

PINO TROGU – SAN FRANCISCO STATE UNIVERSITY

BIOCLAMPING: ARISTOTLE'S LANTERN

GIORGIO SCARPA'S MODEL OF THE MASTICATORY APPARATUS
OF THE SEA URCHIN... AND MORE.

ME411095: BIO-INSPIRED DESIGN
DELFT UNIVERSITY OF TECHNOLOGY



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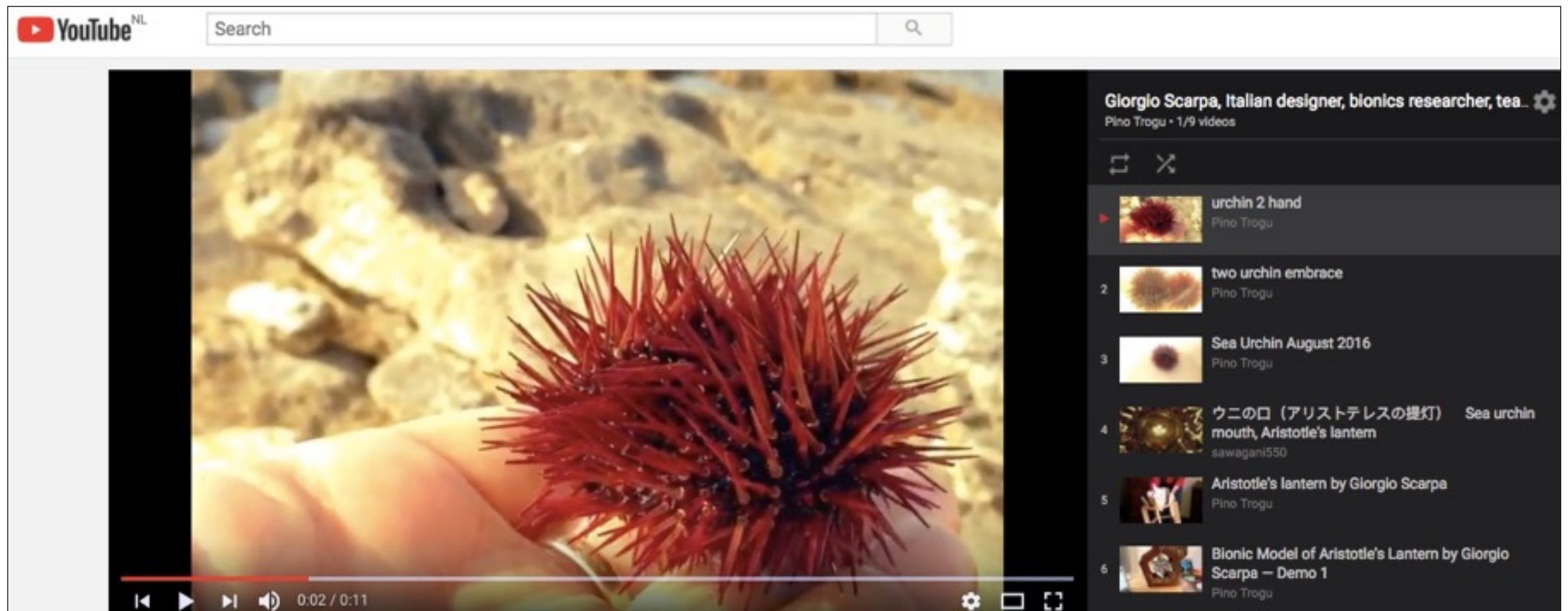
Lantern replicant 2. Delft, NL, 19 Oct. 2017





Giorgio Scarpa's bio-inspired and geometric folding models.

THE SEA URCHIN



Scarpa YouTube Playlist: <https://www.youtube.com/playlist?list=PLM4DV2CfpgjuCtWNJP3iQKRRIFbdMUvim>

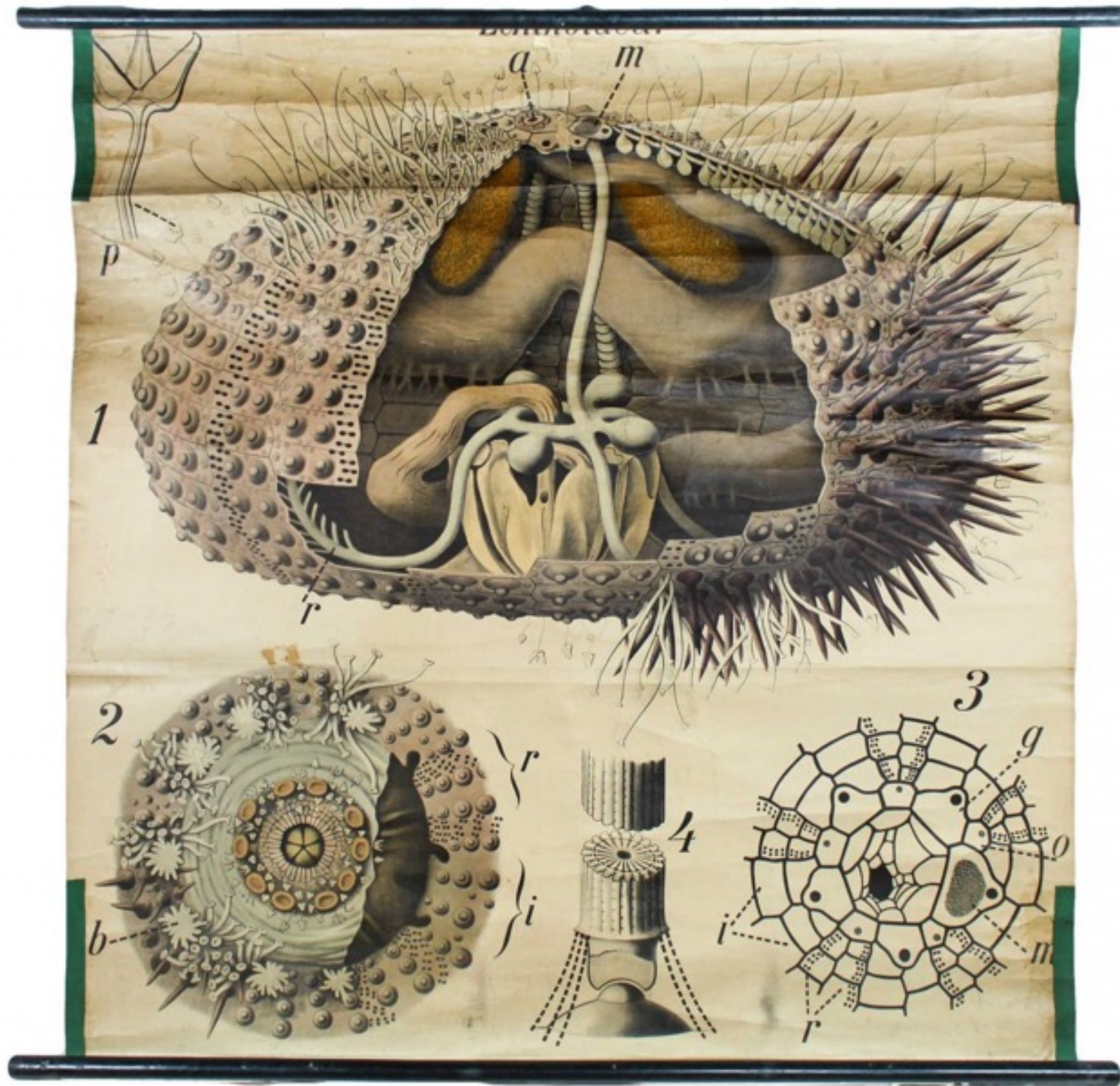


Chart Sea Urchin by Paul Pfurtscheller, 1907: <https://www.pamono.com/antique-wall-chart-sea-urchin-by-paul-pfurtscheller-1907-1>

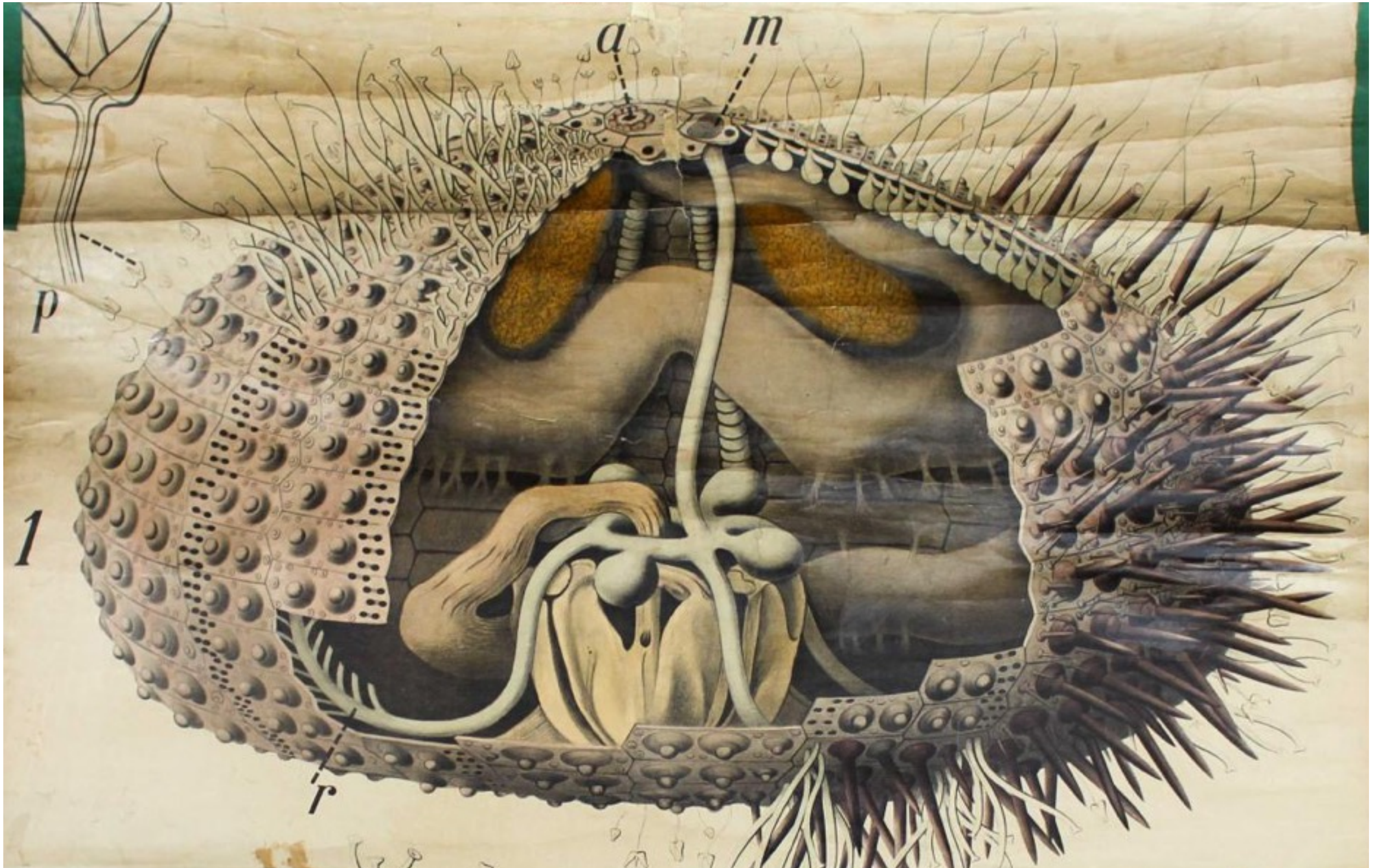


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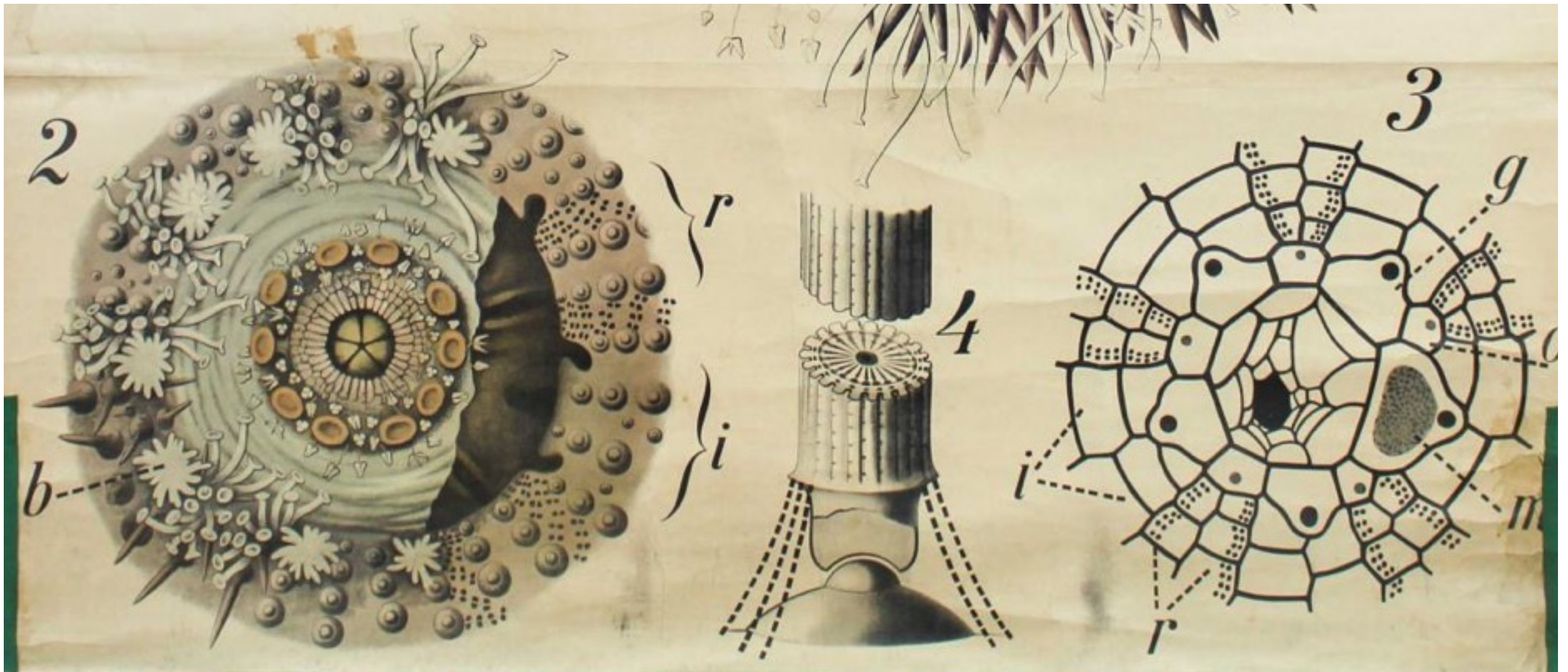


Chart Sea Urchin by Paul Pfurtscheller, 1907: <https://www.pamono.com/antique-wall-chart-sea-urchin-by-paul-pfurtscheller-1907-1>



Frederick H. Evans

British, 1853–1943

Tr. Sec. Spine of Echinus. X.40, 1887

Gelatin silver print

GEORGE EASTMAN MUSEUM, PURCHASE

Morgan Library & Museum, New York



Scarpa Flickr Album: <https://www.flickr.com/photos/pinotrogu/albums/72157661343652018>











Photo: Giorgio Cireddu



Photo: Giorgio Cireddu

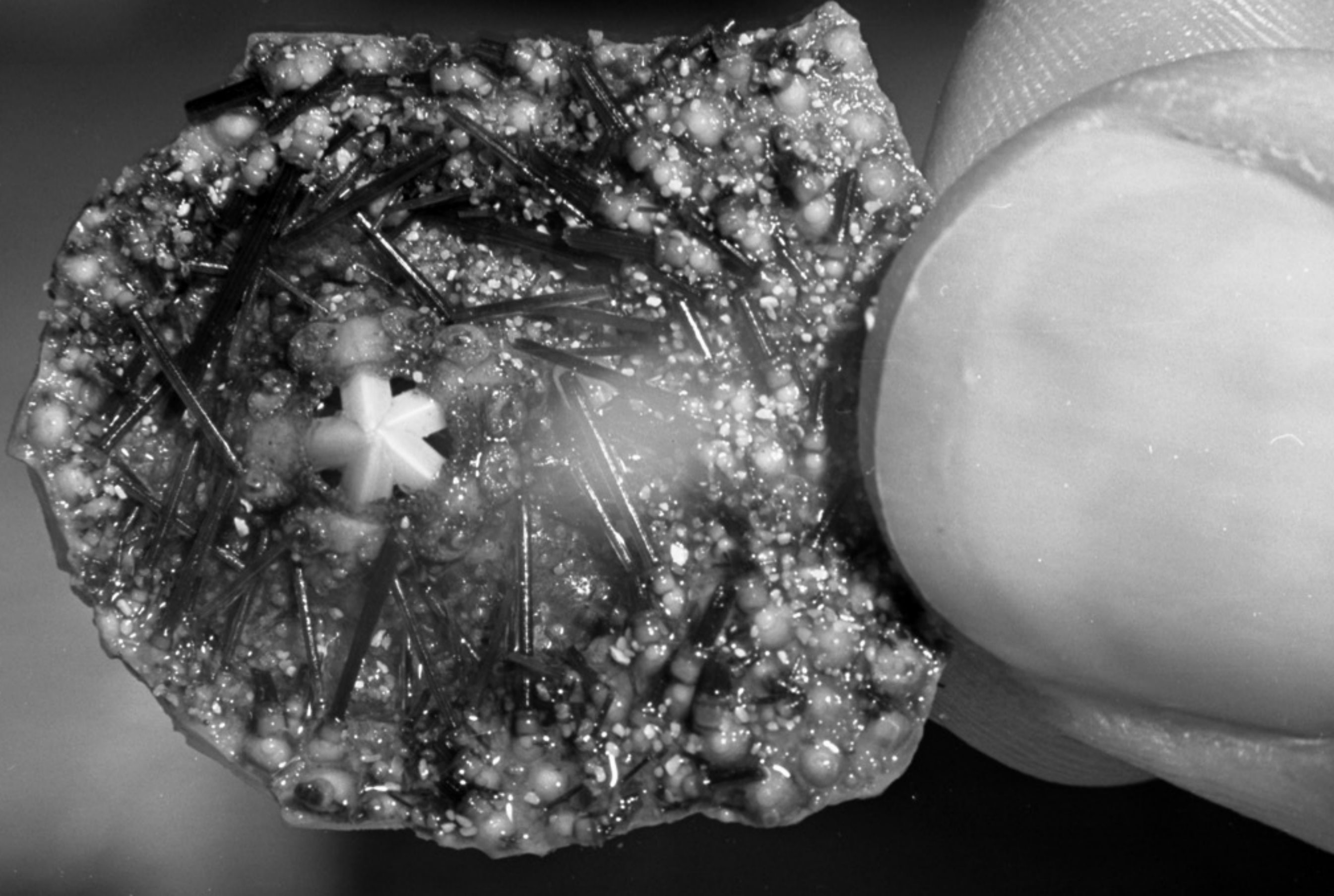


Photo: Giorgio Cireddu

BIONIC MODEL OF ARISTOTLE'S LANTERN

online [sfsu.edu/trogu/scarpa/](http://online.sfsu.edu/trogu/scarpa/)

Giorgio Scarpa

Italian designer, bionics 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. The PDF of book (unpublished draft English translation) is at right. The second 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. Both books were published as part of a new 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 structure.

This page was last updated on Tuesday, May 27, 2014.



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

Bionic Model of Aristotle's Lantern
Video length: 1'12".

Citations:
[Biospired Spring-Loaded Bionic Harvester -- Experimental Prototype Design and Feasibility Tests](#)
Filip Jelinek, Gerwin Smit and Paul Breedveld
Journal of Medical Devices 8(1), March 2014.



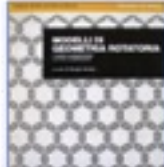
Click [here](#) to download PDF of pages 3-20 and 60- only.
File size: 13MB.

Click image to download PDF of complete Bionic Models book. Unpublished English translation of Italian Edition: *Modelli di Bionica*, 1983. Translated by Pino Trogu. 122 pages
File size: 38MB.



CONFERENCE PAPER (PDF 5MB)

[Rotational Geometry as a Teaching Tool: Applying the Work of Giorgio Scarpa \(Article\)](#)
DBS @ CUMULUS 2013
2nd International Conference for Design Education Researchers
Oslo, 14-17 May 2013



Click [here](#) to download PDF of a sample of Mary Viriri's student work from the *Kanongwebeschule*, Basel, 1966-1967. Various sections of the cube.

Cubic chain of 24 modules. Designed by Florence Yiam. (PDF) San Francisco State University, Fall 20 Instructor: Pino Trogu. The design of the chain follows the principles and methods outlined in *Modelli di Bionica*.

<http://online.sfsu.edu/trogu/scarpa/>

trogu.com

Pino Trogu Last update: 16 Sep 2017 RSS Search

Academic work

Professional work

Personal work



Giorgio Scarpa's Model of a Sea Urchin Inspires New Instrumentation
Posted September 16, 2017
Leonardo Journal, MIT Press

Abstract: Giorgio Scarpa (1938-2012) was an Italian designer, artist and teacher who worked in bionics, topology and rotational geometry. This article describes Scarpa's bionic model of "Aristotle's Lantern"—the mouth of ...
[Read more...]



The Image of the Book: Cognition and the Printed Page
Posted September 11, 2017
Design Issues, MIT Press

Introduction The Making of Books Is it possible that in another five hundred years, paper will be obsolete as the material of choice for making books, and that only digital books will be available? Even though digital gurus such as ...
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Data Visualization Class Blog
Posted September 10, 2017
523informationdesign.blogspot.com

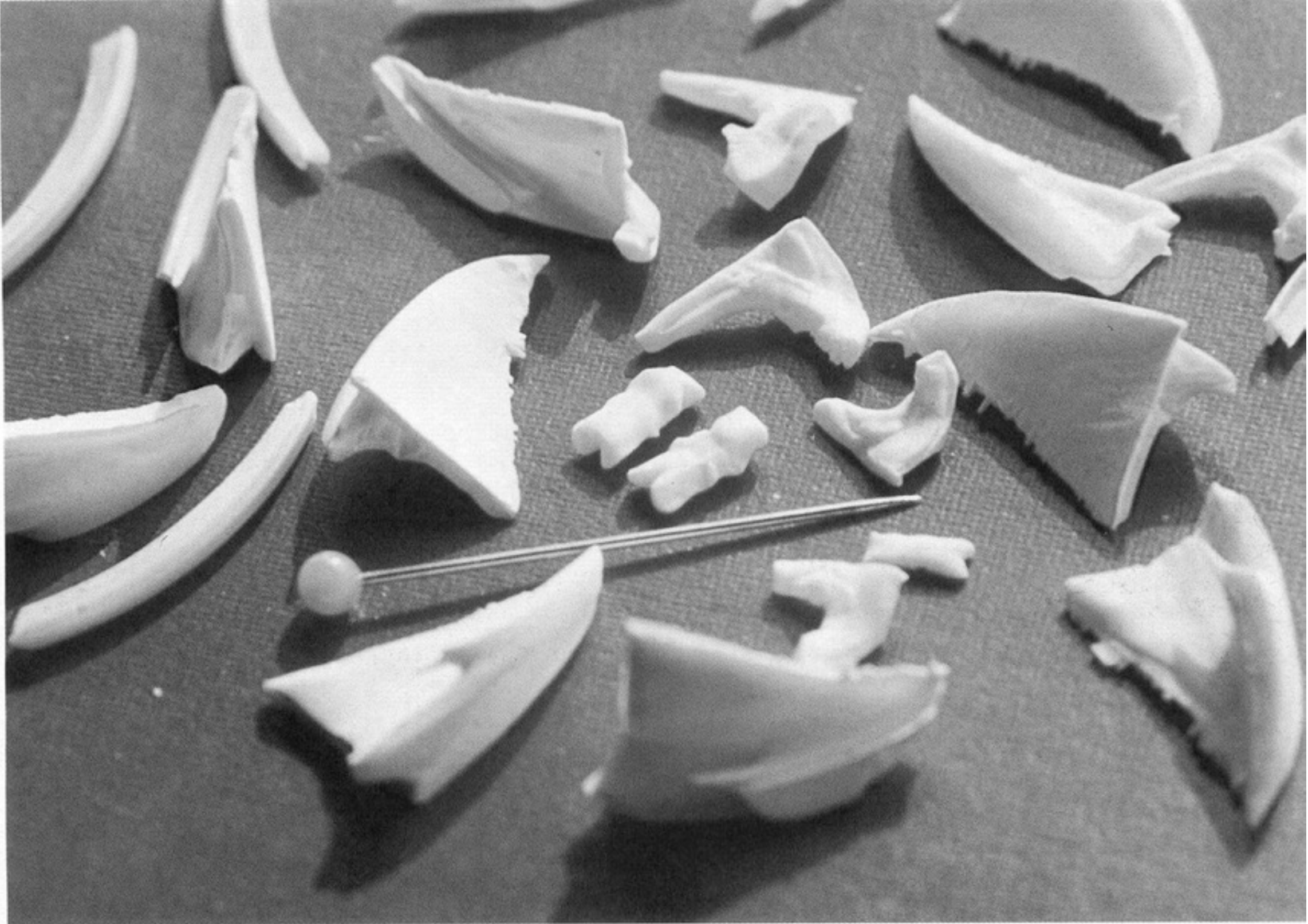
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trogu.com



Calcareous pieces which form the skeletal structure. The pin shows the dimensions of the parts.

Scarpa, Giorgio, Modelli di bionica: capire la natura attraverso i modelli. Quaderni di design 13, ed. B. Munari (Bologna: Zanichelli, 1985).

