

# the first breath

## *relative control in soft robotics*

Jonathan Pêpe, Christian Duriez & Jean-Jacques Gay – November 9, 2023

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• *soft robotics* • *prosthetics* • *simulacra* • *sculpture* • *animated sculpture* • *bio-inspiration* • *organic* • *science fiction* • *animatronics* • *silicon*  
• *translucence* • *anticipation* • *pneumatic* • *anima* • *pneuma*

*Exo-biote* is a work by artist Jonathan Pêpe, first created in 2014 at Le Fresnoy, Studio National des Arts Contemporains, in collaboration with the DEFROST (DEFormable RObotic SofTware) team at INRIA (Institut National de Recherche en Sciences et Technologies du Numérique) and Cristal (Centre de Recherche en Informatique, Signal et Automatique de Lille), headed by Christian Duriez. The result of the meeting between this artist and scientist, the work has enabled them to question their respective disciplines and helped them evolve their practices, and consequently contributed to the development of “Soft Robotics,” also known as “deformable” robotics. As the DEFROST team explored the field of medical assistance equipment, the artist began to imagine a futuristic prosthetic life for his work, a robot composed of flexible materials. To achieve this, casting practices, well known in art but less so in science, particularly in the field of digital technologies, were necessary. This project stimulated reflection by intersecting practices and perspectives, between the arts and sciences. Jean-Jacques Gay—curator and art critic with a long-standing commitment to multidisciplinary approaches—offered to chronicle this singular experience.

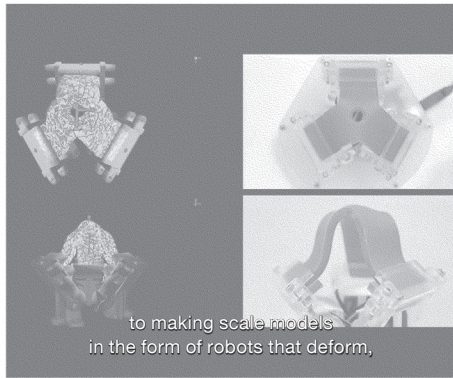
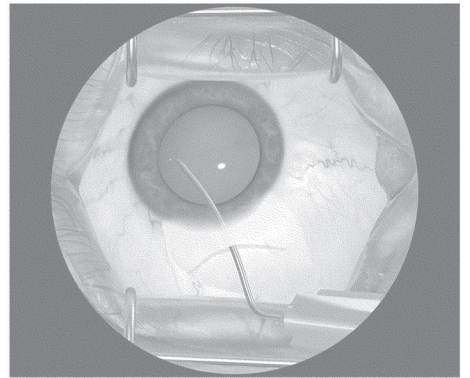
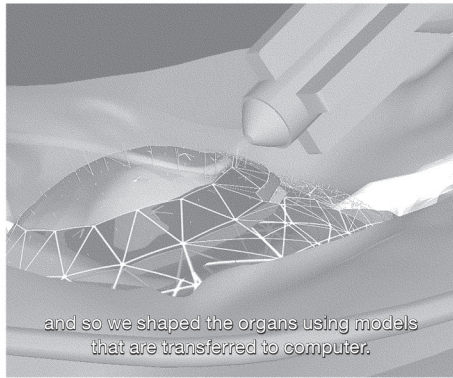
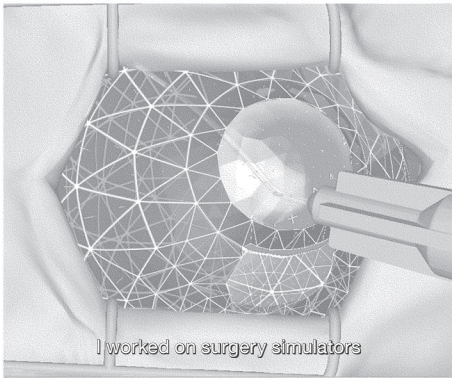
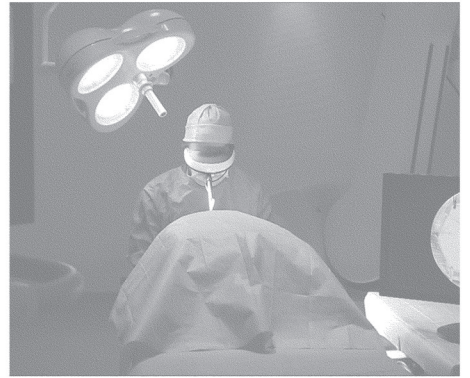
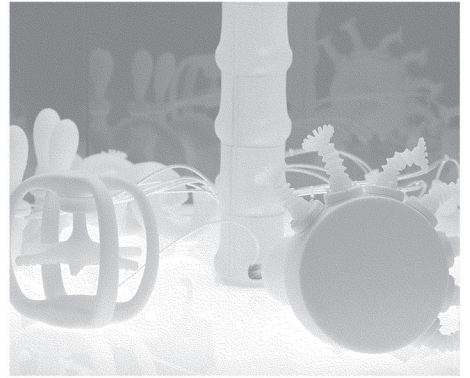
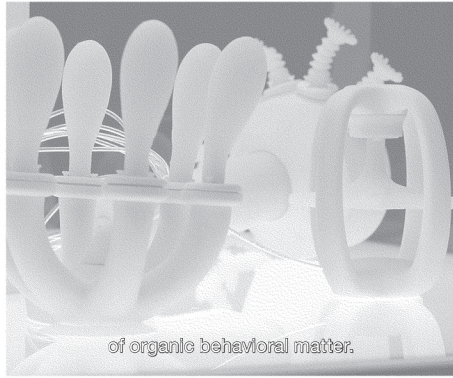
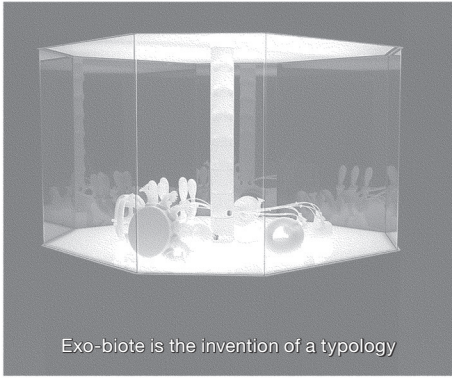
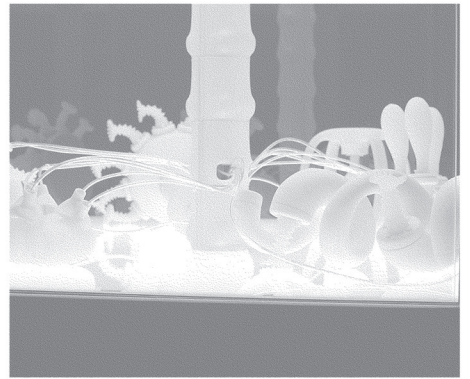
At the heart of this project, and of this kind of robotics are strategies for controlling these deformable objects. Traditional robots are mainly made of hard, articulated parts that allow them to be controlled according to a rigorous, precise, calculable, and predictable geometry. How can the mechanical life of these “soft” robots be reconceptualized to challenge the various paradigms of robotic control and make way for “relative control”? The prosthetic function envisaged by the artist stimulates this approach to thinking and doing, offering a field of experimentation as concrete as it is original. The sculptor and researcher are working together to design objects from the inside out, to achieve the

