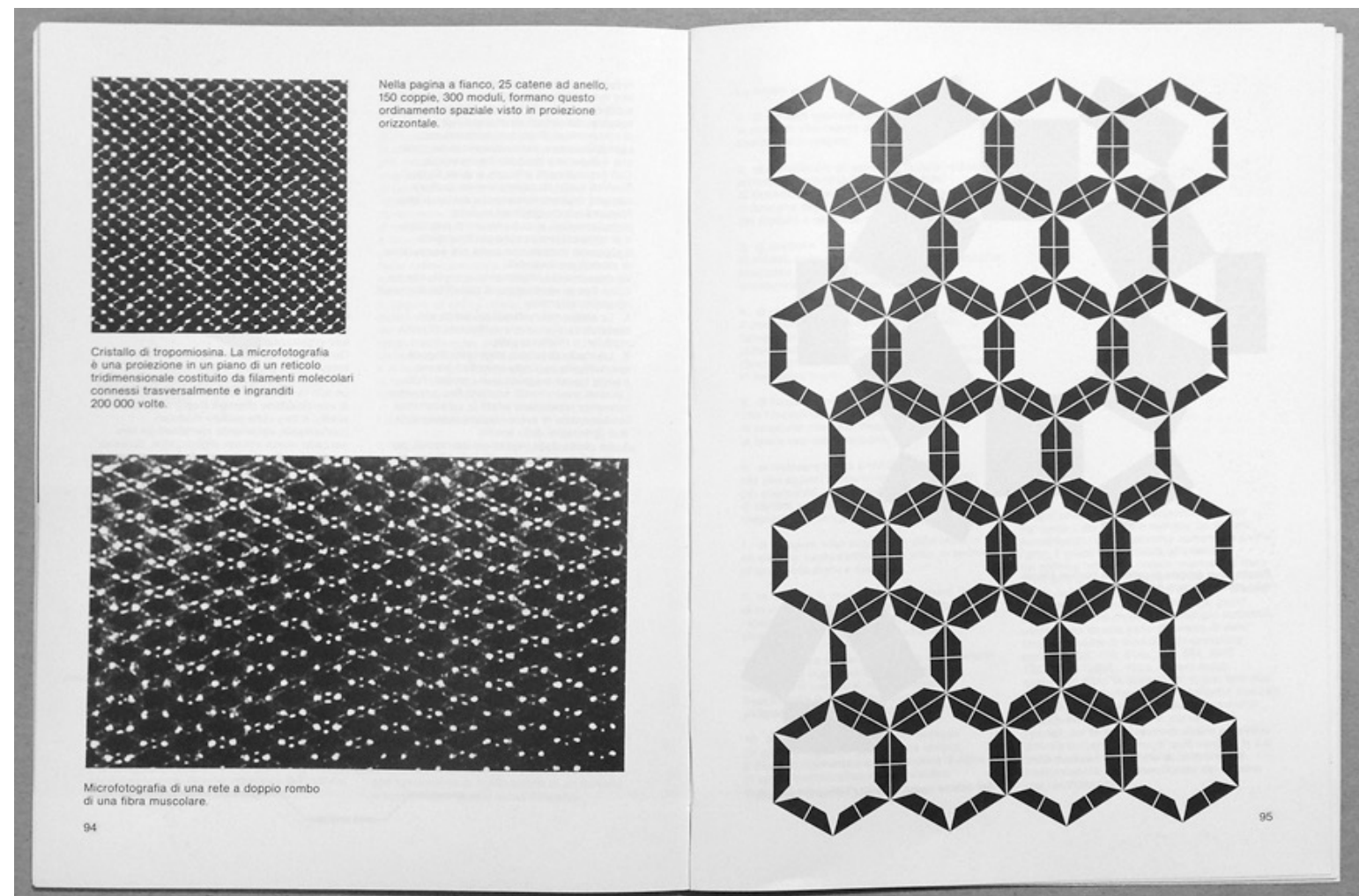


SCARPA

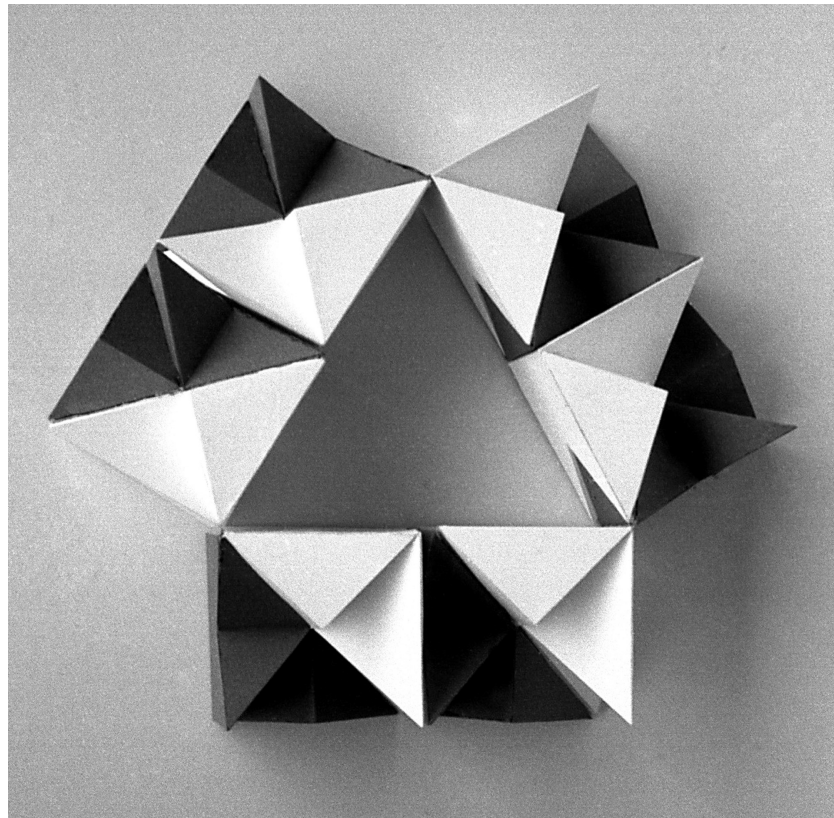
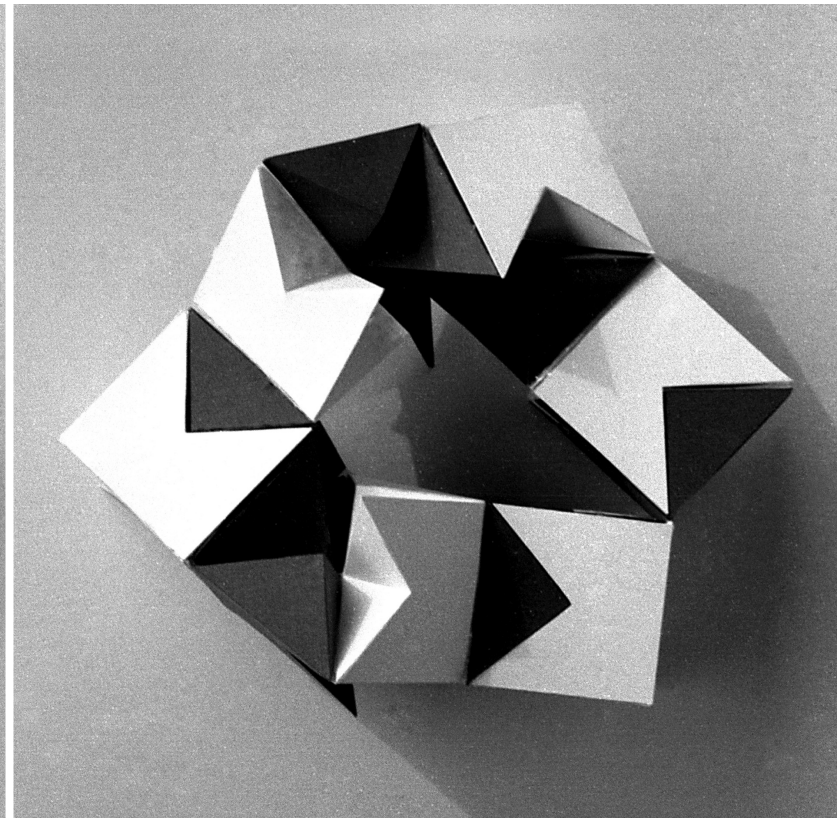
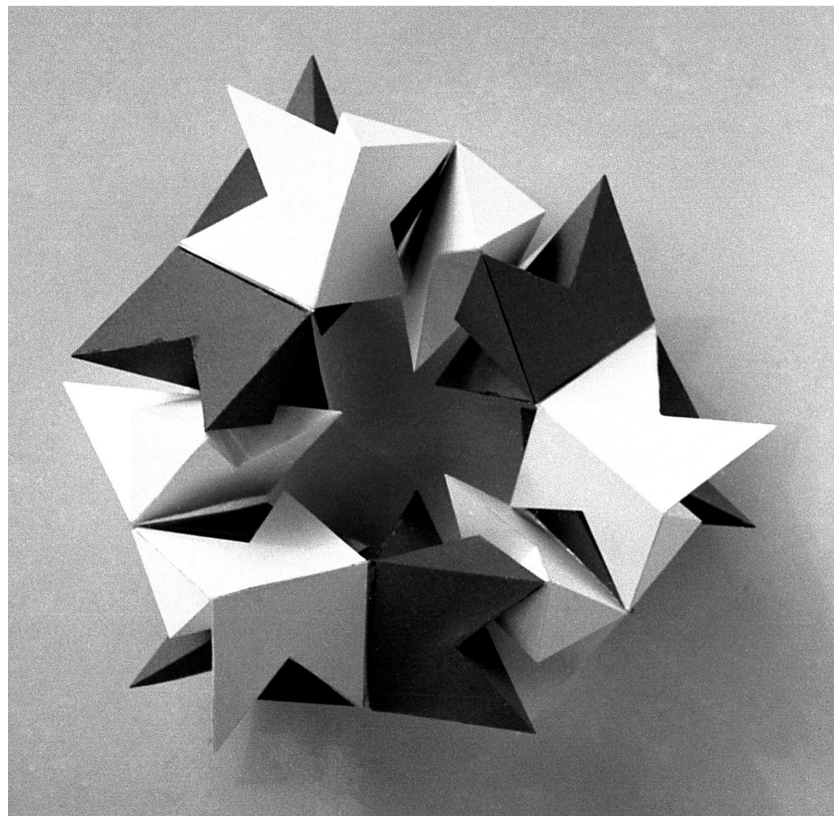
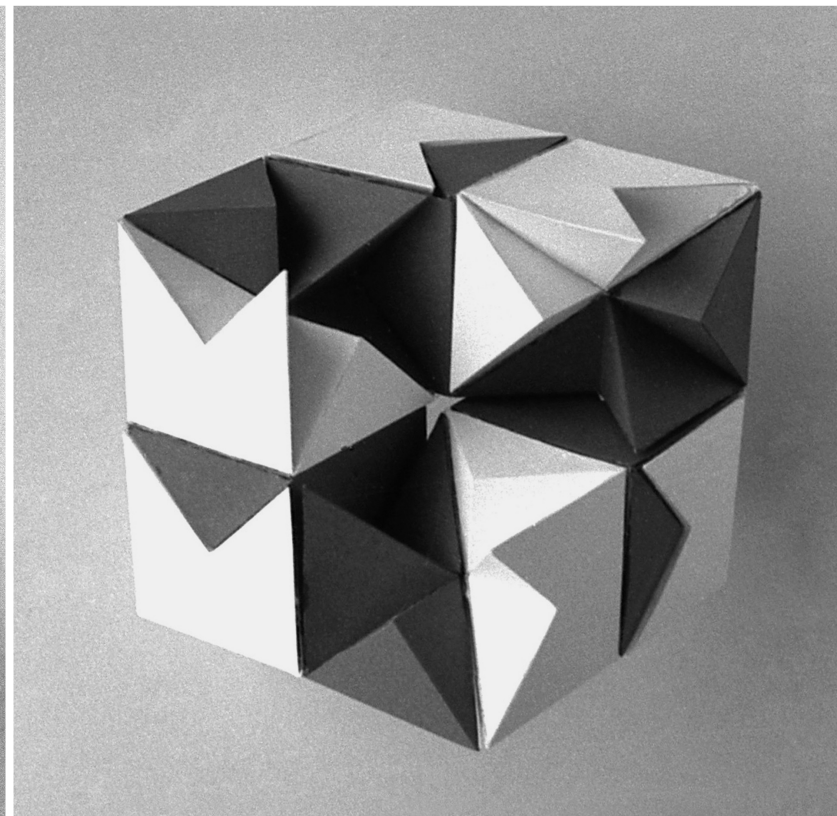
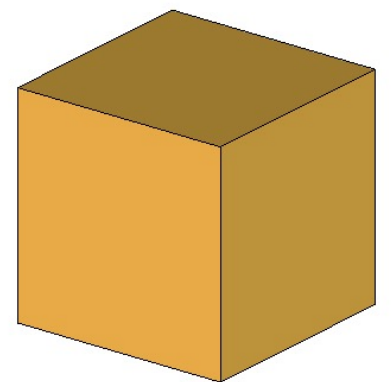
MODELLO DI DNA, C. 1985



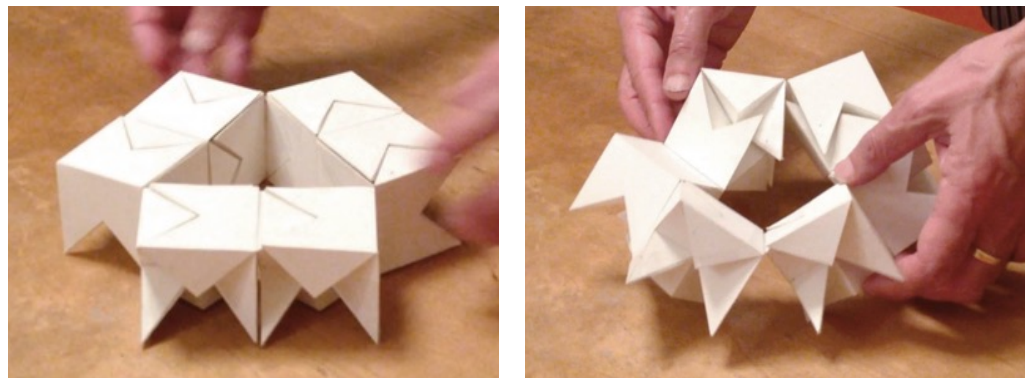
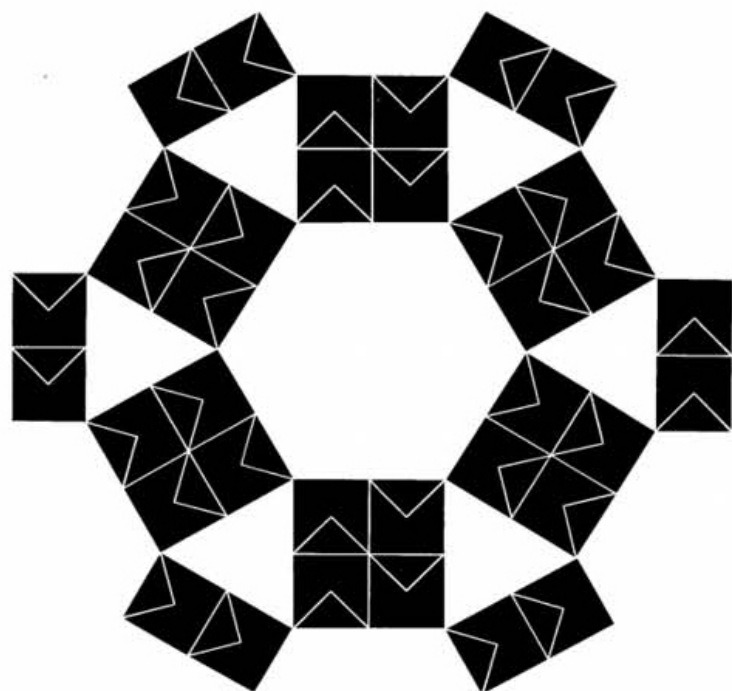
MODELLI DI GEOMETRIA ROTATORIA “TESSUTI TRASFORMABILI” E POLIEDRI