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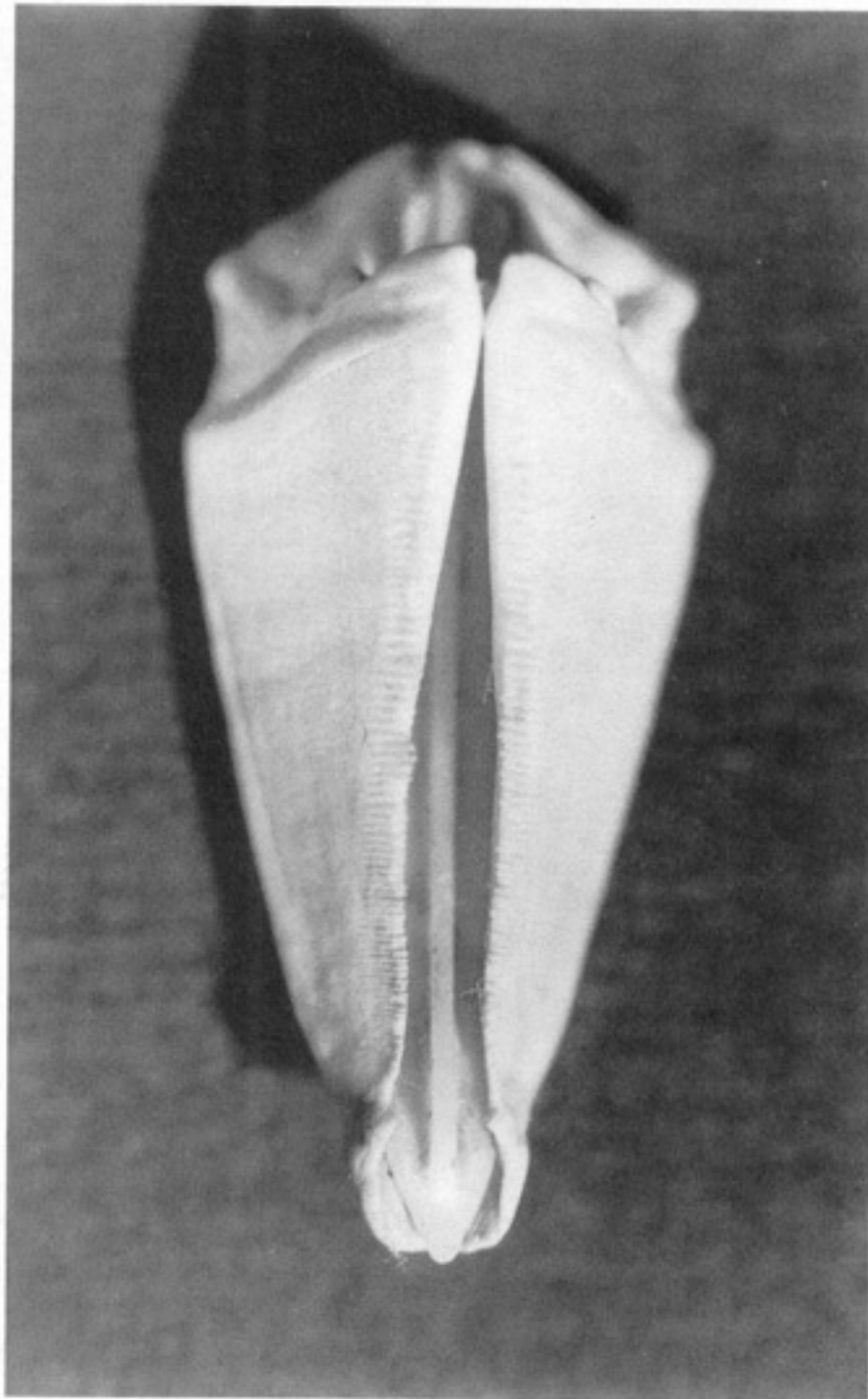
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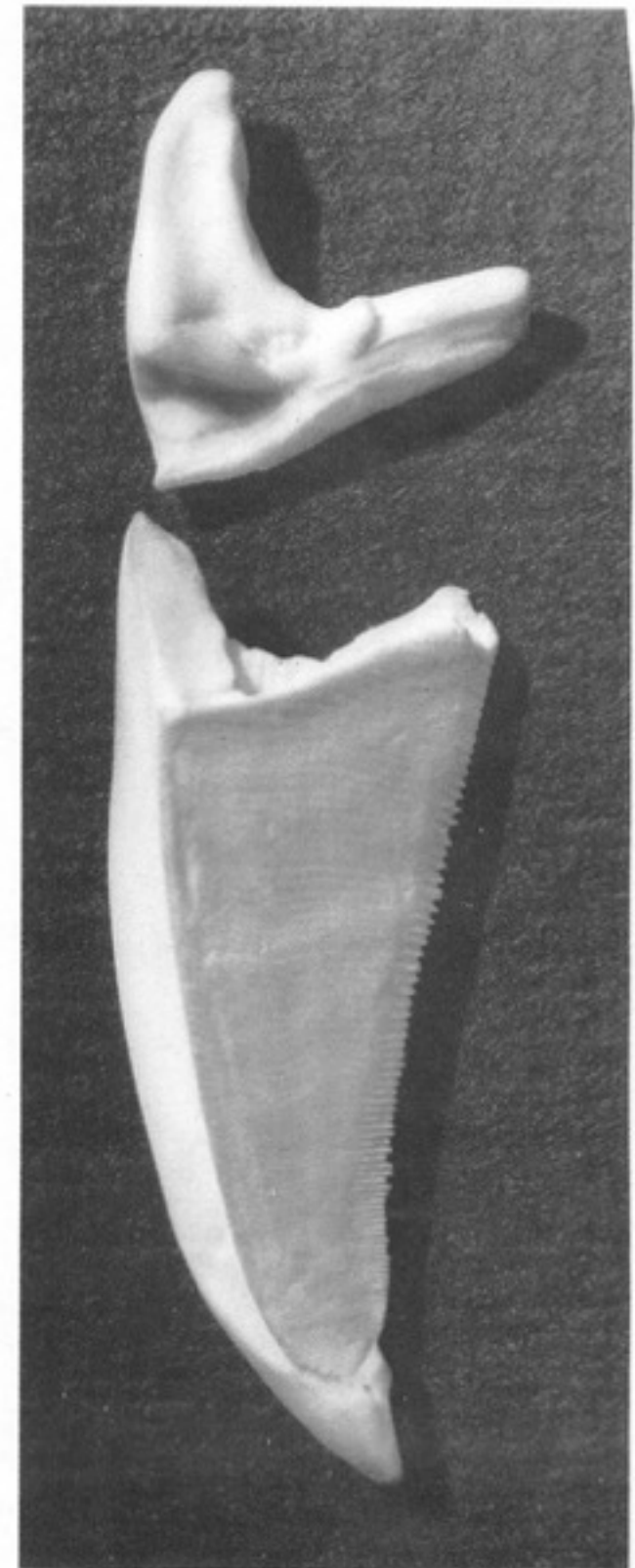
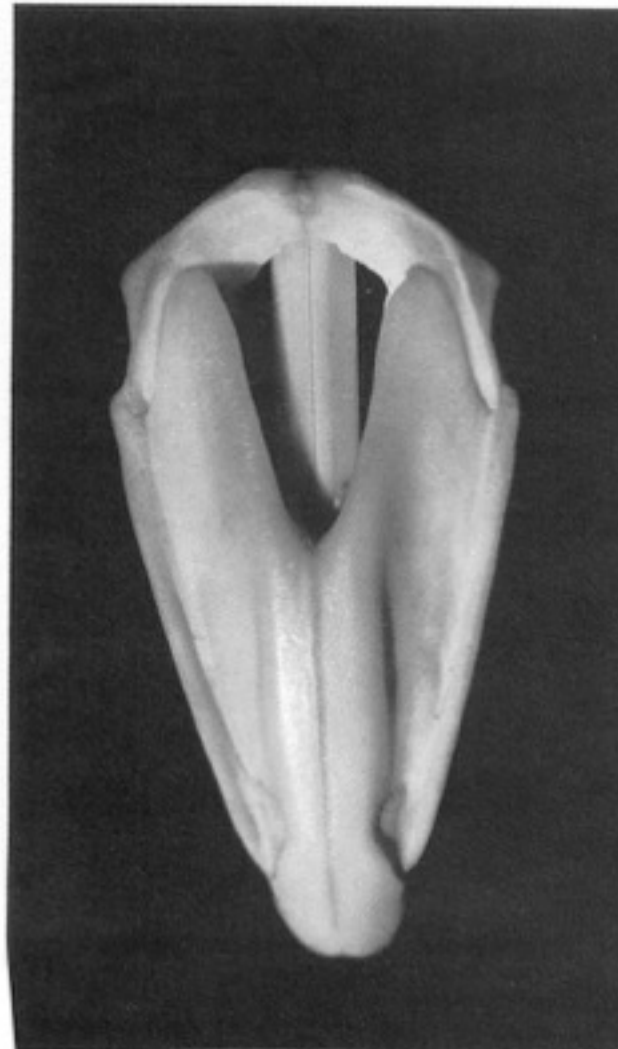
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One of the jaws seen in front view.
A tooth housed in the inside is
partially visible.



The same jaw seen from the opposite
side.

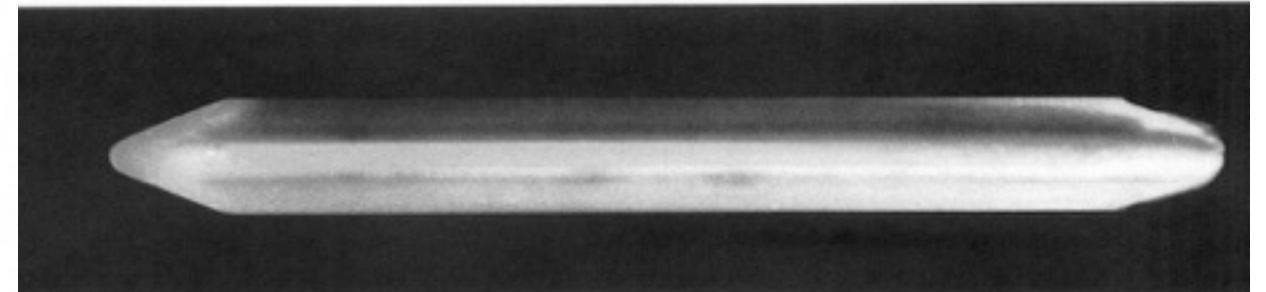
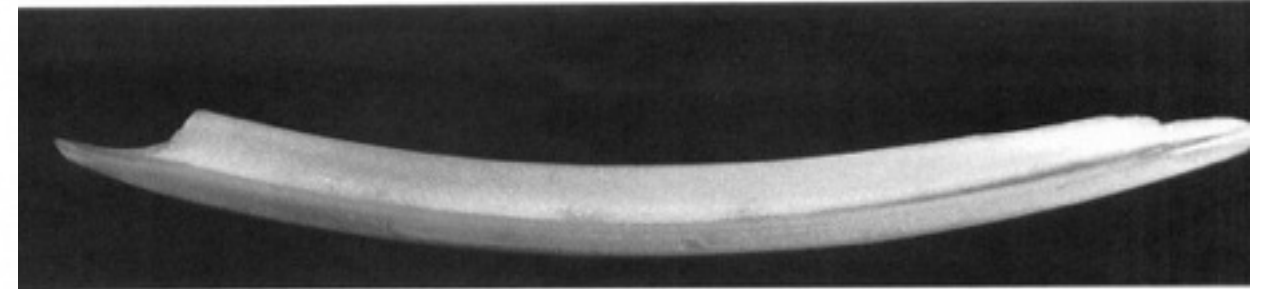


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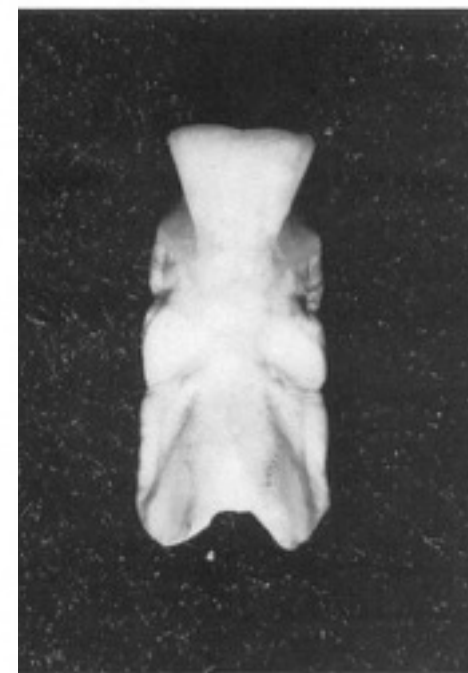
Scarpa, Giorgio, Modelli di bionica, 1985.



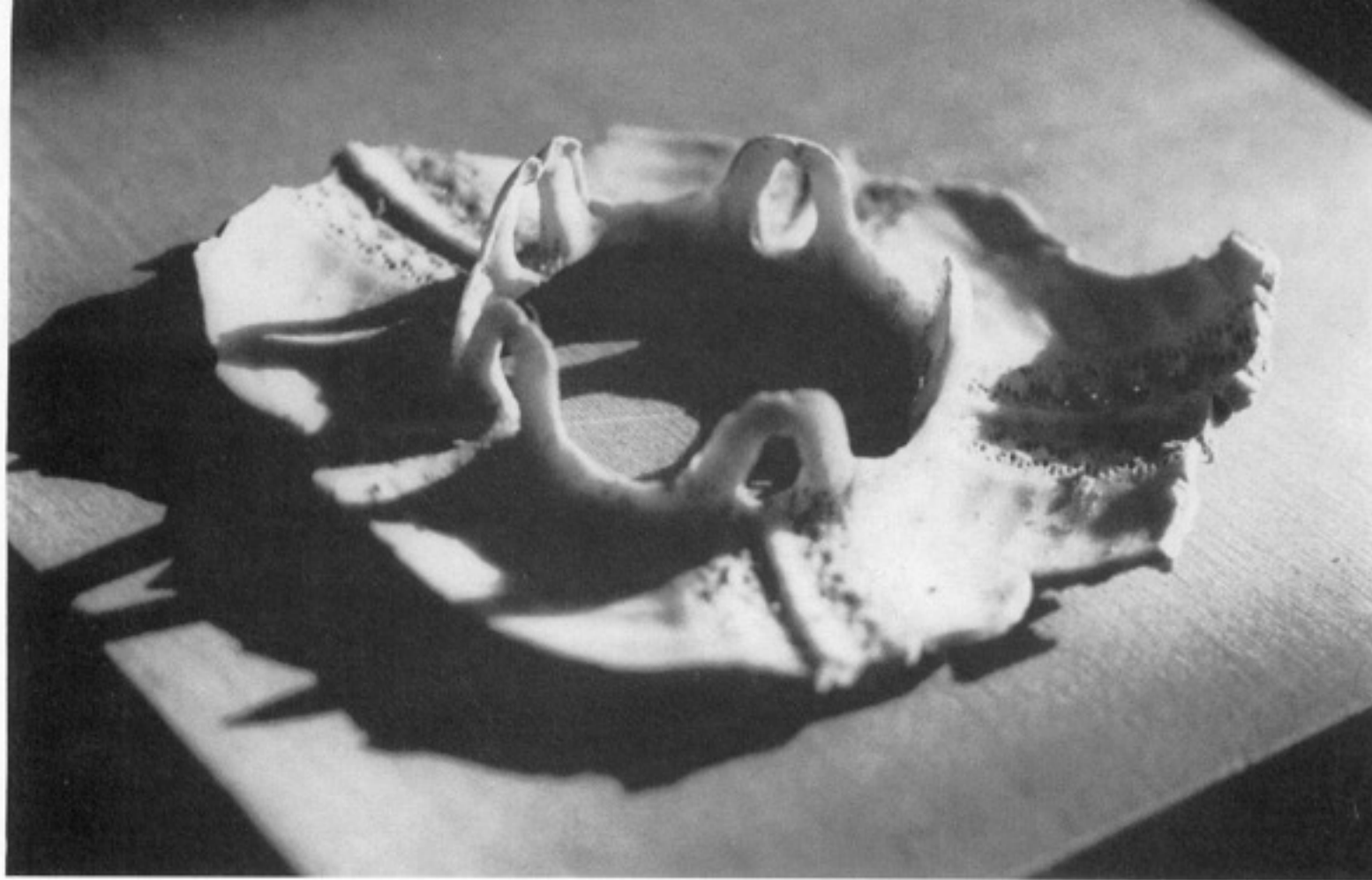
Each jaw can "break up" spontaneously or be decomposed into four parts.



One of the five teeth belonging to each jaw, seen in front and side views.



The forms shown above are found in the upper part of the lantern.



Inside the shell, a crown-like structure, surrounding the mouth opening, holds the muscular structure to which the lantern is connected.



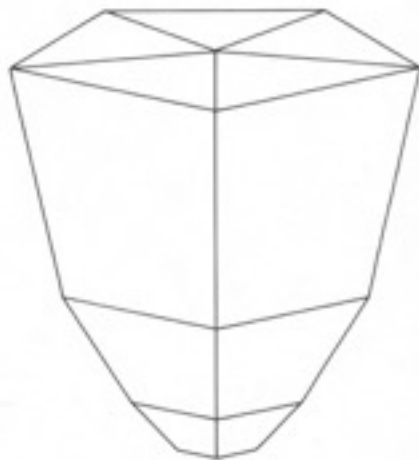
One the five "ridges" to which the muscles are attached - forming the crown - seen here from the front and the side.



Scarpa, Giorgio, Modelli di bionica, 1985.

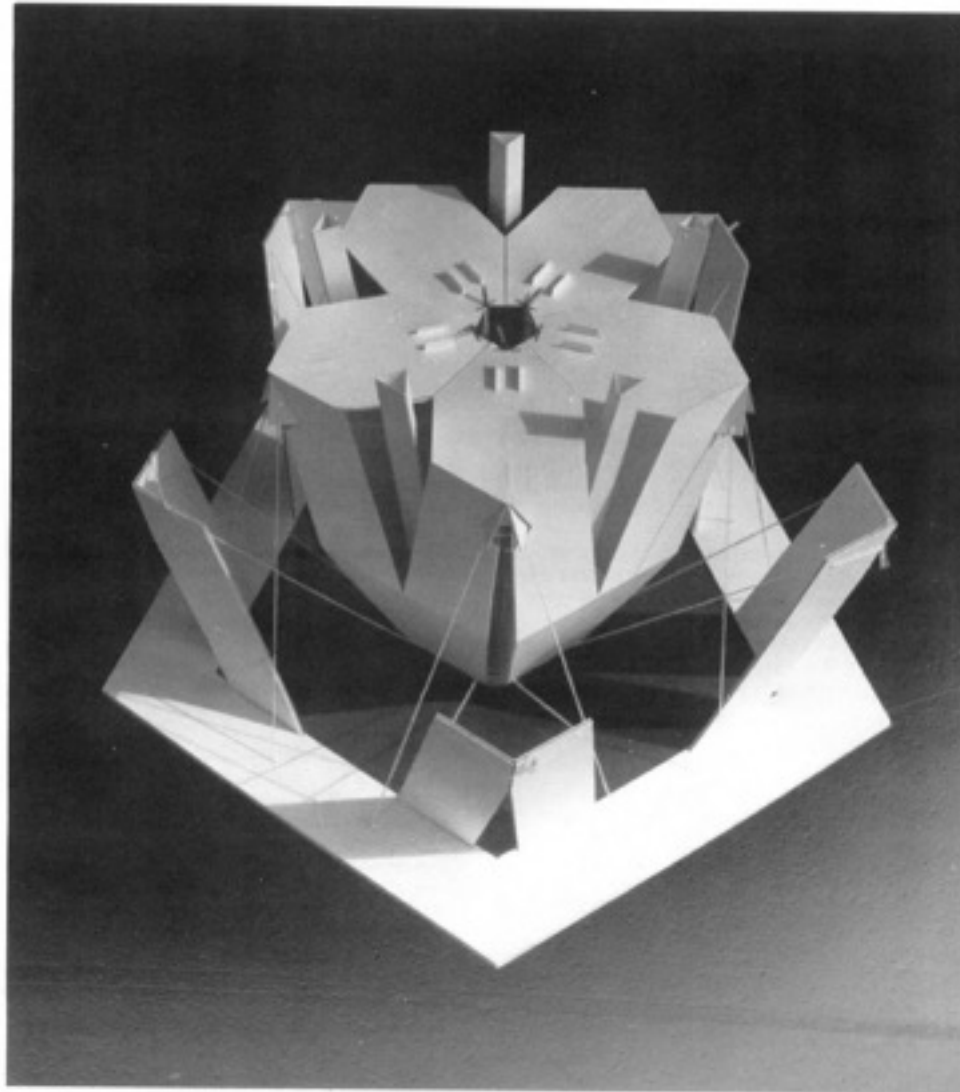


Drawing of a model of jaw.



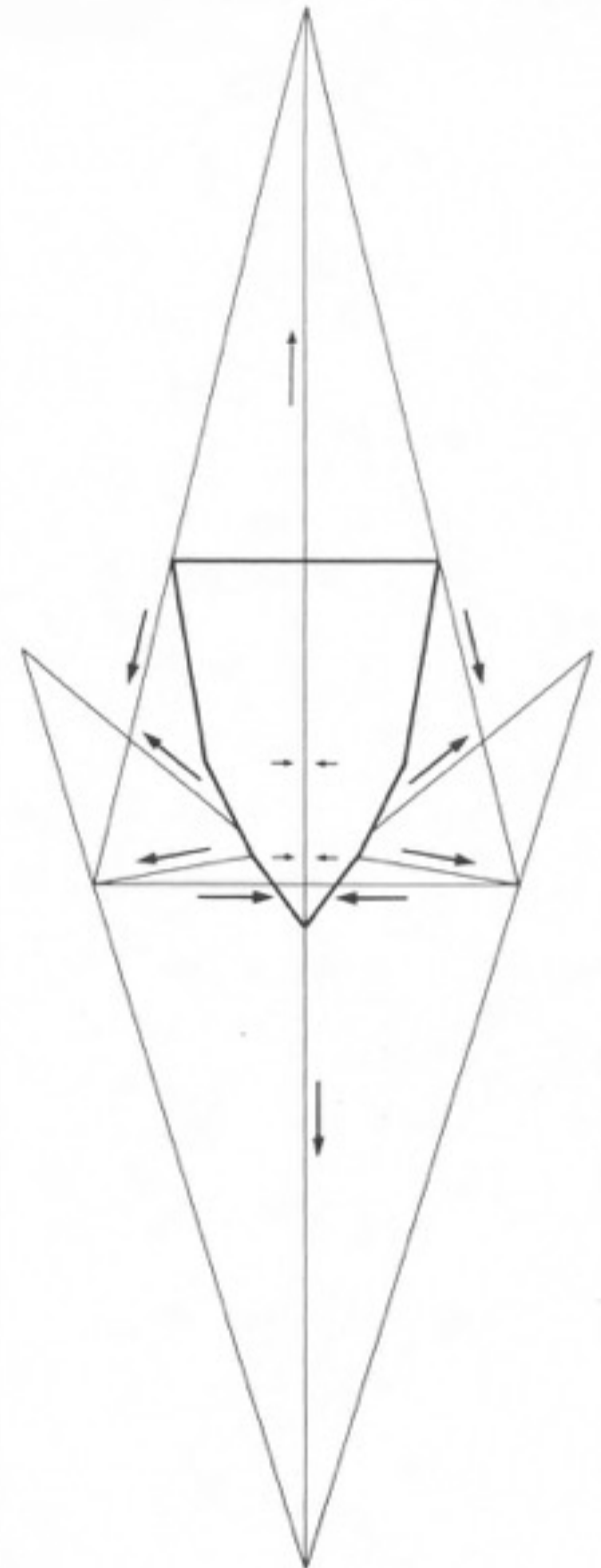
Five models combined together.

41



Overall model, complete with all the parts.

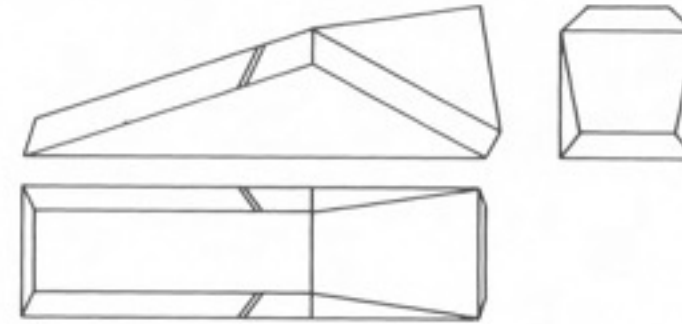
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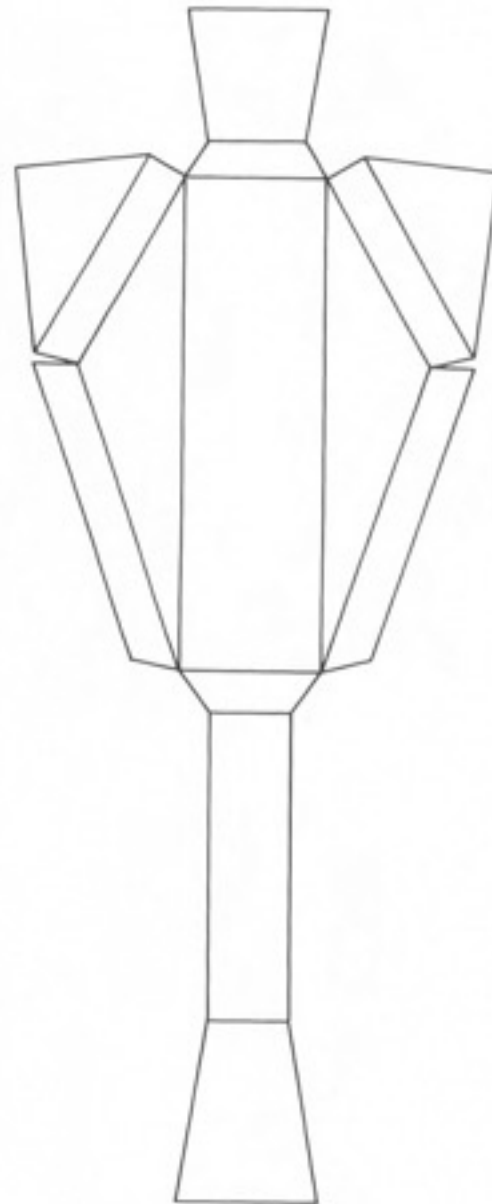
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Scarpa, Giorgio, Modelli di bionica, 1985.

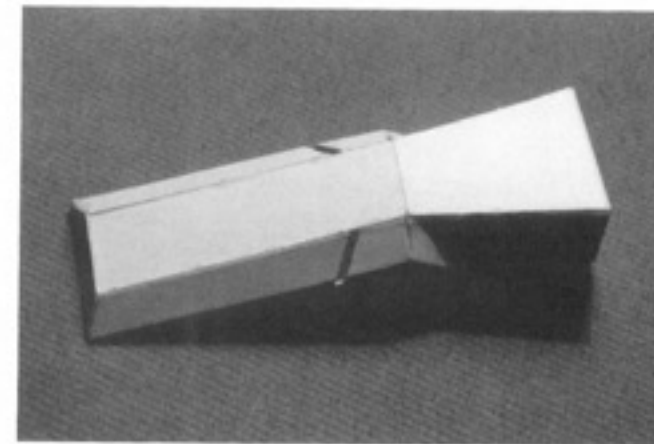
In the light of these new observations, the construction of a new model of the bridge-plate will have to be based on a clearer definition of its functions. In fact, compared to the first model, the new one will be supplied with appropriate slots where the complementary forms - belonging to the jaw models - will be able to rotate.



Top, front, and side view drawing of the new model.