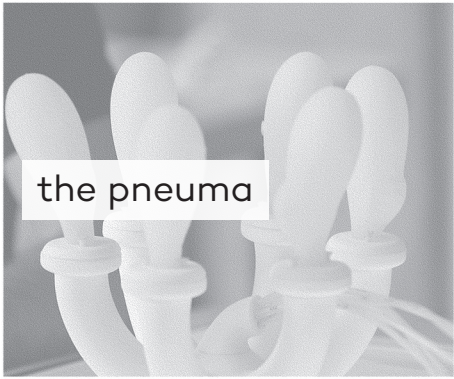
deformation of these objects, whose activity would depend on the breath of a compressor. Animated in this way, by a “pneuma”—recalling the myth of vital breath that the Stoics borrowed from the language of biology (Muller 2006)—these objects become organs or body parts that can be shaped or repaired as required. This pneuma is akin to the *cybernetic energy* that Nicolas Schöffer described as “the awareness of the vital process that maintains the balance of all phenomena” in a biotope.

For both the scientist and sculptor, deformable, pneumatic robotics use breath that brings control and maintains vital equilibrium. Vital for sculpture, medicine, art, and design within an organogenesis defined as “the genesis of the artifact, and the genesis of social and psychosomatic organs through the reconstitution of the techno-aesthetic environment” (Stiegler 2015).

Eight years after their first collaboration on *Exo-biote*, the artist and researcher come back on the designing of these objects, which they produce, to implement this pneuma in their respective practices. These practices, which have become more common, overlap, and echo the reflections on hybridization by American theorist, physicist, and feminist Karen Barad. In 2005, Barad questioned “the givenness of the differential categories of ‘human’ and ‘nonhuman,’ examining the practices through which these differential boundaries are stabilized and destabilized.”

Since the flexible, deformable robots of *Exo-biote*, the artist and researcher have been cultivating alternative forms of control, even non-control, that make manifest the destabilization of these subject/object boundaries. This questioning of the notion of control empowers their machines and nurtures forms of life that the artist and scientist seek to develop.

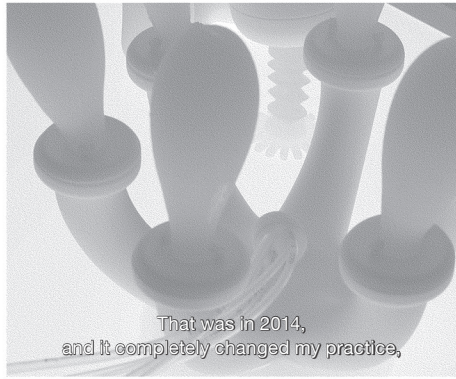




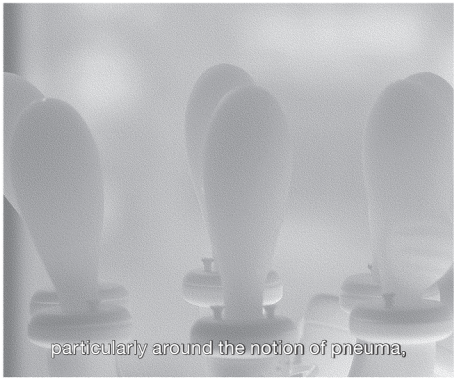
the pneuma



That was when we first met.