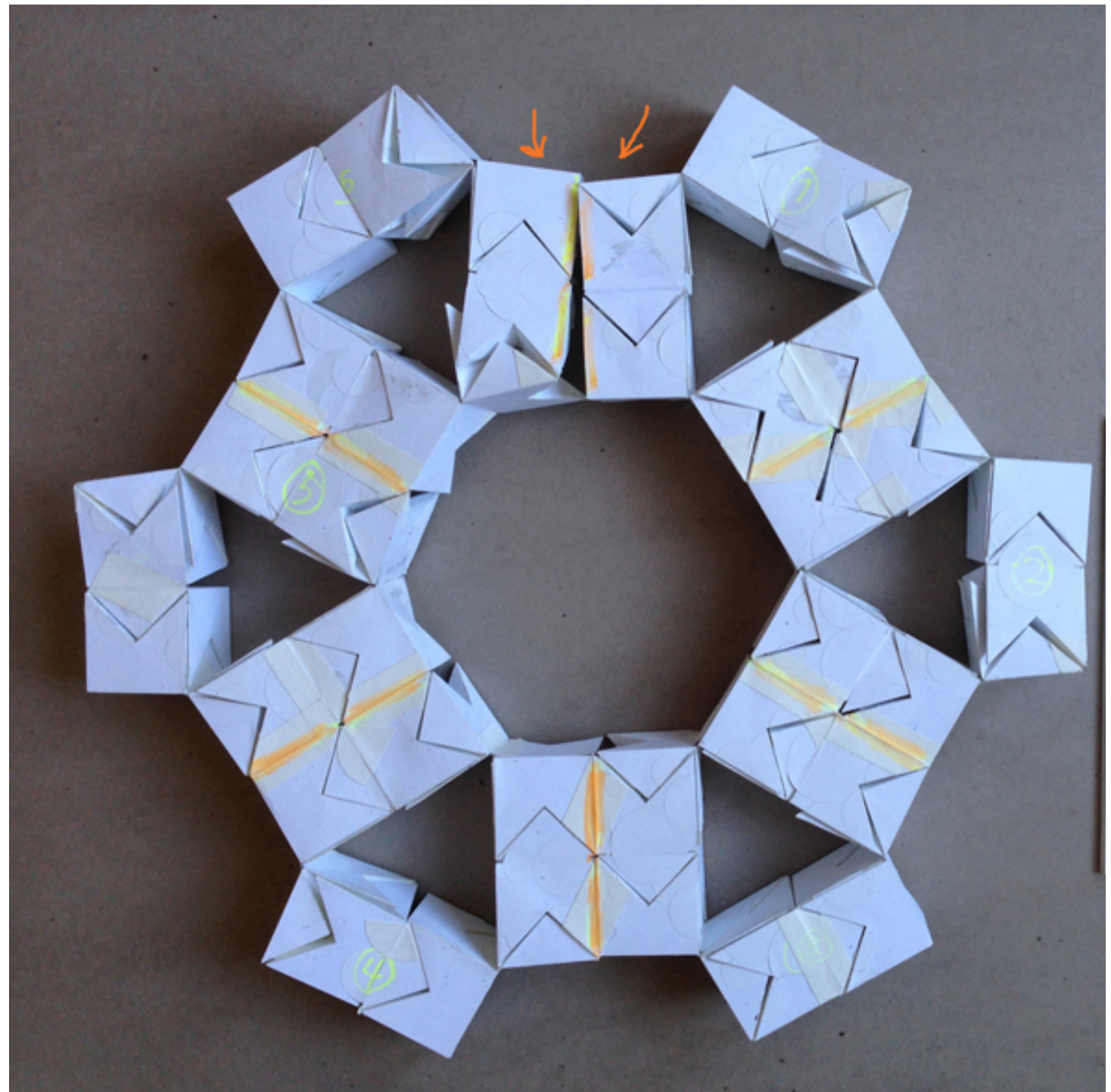
(G. Scarpa, Modelli di geometria rotatoria 1978)



SCARPA



CATENA ESAEDRICA, 1978



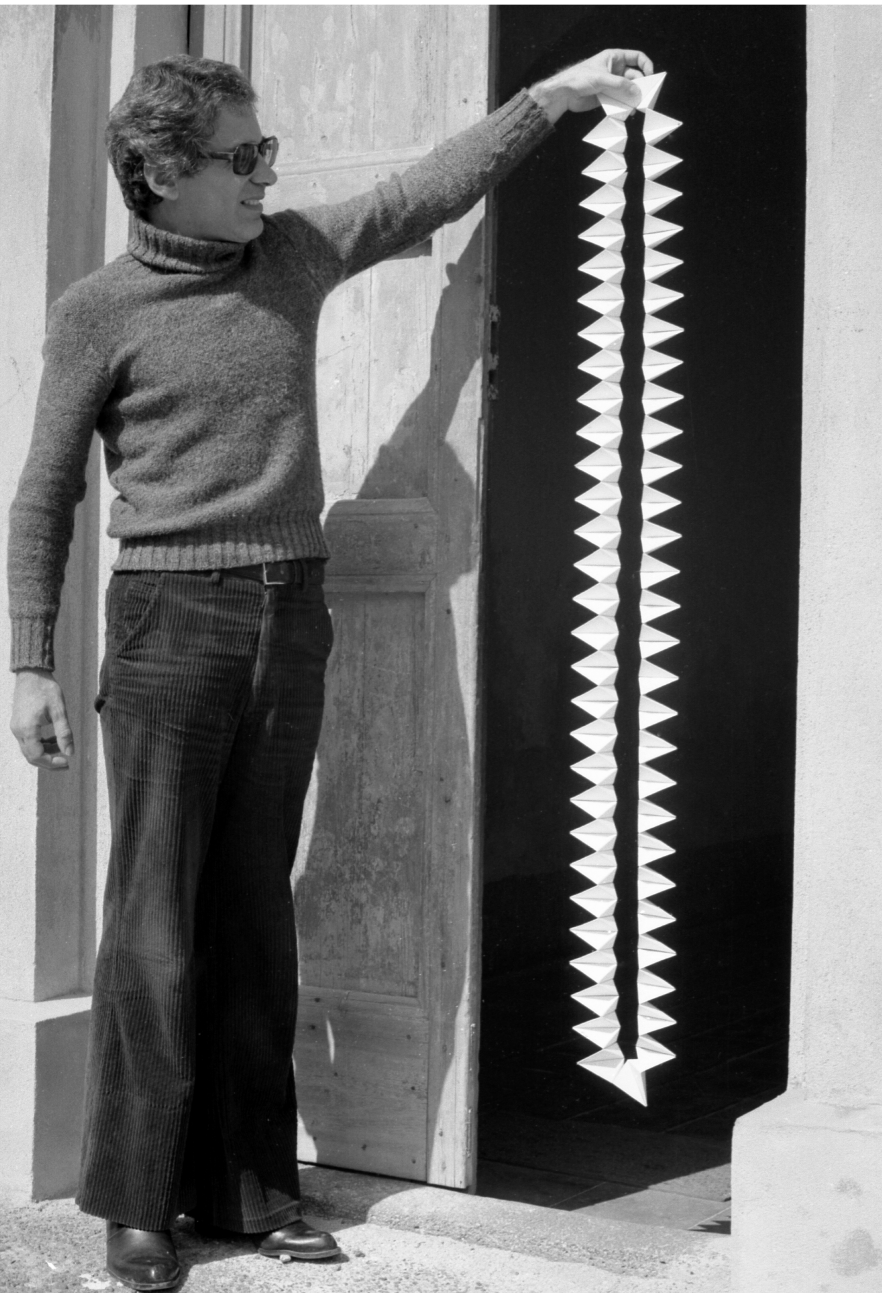
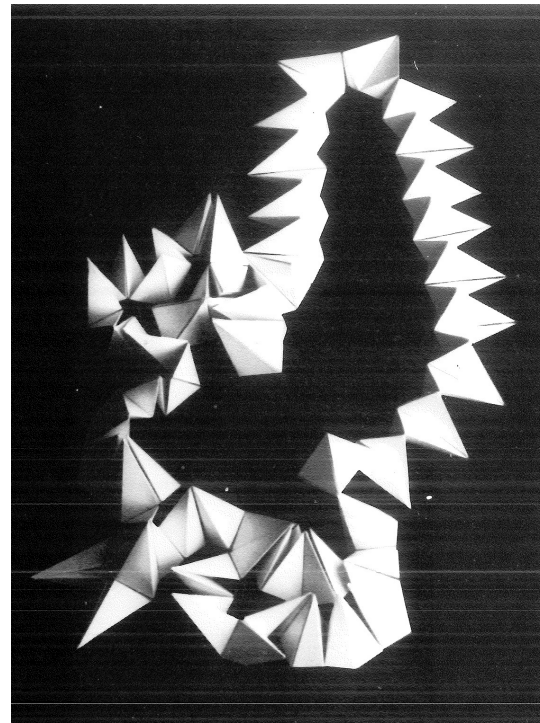
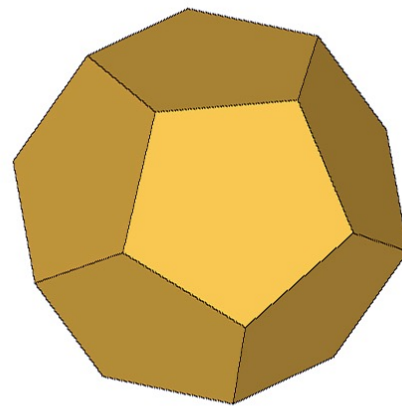
(Trogu & Nies, 2015)

PROTOTIPO DI CATENA TRASFORMABILE



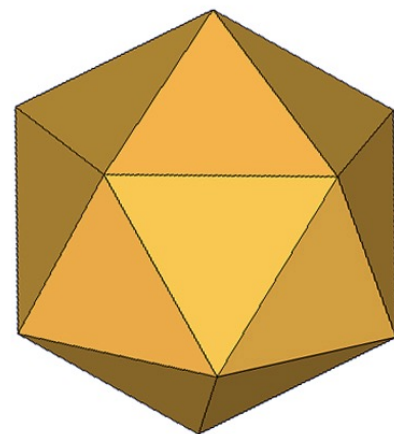
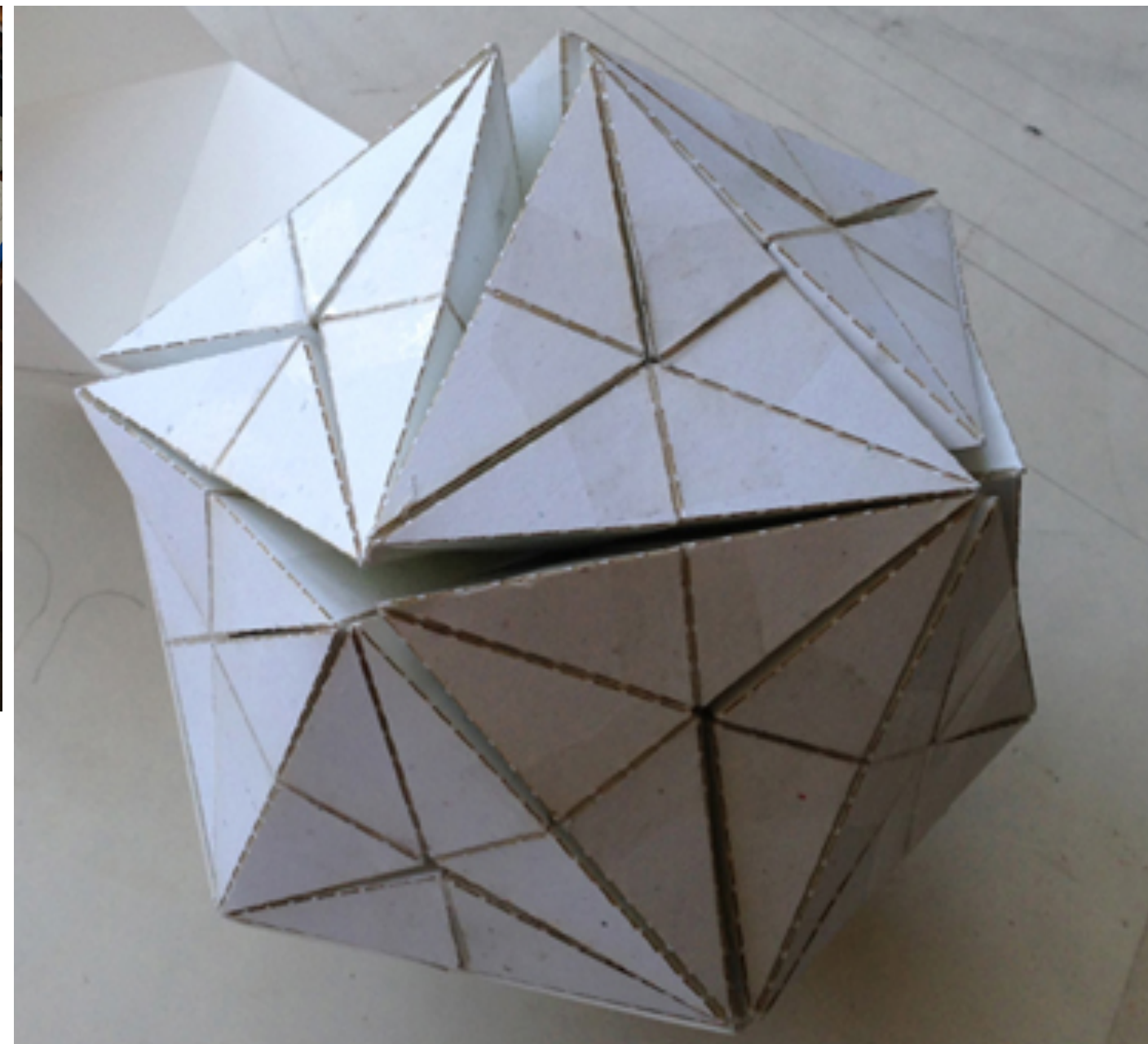
SCARPA

CATENA DODECAEDRICA, 1978



120 PIRAMIDI TRIANGOLARI

CATENA ICOSAEDRICA, (COSTRUZIONE 2015)