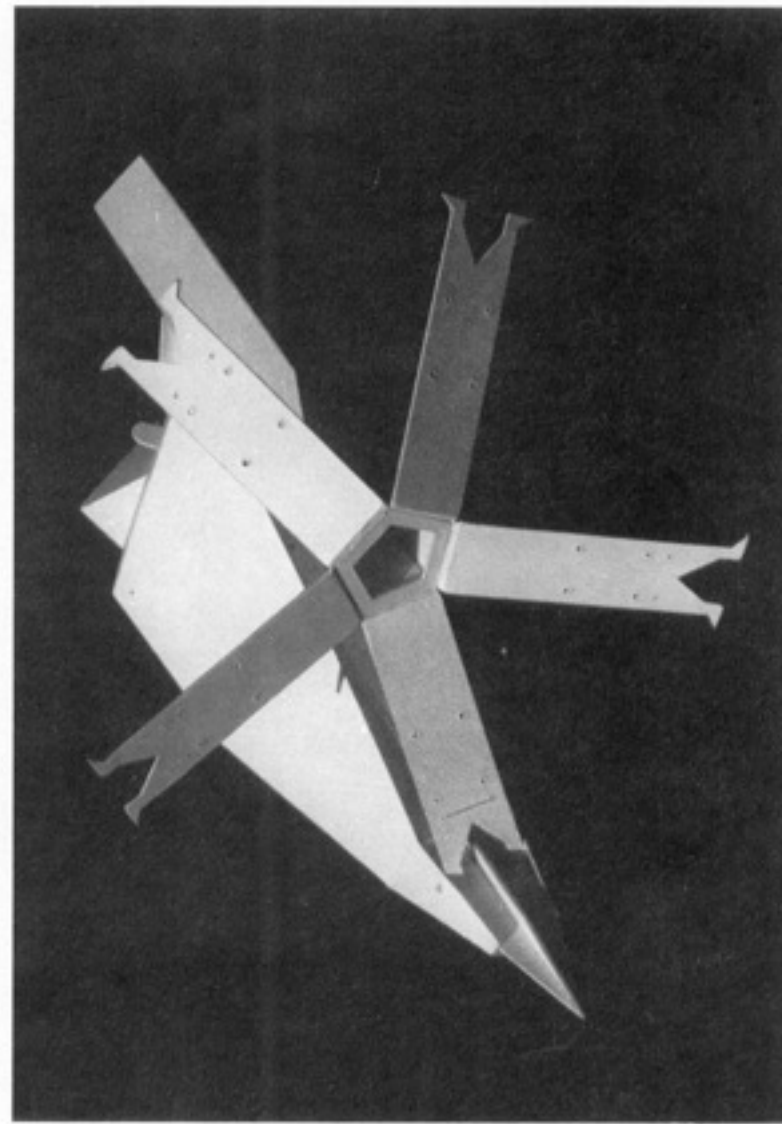
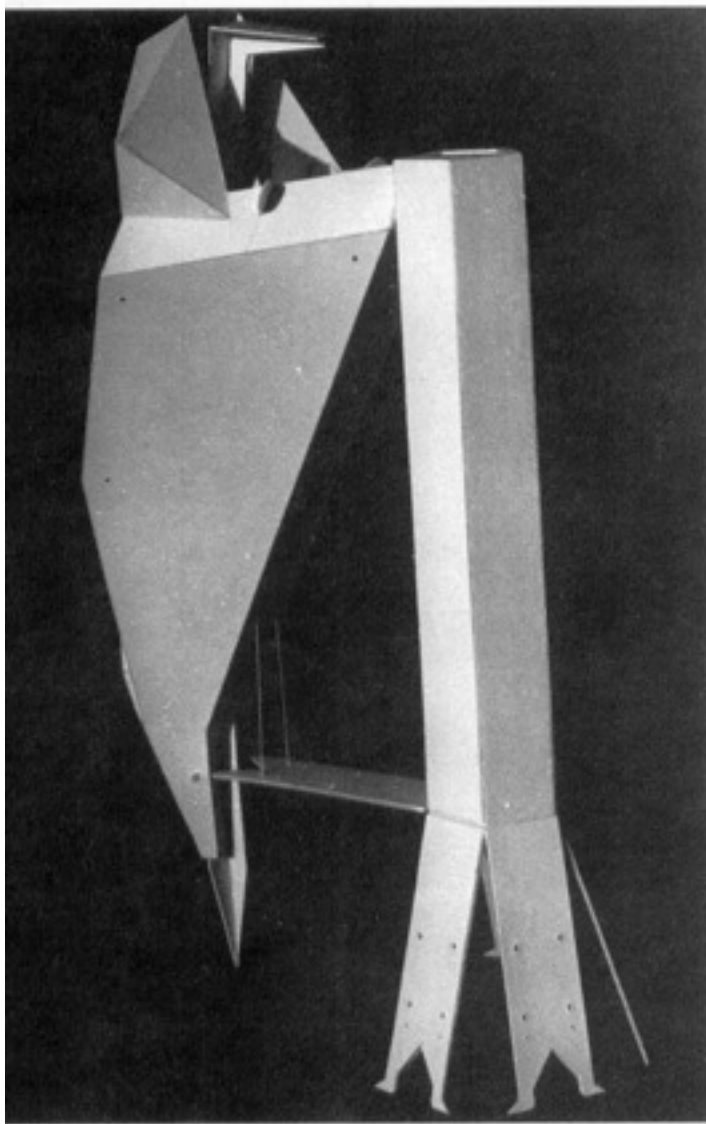


Fold-out



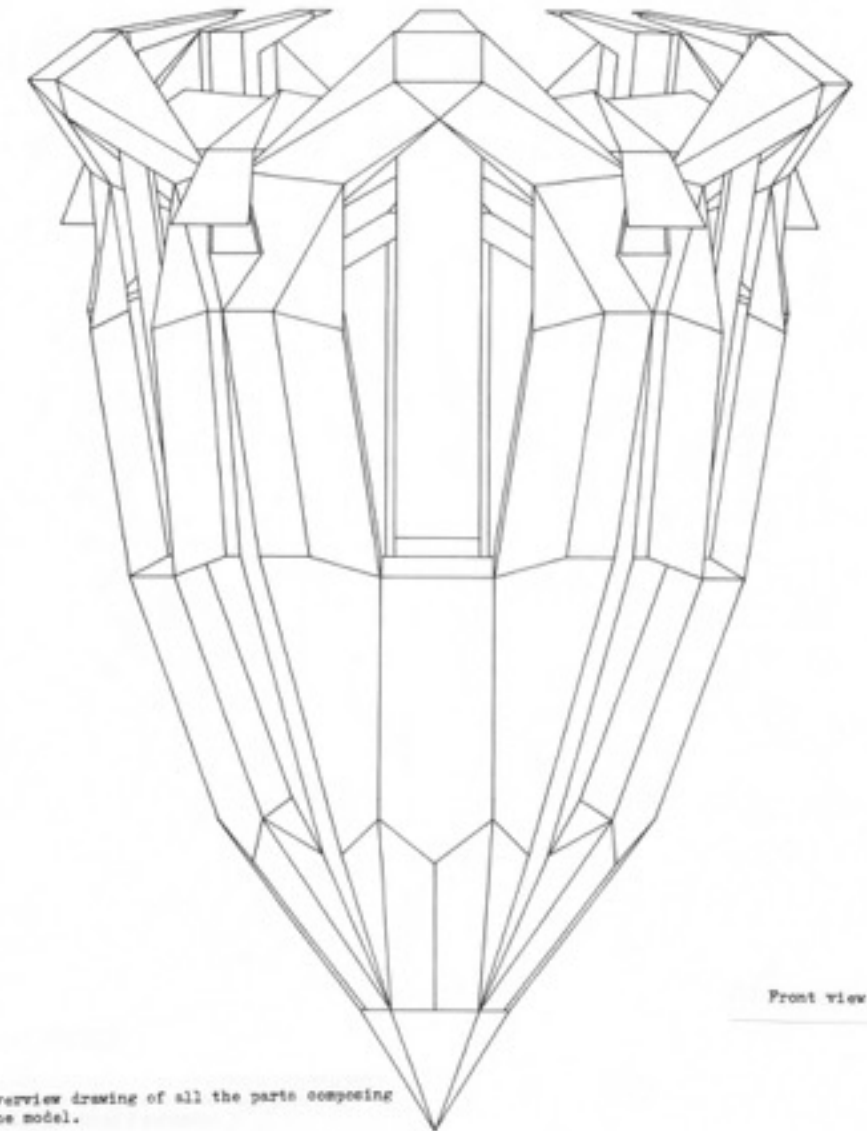
Model.

Scarpa, Giorgio, Modelli di bionica, 1985.



Models of the pentagonal prism and the jaw, connected together.

Of course, in some cases, the inserting of these new forms will require changes in the previously designed forms. An accurate check-up is made, in order to improve the coordination of the various pieces, towards an improvement in their functionality. After these changes are made, we move on to the final assembling of the model.

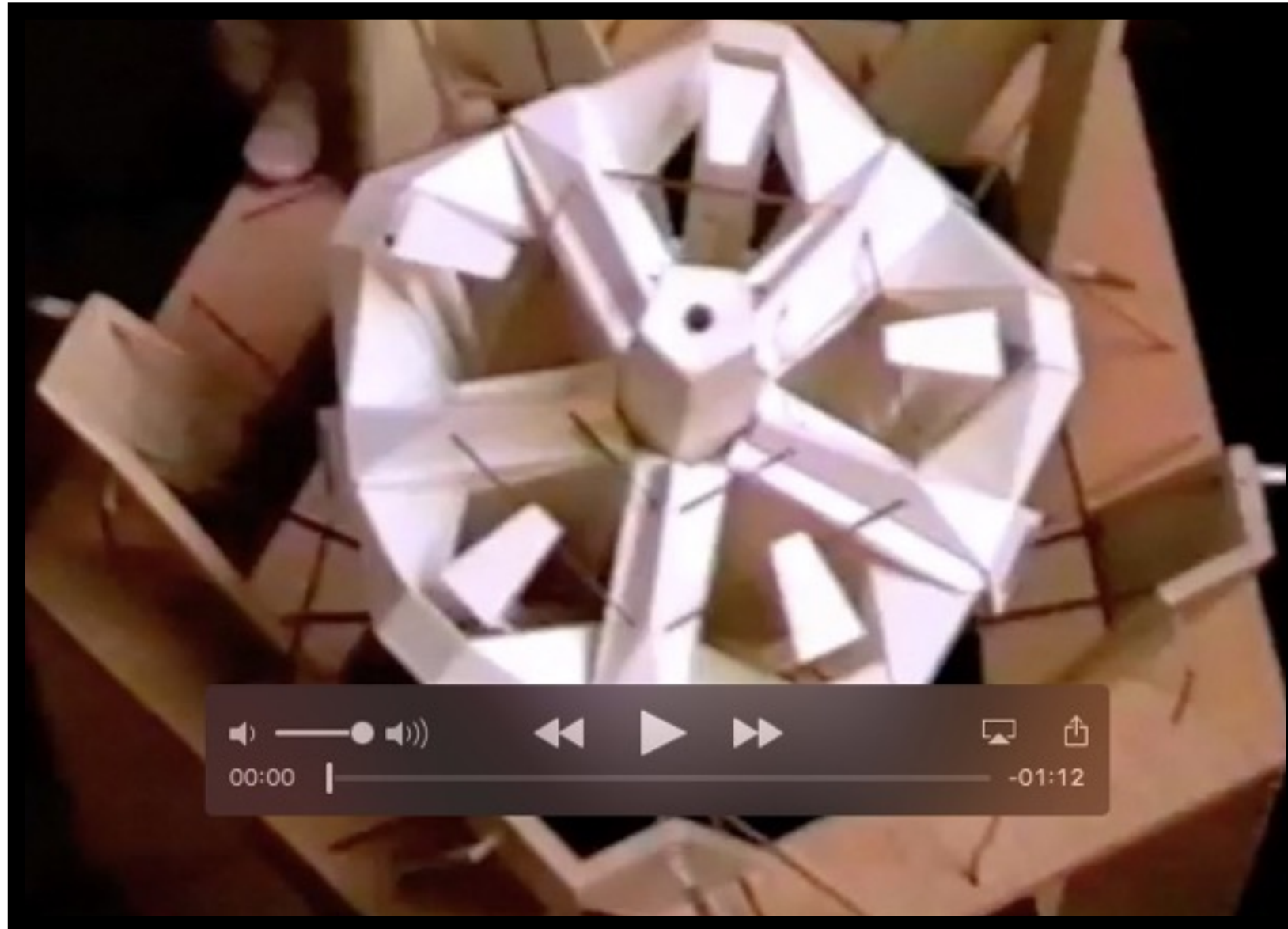


Front view.

Overview drawing of all the parts composing the model.

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Scarpa, Giorgio, Modelli di bionica, 1985.



[Bionic Model of Aristotle's Lantern by Giorgio Scarpa -- Youtube video](#)

Scarpa, Giorgio, Modelli di bionica, 1985.

GIORGIO SCARPA'S MODEL OF A SEA URCHIN INSPIRES NEW INSTRUMENTATION

[PDF: static.trogu.com/documents/scarpa/leon_a_01384.pdf](https://static.trogu.com/documents/scarpa/leon_a_01384.pdf)

Trogu, 2016
Leonardo Just Accepted MS.
doi: 10.1162/LEON_a_01384
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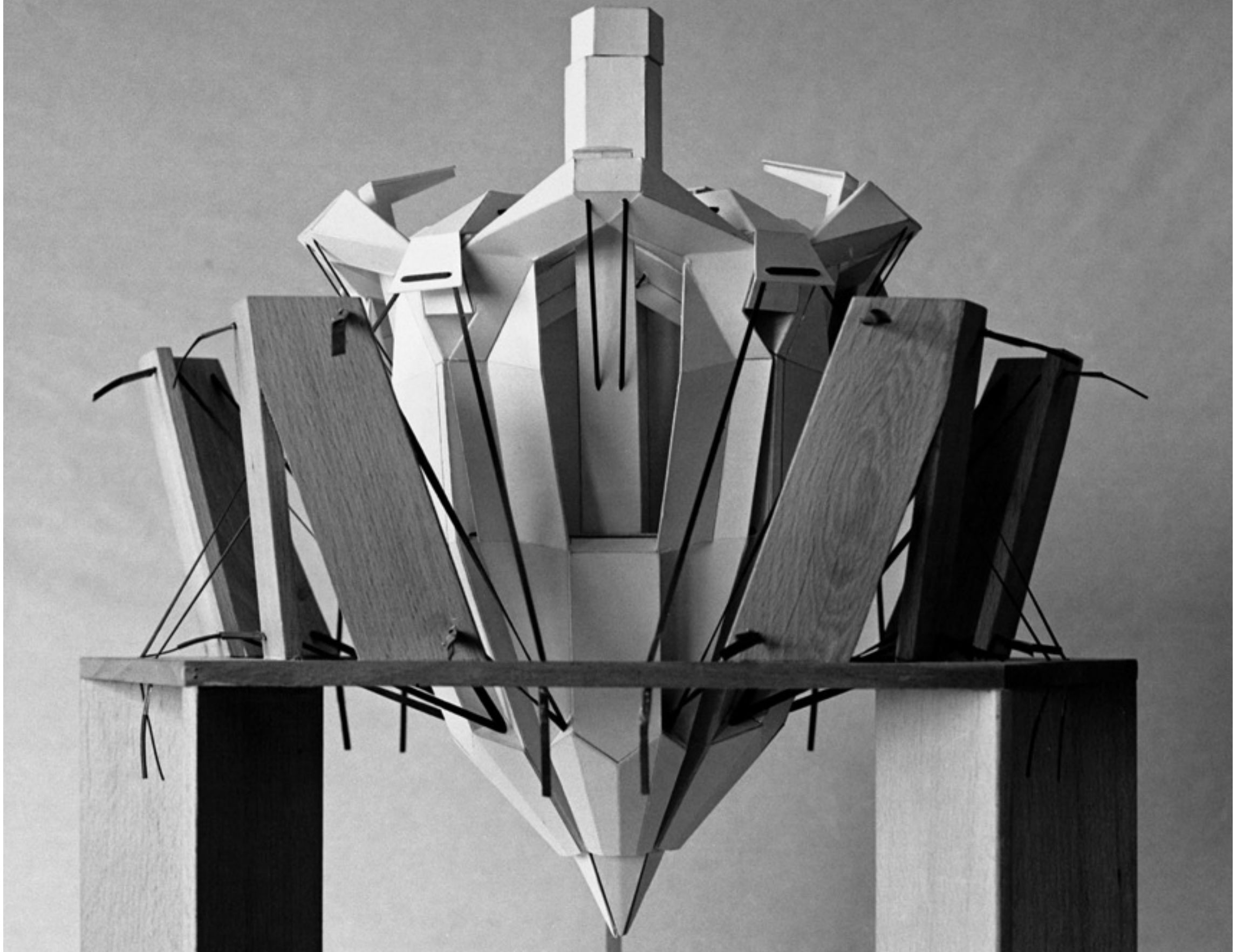


Photo: Giorgio Cireddu

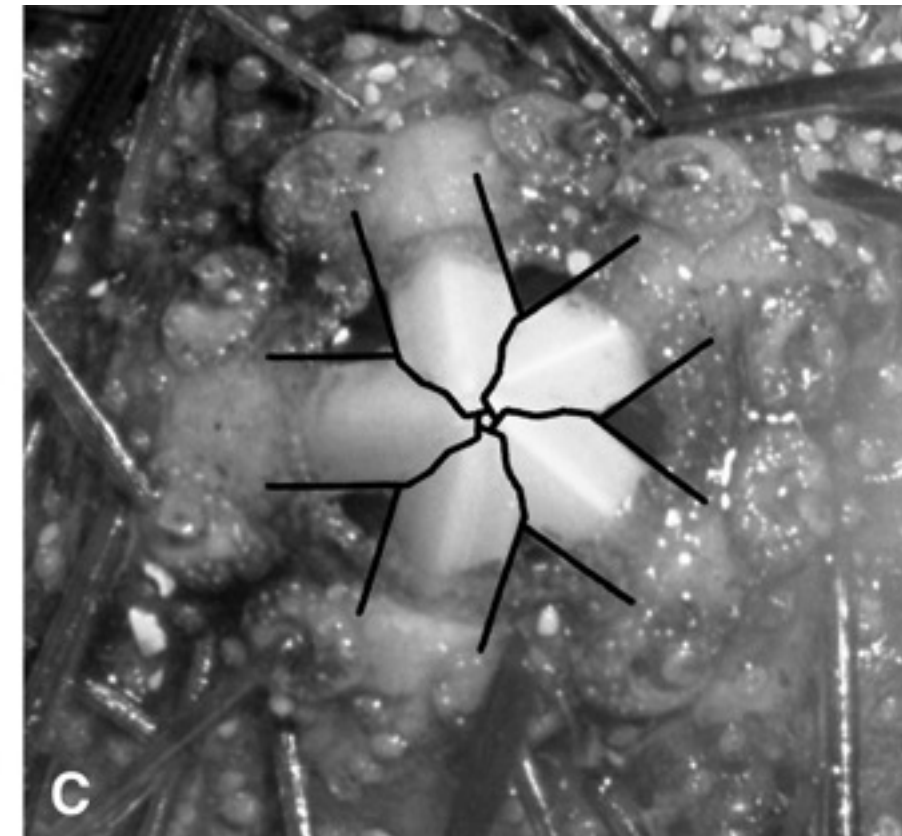
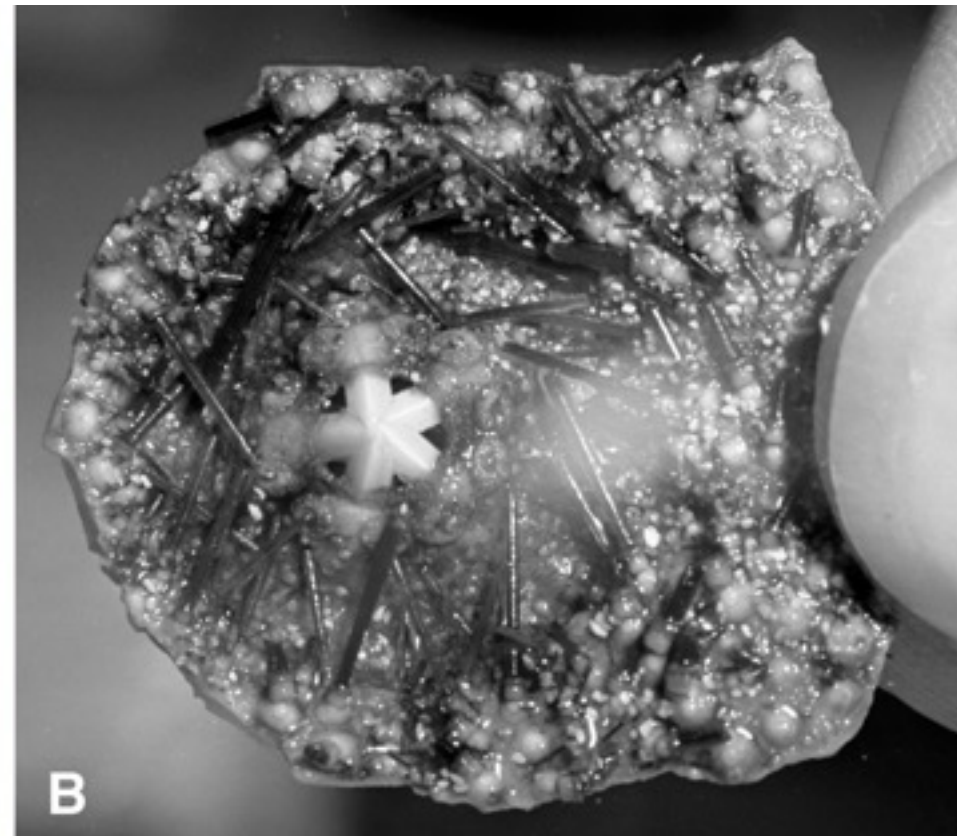
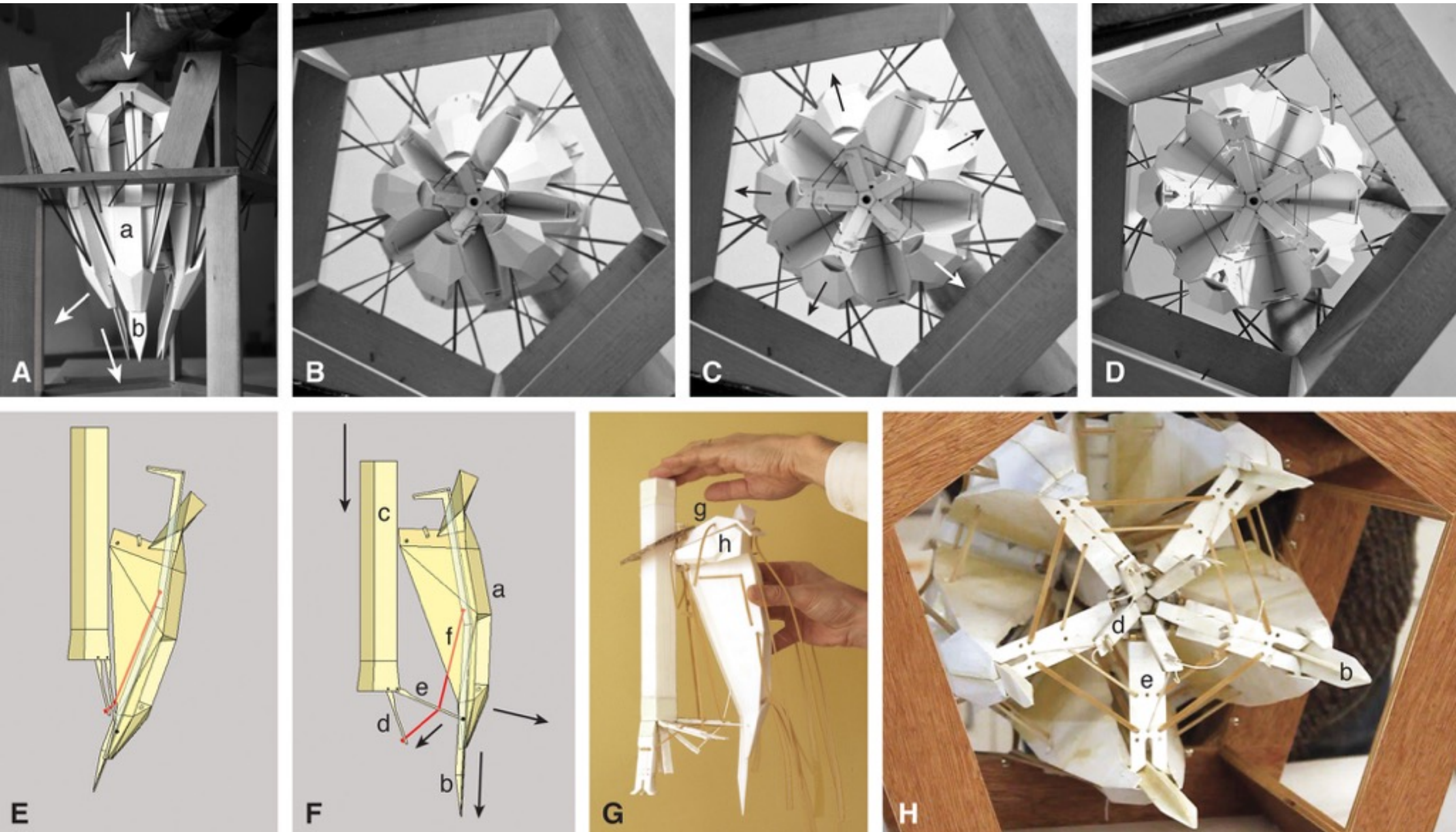
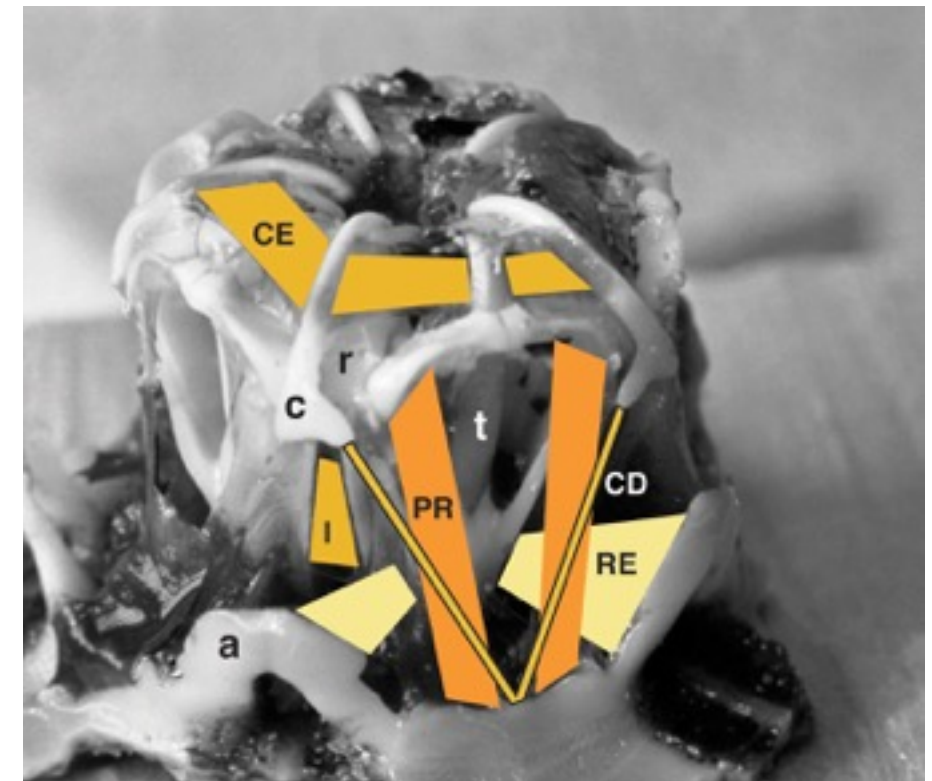
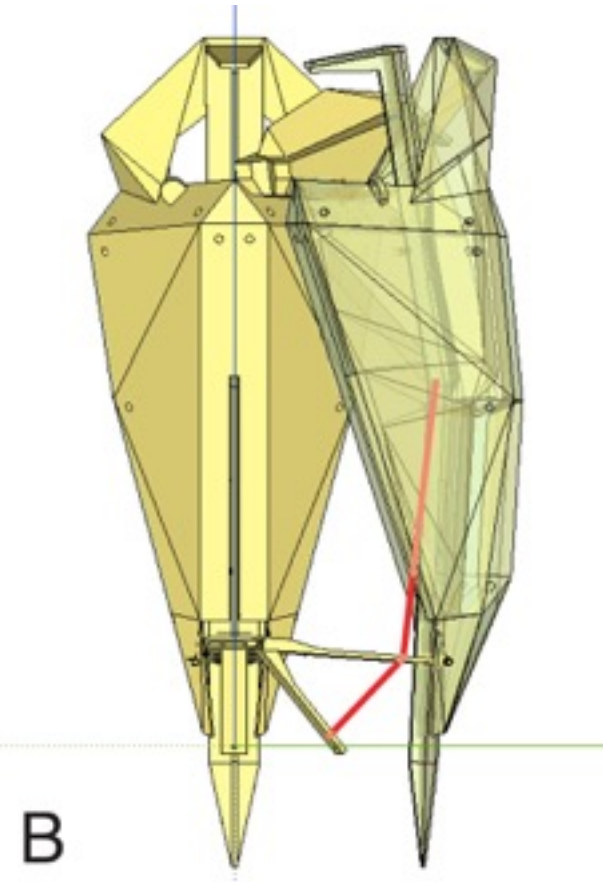
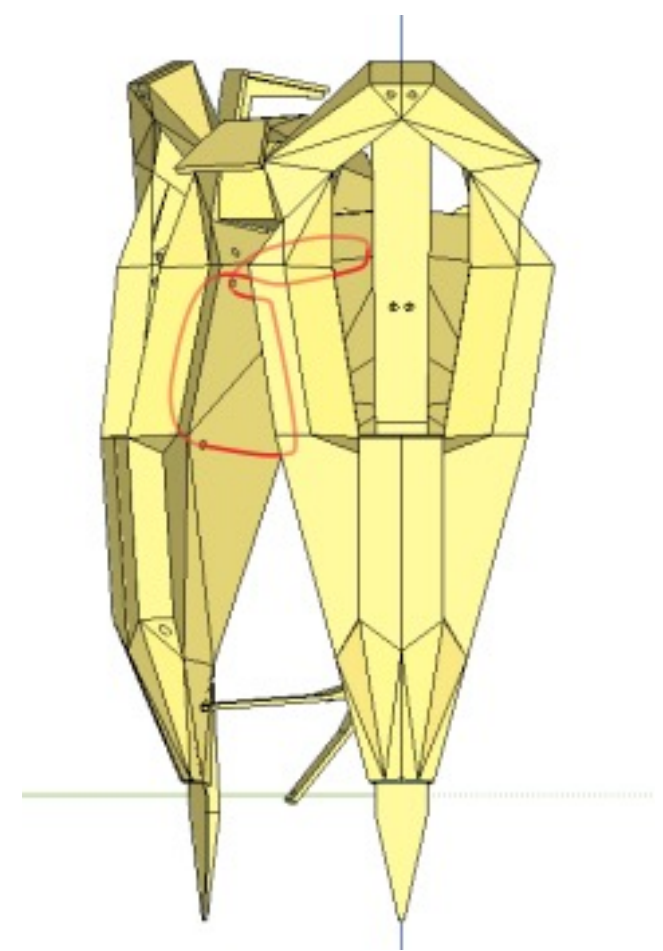
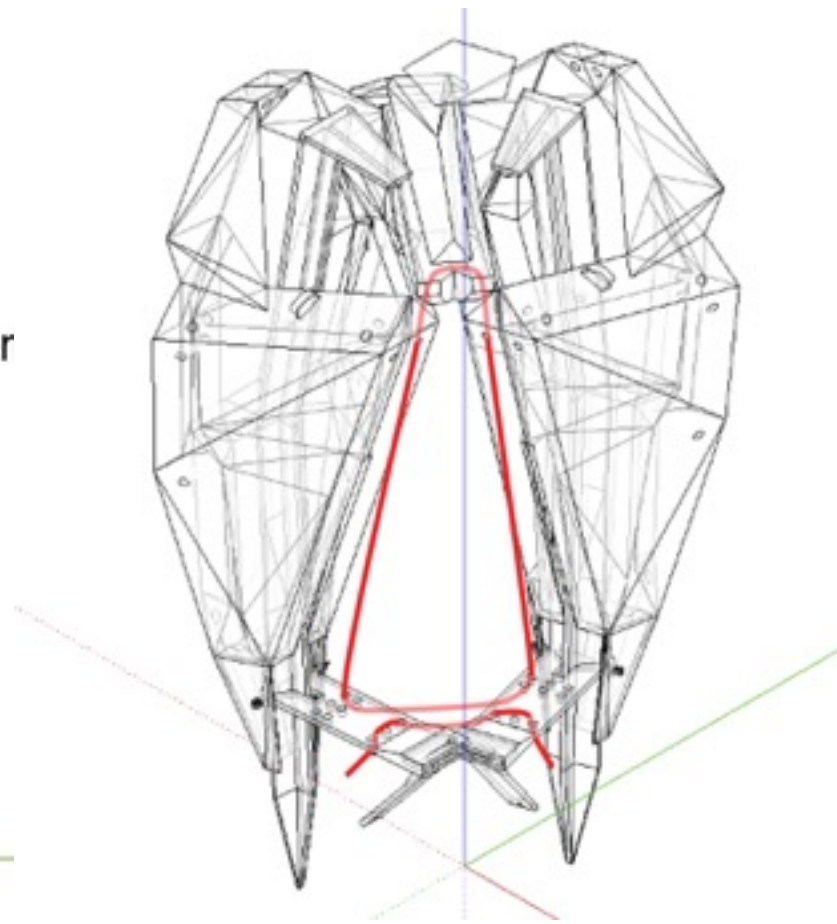
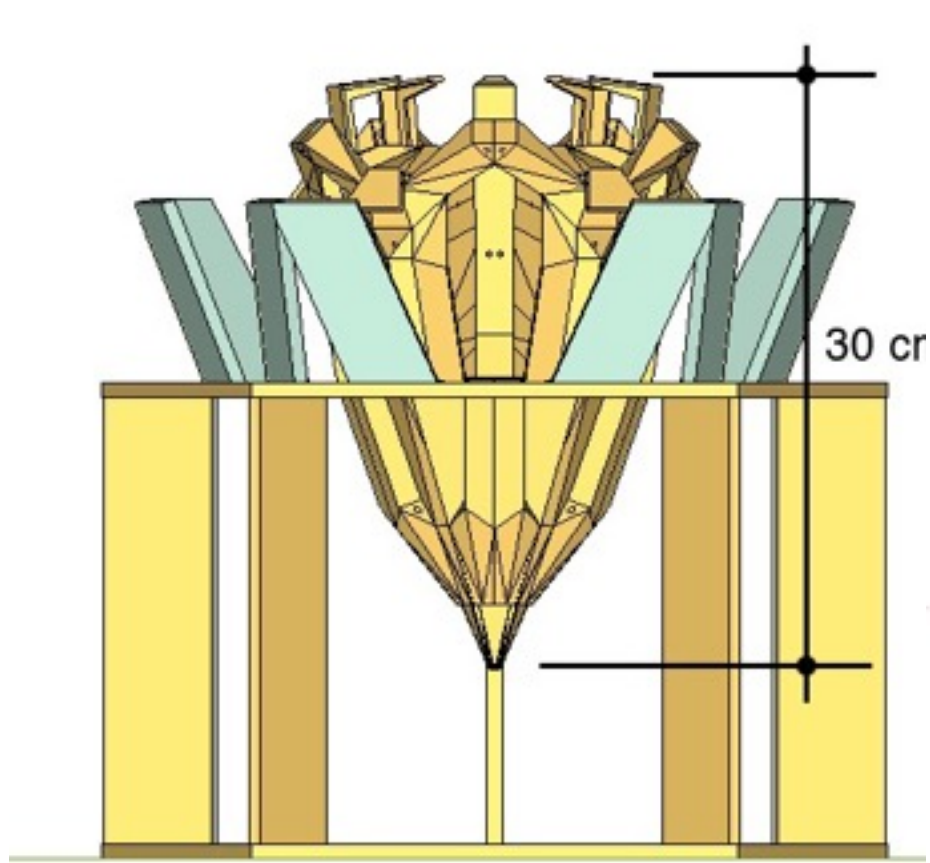