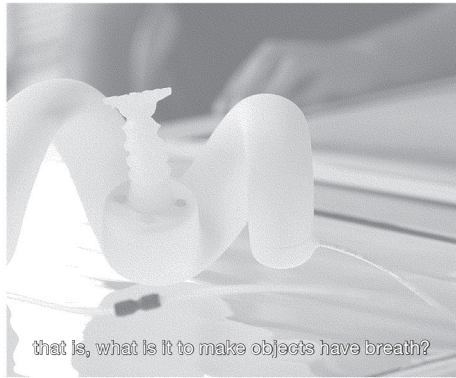
That was in 2014,  
and it completely changed my practice,



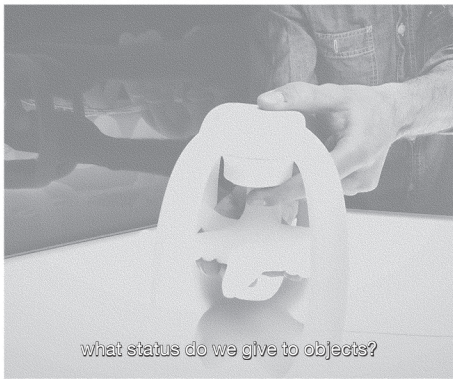
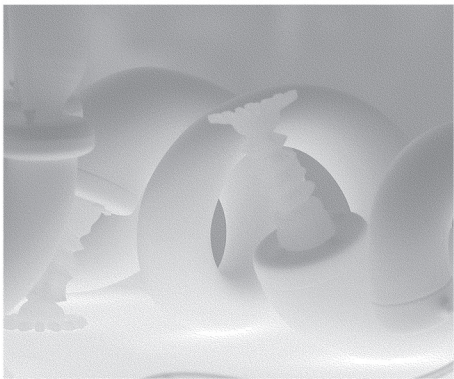
particularly around the notion of pneuma,



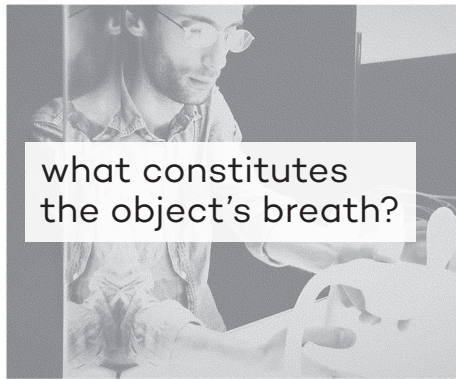
a philosophical concept dating back to antiquity,



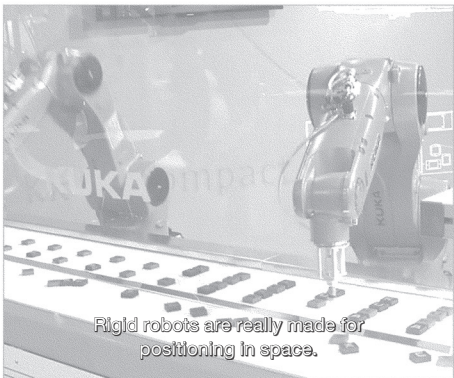
that is, what is it to make objects have breath?



what status do we give to objects?



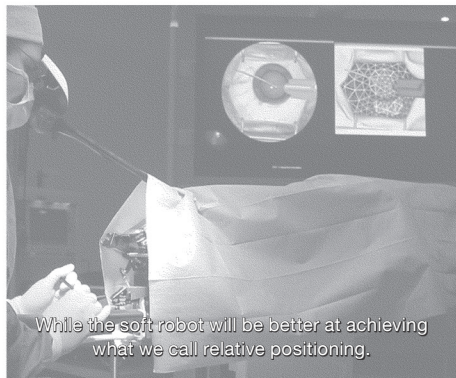
what constitutes  
the object's breath?



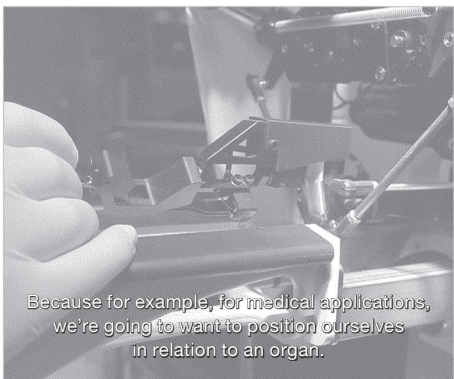
Rigid robots are really made for  
positioning in space.