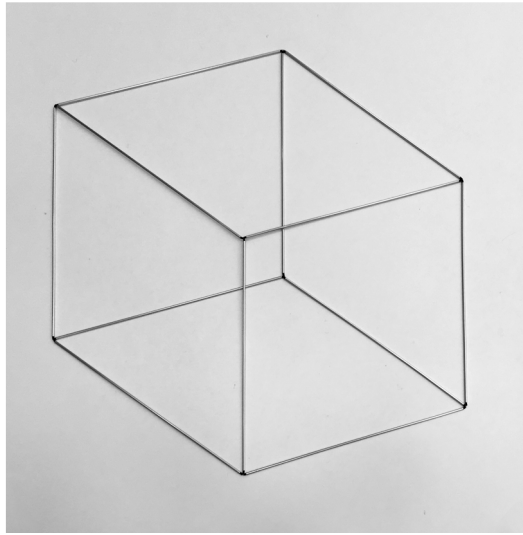
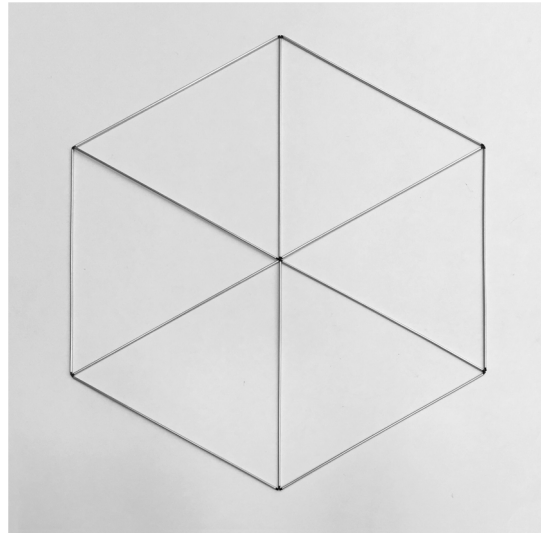
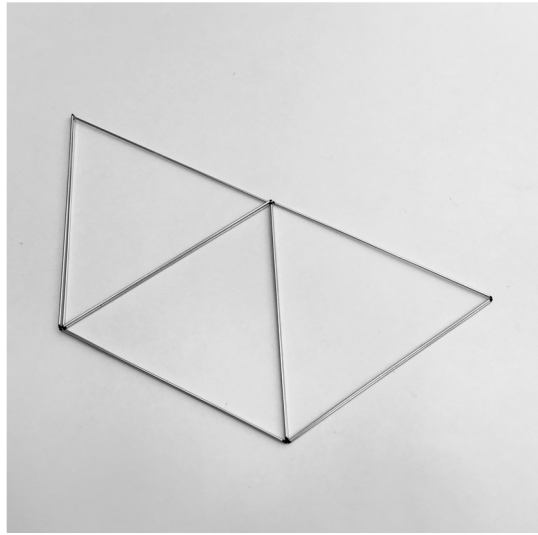
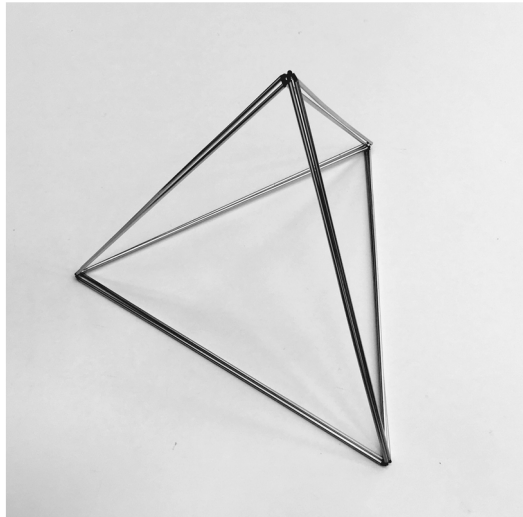
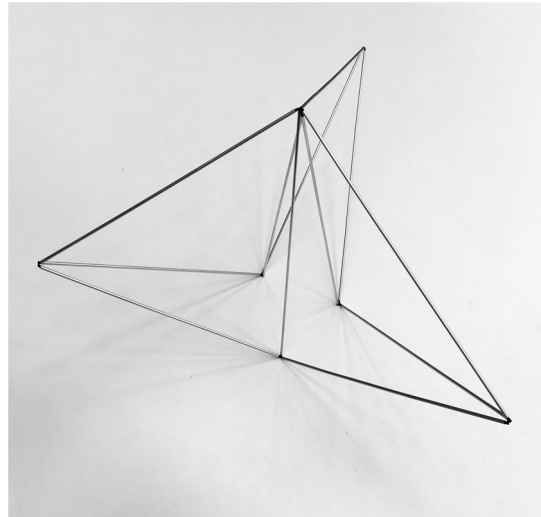
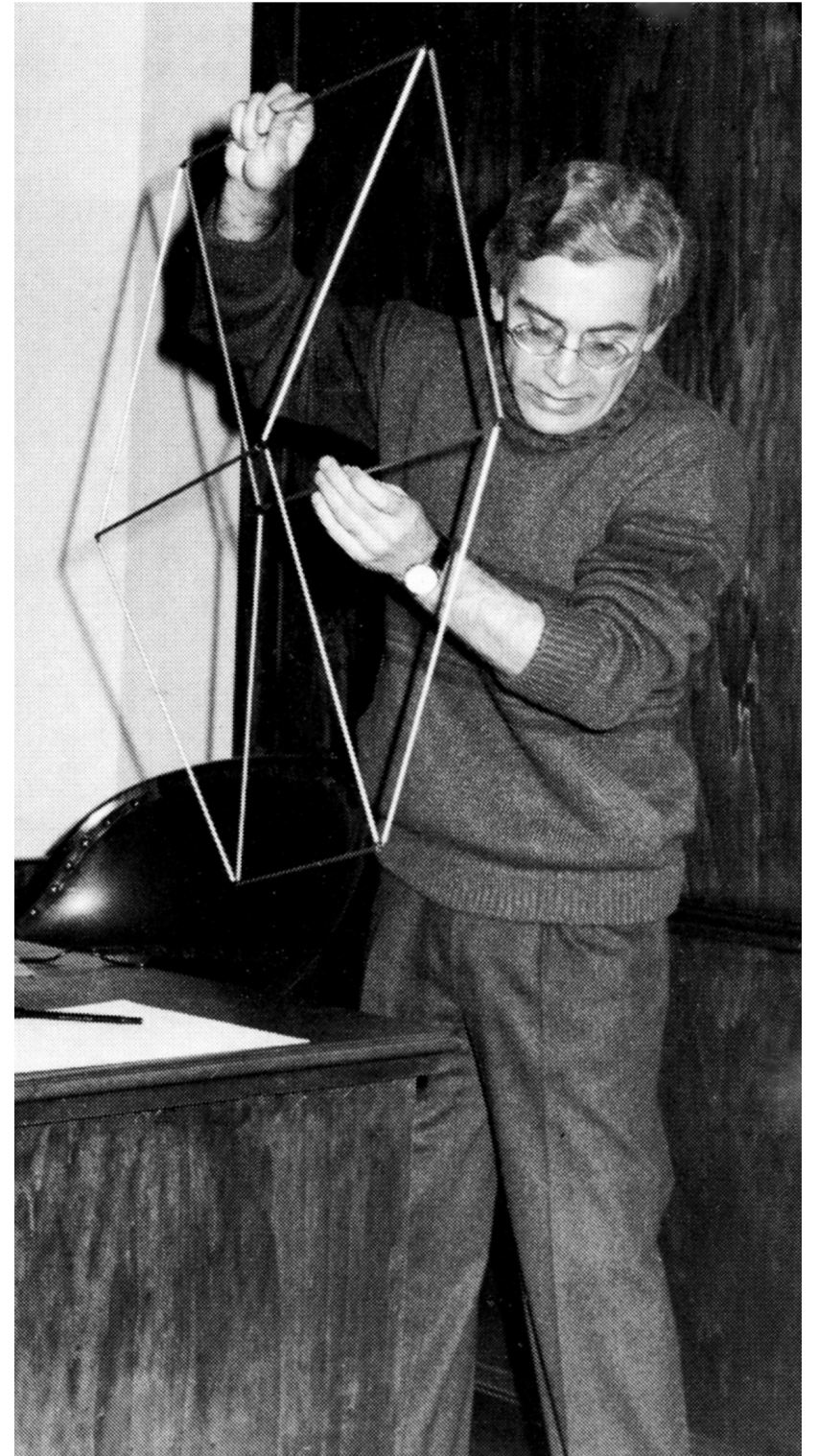


(Trogu & Nies, modello dopo Scarpa, 2015)

120 PIRAMIDI TRIANGOLARI

SCARPA

CUBO TRASFORMABILE, 1965

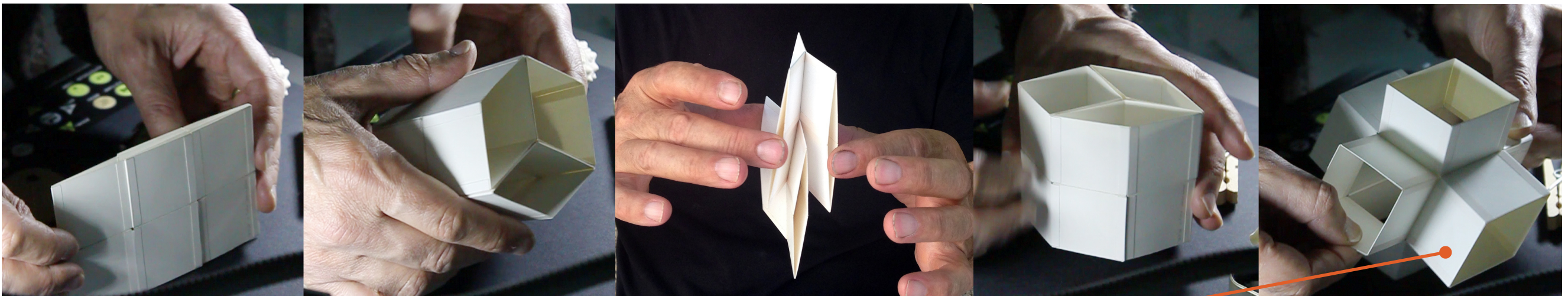
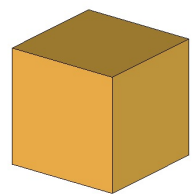


DUE “FIGURE TRASFORMABILI” 1996

Spero che la forma trasformabile che troverai nel pacchetto ti piaccia. Ma era qualcos'altro che volevo mandarti: un oggetto di carta che ho realizzato in tre versioni differenti, ma che presenta ancora più di un problema da risolvere.

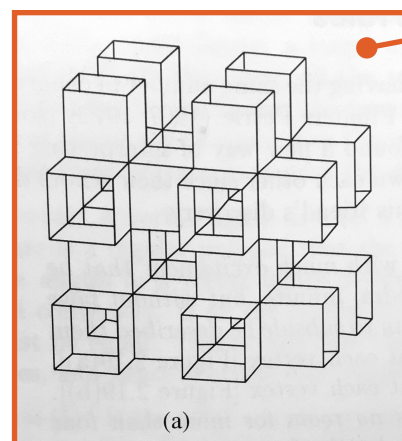
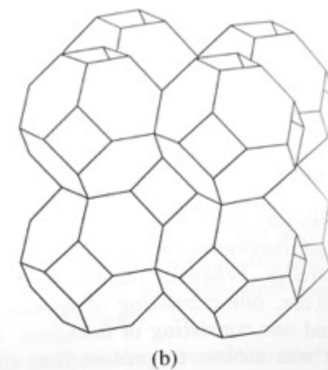
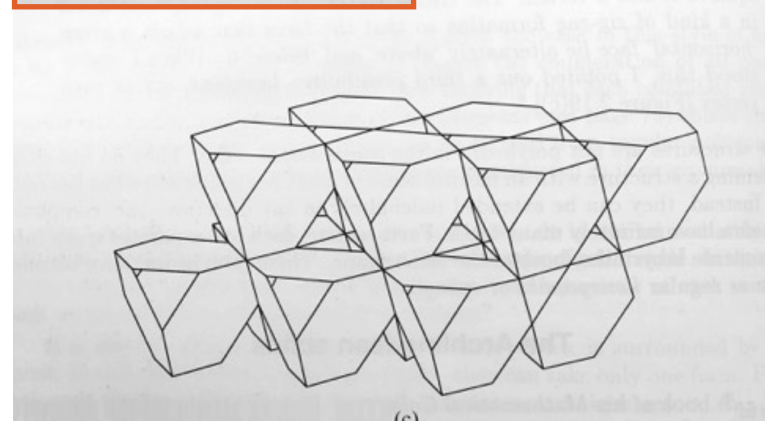
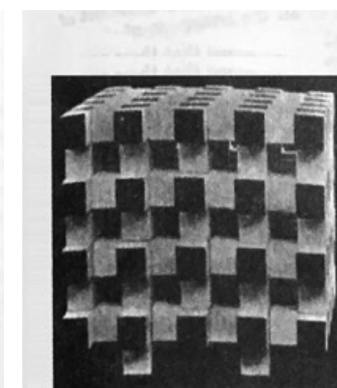
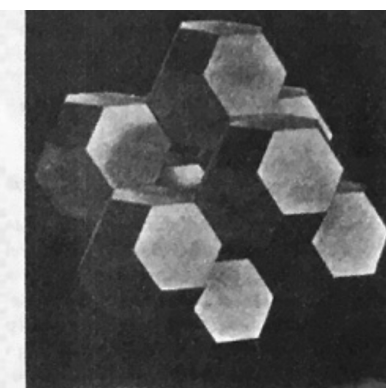
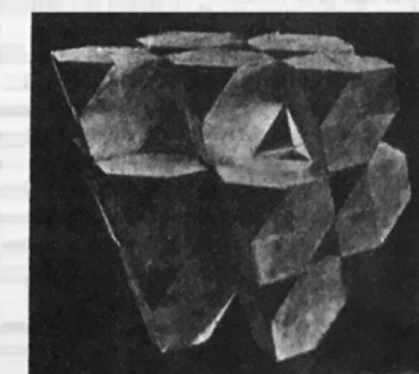
Com. pers., 28 luglio 1996

CUBO ESTRUSO



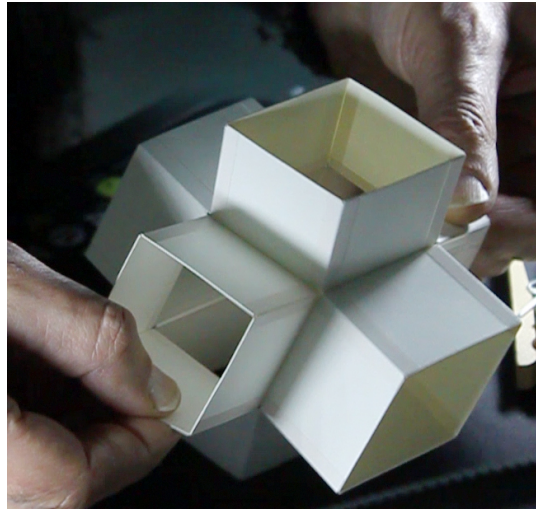
J. F. PETRIE REGULAR HONEYCOMB 1926

P. Cromwell, Polyhedra,
Cambridge University Press, 1997. p.79

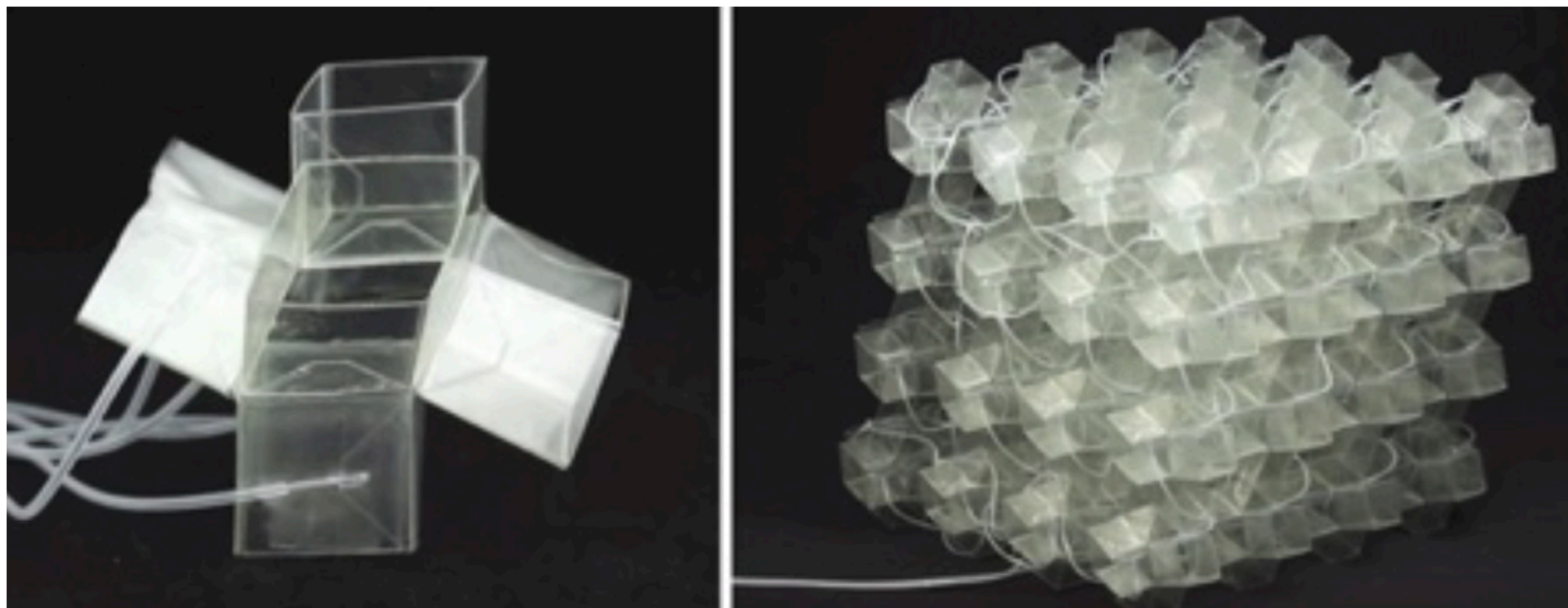


H.S.M. Coxeter, Regular Skew Polyhedra in Three and Four Dimensions, and Their Topological Analogues, *Proc. London Math. Soc.* (series 2) 43 (1937) pp. 33–34