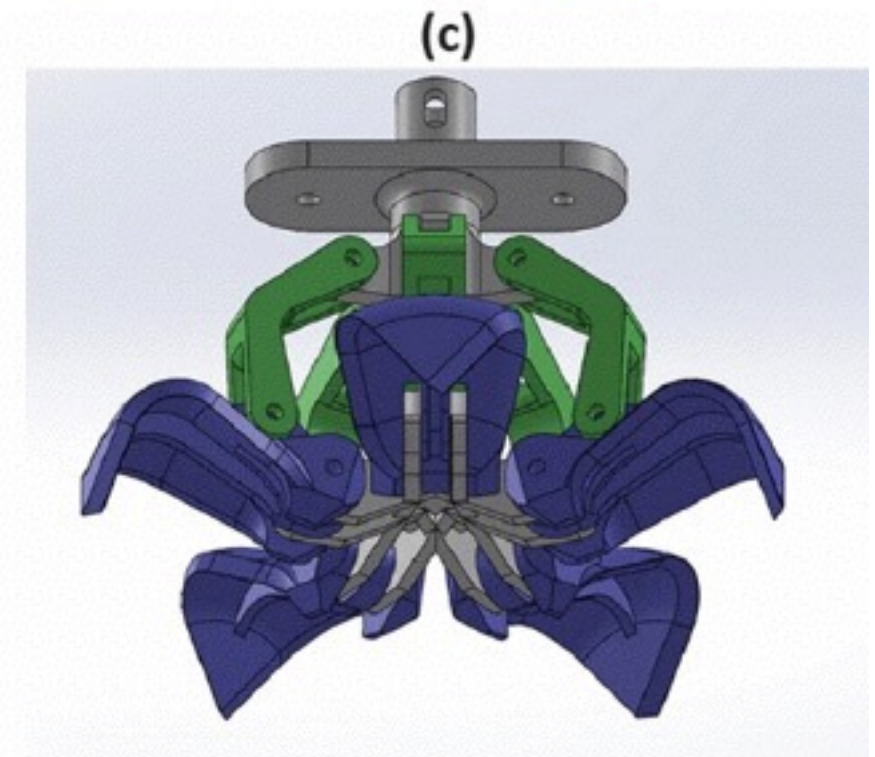
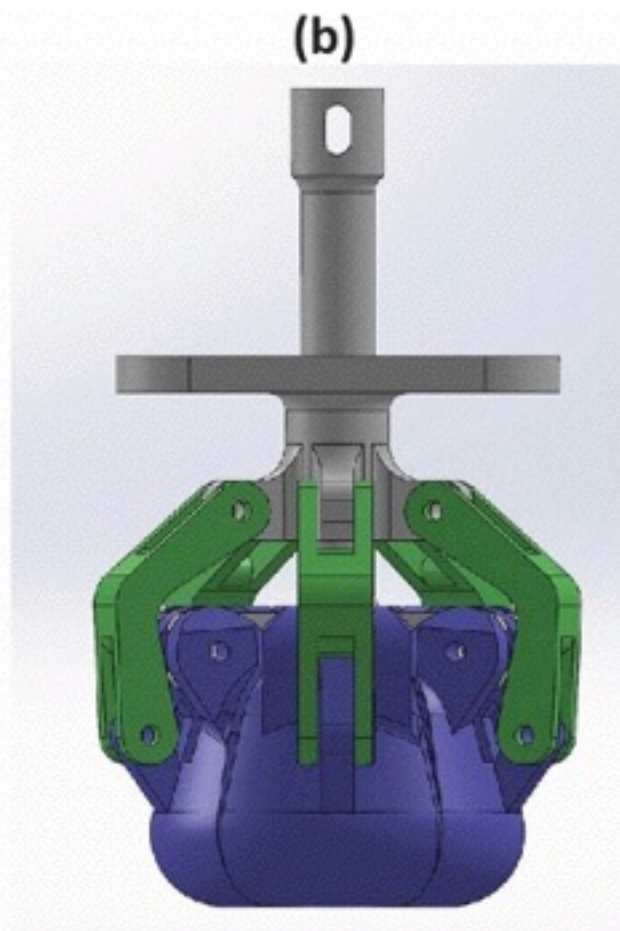
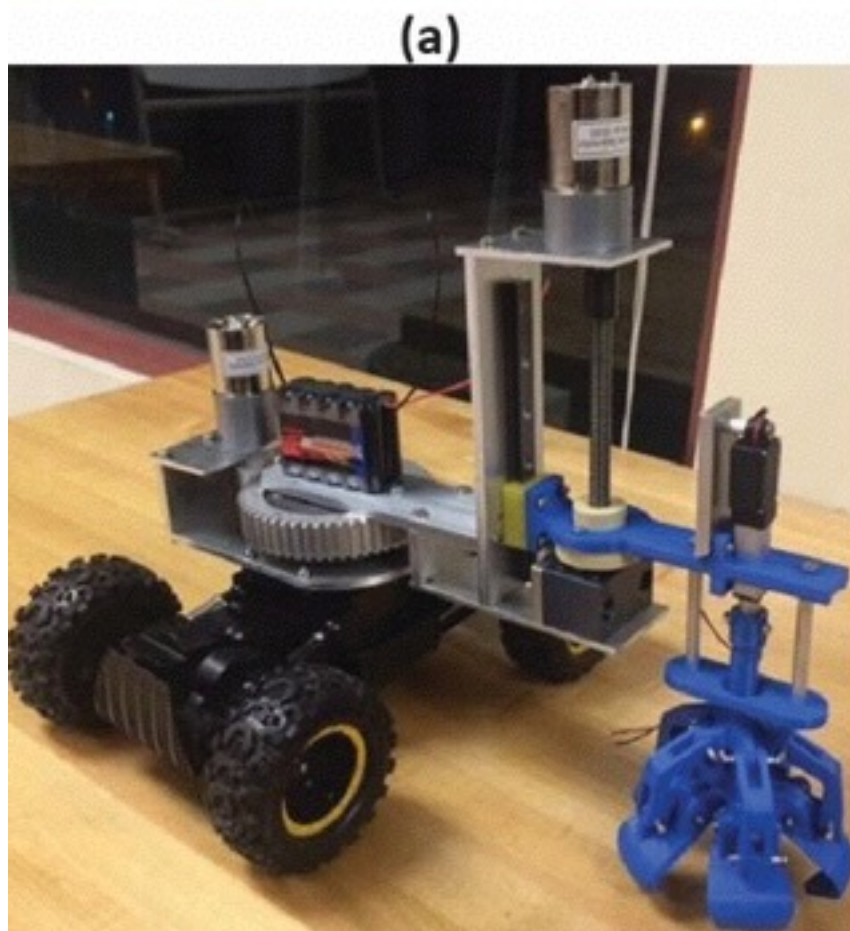
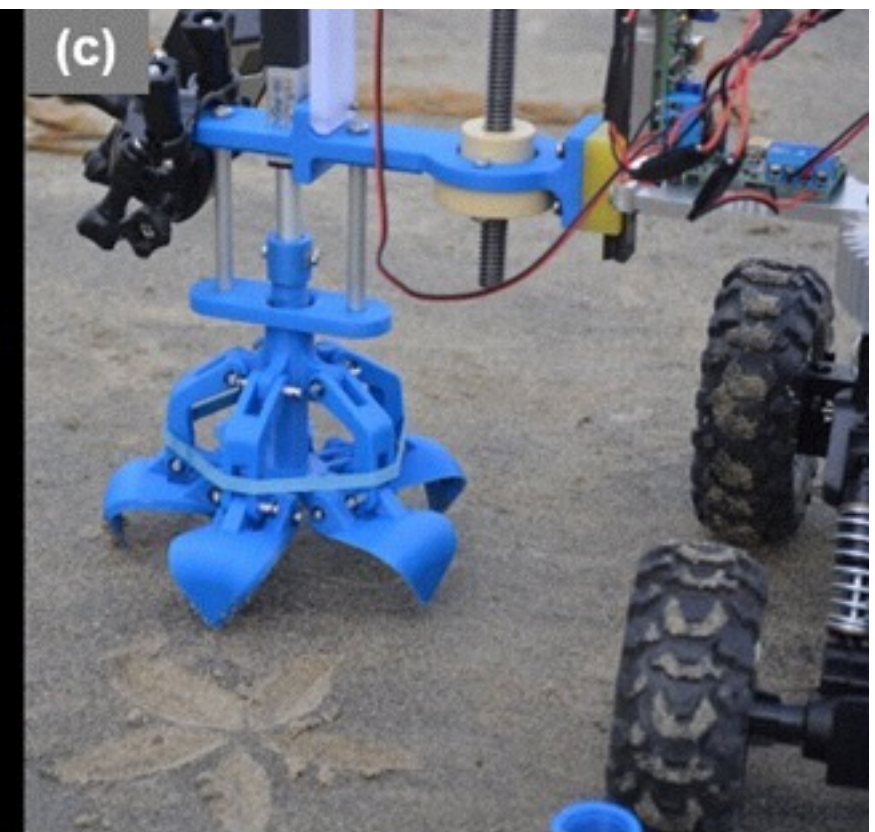
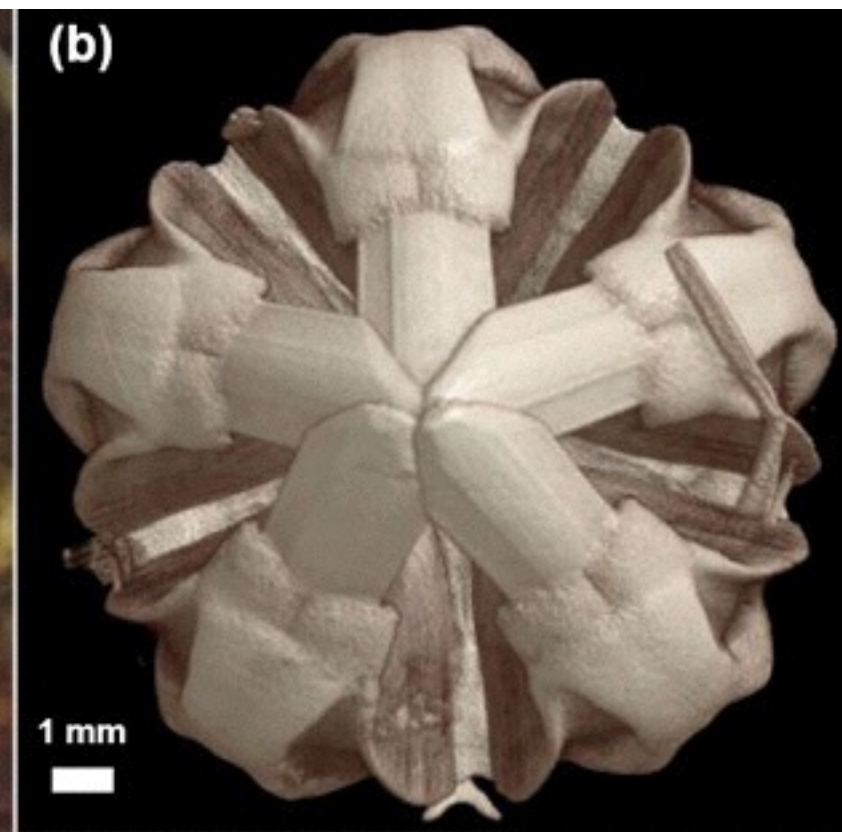
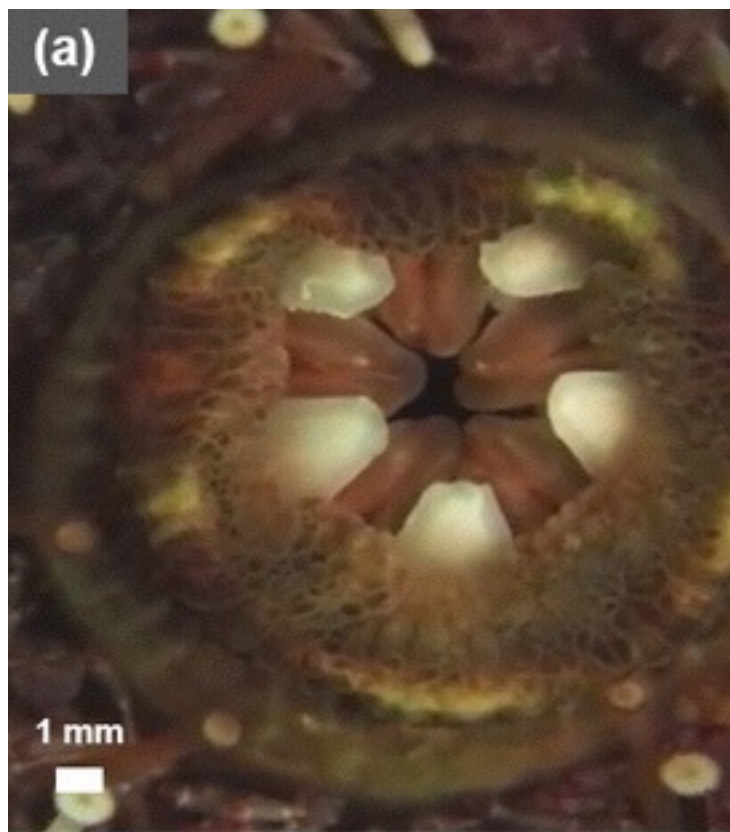
Photo: Giorgio Cireddu



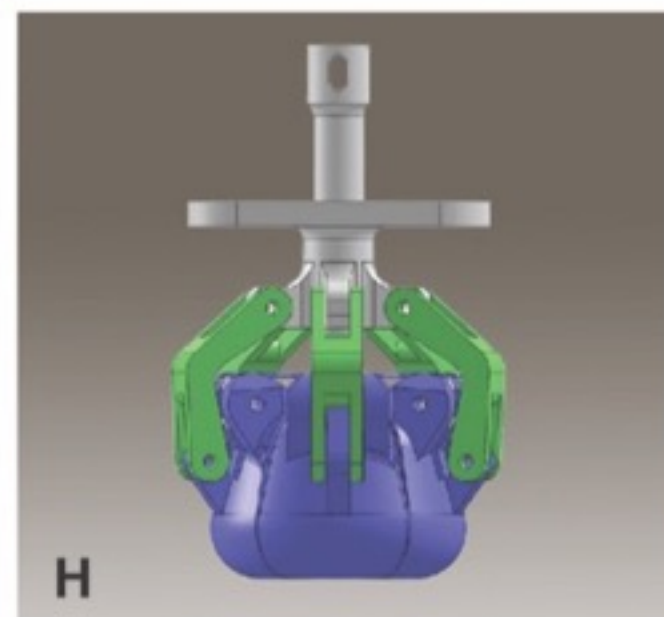
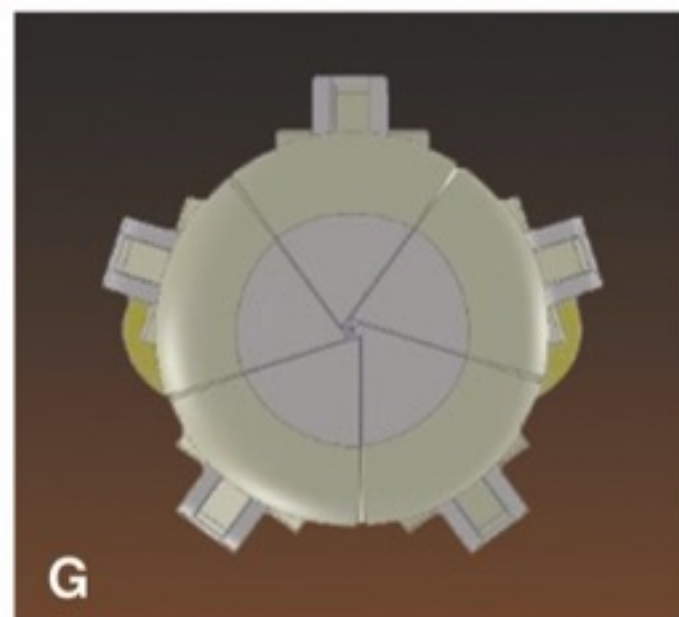
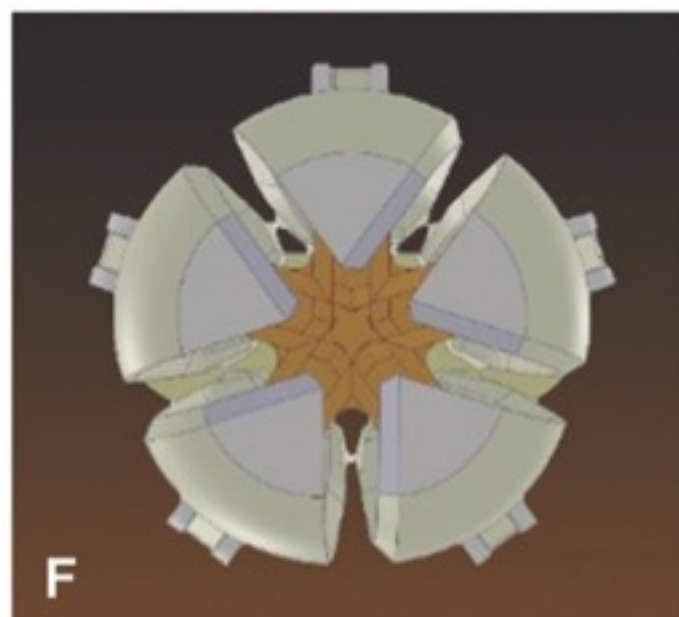
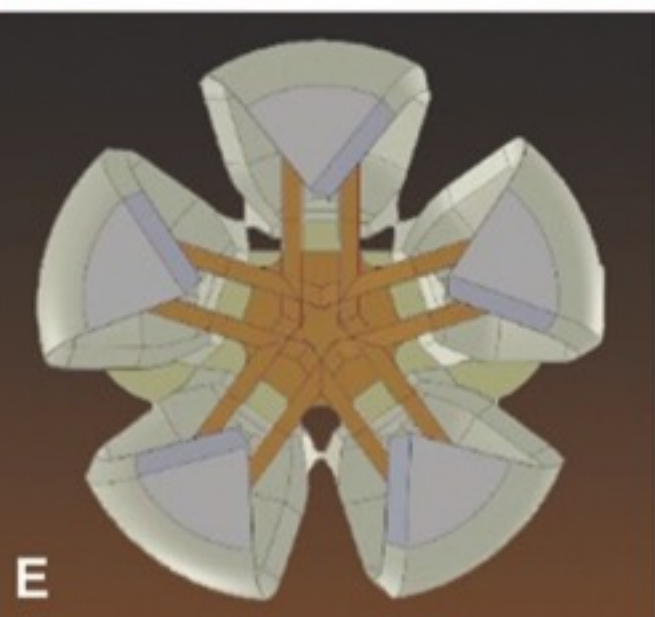
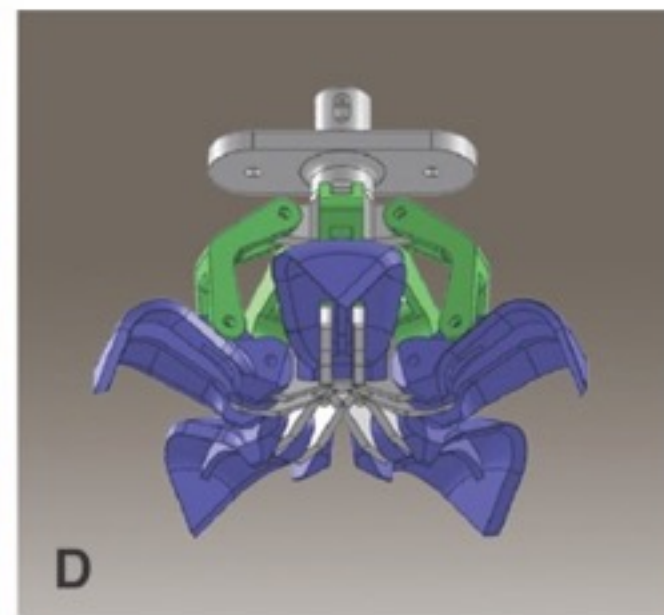
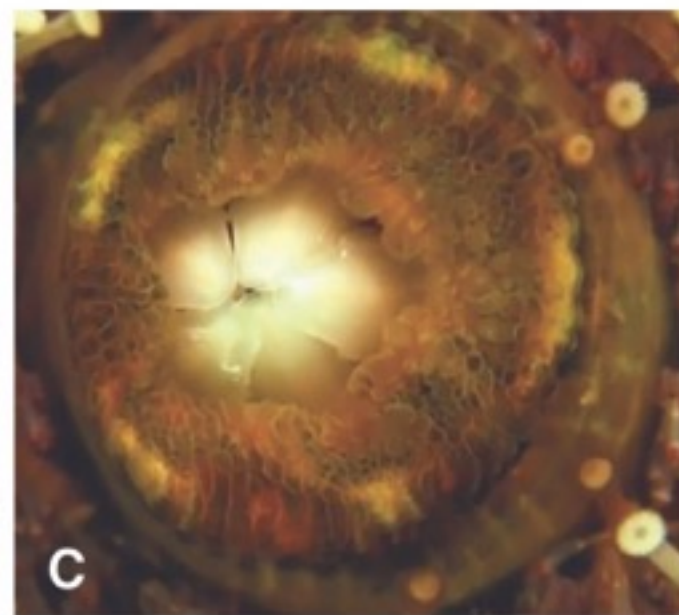
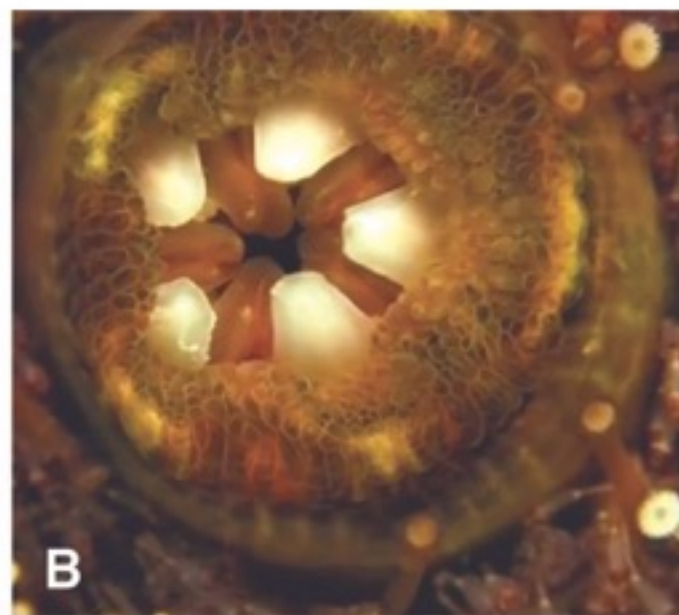
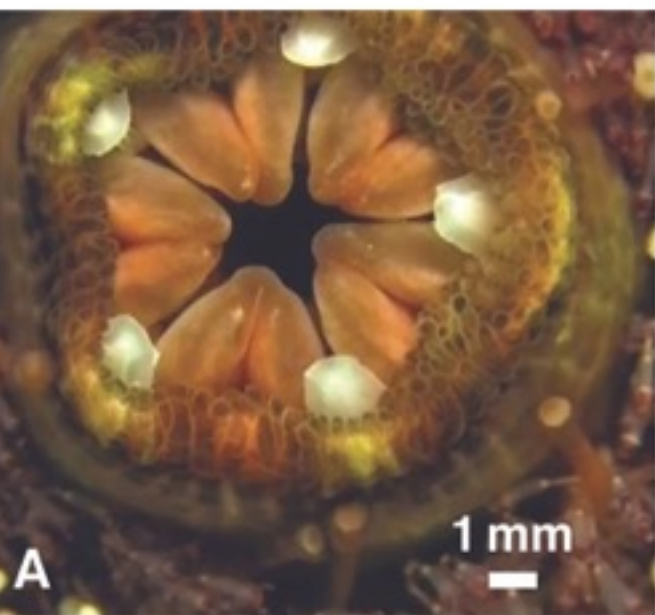


THE GROUND SAMPLER OF FRANK ET AL.