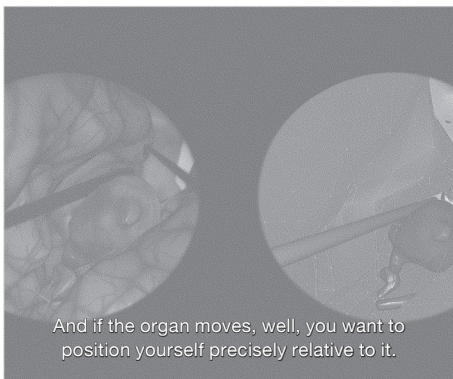
You have to tell it: "You're going to these spatial  
coordinates," and it will move into position.



While the soft robot will be better at achieving  
what we call relative positioning.

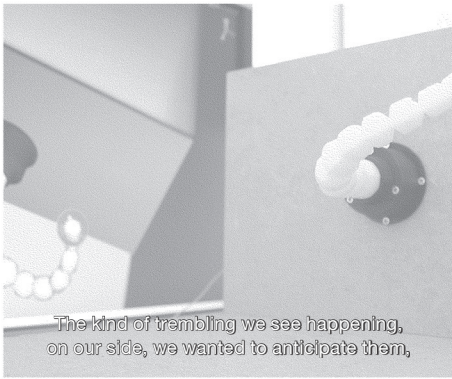


Because for example, for medical applications,  
we're going to want to position ourselves  
in relation to an organ.



And if the organ moves, well, you want to  
position yourself precisely relative to it.

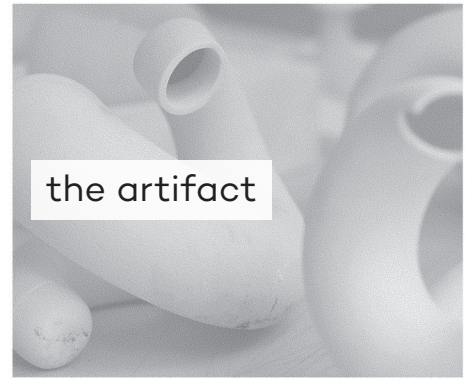




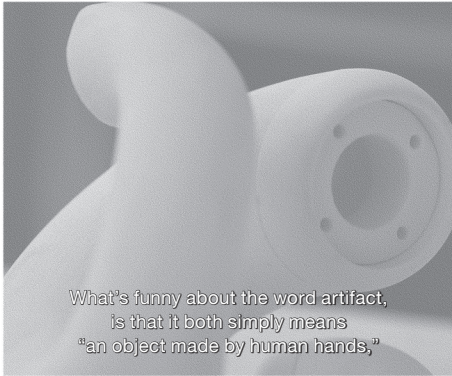
The kind of trembling we see happening, on our side, we wanted to anticipate them,



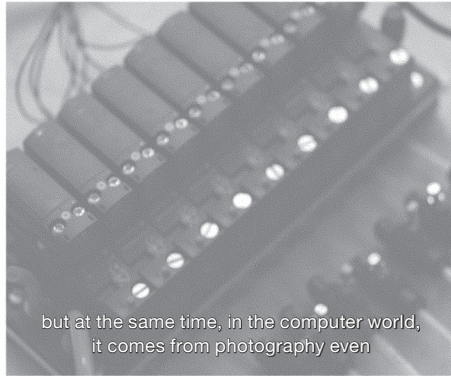
But you tried to embrace them.



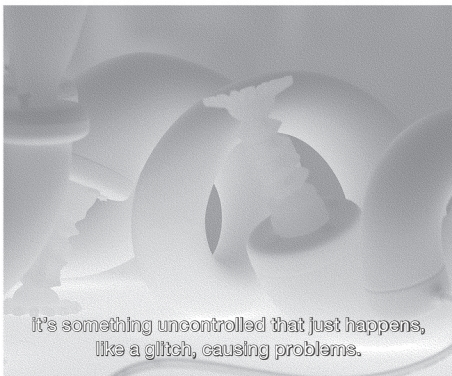
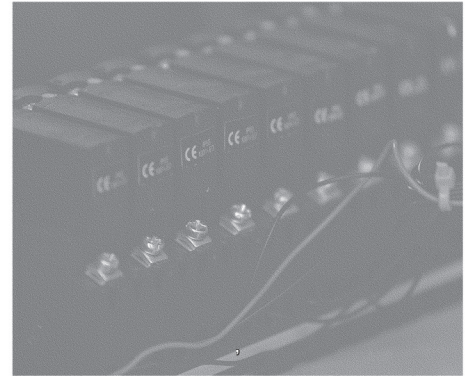
the artifact