SCARPA, 1996



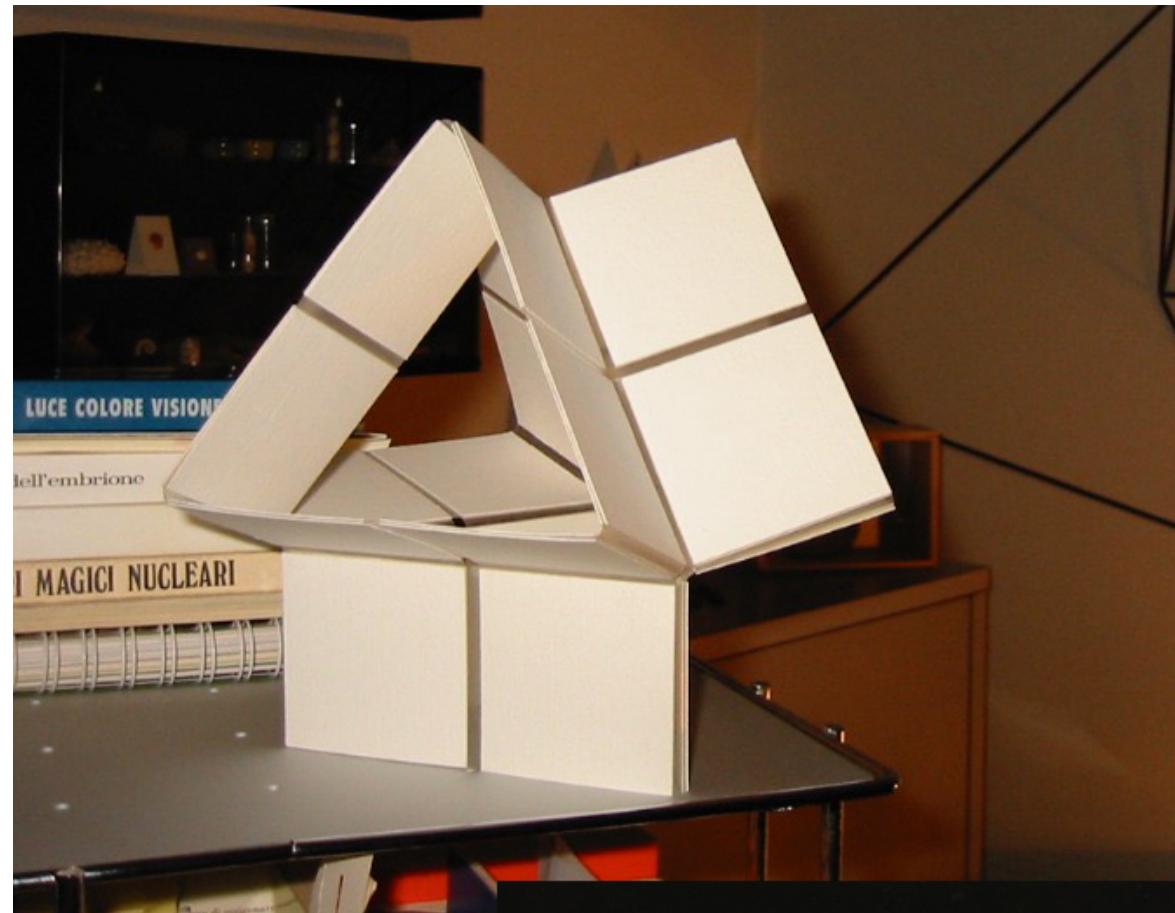
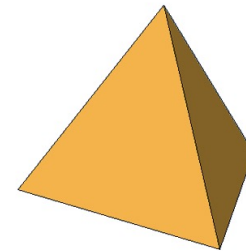
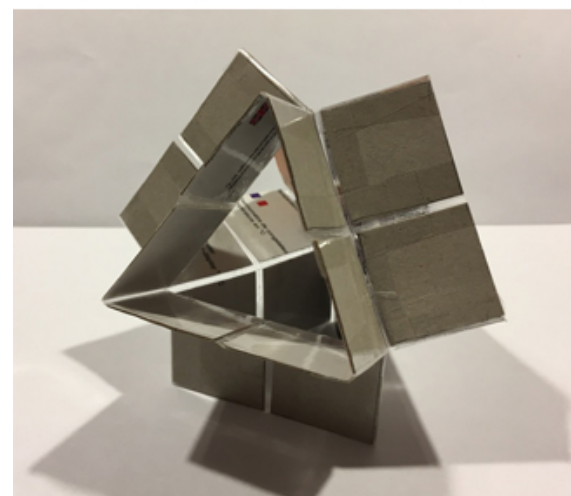
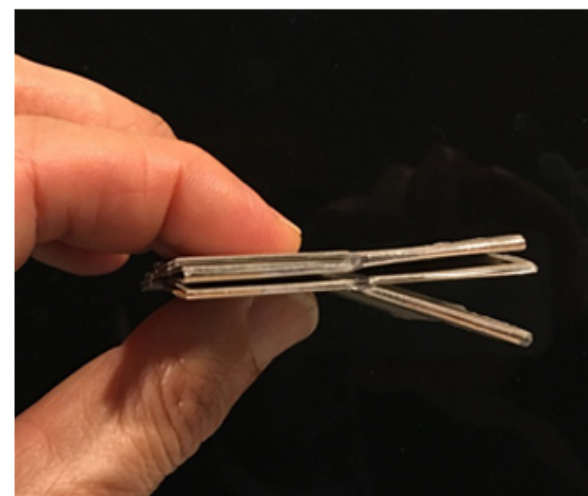
OVERVELDE ET AL, 2016



Overvelde, J.T. B. et al, A three-dimensional actuated origami-inspired transformable metamaterial with multiple degrees of freedom.
Nat. Commun. 7, 10929 (2016)

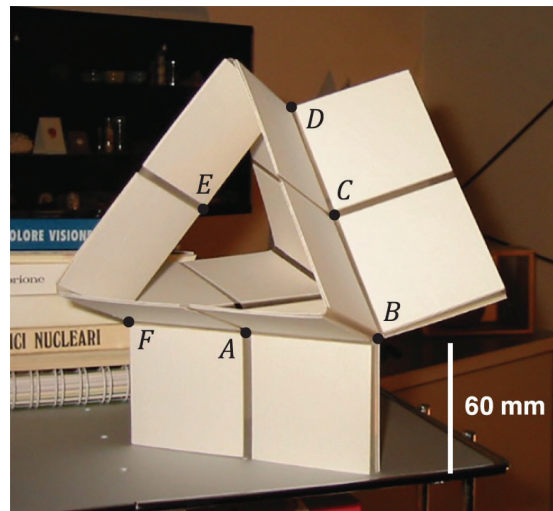
TETRAEDRO ESTRUSO

G. SCARPA – TETRAEDRO ESTRUSO – 1996



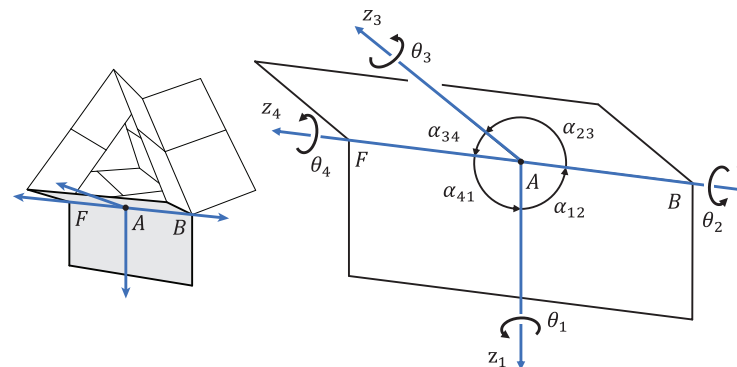
Trogu, prima replica, 2017

Scarpa's transformable model (1996)

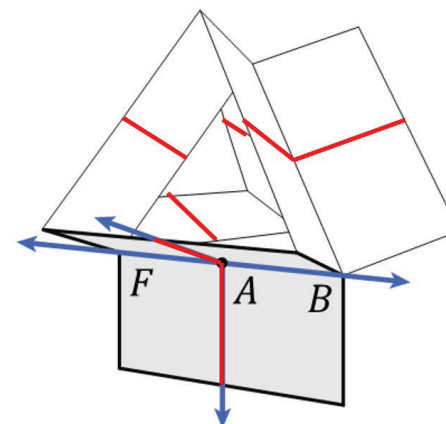


It is flat-foldable

Rigid foldability analysis



D-H notation of the four-crease vertex A .



— inactive creases

It is not rigidly foldable

Conditions:

$$\alpha_{12} = \alpha_{23} = \alpha_{34} = \alpha_{41} = \frac{\pi}{2}$$

Closure equation (D-H):

$$Q_{21}Q_{32} = Q_{41}Q_{34}$$

where

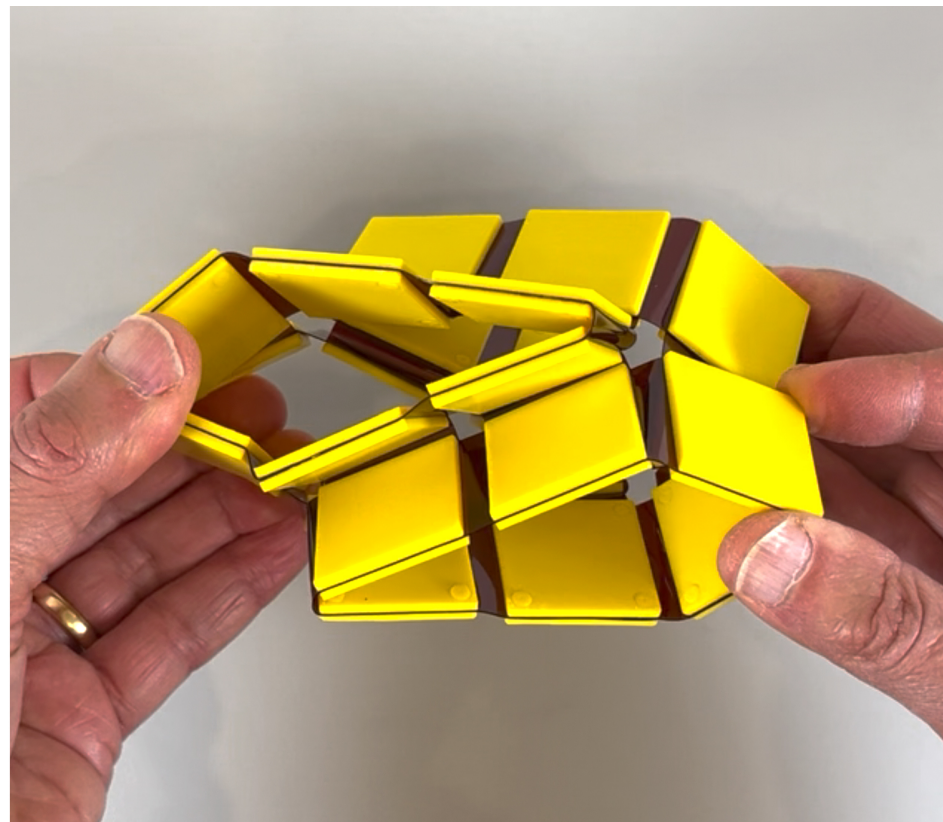
$$Q_{(i+1)i} = \begin{bmatrix} \cos \theta_i & -\cos \alpha_{i(i+1)} \sin \theta_i & \sin \alpha_{i(i+1)} \sin \theta_i \\ \sin \theta_i & \cos \alpha_{i(i+1)} \cos \theta_i & -\sin \alpha_{i(i+1)} \cos \theta_i \\ 0 & \sin \alpha_{i(i+1)} & \cos \alpha_{i(i+1)} \end{bmatrix}$$

$$Q_{i(i+1)} = \begin{bmatrix} \cos \theta_i & \sin \theta_i & 0 \\ -\cos \alpha_{i(i+1)} \sin \theta_i & \cos \alpha_{i(i+1)} \cos \theta_i & \sin \alpha_{i(i+1)} \\ \sin \alpha_{i(i+1)} \sin \theta_i & -\sin \alpha_{i(i+1)} \cos \theta_i & \cos \alpha_{i(i+1)} \end{bmatrix}$$

Solution:

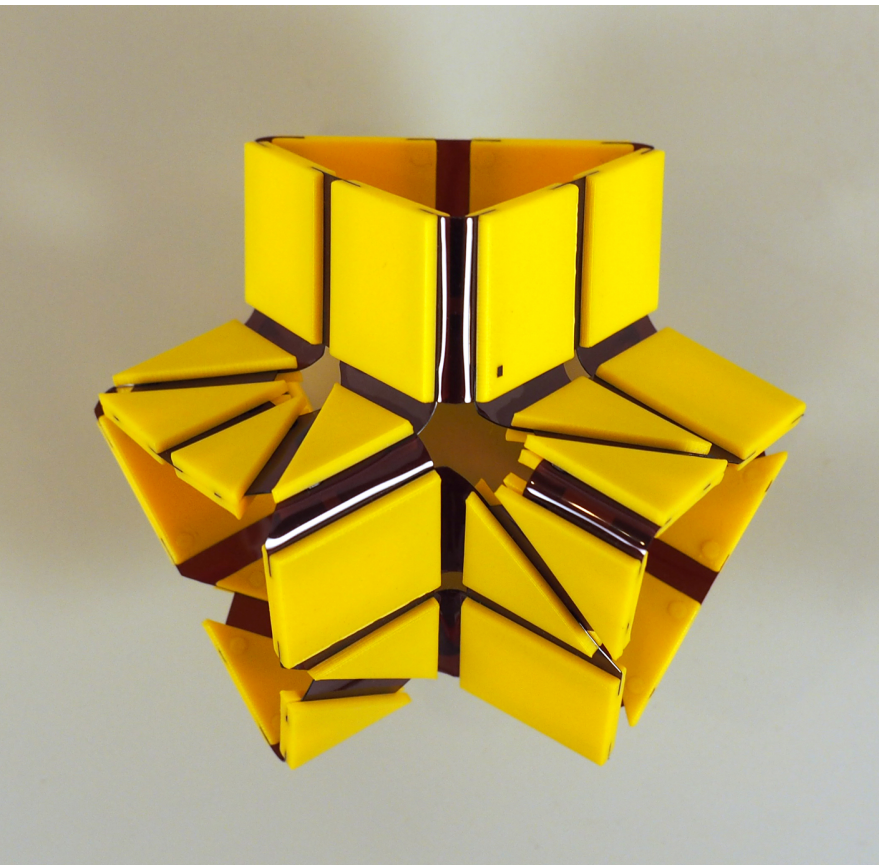
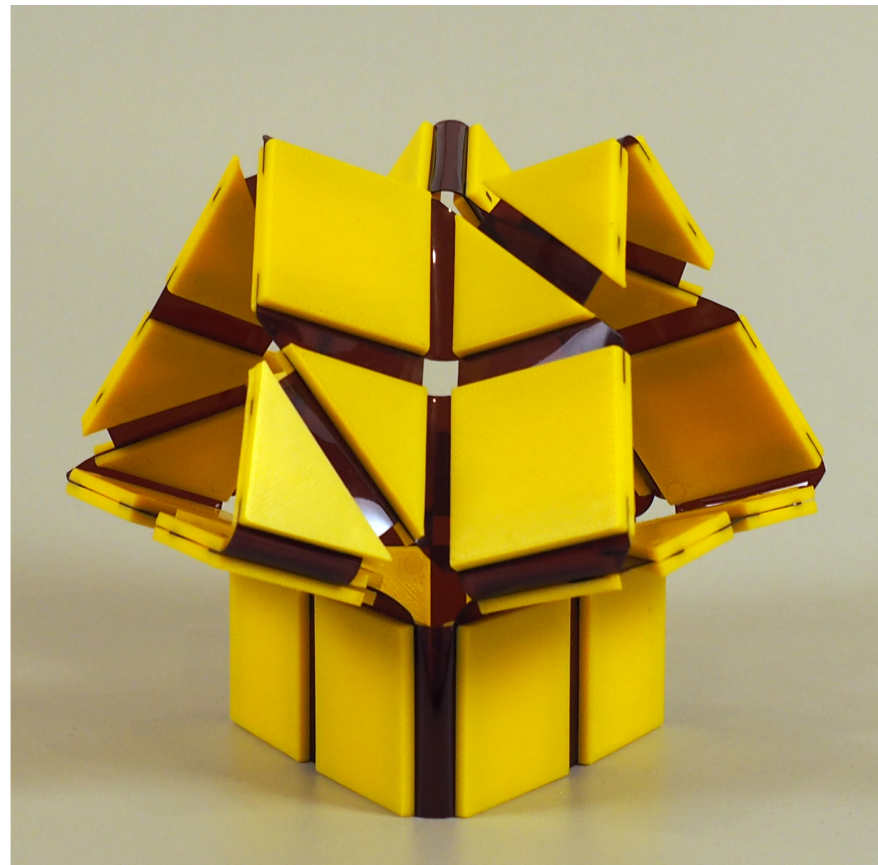
$$\theta_1 = \theta_3 = 0, \theta_2 = \theta_4; \\ \text{or } \theta_2 = \theta_4 = 0, \theta_1 = \theta_3.$$