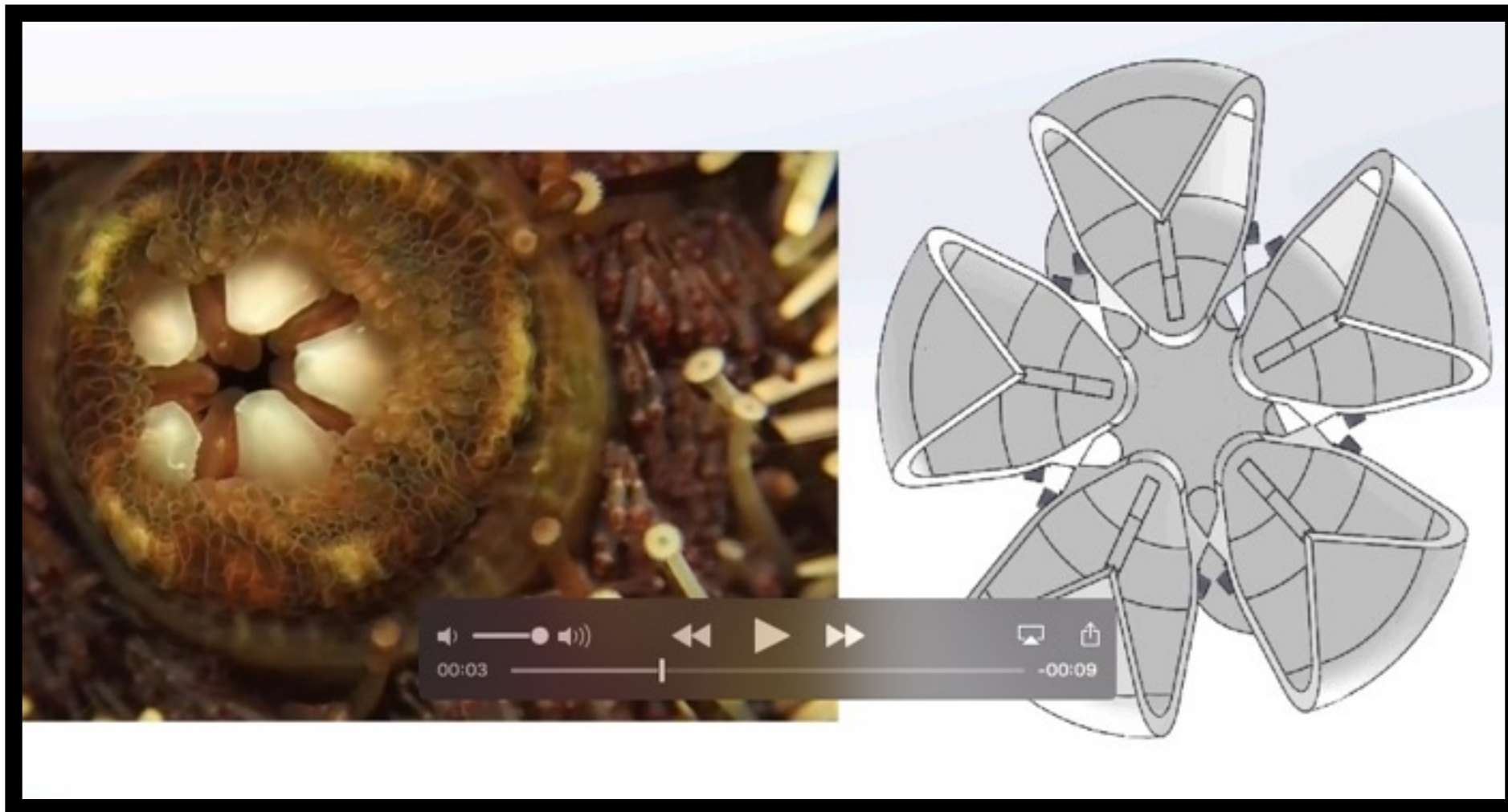
(Frank et al, UC San Diego, 2015)



(Frank et al, UC San Diego, 2015)



(Frank et al, UC San Diego, 2015)



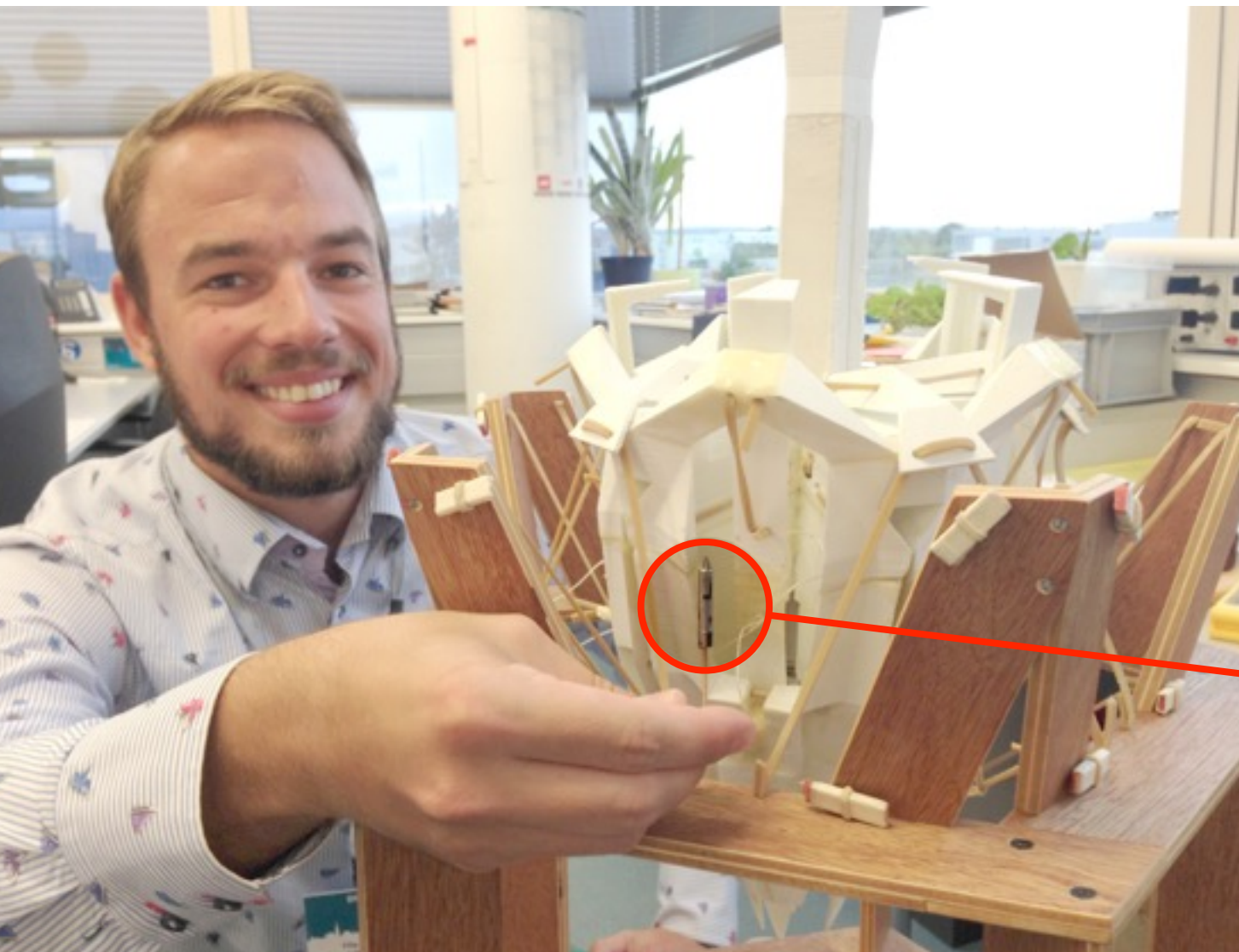
[Frank et al., UCSD urchin side-by-side video](#)

(Frank et al, UC San Diego, 2015)

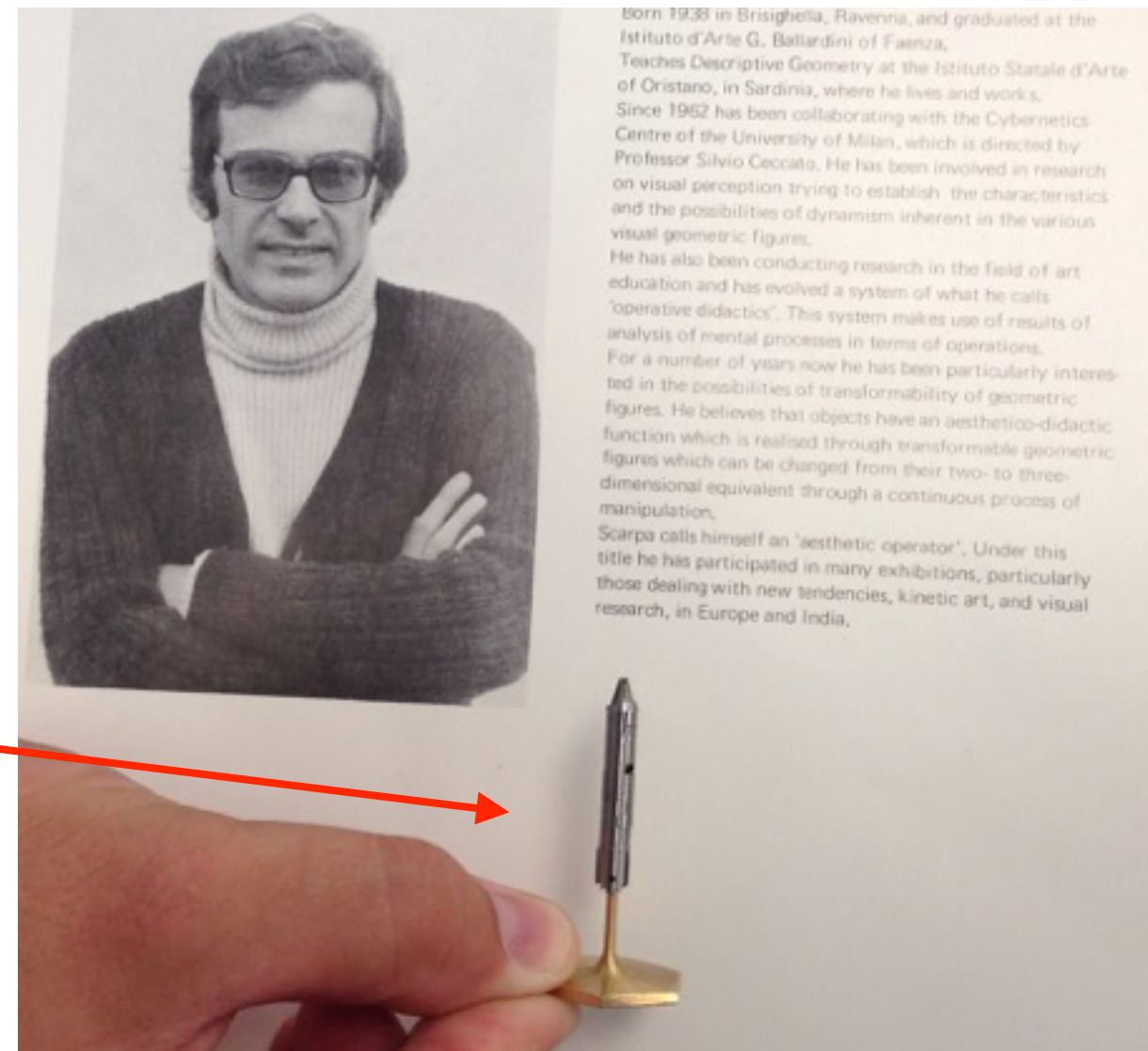
THE BIOPSY HARVESTER OF JELÍNEK ET AL.

(Jelínek, Smit, Breedveld, TU Delft; ACMIT, Austria, 2014)

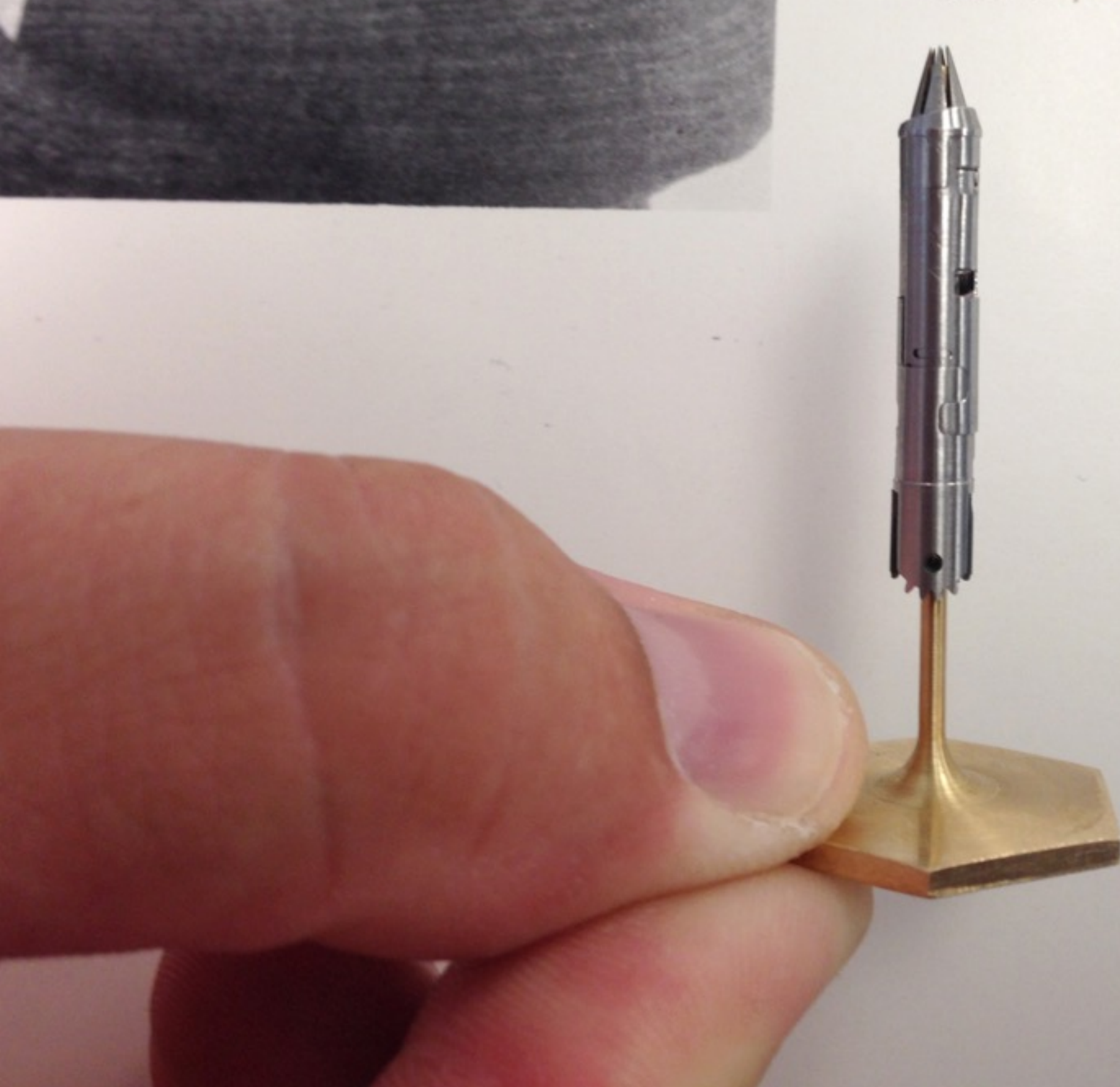
Filip Jelínek



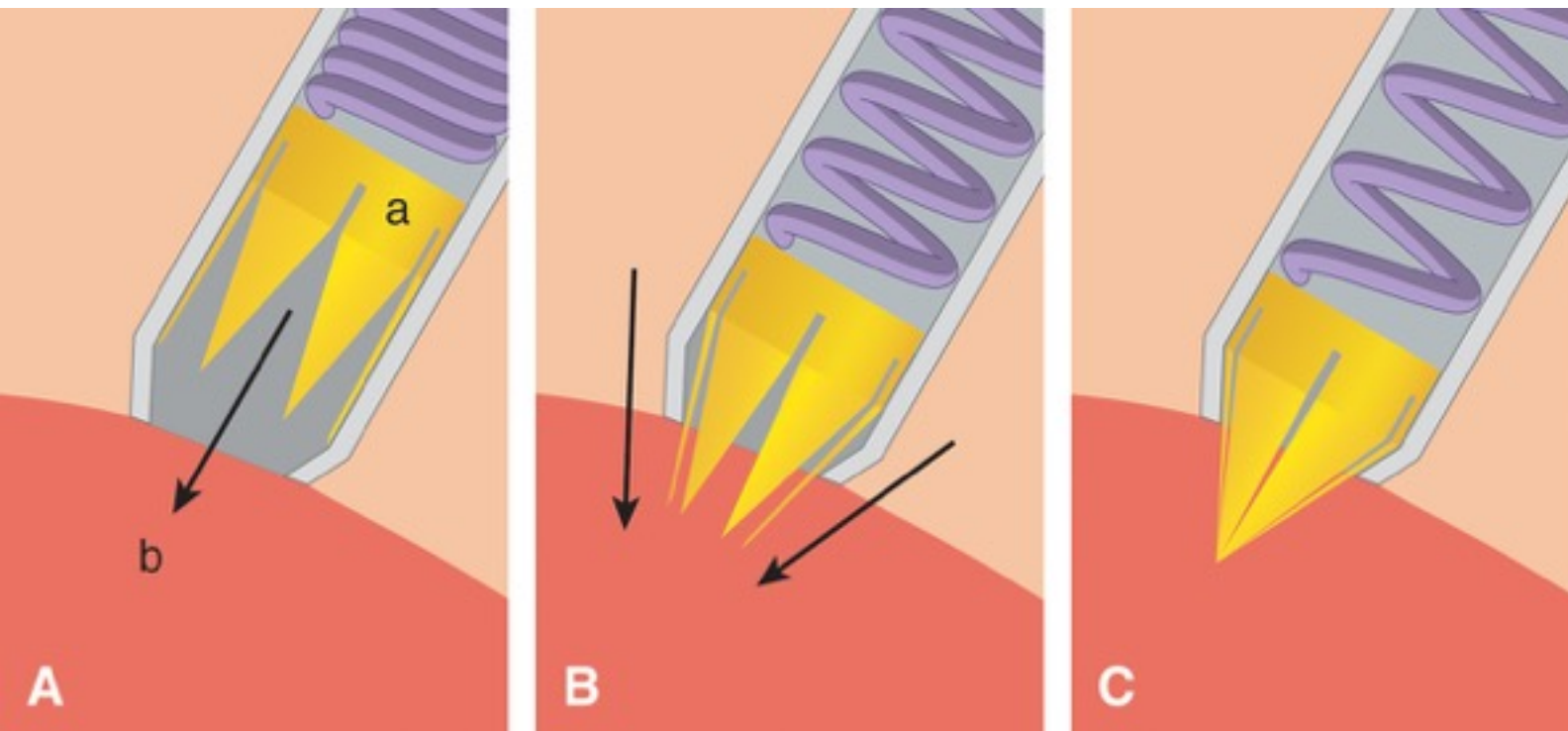
Giorgio Scarpa



(Jelínek, Smit, Breedveld, TU Delft; ACMIT, Austria, 2014)



(Jelínek, Smit, Breedveld, TU Delft;
ACMIT, Austria, 2014)



(Jelínek, Smit, Breedveld, TU Delft;
ACMIT, Austria, 2014)



(Jelínek, Smit, Breedveld, TU Delft; ACMIT, Austria, 2014)

Figure 9.4 *Final manufactured steerable opto-mechanical biopsy harvester prototype.*

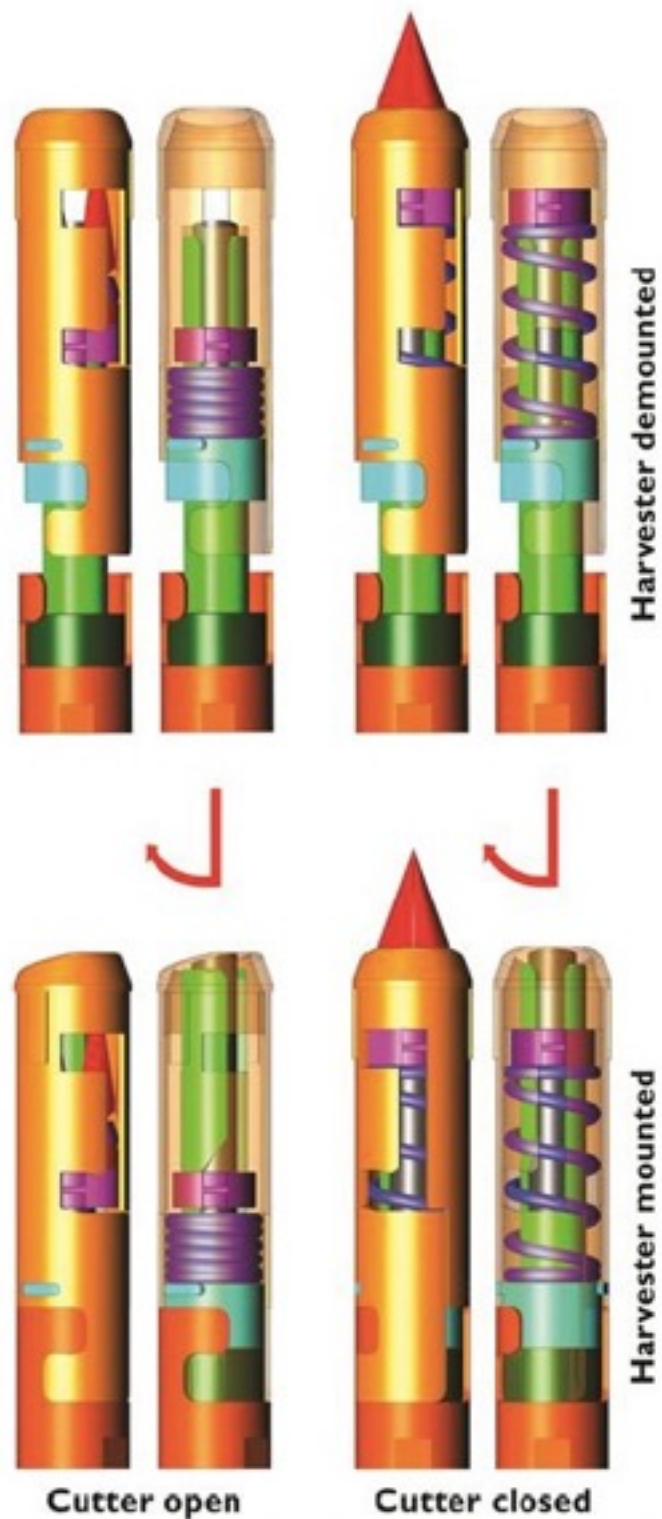


Figure 9.2 Method of mounting the disposable part of the biopsy harvester to the permanent part by means of a bayonet connector (transparency and hidden features for the clarity of component alignment).

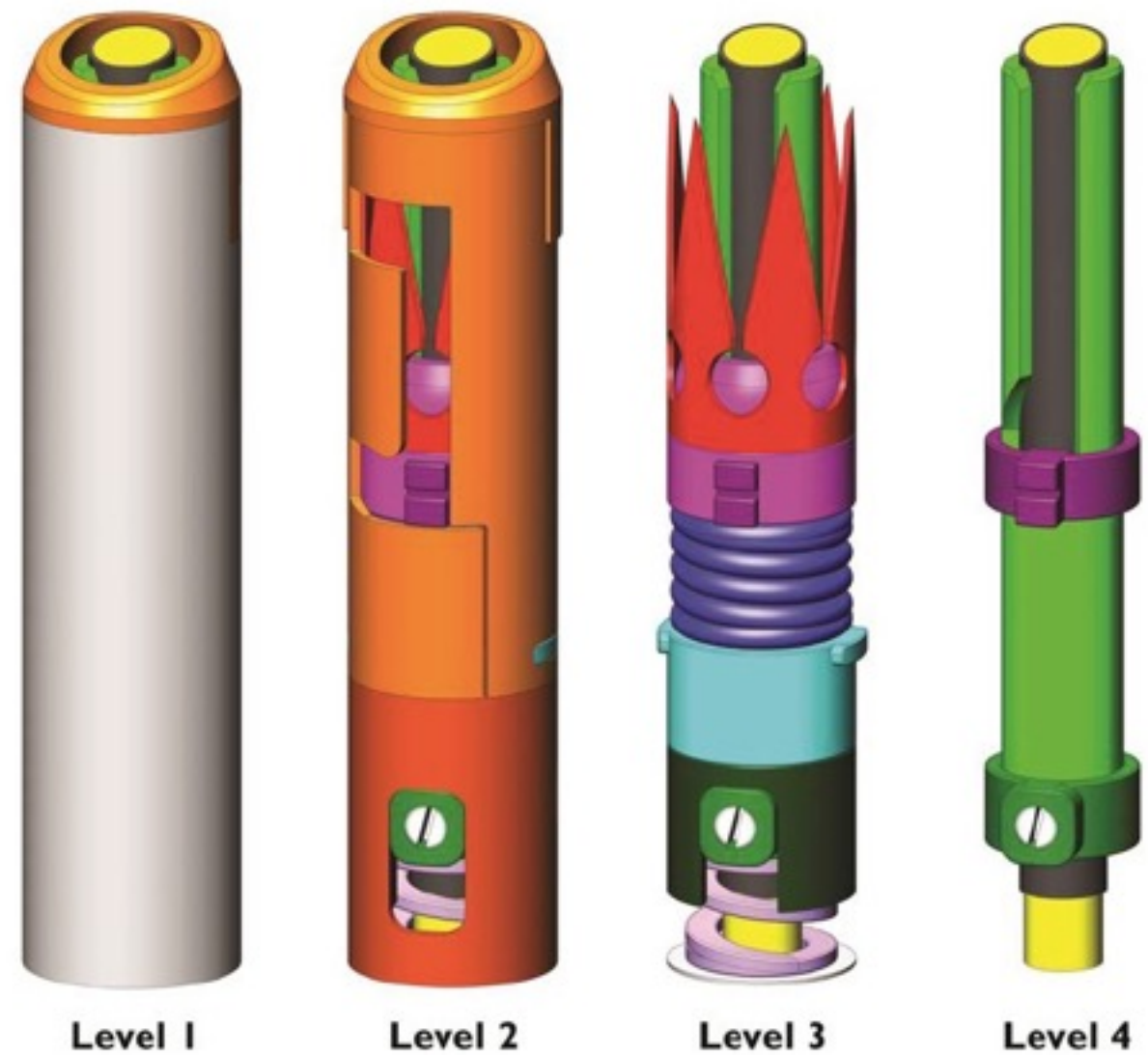


Figure 9.1 Decomposition of the final envisioned biopsy harvester design in four levels.