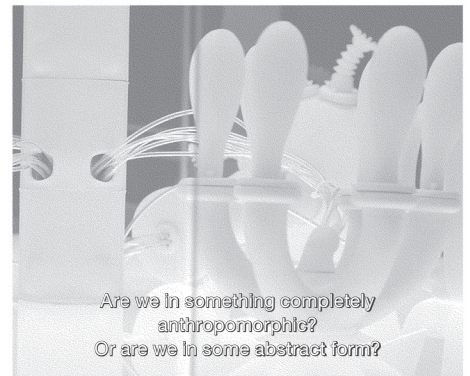
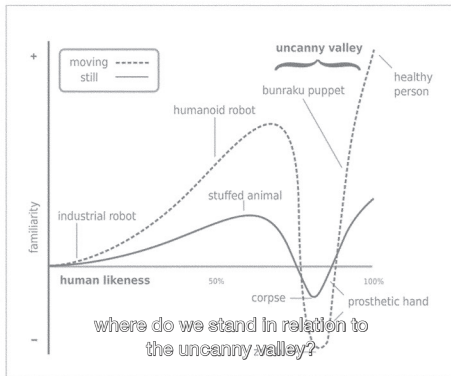
What's funny about the word artifact, is that it both simply means "an object made by human hands,"



but at the same time, in the computer world, it comes from photography even



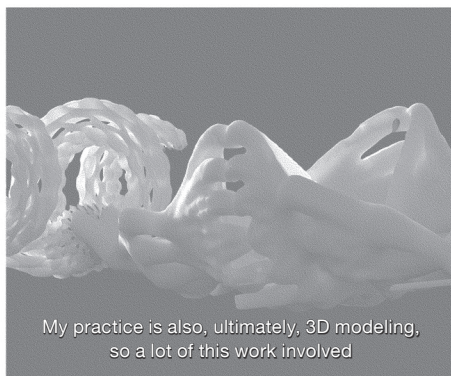
it's something uncontrolled that just happens, like a glitch, causing problems.



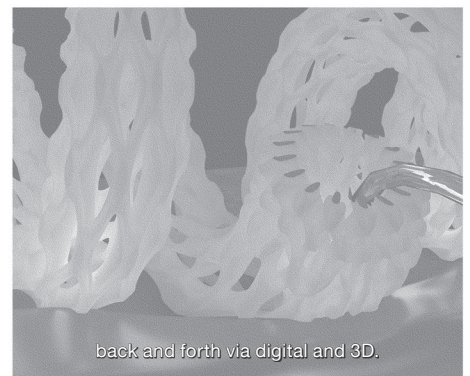
Are we in something completely anthropomorphic? Or are we in some abstract form?



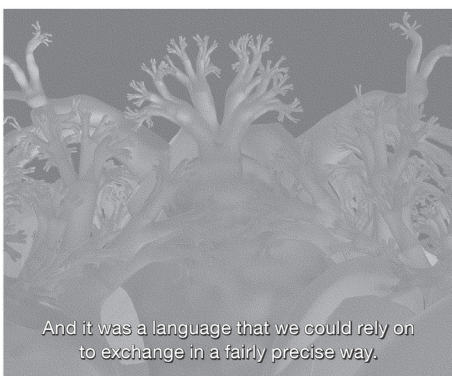
make the objects anthropomorphic



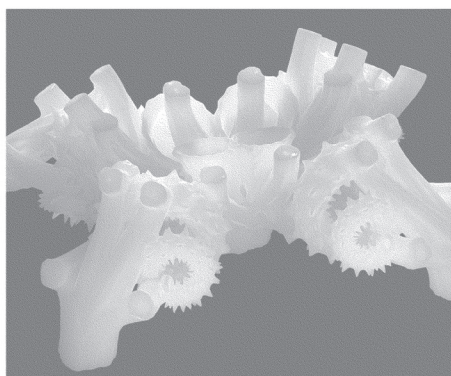
My practice is also, ultimately, 3D modeling, so a lot of this work involved



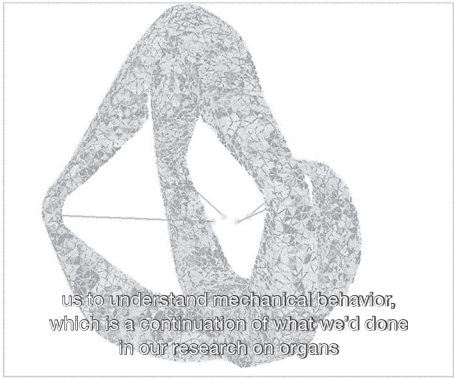
back and forth via digital and 3D.



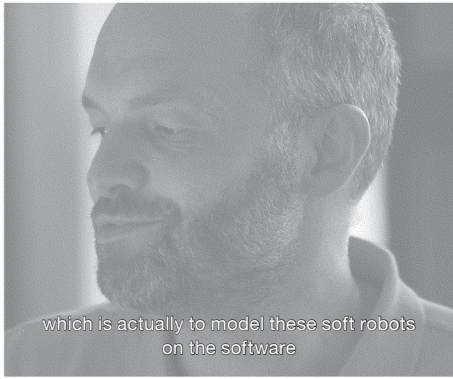
And it was a language that we could rely on to exchange in a fairly precise way.