FORMA ORIGINALE DI SCARPA: NON PIEGHEVOLE IN MODO RIGIDO

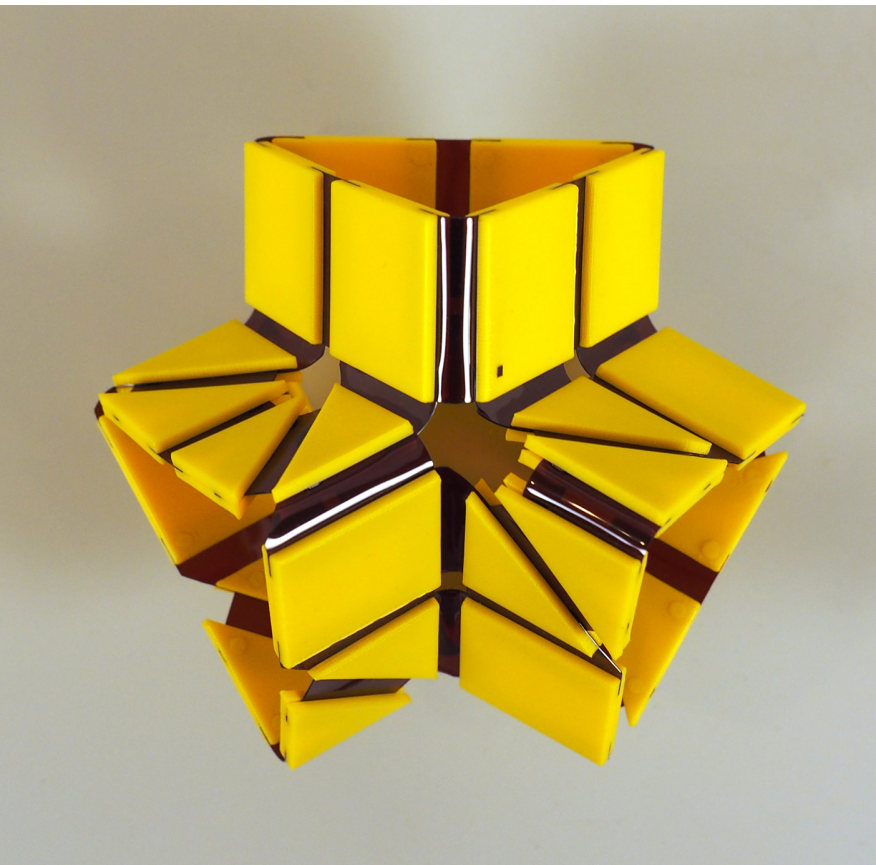
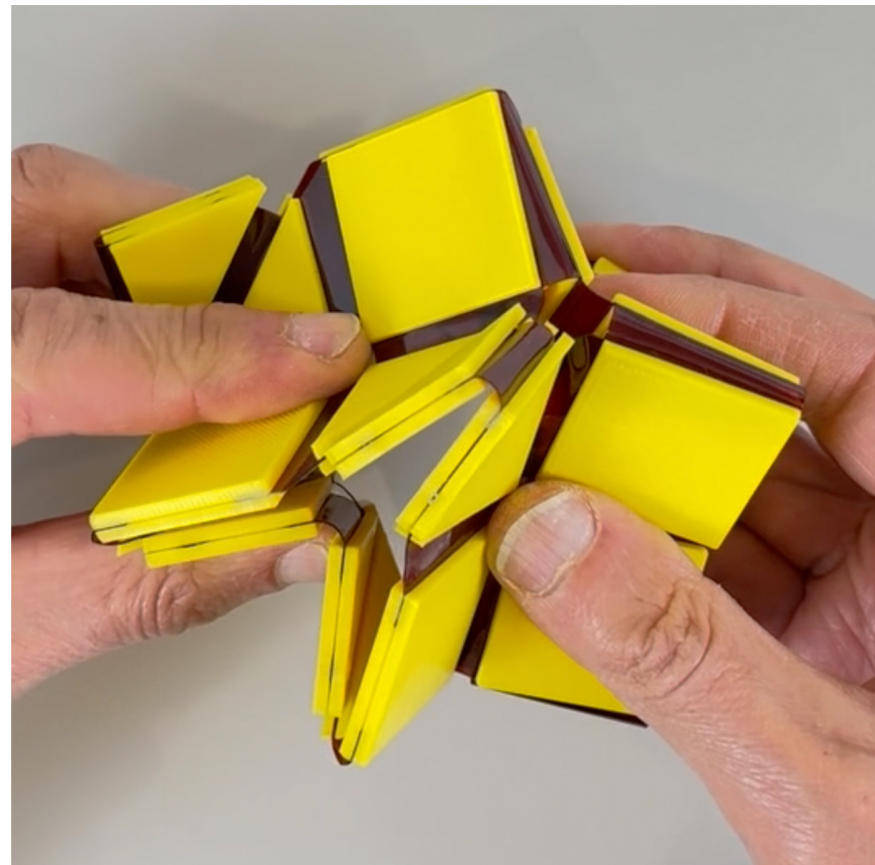
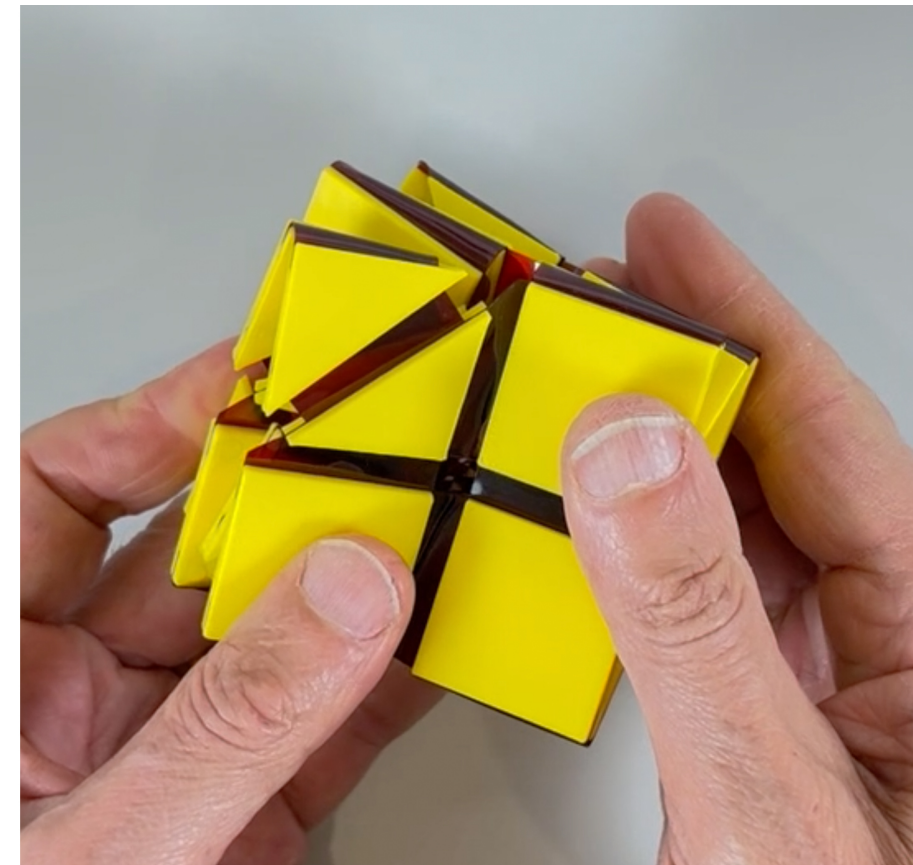


Costruzione modello: H. Feng, W. Shi, P. Trogu, E. Montano,
J. Minnick, G. Montalvo, T. Casanova, 2023

FORMA MODIFICATA: PIEGHEVOLE IN MODO RIGIDO CON CERNIERE AGGIUNTIVE



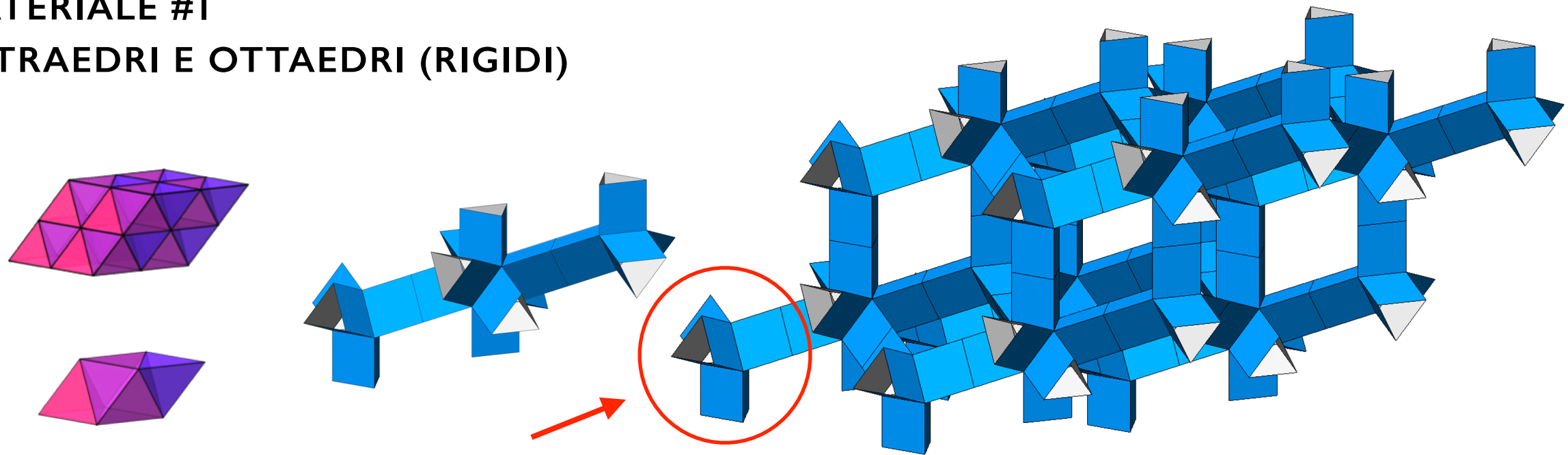
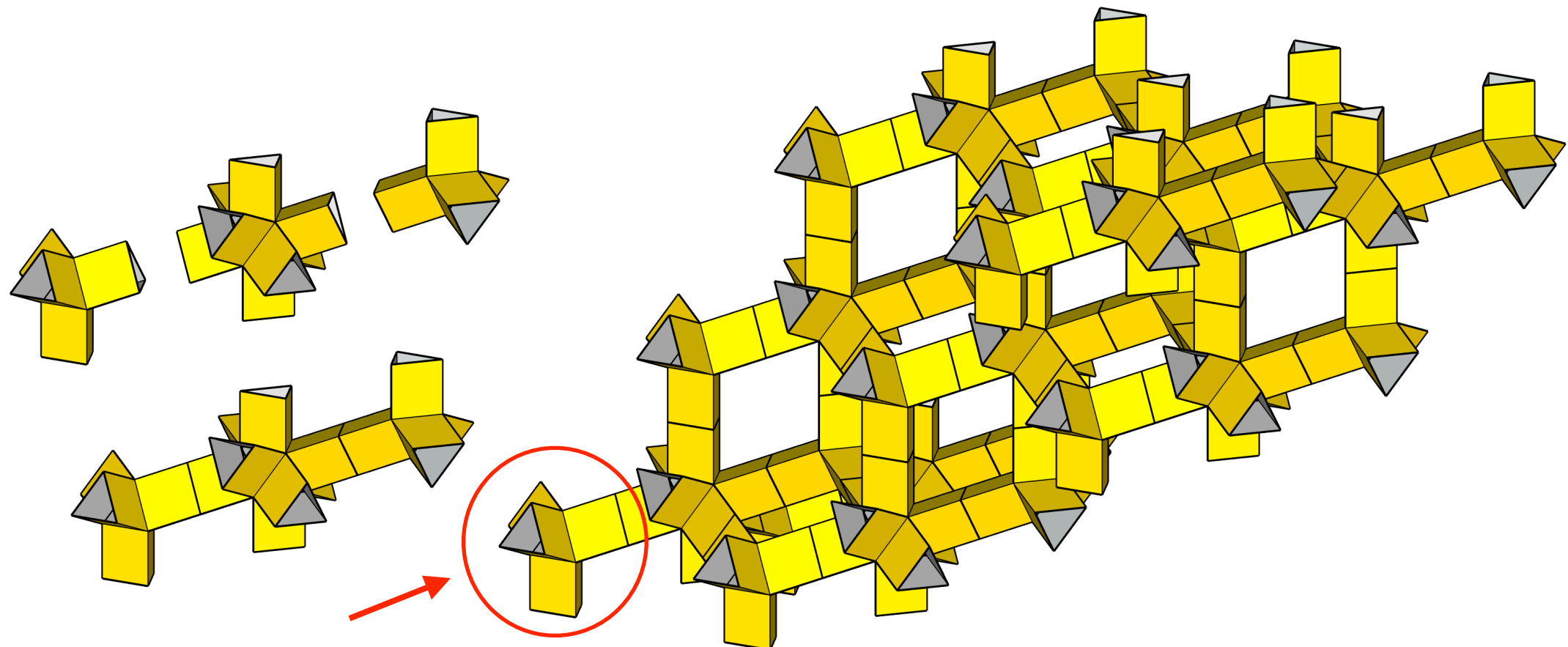
FORMA MODIFICATA: PIEGHEVOLE IN MODO RIGIDO CON CERNIERE AGGIUNTIVE



METAMATERIALI

RIGIDI & PIEGHEVOLI

MATERIALE #1
TETRAEDRI E OTTAEDRI (RIGIDI)

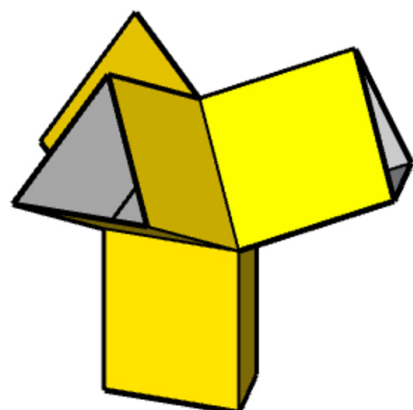


MATERIALE #1

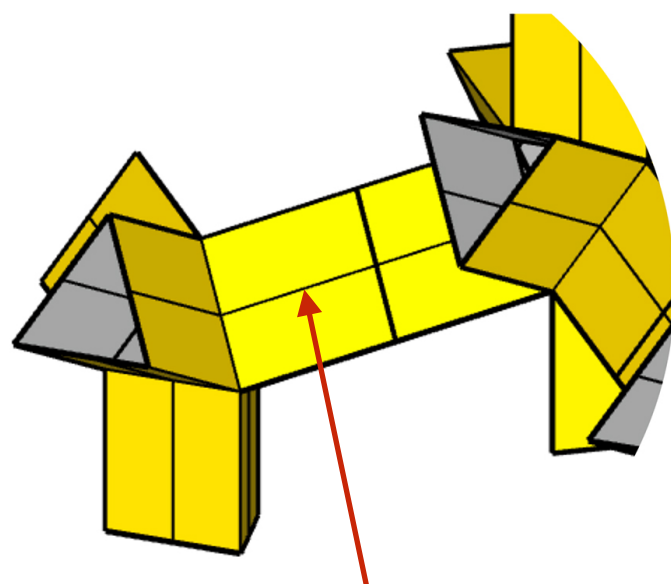
COME SI PIEGA LA FORMA ORIGINALE?

MATERIALE #1

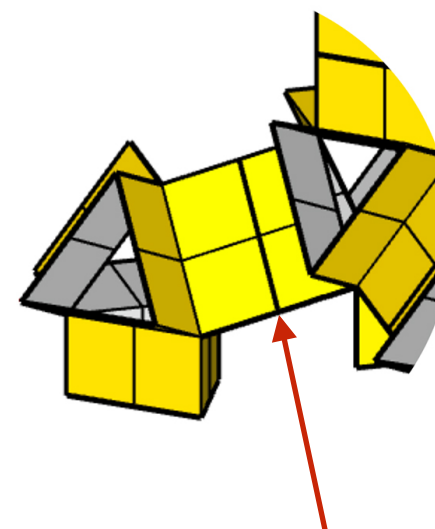
TETRAEDRI E OTTAEDRI PIEGHEVOLI (FLAT-FOLDABLE)



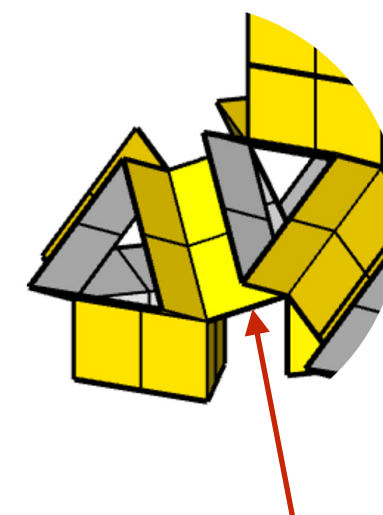
START



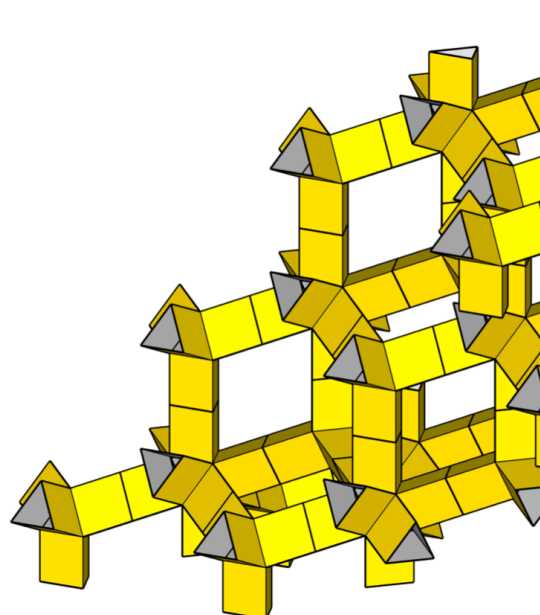
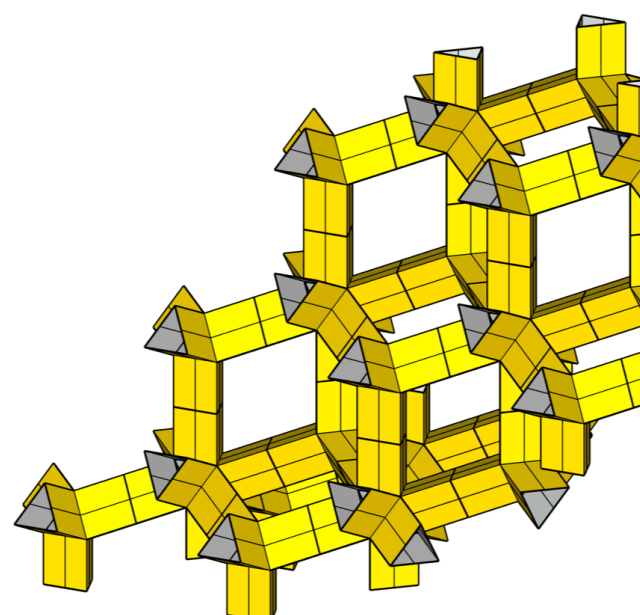
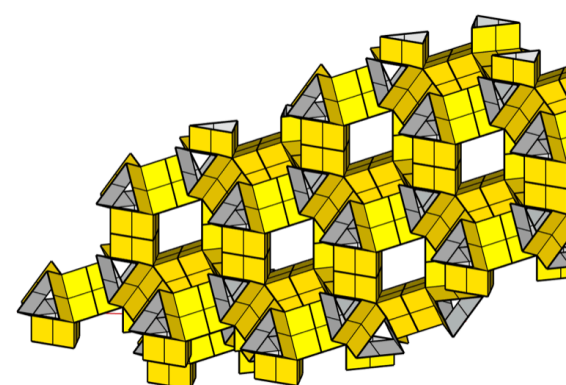
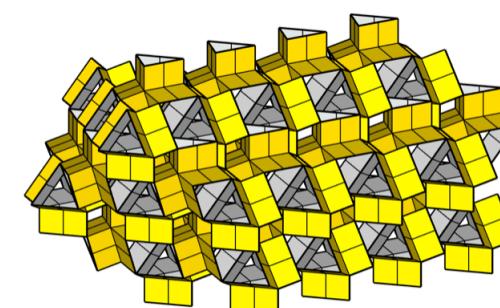
STEP 1: BISECARE LE
PARETI DEI PRISMI ESTRUSI