(Jelínek, Smit, Breedveld, TU Delft; ACMIT, Austria, 2014)

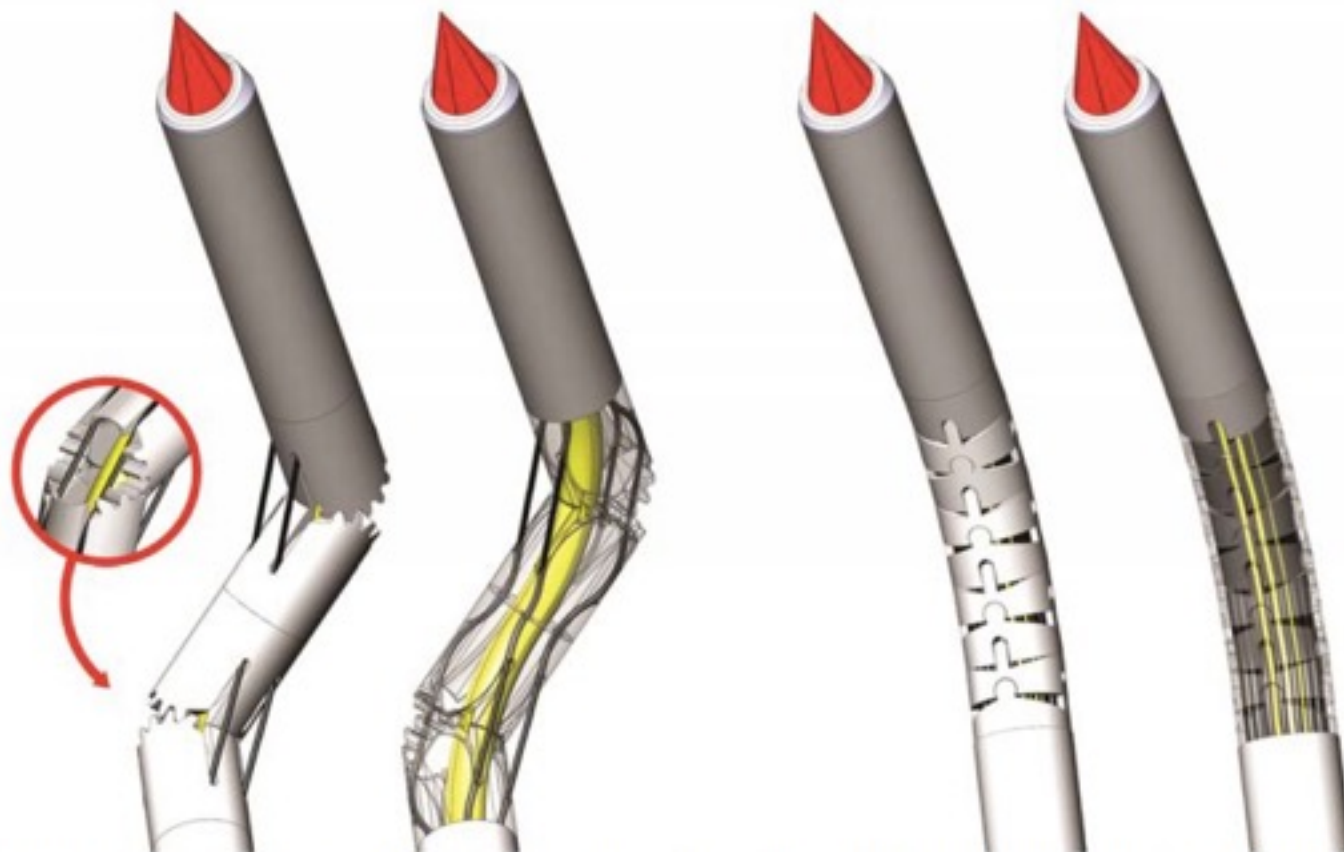
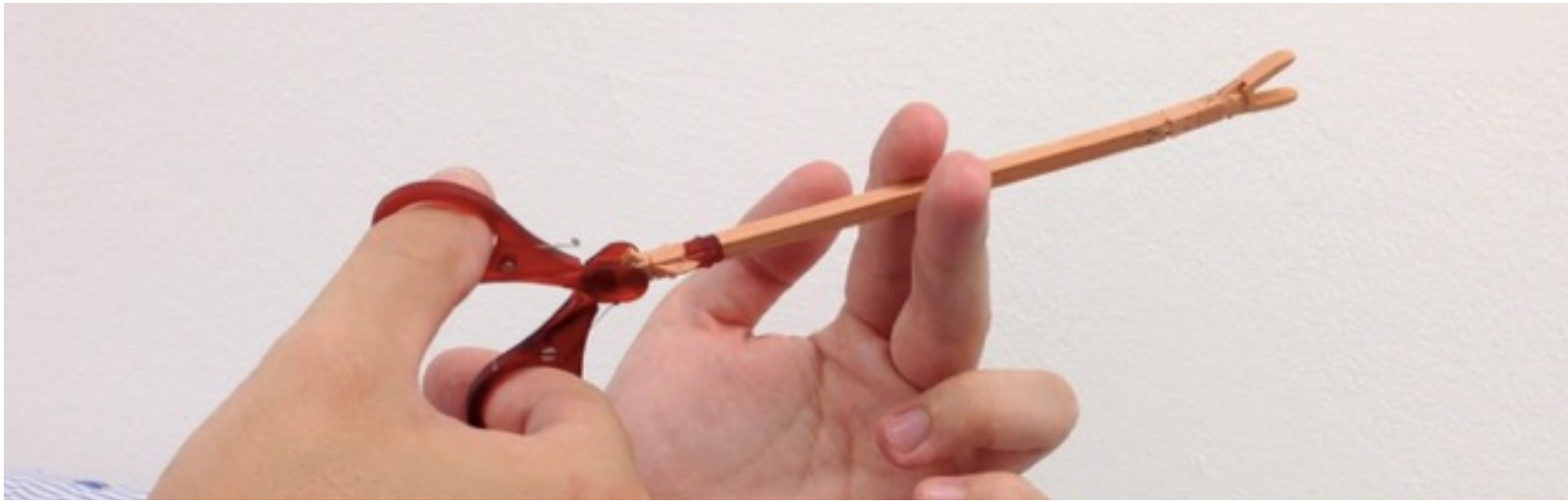


Figure 9.3 Feasible steerable joint constructions: the additive manufactured rolling joint construction and the laser cut joint construction. Joints are actuated by steering cables (black).

Jelínek, Filip, Steering and Harvesting Technology for Minimally Invasive Biopsy

PhD dissertation

doi:10.4233/uuid:18bc7cc6-153b-4ffe-8da1-474f08a212fc

Delft University of Technology, 2015

[Jelínek, Filip, Steering and Harvesting Technology for Minimally Invasive Biopsy](#)

BIONICS: EXPLORATION BETWEEN PLAY AND RESEARCH

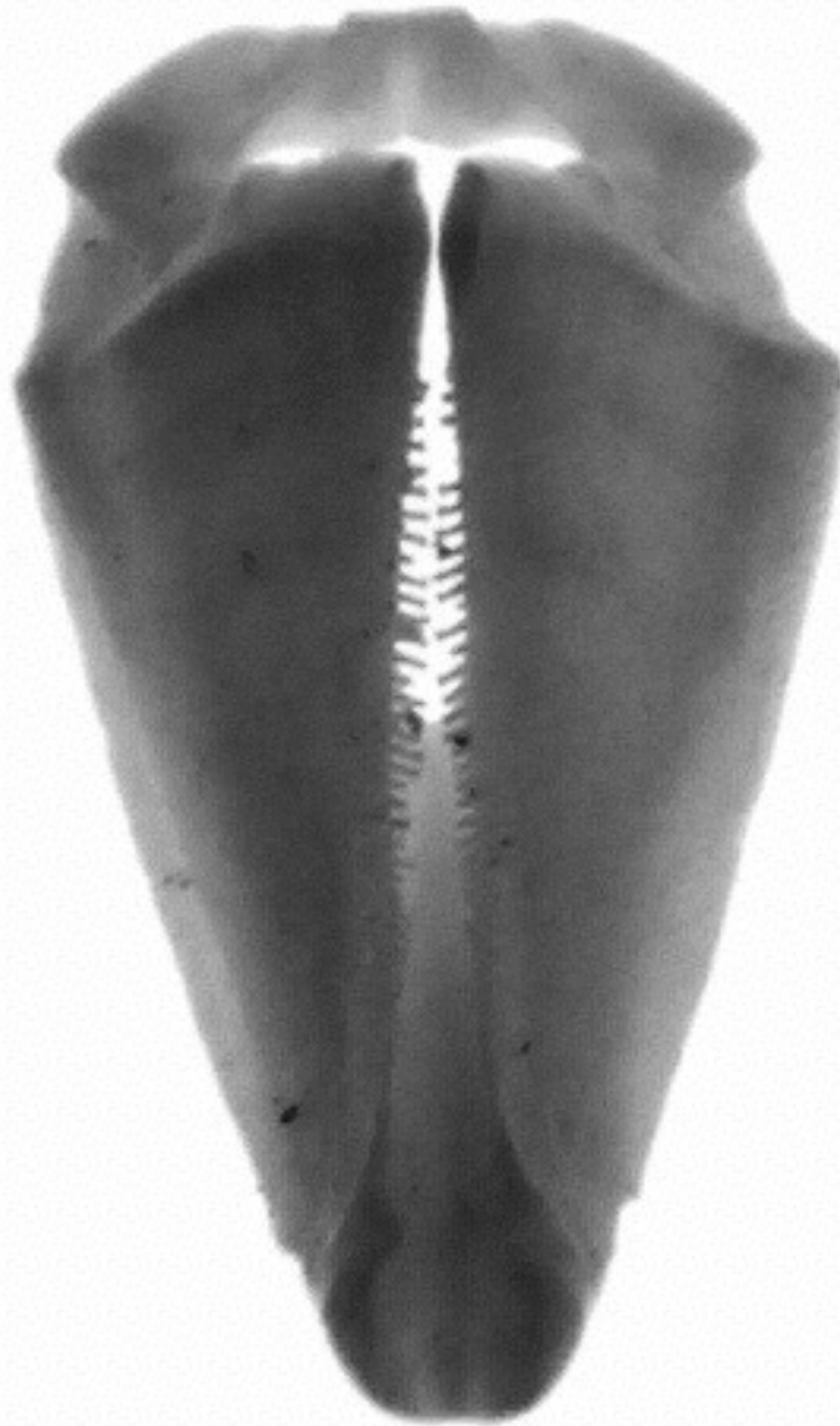
To play (to explore) is something that costs nothing and brings the mind closer to its desires by asking about the goals and function of every choice, so that every project, before it even becomes an application in its diversified specificity, every project should mean freedom and spontaneity in making, a non-paralyzing immersion, a contrast to what surrounds us, in a seamless process. [...]

The image of destroyed sea urchins, their scattered fragments in the sand, and of the live sea urchins observed in their marine habitat, are the source of this study. [...]

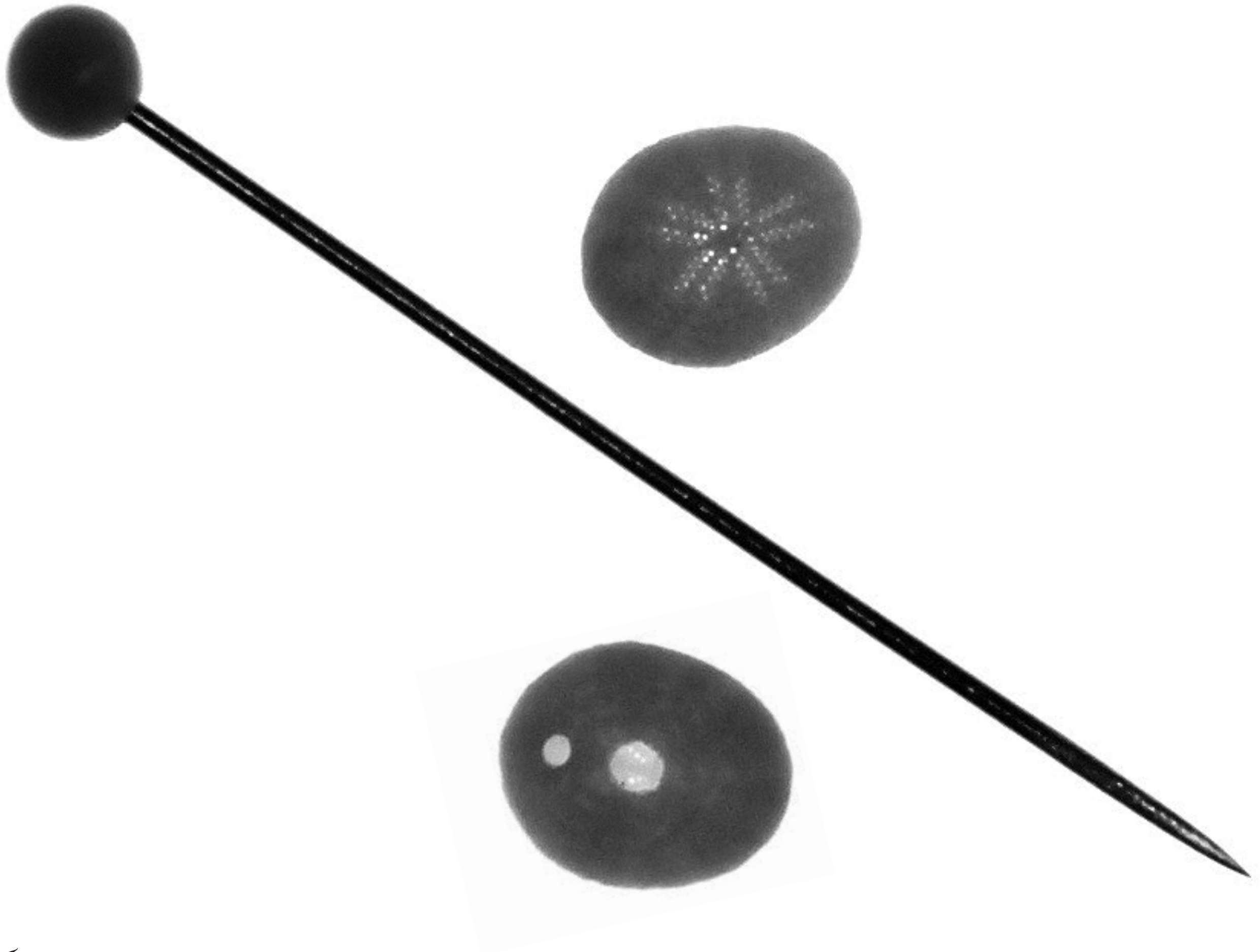
Not a single sea urchin was sacrificed in order to study it.

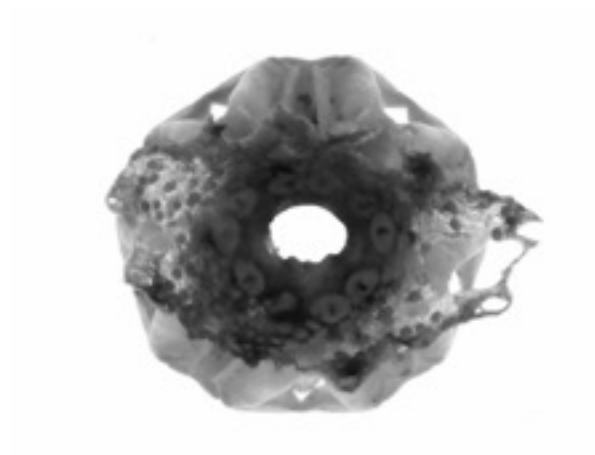
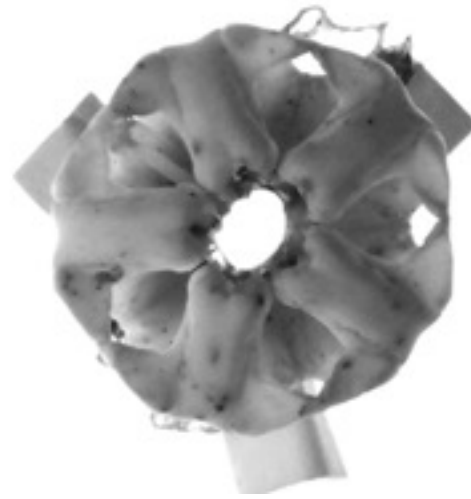
Giorgio Scarpa, c. 1970

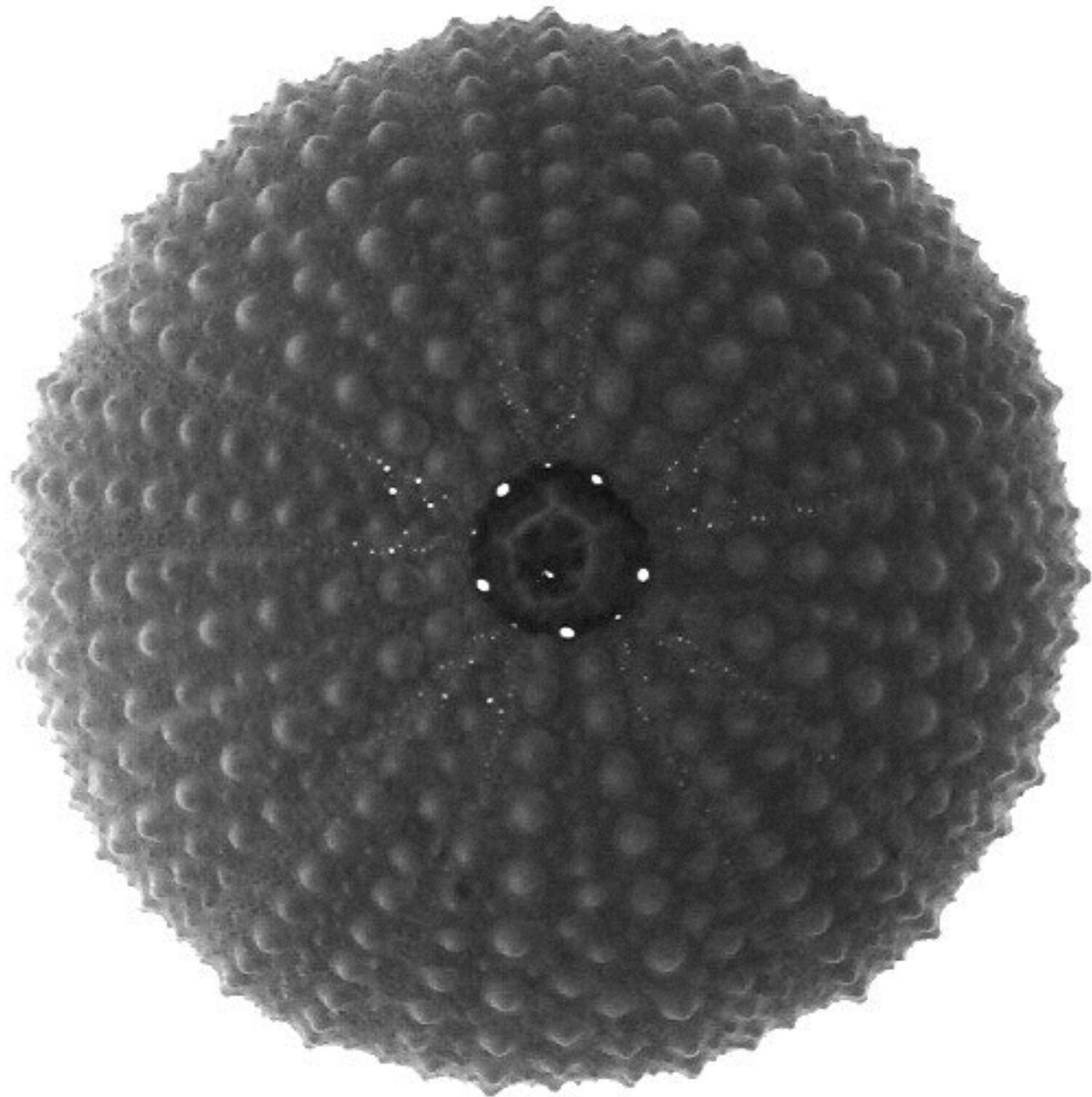


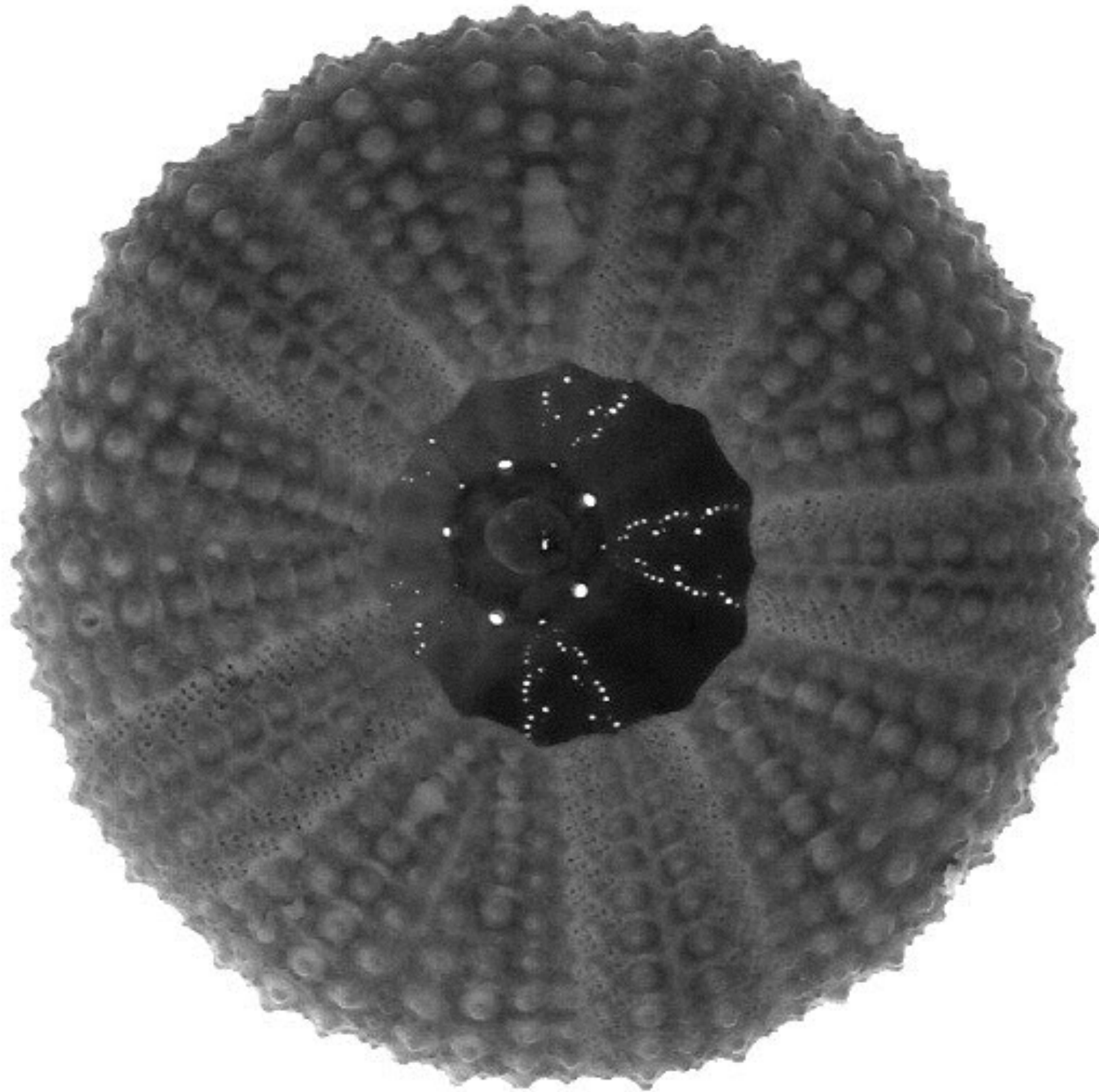












“If you are going to do research in bionics, don’t forget to study seeds, for the knowledge that nature displays in their creation, and for the originality and unpredictability of some of their self-dispersal mechanisms.”

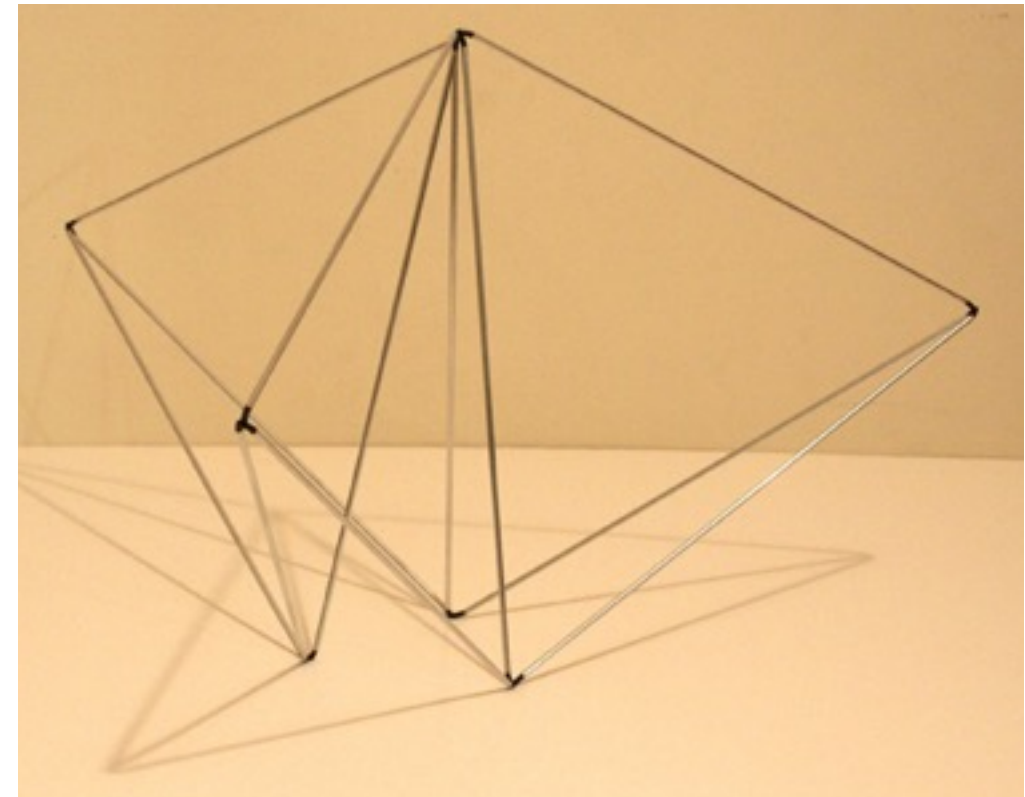
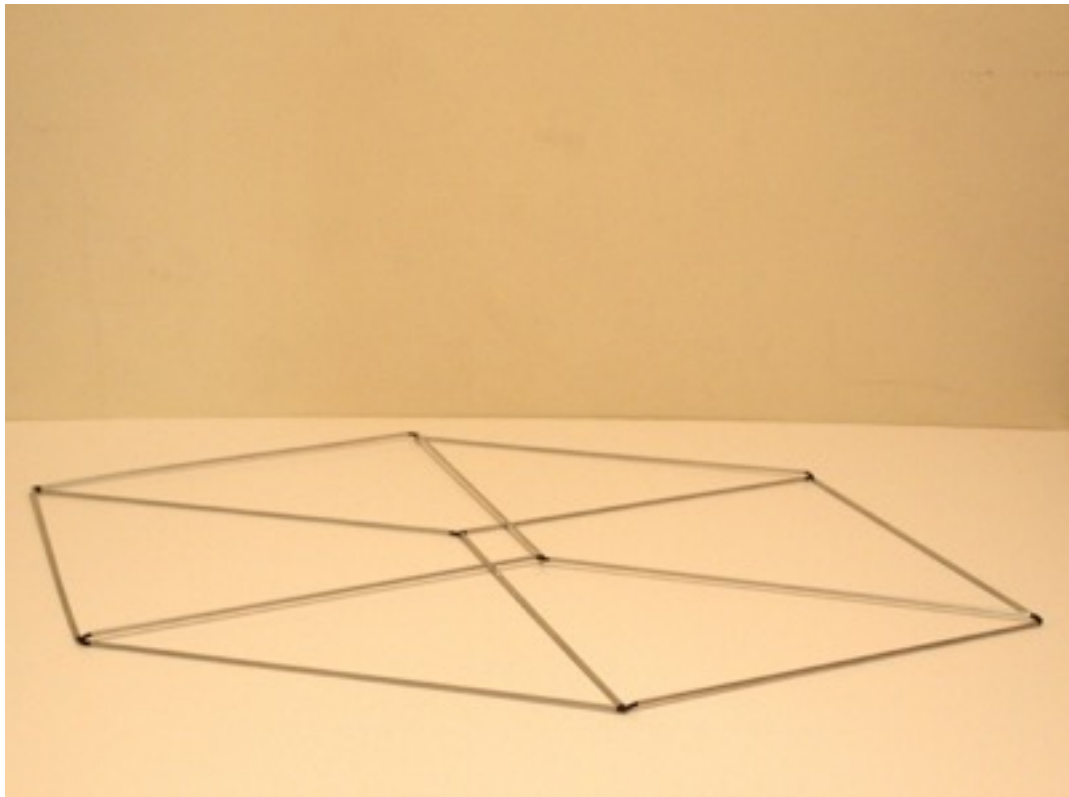
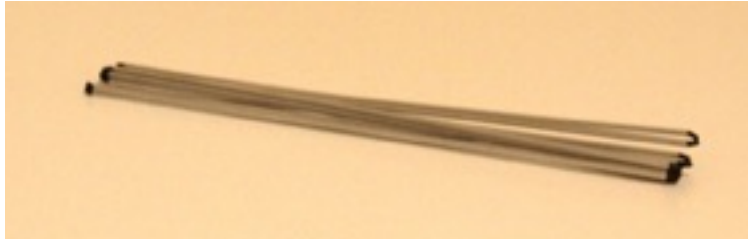
Giorgio Scarpa, 1988



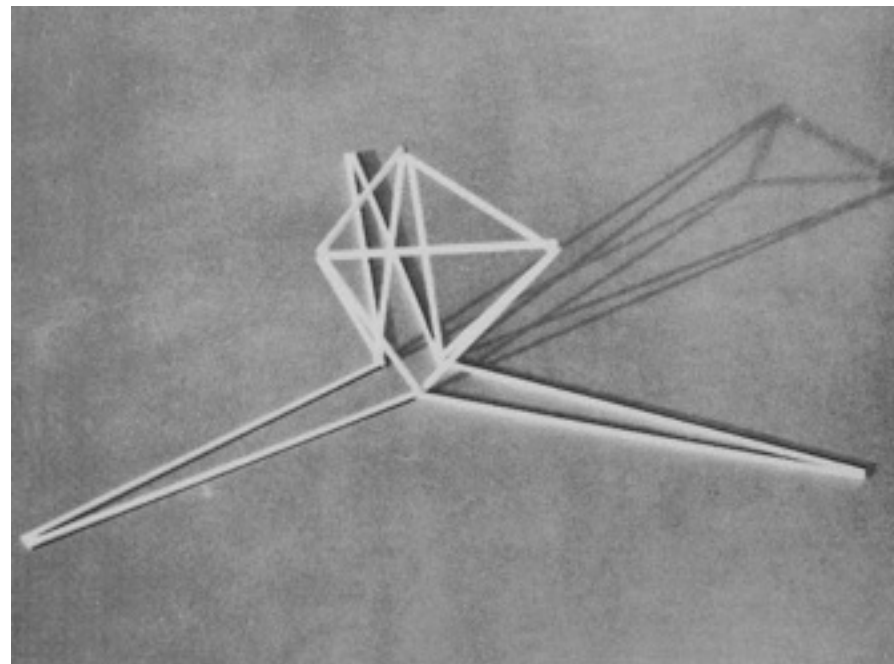
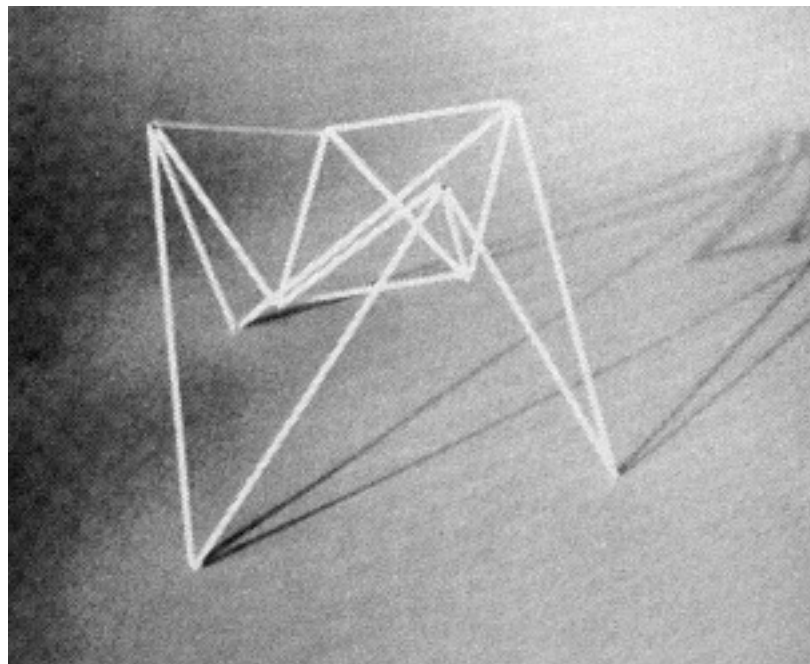
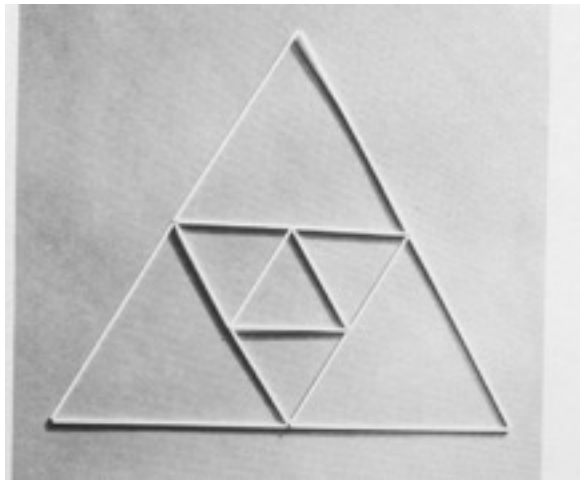
Giorgio Scarpa's collection of seeds on his workshop's desk in Castel Bolognese, Italy, 2002. (© Pino Trogu)

...AND MORE???