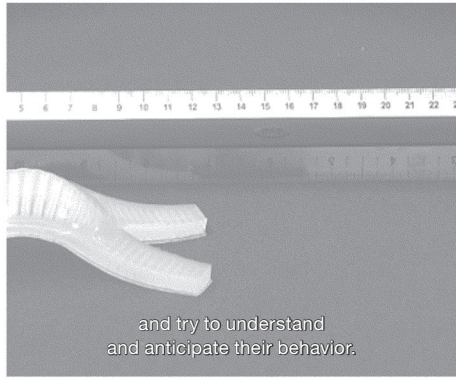
So there was some truly experimental work. We have a software that allows



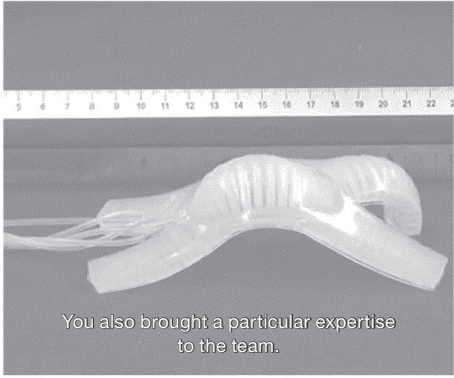
us to understand mechanical behavior, which is a continuation of what we'd done in our research on organs



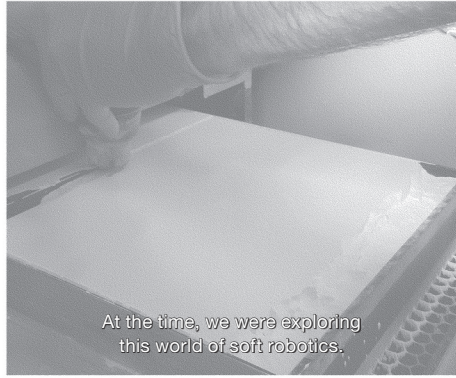
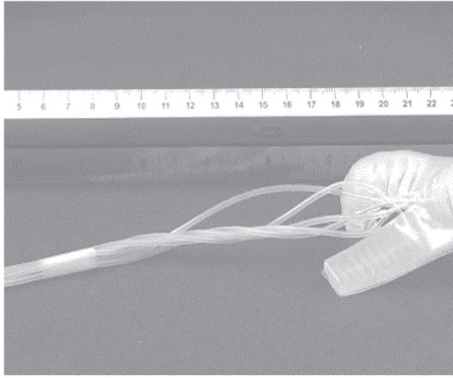
which is actually to model these soft robots on the software



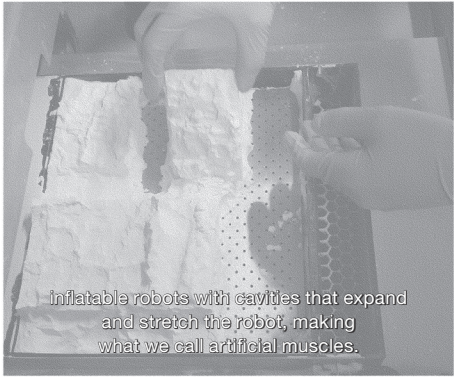
and try to understand and anticipate their behavior.



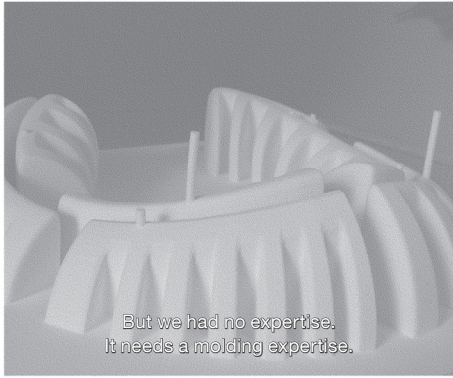
You also brought a particular expertise to the team.



At the time, we were exploring this world of soft robotics.



Inflatable robots with cavities that expand and stretch the robot, making what we call artificial muscles.



But we had no expertise. It needs a molding expertise.



back then that was your job which led us to understand how to make molds. Because we didn't have that type of expertise,



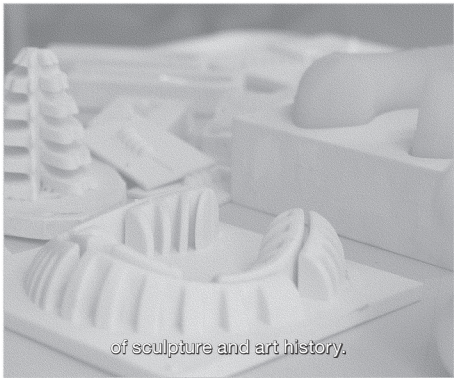
And it's actually quite funny



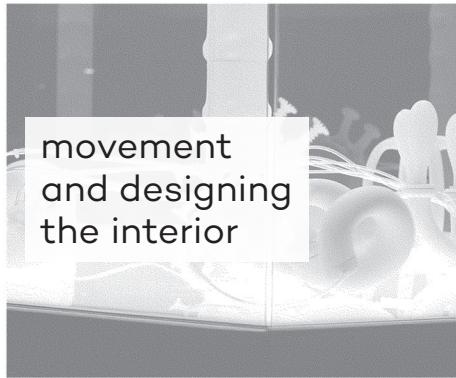
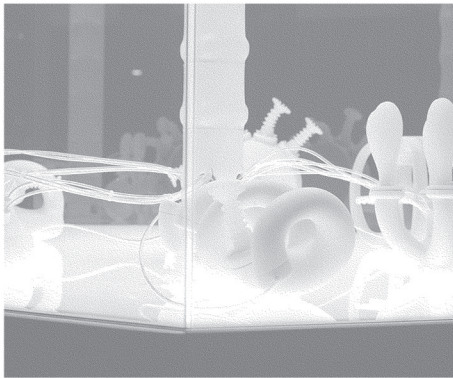
that there is interest in science,