STEP 2: DIMEZZARE LA
LUNGHEZZA ESTRUSIONE

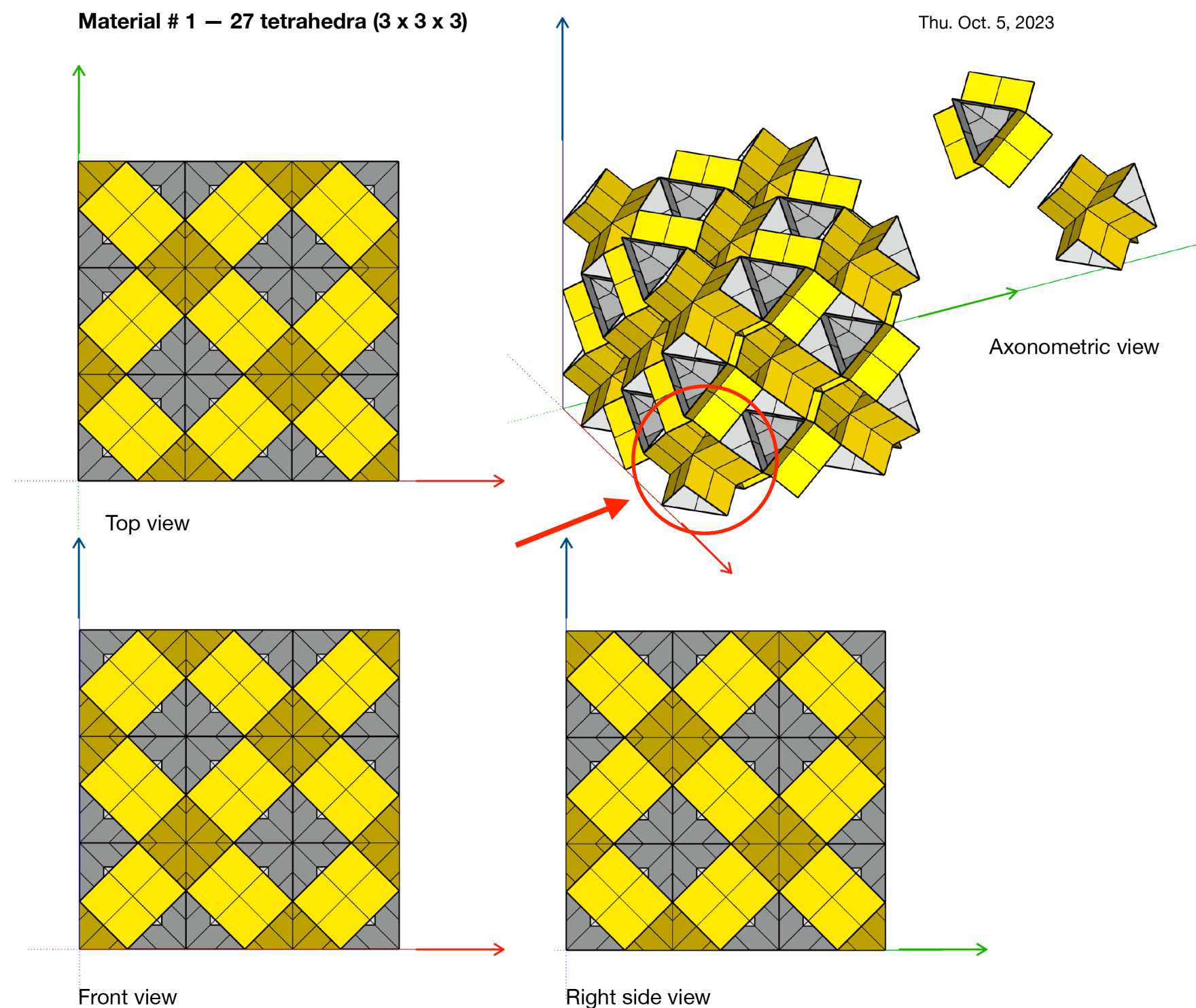


STEP 3: INCASTRARE I
PRISMI ESTRUSI (PUSH-FIT)



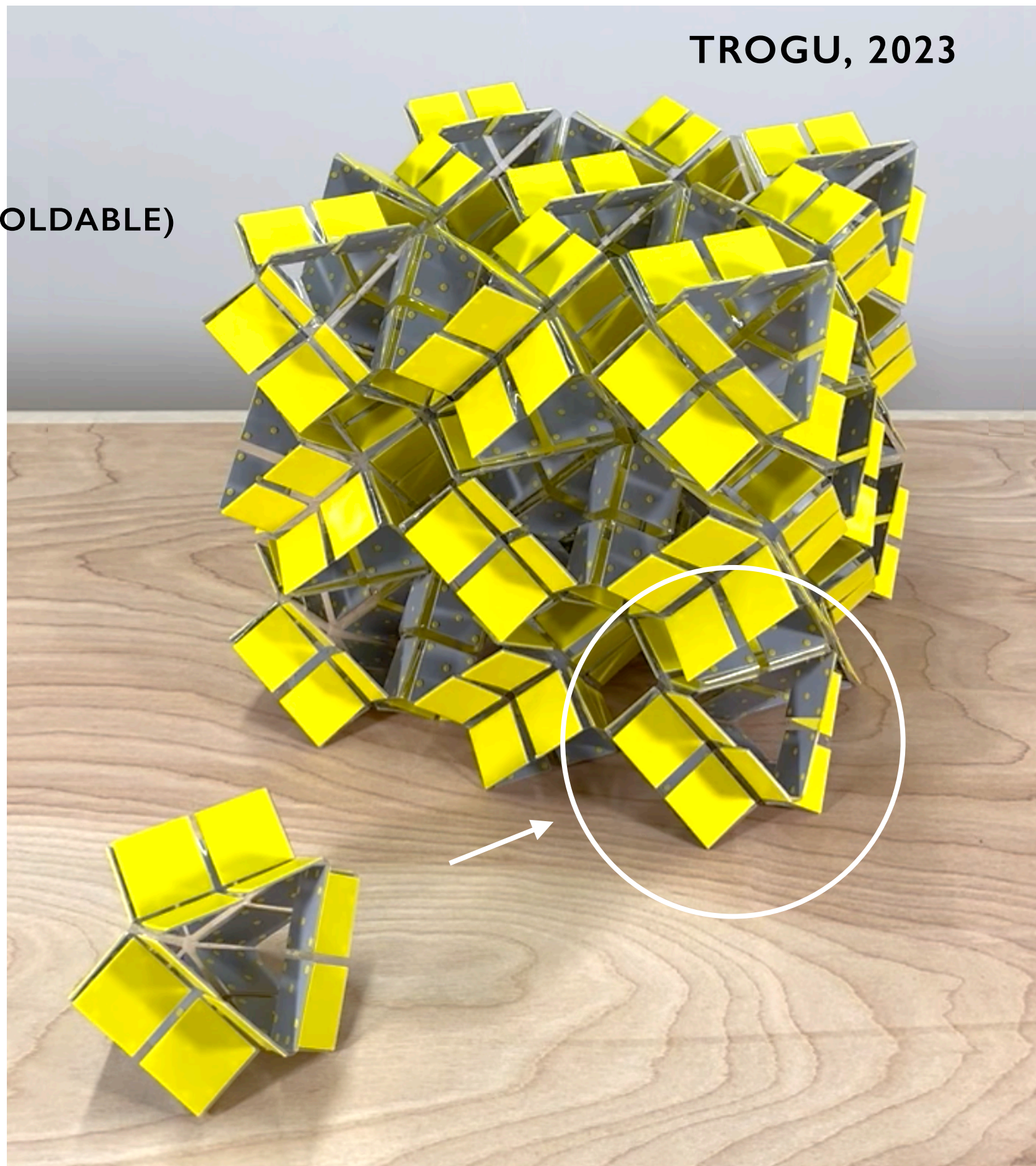
MATERIALE #1
TETRAEDRI E OTTAEDRI (FLAT-FOLDABLE)

PROIEZIONE
ORTOGONALE
E ISOMETRICA



MATERIALE #1
TETRAEDRI E OTTAEDRI (FLAT-FOLDABLE)
MODELLO FISICO

(Costruzione modello:
E. Montano, J. Minnick,
D. Munechica, J. Cuellar,
P.Trogu, 2023)



Giorgio Scarpa

Italian designer, bionics and topology researcher, teacher, and artist.

Profile and videos by **Pino Trogu**, San Francisco State University [trogu at sfsu dot edu]

The short videos below refer to the topics of Scarpa's two books. The first is a bionic study of the mouth apparatus of the sea urchin, also known as Aristotle's Lantern, after the first detailed study of it by the Greek philosopher. Recently new prototypes of a biopsy harvester and a ground sampler were inspired by Scarpa's model of the urchin. This new instrumentation is described in an article published in 2016 by the journal Leonardo (MIT). Click links below to download those articles. The PDFs of the bionics books are at right. The English is an unpublished draft translation; the Italian is the original text and images.

The second video shows one of the many modular chains described in the rotational geometry book, which focuses on rotational movement as a basic form generating process. Scarpa dissects the five Platonic solids and other solids into chains of hinged triangular pyramids that fold back into their enclosure cells. The PDFs of the geometry books are at right. The English is an unpublished draft translation; the Italian is the original text and images.

Both bionics and geometry books were published as part of a now out-of-print series called Design Notebooks, edited by the late Italian designer Bruno Munari. The covers of the books in that series are shown below. The other videos show more topological and bionic studies by Scarpa, including DNA models and studies of muscle cells.

This page was last updated on Sunday Feb. 6, 2022.

On July 29, 2021, the website was moved from <http://online.sfsu.edu/trogu/scarpa/> to <https://res.trogu.com/scarpa>



Bionic Model of Aristotle's Lantern
Video length: 1:12 | Video: Pino Trogu, 1994.

Interviews

[Leonardo Book Club: Live discussion with Pino Trogu, author, "Giorgio Scarpa's Model of a Sea Urchin Inspires New Instrumentation"](#)
Length: 58:30 | April 24, 2019.

Articles

Pino Trogu
[Giorgio Scarpa's Model of a Sea Urchin Inspires New Instrumentation](#),
Leonardo Journal, 52.2, 2019.
Free article download from MIT Press website:
[doi:10.1162/LEON_a_01384](https://doi.org/10.1162/LEON_a_01384).



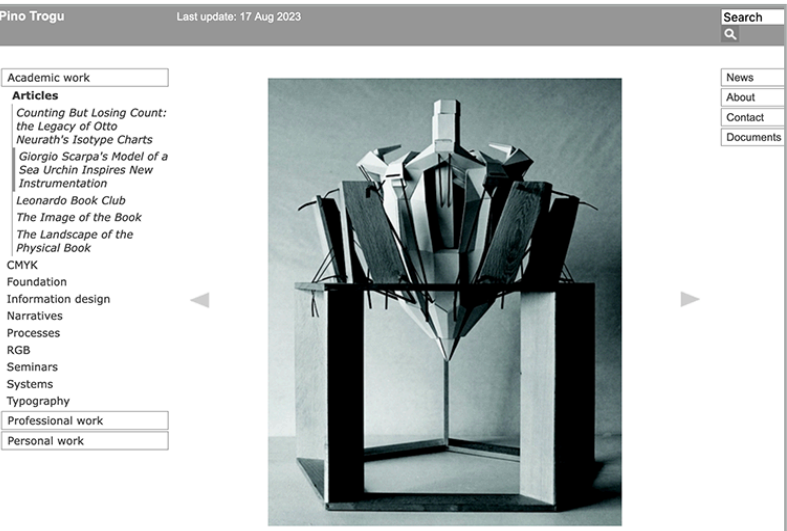
Download PDF of complete Bionic Models book.
Unpublished English translation of Italian Edition: Modelli di Bionica, 1985.
Translated by Pino Trogu. 120 pages. File size: 38MB.



Scarica PDF completo del libro Modelli di Bionica Zanichelli, Bologna, 1985. 120 pagine. File size: 50MB.

LINKS

res.trogu.com/scarpa



trogu.com

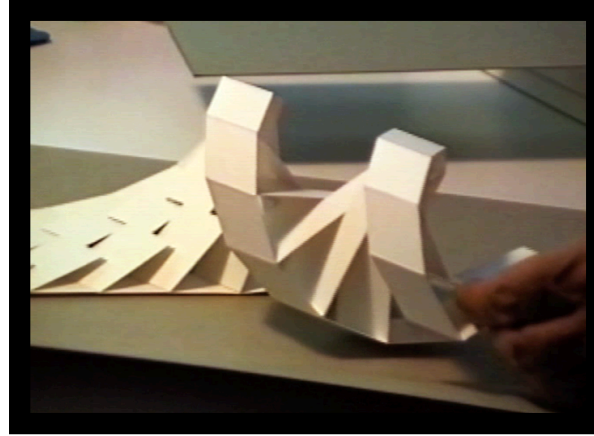


lorenzobocca.com/giorgioscarpa

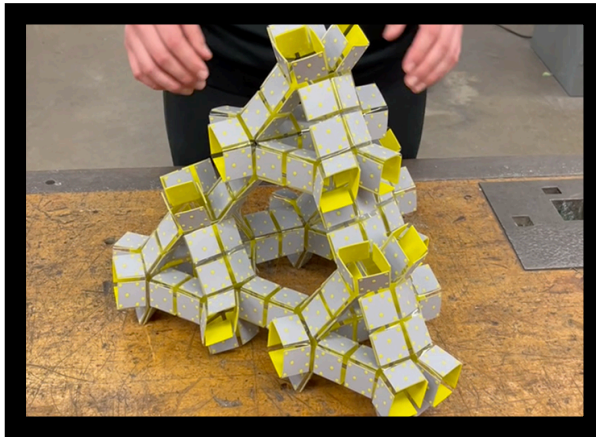
VIDEO



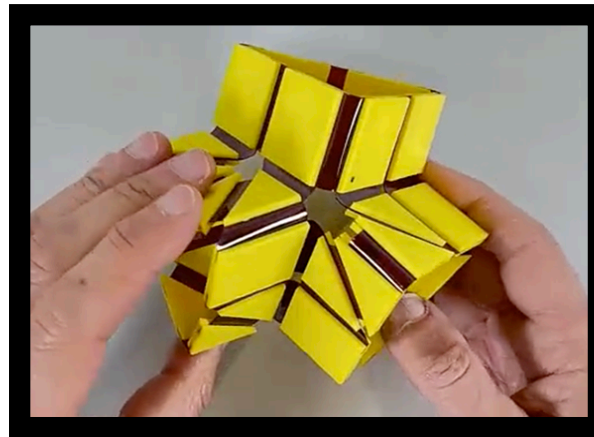
[Scarpa: Aristotle's Lantern](#)



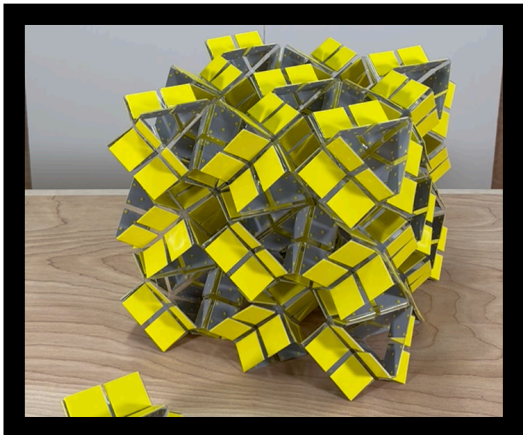
[Scarpa: DNA Model](#)



[Trogu: Material #6](#)



[Feng, Shi, Trogu, & Dai: Auxetic Metamaterial](#)



[Trogu: Material #1](#)

THANK YOU!