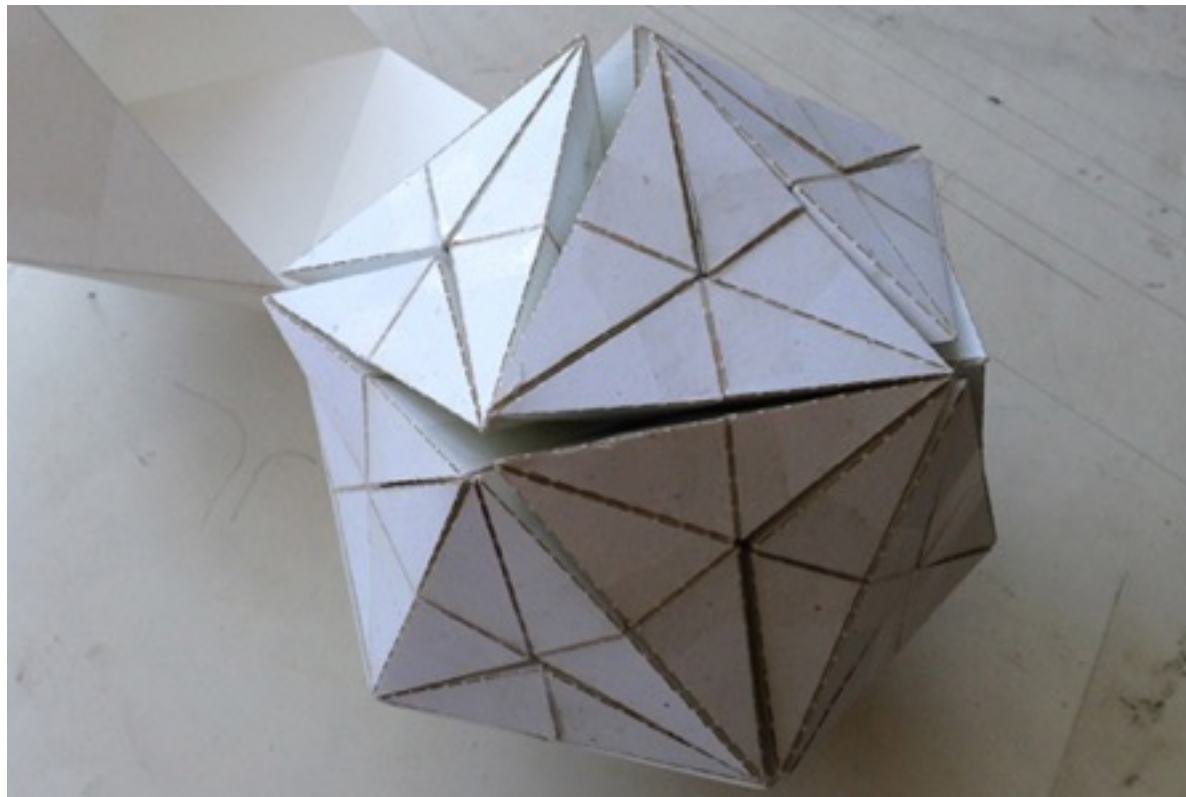
BIOINSPIRED
GEOMETRIC FOLDING MODELS
(ORIGAMI)



Scarpa, *Transformable cube*, 1965.

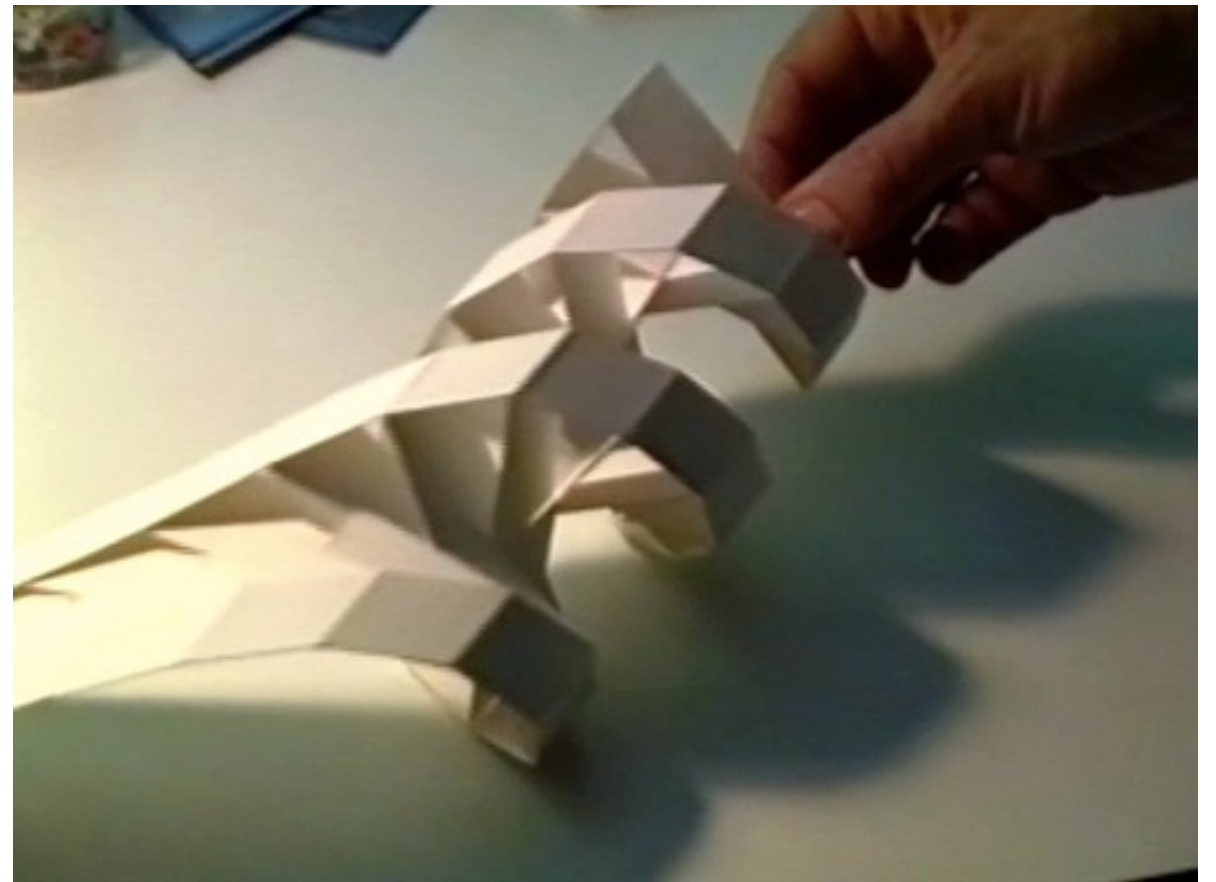
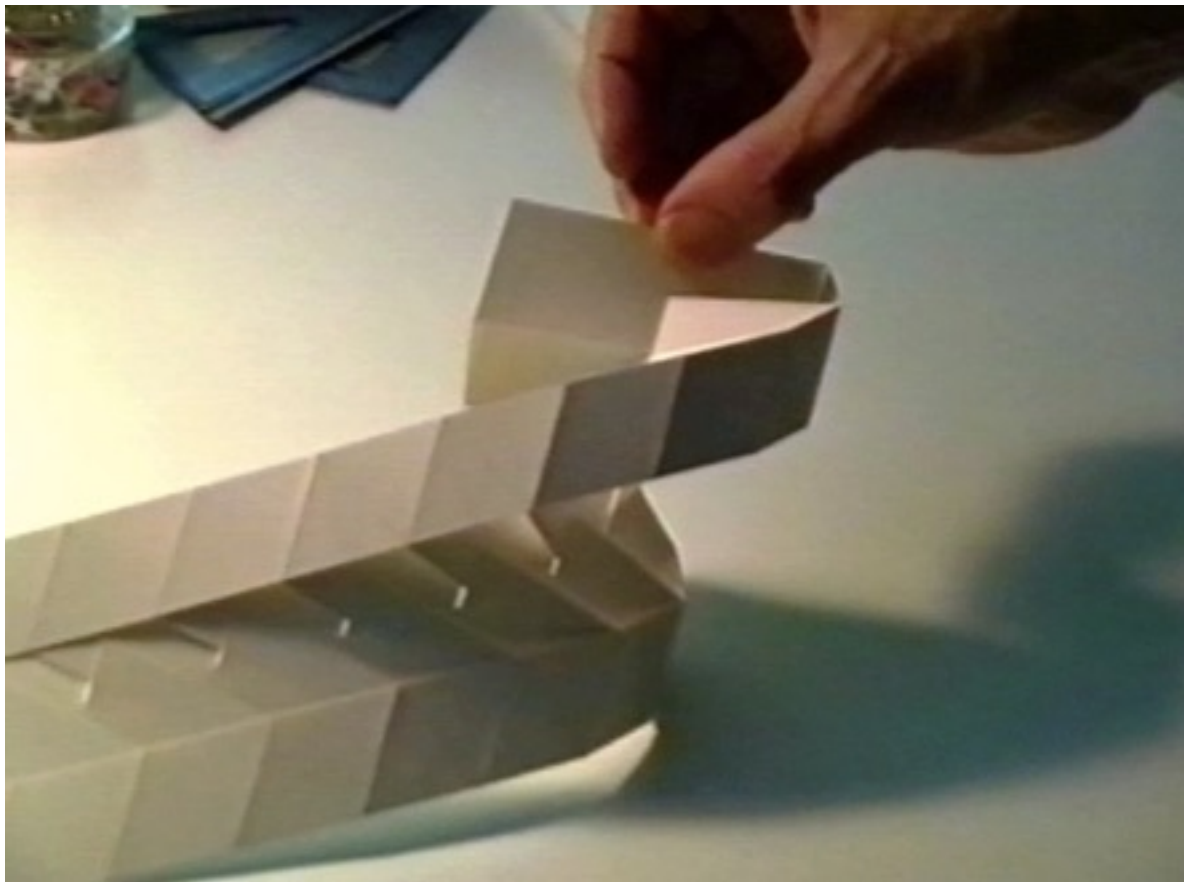


Scarpa, *Transformable triangle*, 1965.

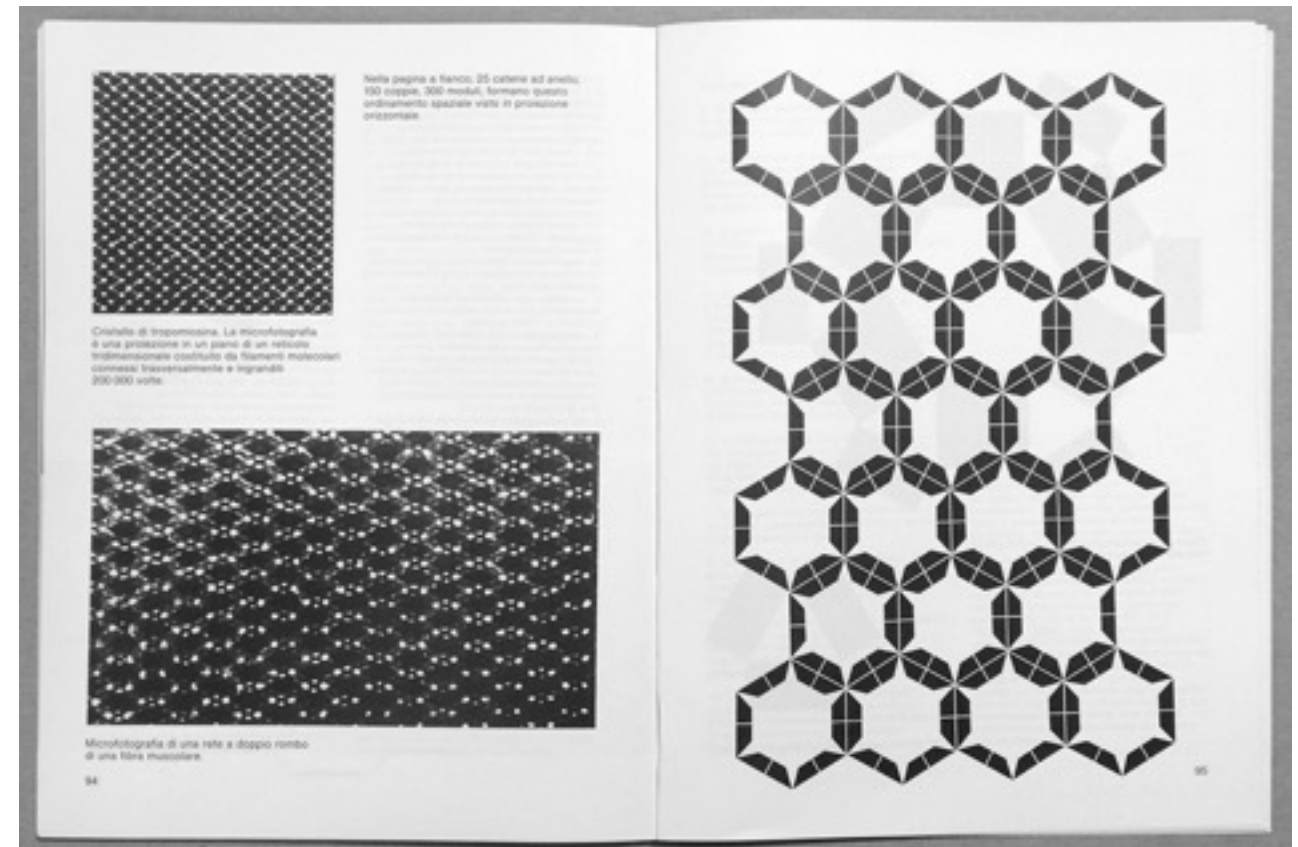
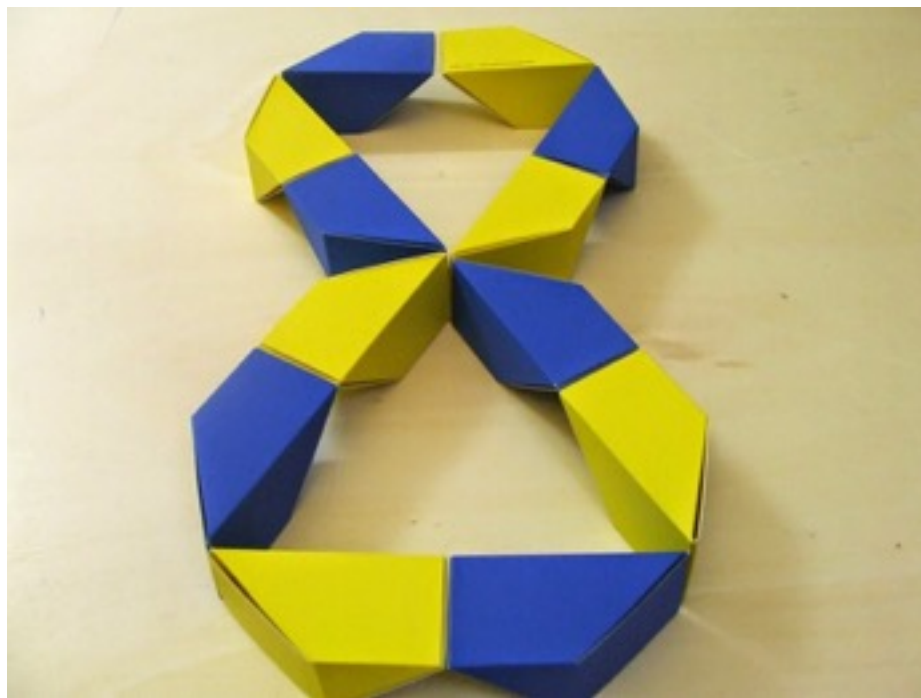
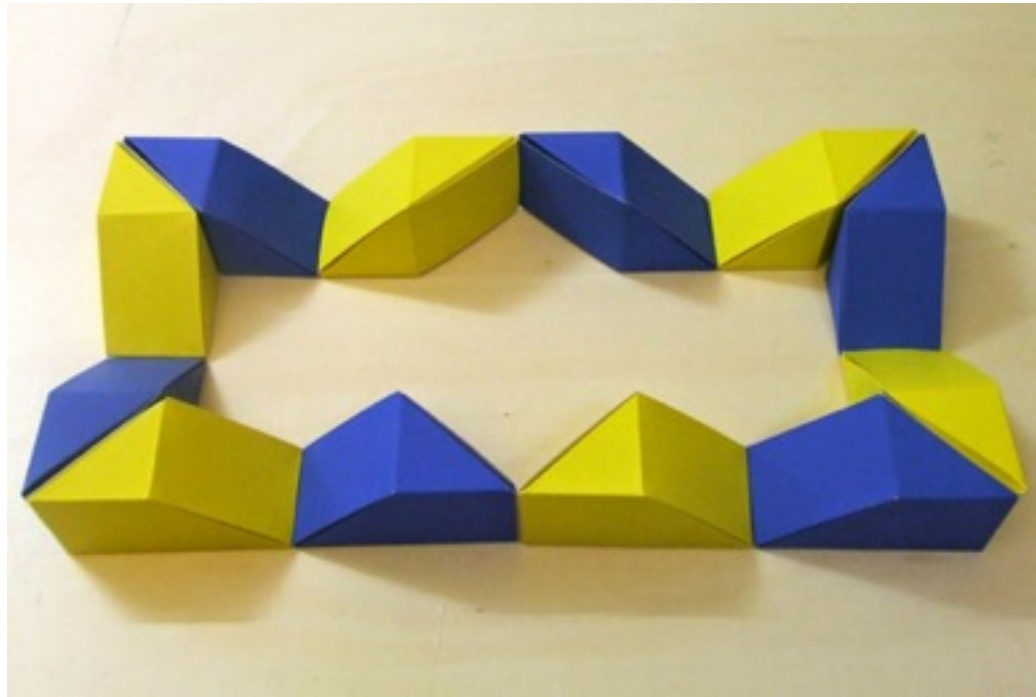


(Trogu & Nies, model based on Scarpa, 2015)

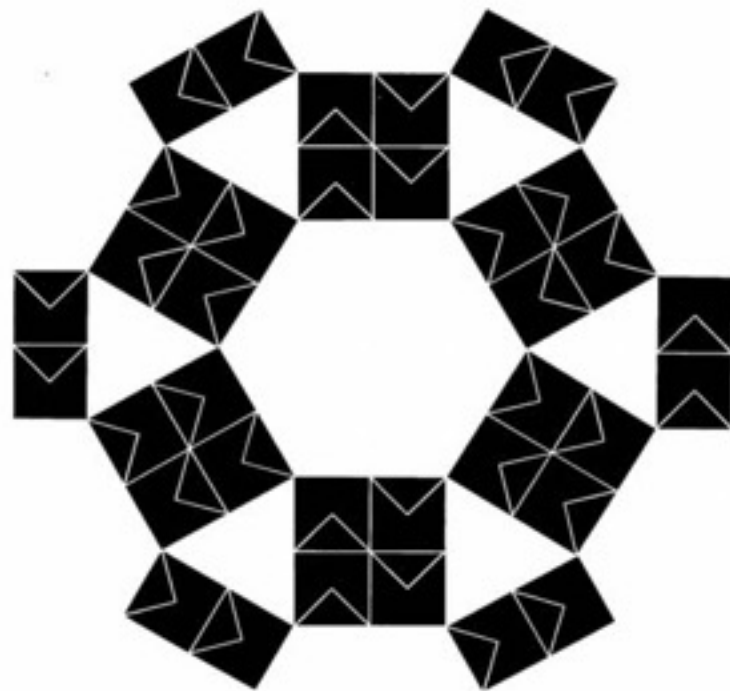
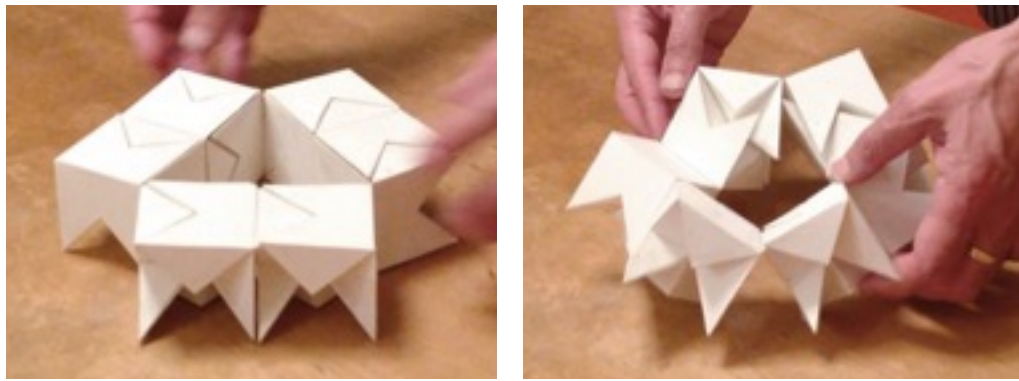
Scarpa, *Models of Rotational Geometry*, p. 112, & cover.



Scarpa, *DNA model*, circa 1980.