for a kind of specialized branch



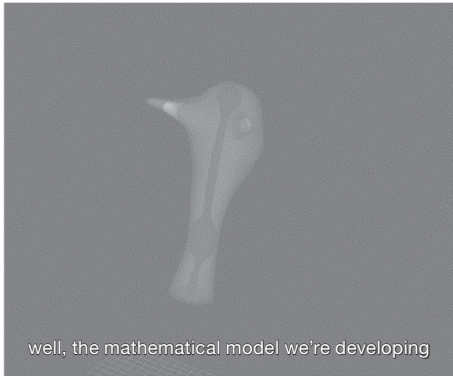
of sculpture and art history.



movement and designing the interior



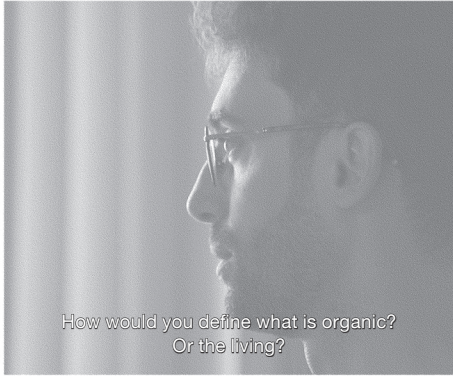
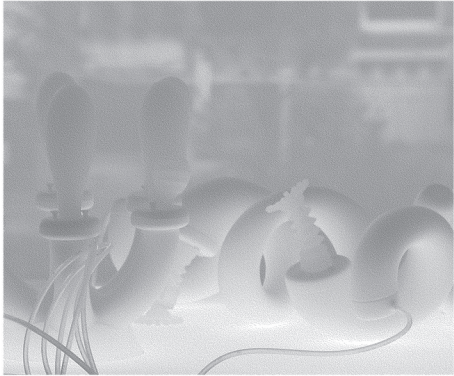
And I remember we worked on this very robot,



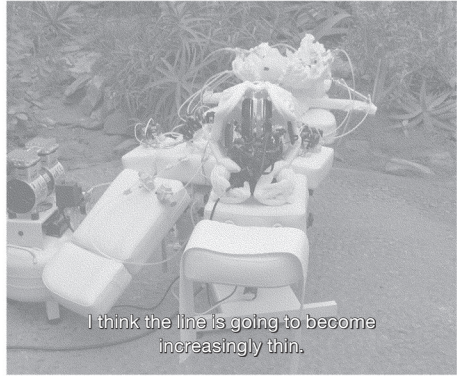
well, the mathematical model we're developing



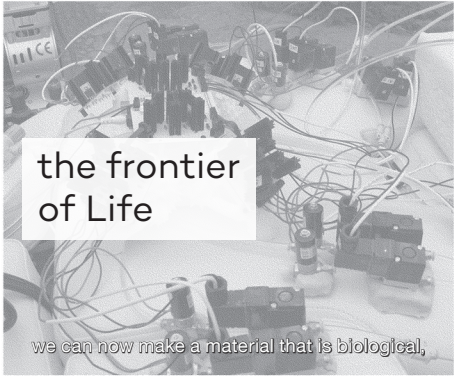
doesn't always match reality.



How would you define what is organic?  
Or the living?

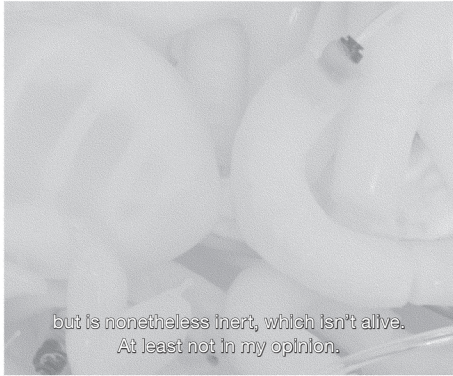


I think the line is going to become  
increasingly thin.