PINO TROGU – SAN FRANCISCO STATE UNIVERSITY, USA

LORENZO BOCCA – ARCHITETTO, SAN BASSANO (CREMONA)

L'OPERA VISIONARIA DI GIORGIO SCARPA TRA SCIENZA, DESIGN E DIDATTICA

GIOVEDÌ 22 OTTOBRE 2026, ORE 17.00

ISIA FAENZA / PALAZZO MAZZOLANI

CORSO GIUSEPPE MAZZINI 93, FAENZA

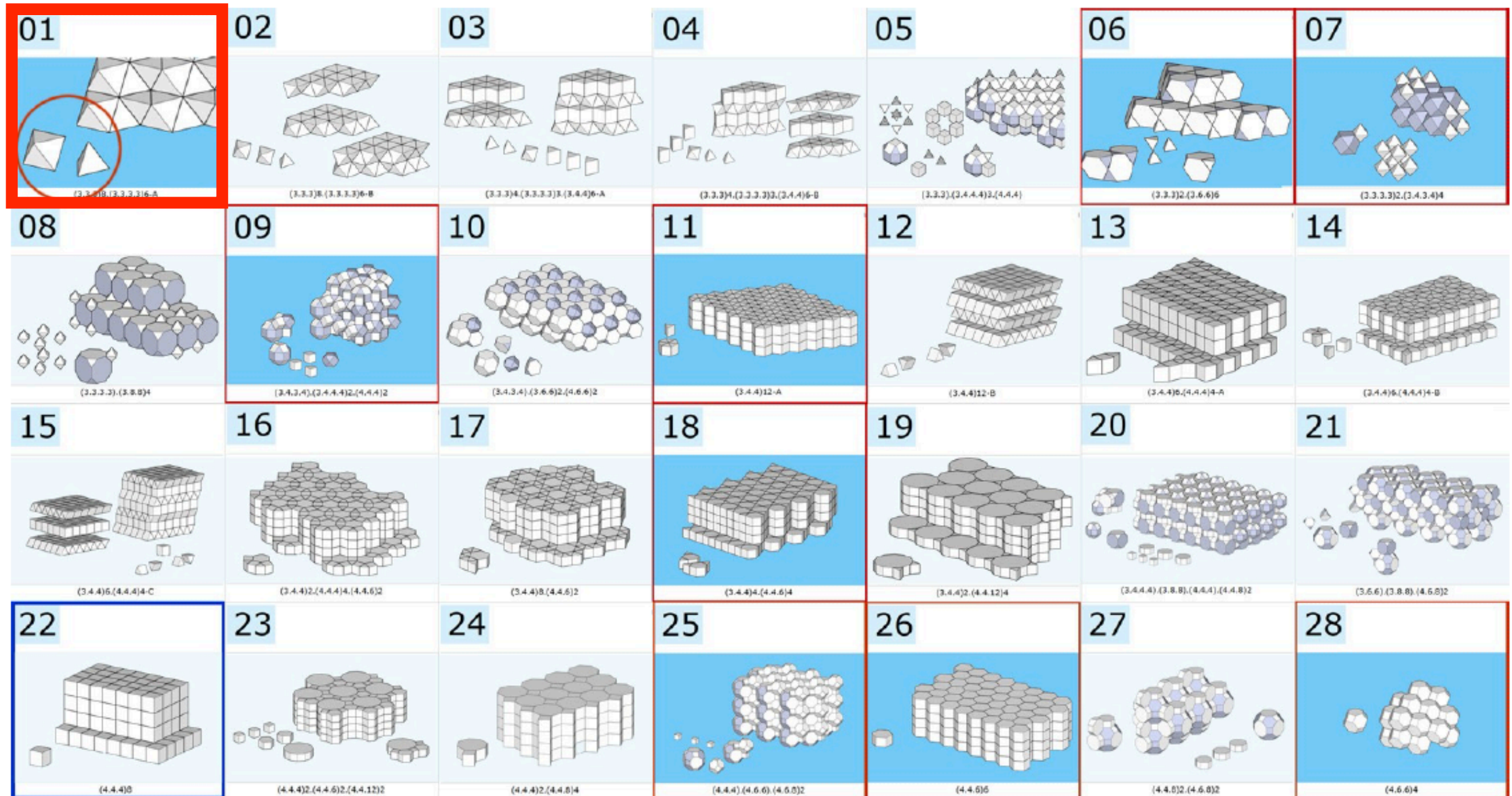
TROGU@SFSU.EDU

LORENZ.BOCCA@GMAIL.COM

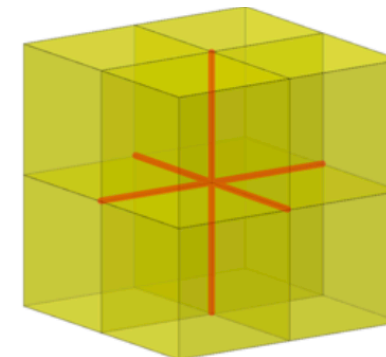
[go to first slide](#)

(EXTRA)

UNIFORM TILINGS OF 3-SPACE*

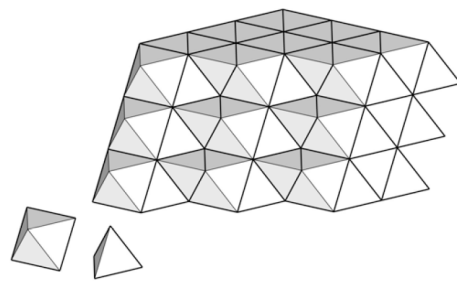


*Grünbaum, 1994
“Vertex neighborhoods”
are all the same.



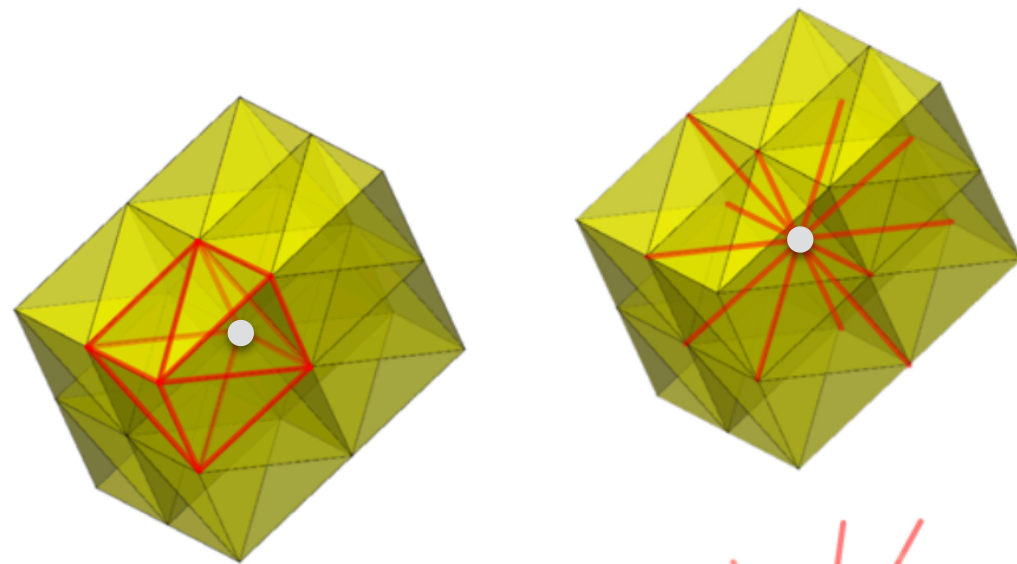
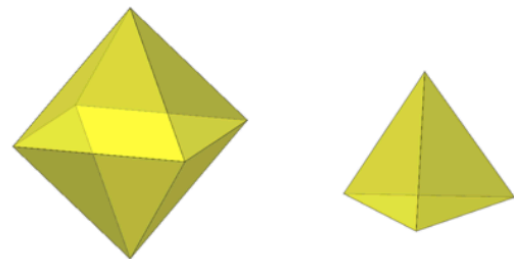
Vertex neighborhood in tiling #22 (cubes)

Uniform tiling #1

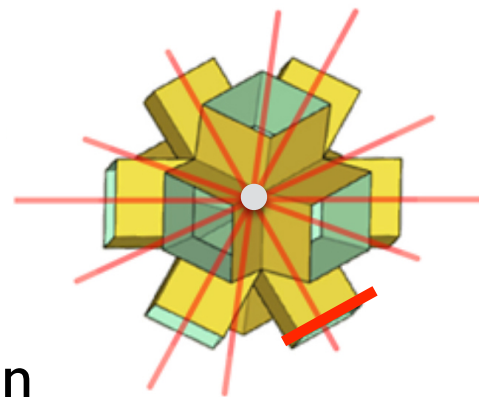


VERTEX NEIGHBORHOOD

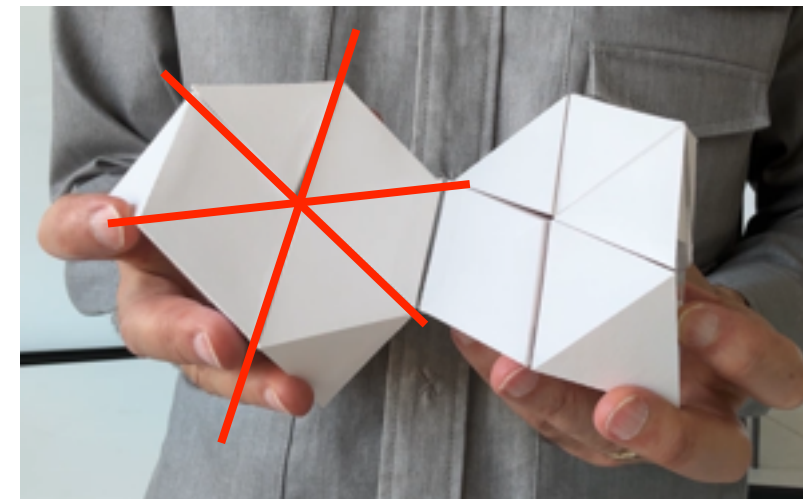
Eight tetrahedra and six octahedra meet at a vertex.



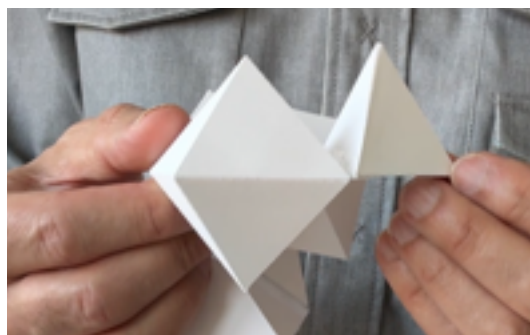
Octahedron Tetrahedron



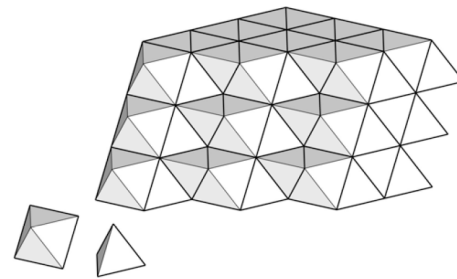
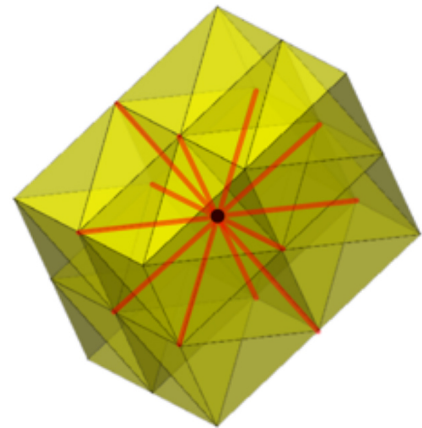
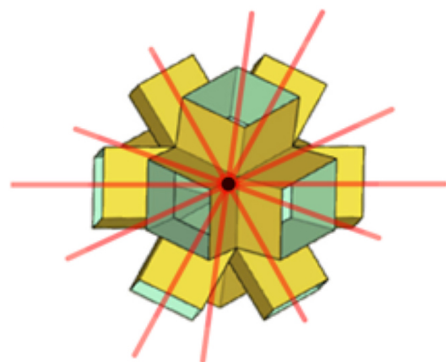
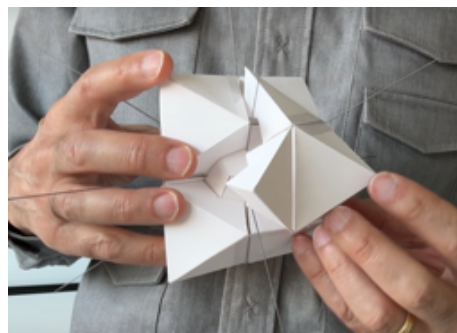
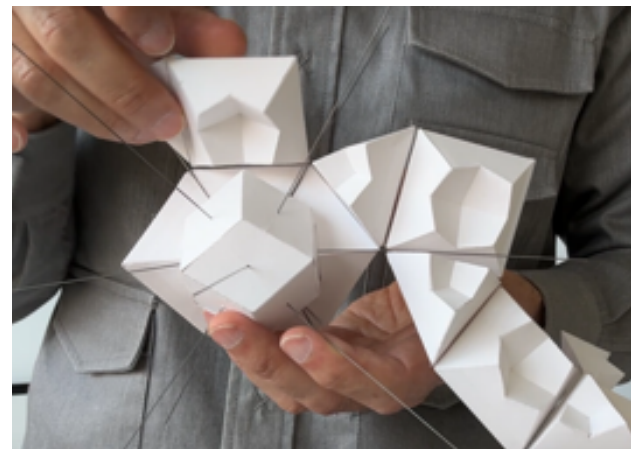
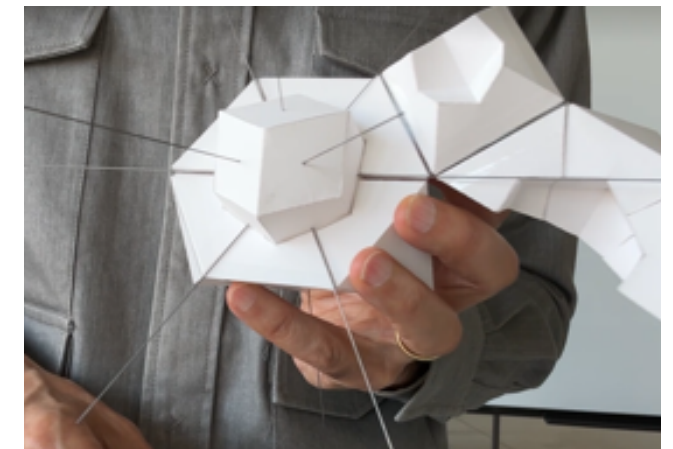
Extruded
rhombic
dodecahedron
(twelve prisms)



Common edges
form a six-axis star.