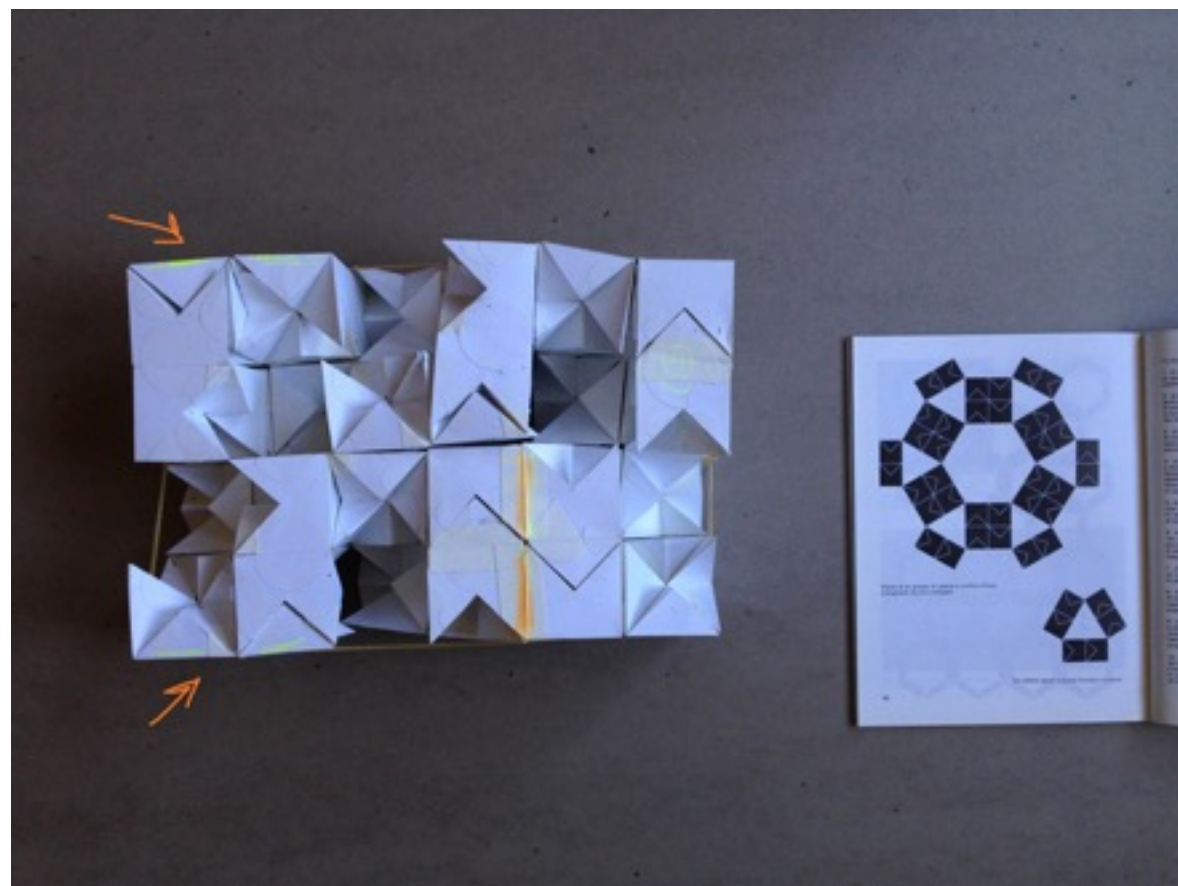
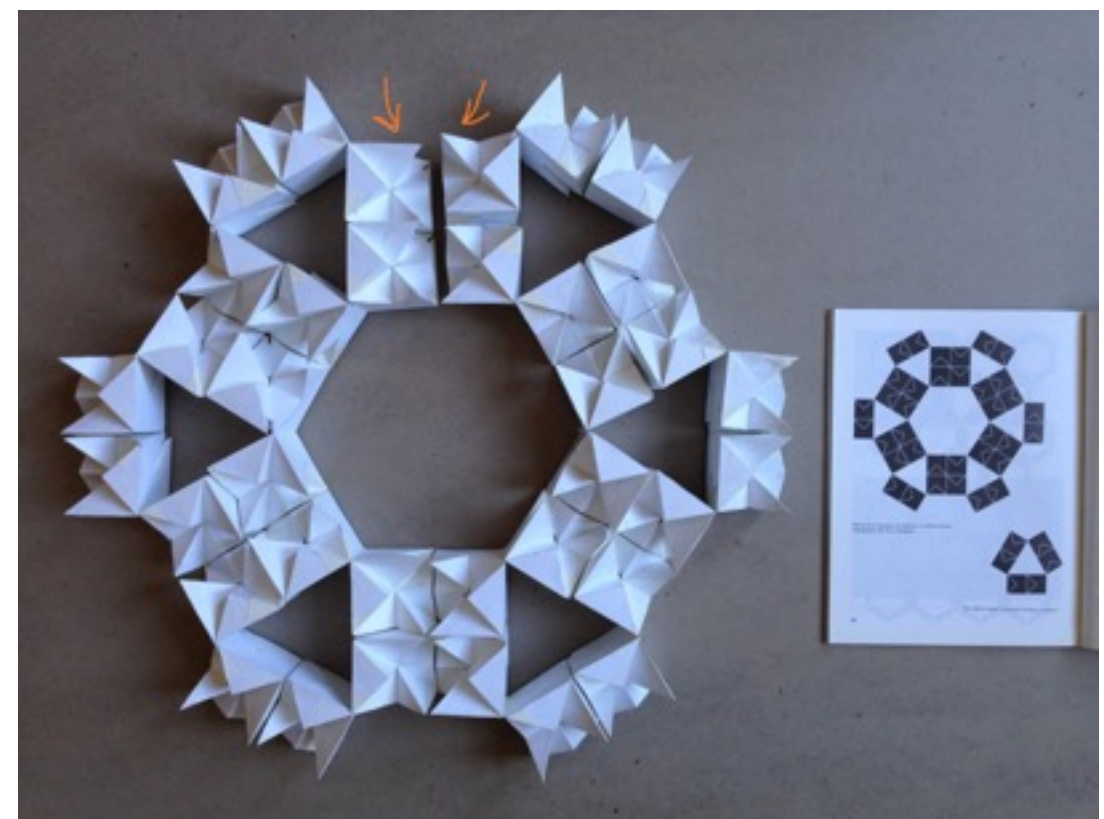
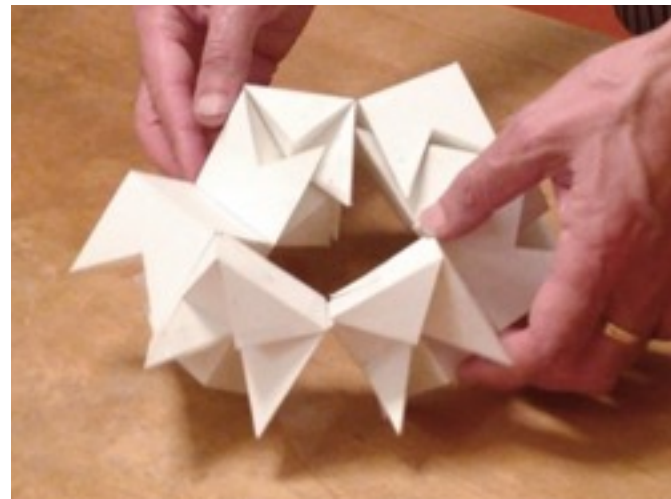
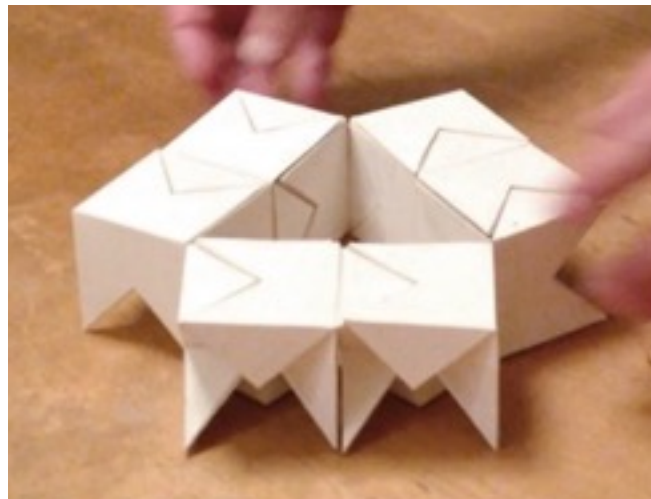


Scarpa, *Models of Rotational Geometry*, pp. 73, 95, & cover.



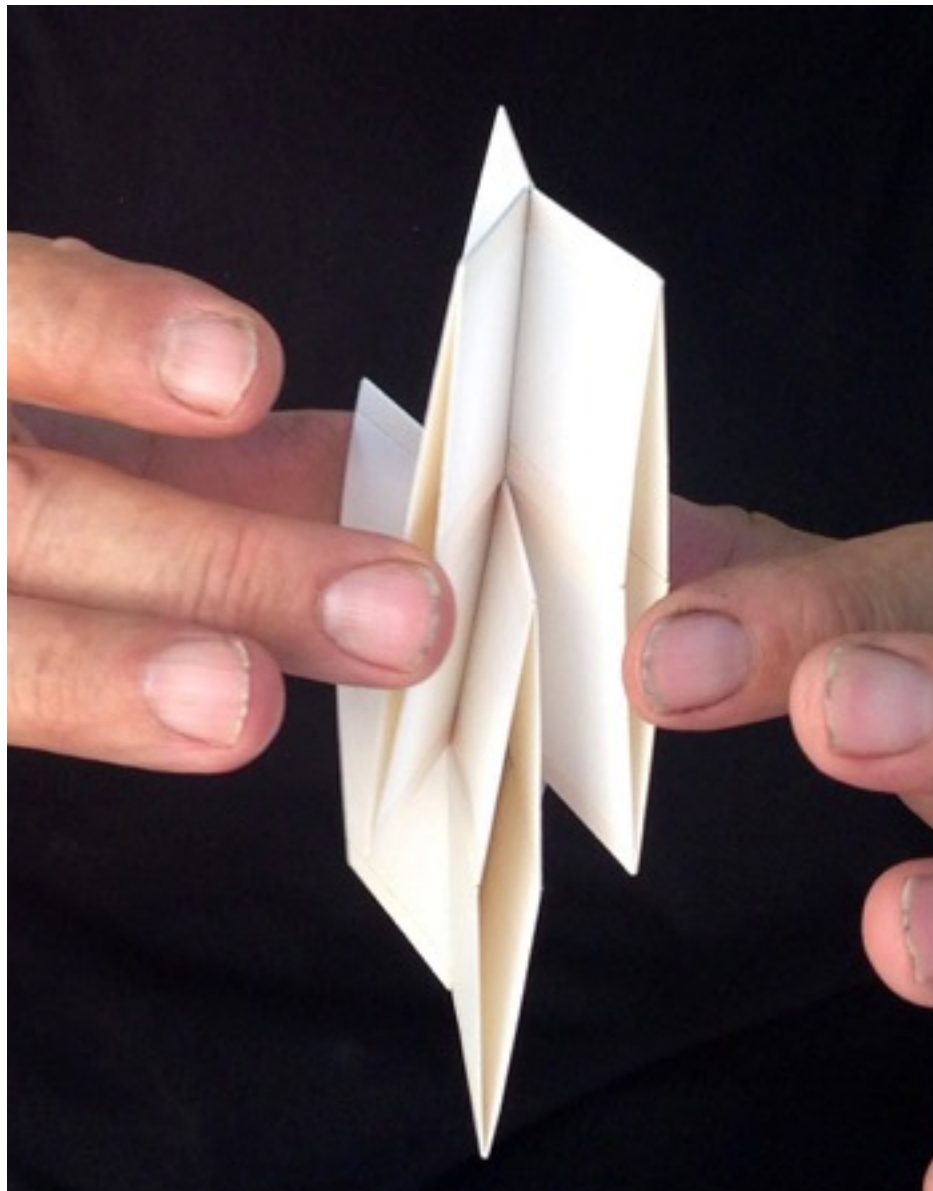
Scarpa, *Models of Rotational Geometry*, pp. 66-68, 96

(Trogu & Nies, prototype, 2015)

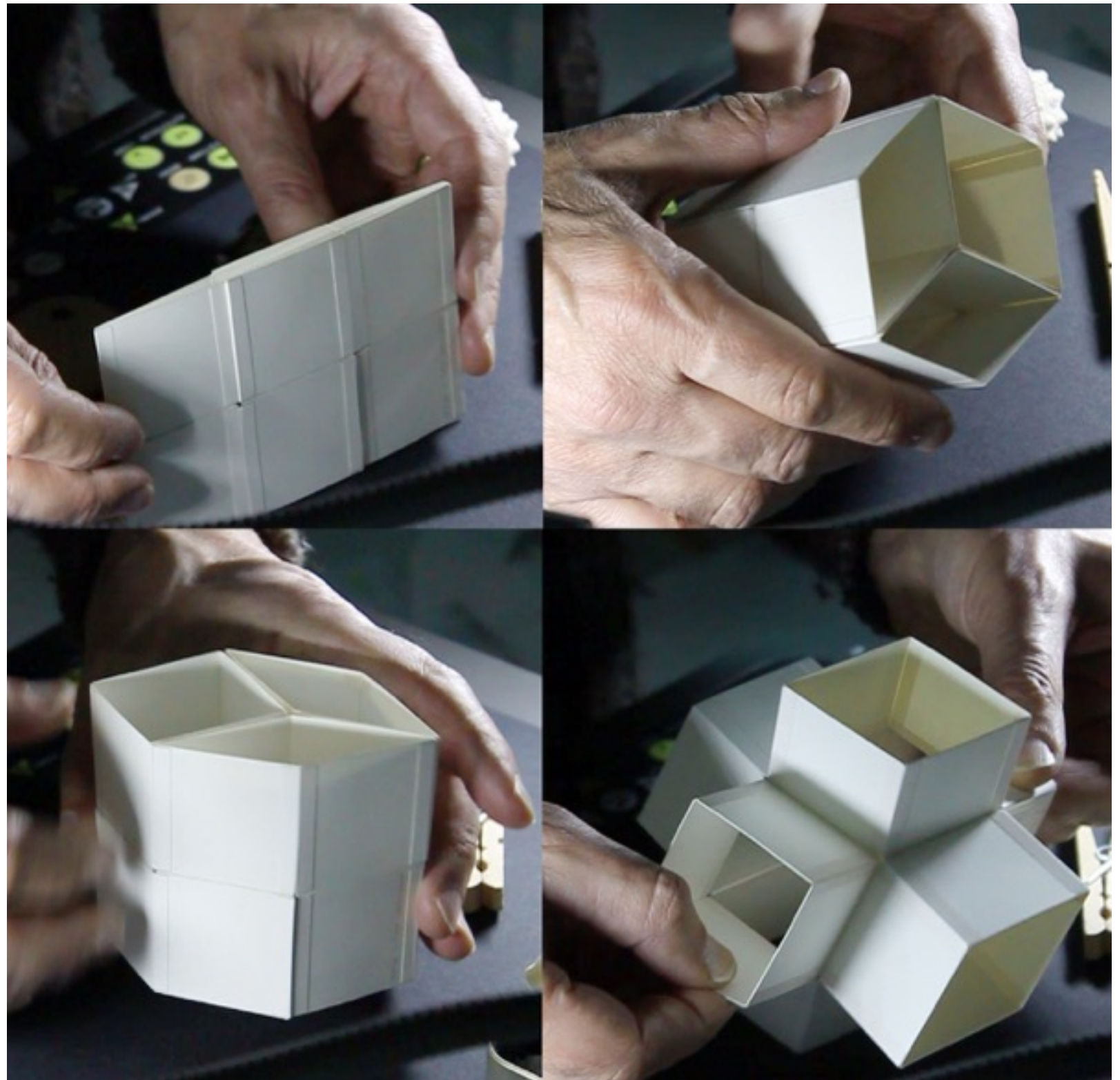


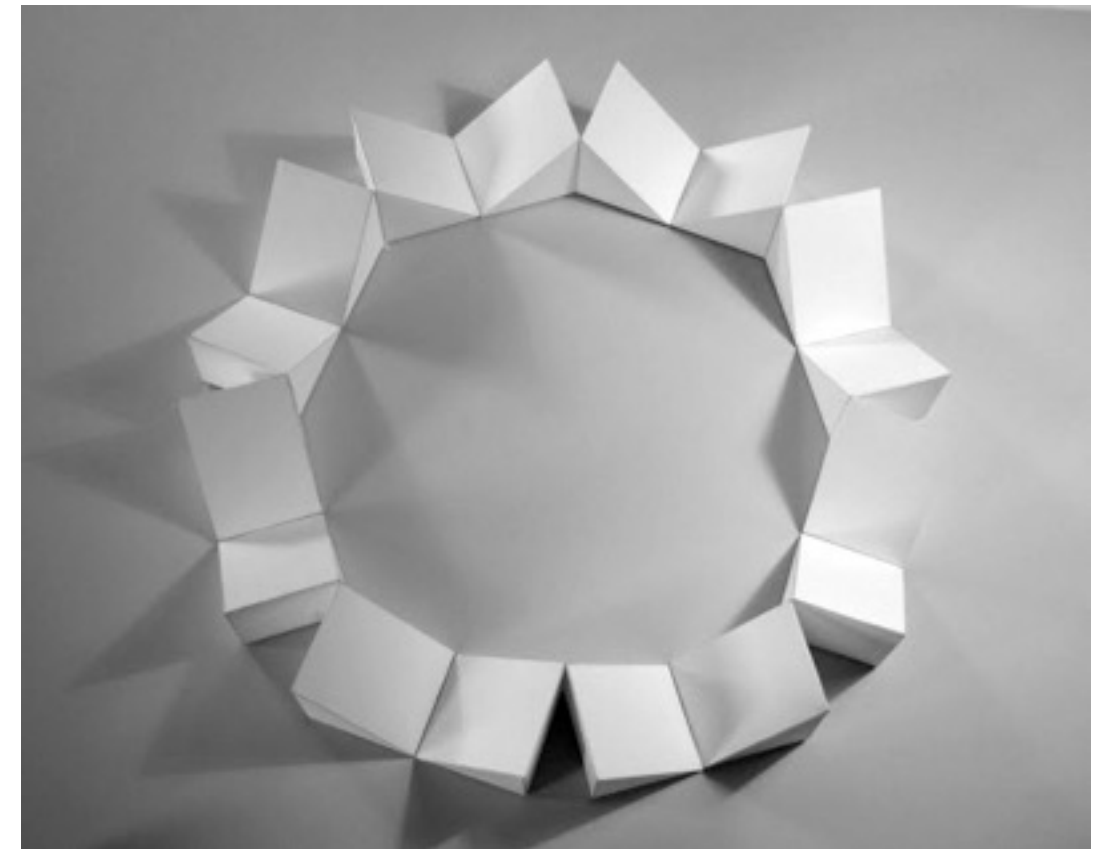
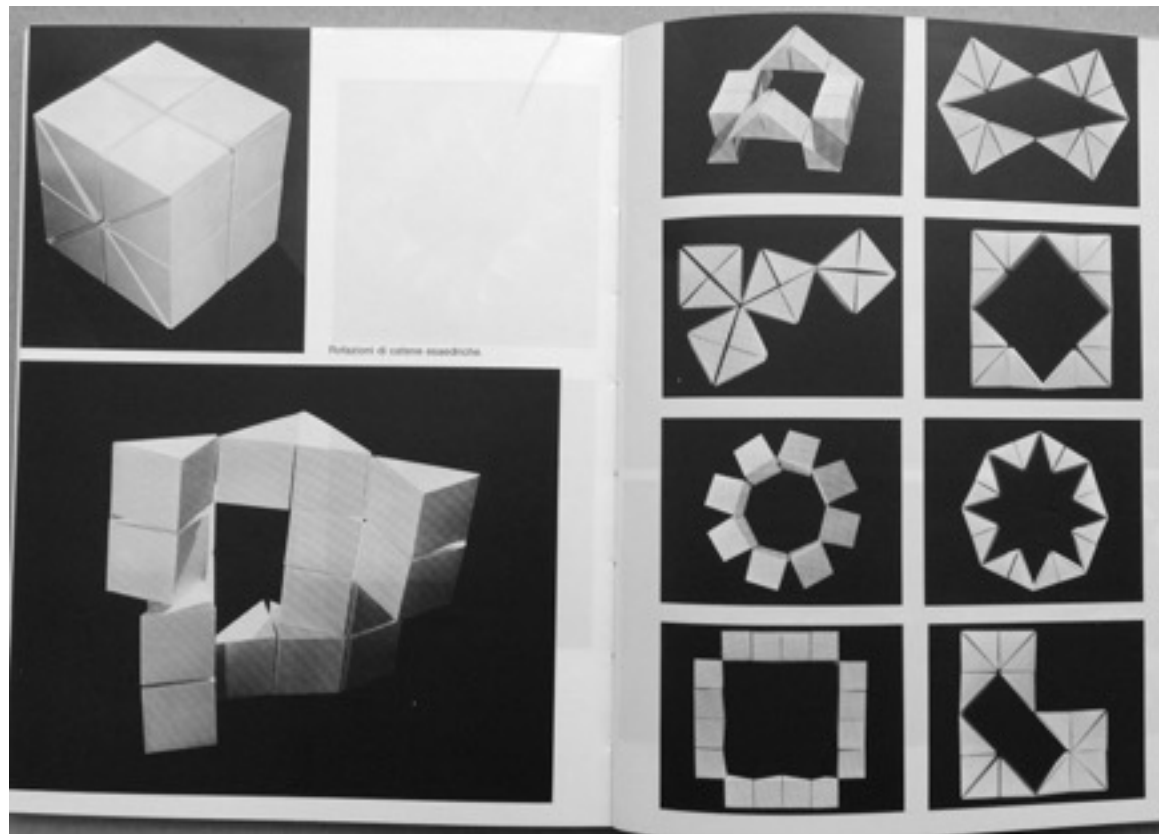
Scarpa, *Models of Rotational Geometry*, pp. 66-68, 96

(Trogu & Nies, prototype, 2015)



Scarpa, *Untitled*, 1996

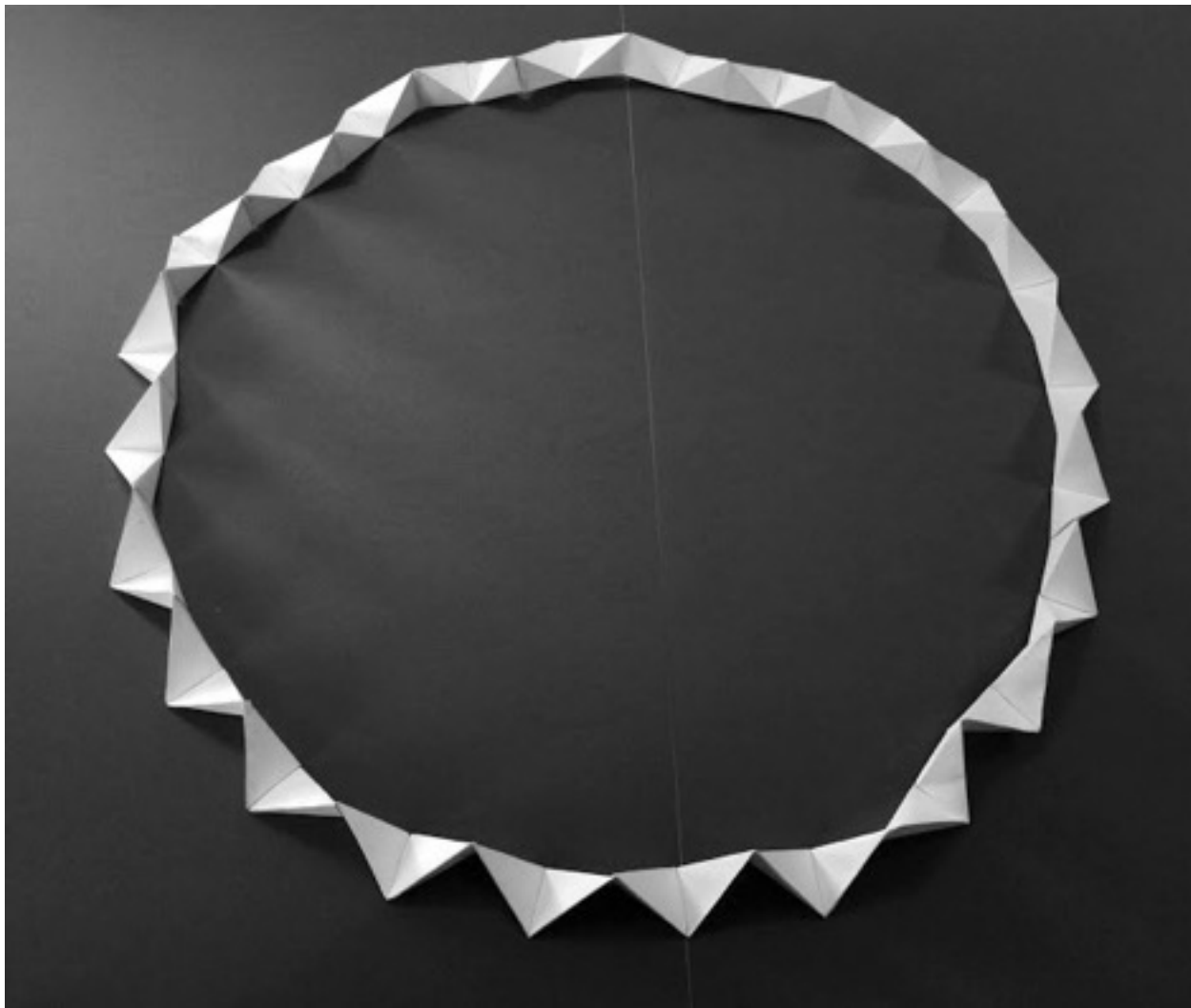
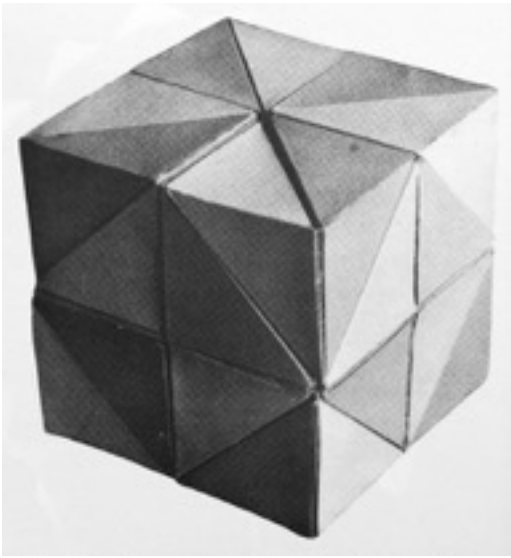




Scarpa, *Models of Rotational Geometry*
pp. 76–77

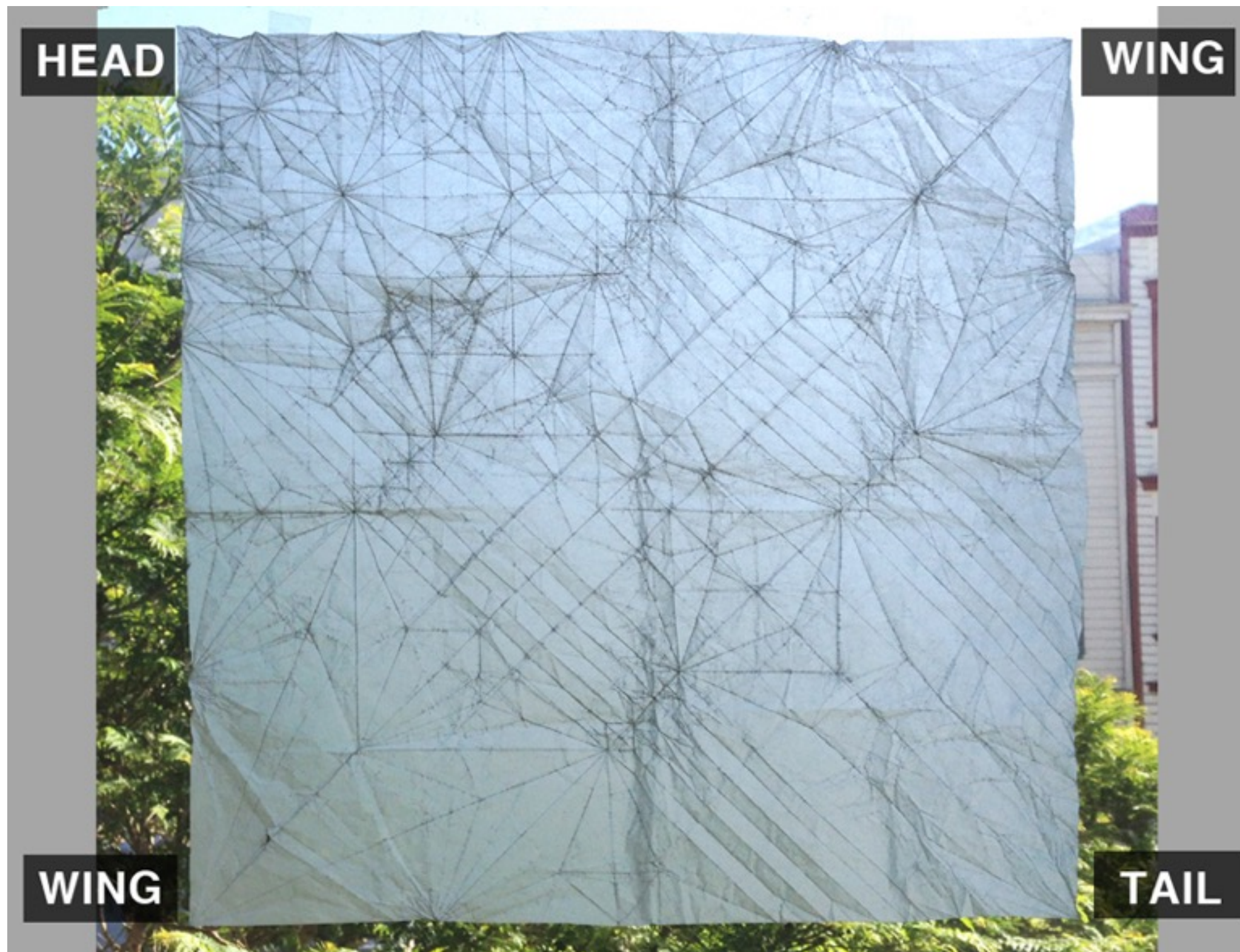


(L. Bocca, model replica, 2014)



Scarpa, *Models of Rotational Geometry*, pp. 87–92

(L. Bocca, model replica, 2014)



What animal does the origami crease pattern above yield?

It's one of the models found here:

[Francesco Trogu — Origami models: http://trogu.blogspot.nl/search/label/Origami%20Models](http://trogu.blogspot.nl/search/label/Origami%20Models)

THANK YOU!

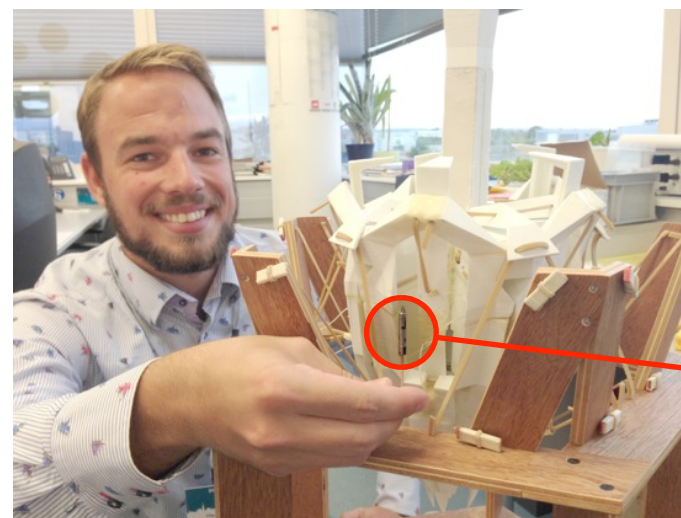
PINO TROGU

BIOCLAMPING: ARISTOTLE'S LANTERN

GIORGIO SCARPA'S MODEL OF THE MASTICATORY APPARATUS
OF THE SEA URCHIN... AND MORE.



Giorgio Scarpa, Pino Trogu, 1988



Filip Jelínek, 2015



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