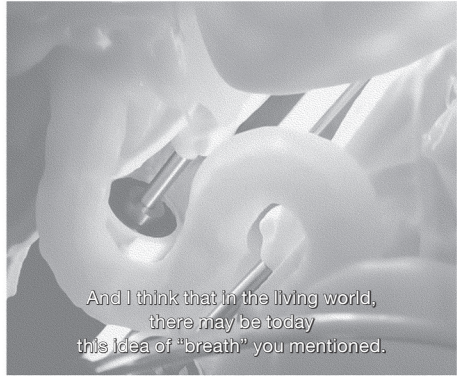


## the frontier of Life

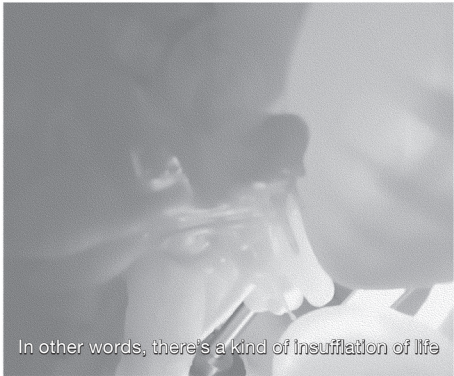
we can now make a material that is biological,



but is nonetheless inert, which isn't alive.  
At least not in my opinion.



And I think that in the living world,  
there may be today  
this idea of "breath" you mentioned.



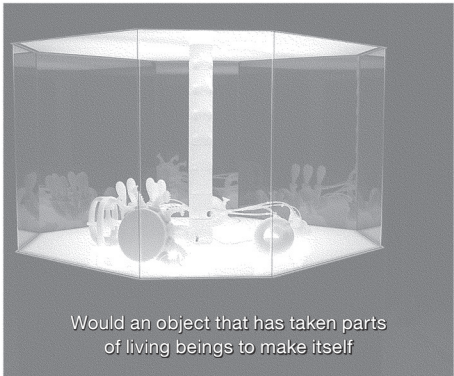
In other words, there's a kind of insufflation of life



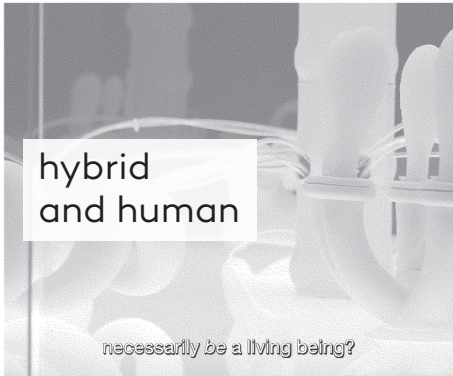
In the living world that is not yet present in robots.



Is this object a living being or not?

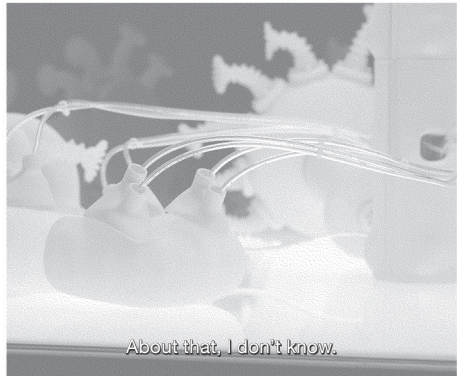


Would an object that has taken parts  
of living beings to make itself



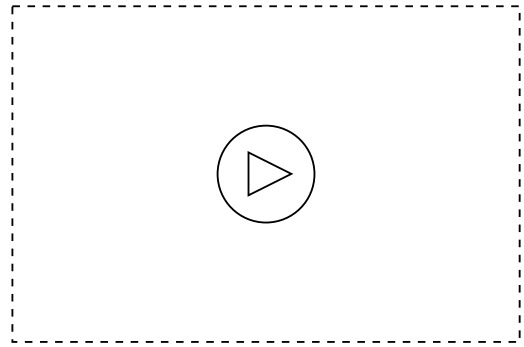
## hybrid and human

necessarily be a living being?



About that, I don't know.

This contribution has been published on  
[www.able-journal.org](http://www.able-journal.org) in video format:  
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## credits

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**production and editing:** Jean-Jacques Gay

**editorial mediation:** Jean-Jacques Gay

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*Exo-biote*, pneumatic and lighting installation, Jonathan Pêpe, Production Le Fresnoy, 2014–2015.

## about the authors

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**Jonathan Pêpe** is an artist and filmmaker. He studied at the École Nationale Supérieure d'Art de Bourges then at Le Fresnoy. His visual research is expressed through drawings, films, video, and interactive, digital, and robotic installations. He produces fictions by rerouting contemporary techniques such as 3D and soft robotics.

<https://jonathan-pepe.com/>

**Christian Duriez** (PhD) is Research Director at Inria and team director of DEFROST - DEFormable RObotic SofTware - (Université de Lille, École Centrale, Inria, CNRS). He specializes in mechanical modeling, simulation, and control of deformable robots, contact modeling and haptic feedback in surgical simulations. His research aims to improve the way deformations are factored into robotics.

<https://team.inria.fr/defrost/>

<https://sofa-framework.org>

<https://insimo.com>

**Jean-Jacques Gay** (PhD) is a curator, art critic, journalist, and researcher at the Citu-Paragraphe laboratory. He is also an author, creator and maker of films, exhibitions, and transmedia works. Currently he is the director of the Festival accès(s) (electronic cultures, and collaborates with the Le Fresnoy Studio National des Arts Contemporains and with AICA, the international association of art critics.

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