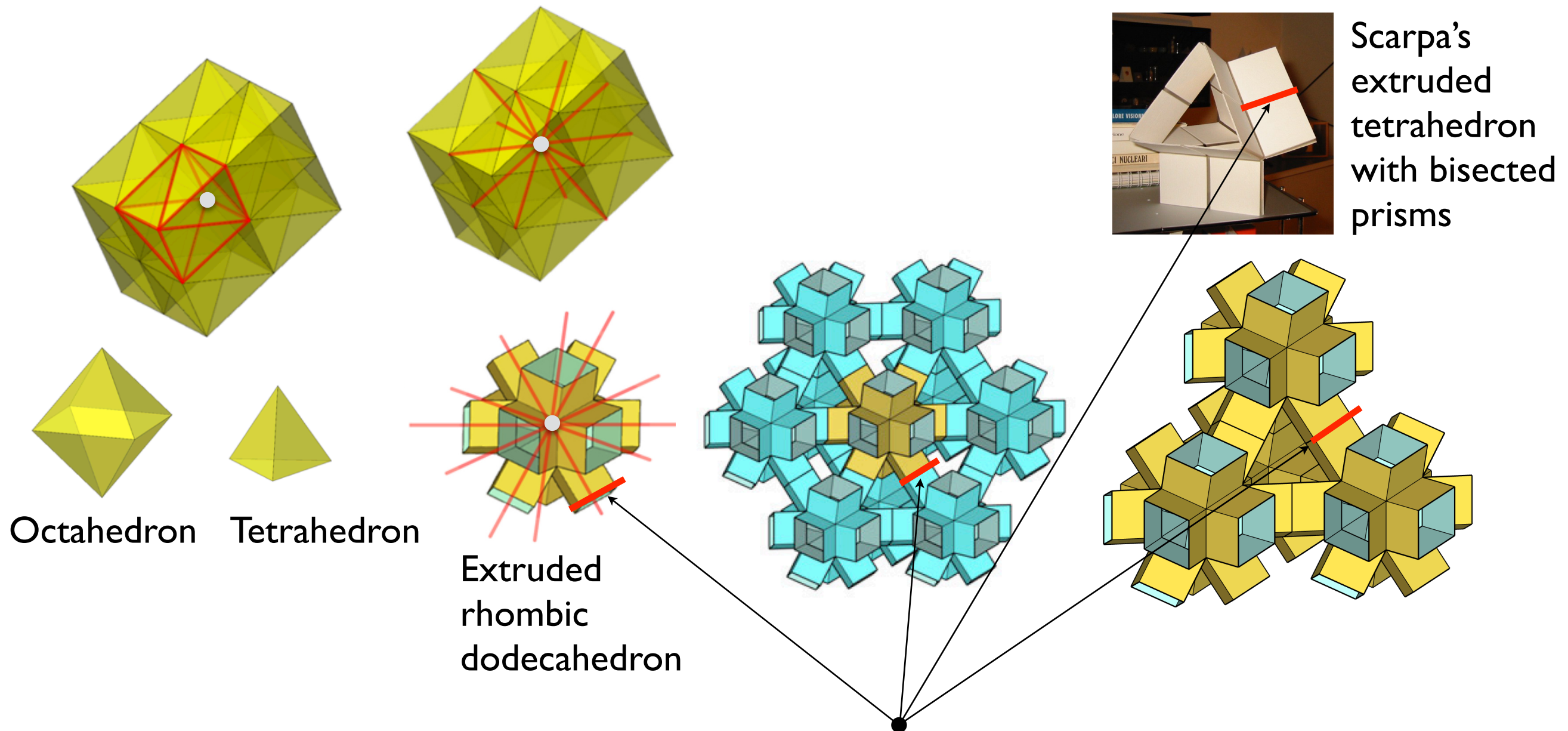
Uniform tiling #1



BYPRODUCT POLYHEDRA

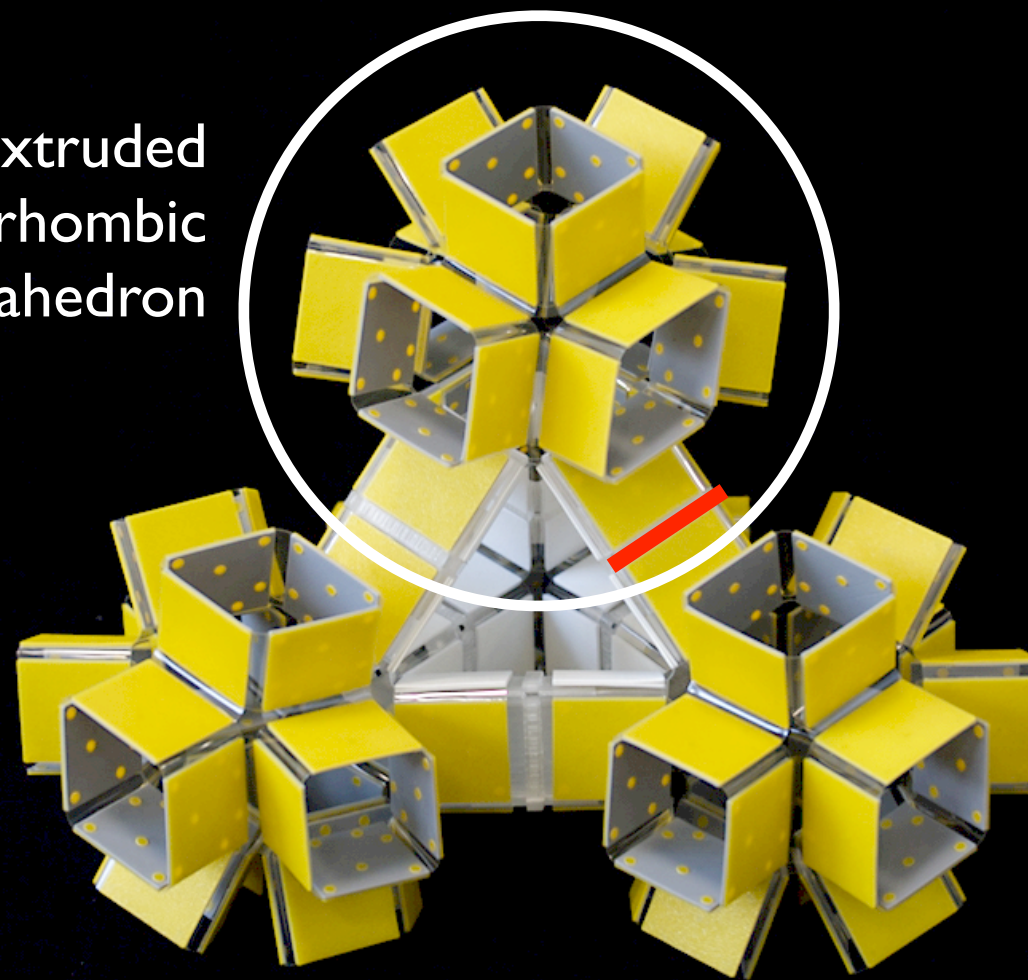
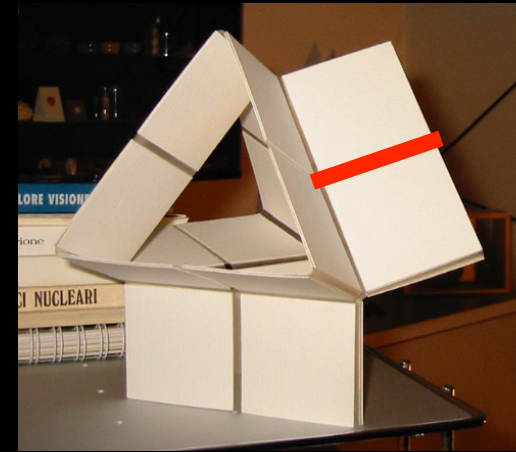
A way to predict what “byproduct polyhedra” will be generated after the base polyhedra are extruded, is to consider the dual honeycomb of the original honeycomb. Lines connecting the centers of adjacent tetrahedra and octahedra are the edges of a rhombic dodecahedron.

After extruding the faces of the tetrahedra and octahedra in the base tiling of material #1, rhombic dodecahedra or “byproduct polyhedra” – form at the location of the original vertex neighborhoods.



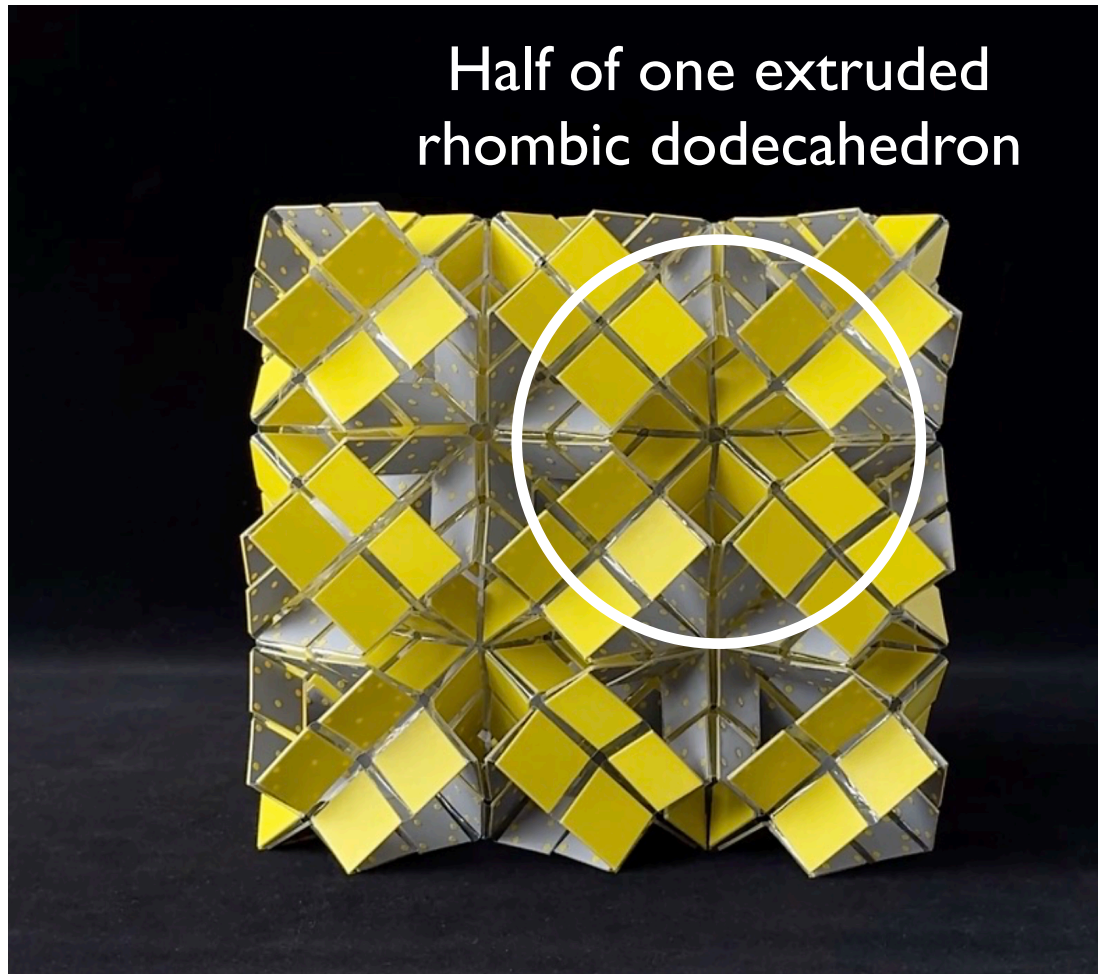
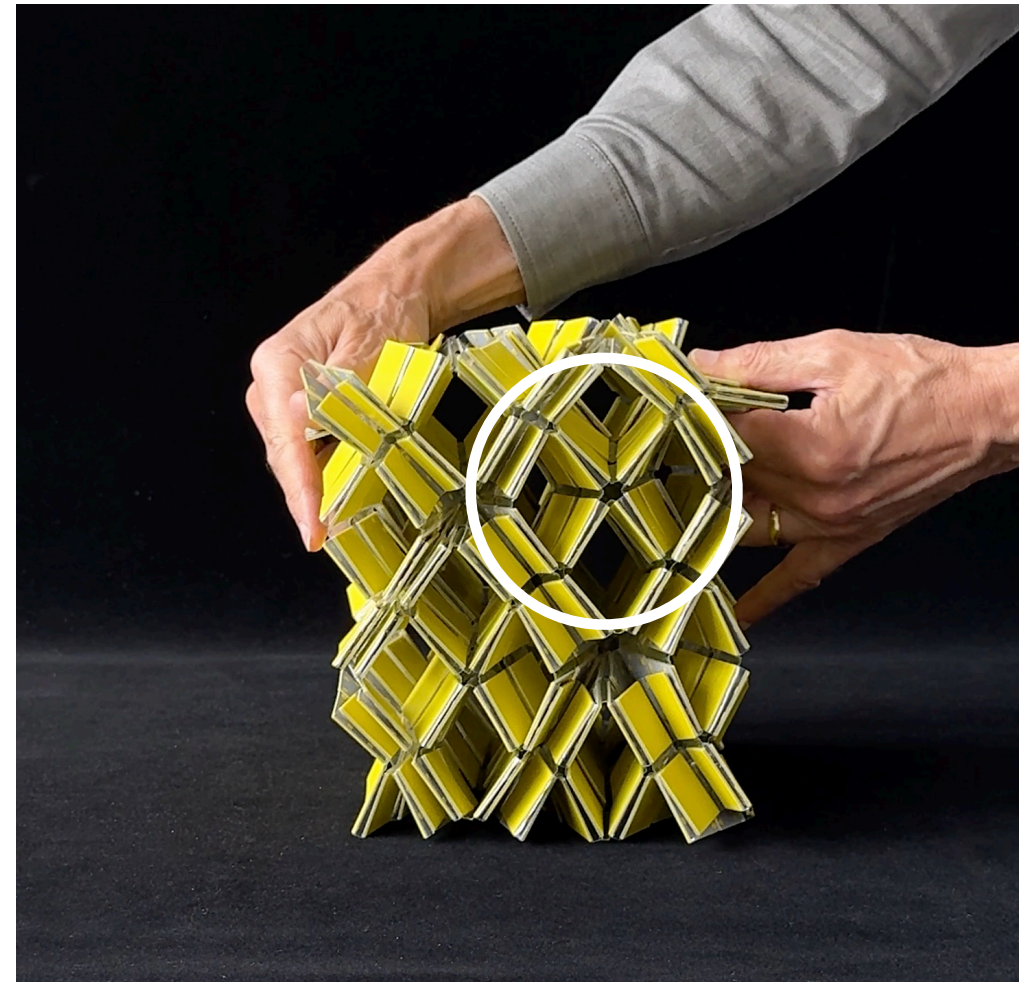
The ends of the non-split prisms in the rhombic dodecahedra correspond to the bisections in Scarpa's original tetrahedron

Extruded
rhombic
dodecahedron



3x3x3 TETRAHEDRA MATERIAL

Half of one extruded
rhombic dodecahedron

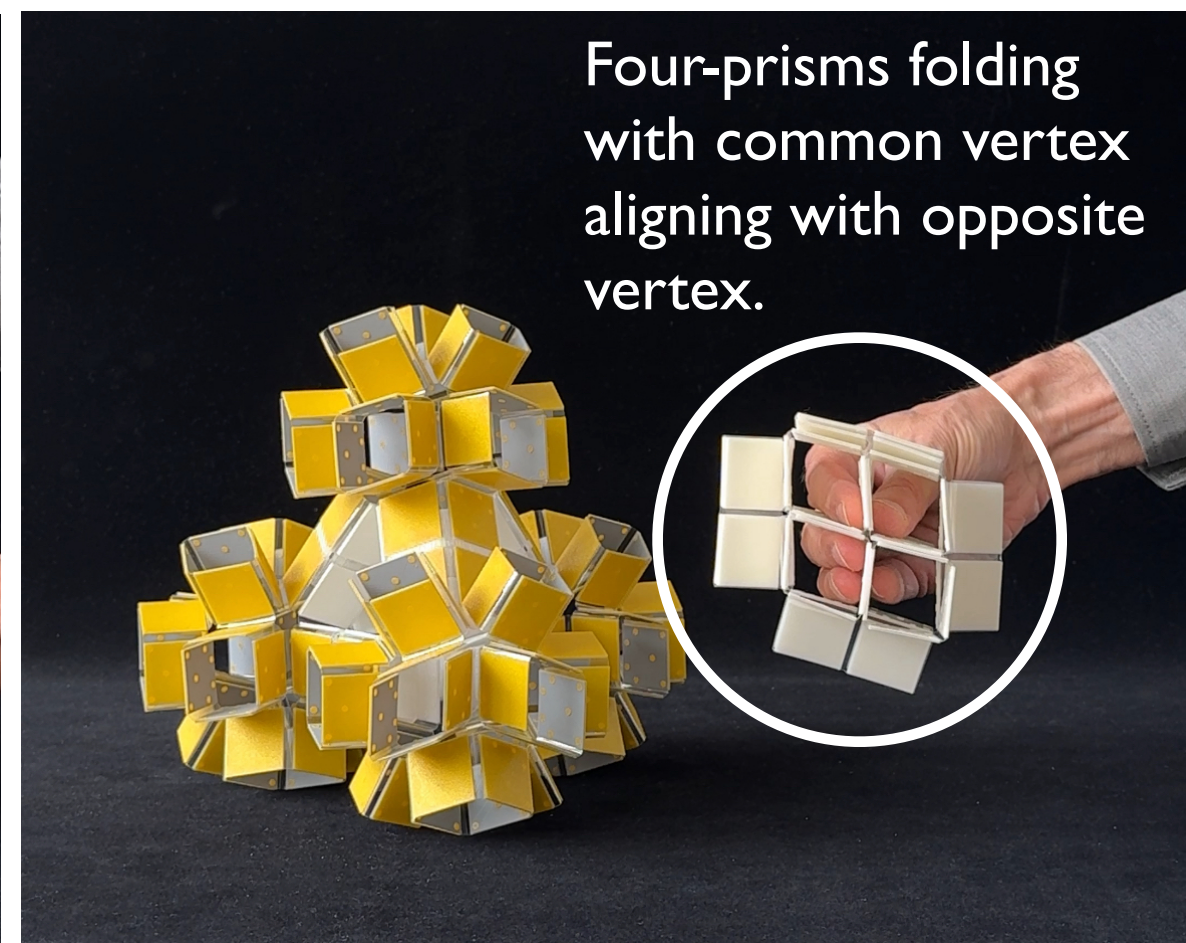


Four “channels”* are seen
forming at a four-crease
vertex of the rhombic
dodecahedron during folding.

*(B. Kresling)



Four-crease vertex
with four prisms in
the rhombic
dodecahedron.



Four-prisms folding
with common vertex
aligning with opposite
vertex.

