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## The Biological Unseen. Producing and Mediating imaginaries of Protocells

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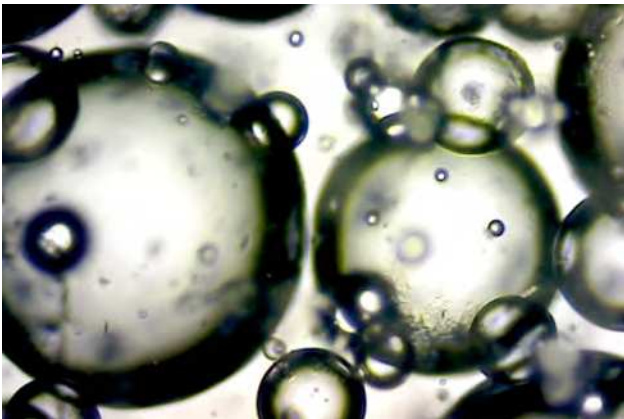


Photo: Carolina Ramirez-Figueroa, Luis Hernan, Pei-Ying Lin

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# The Biological Unseen

## Producing and Mediating Imaginaries of Protocells

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**Abstract**

This paper engages with issues of the bio-image body, identifying the mechanisms by which the microscopic is understood and interacted with by a range of audiences. We are interested in how images are used to mediate with the biological unseen, and how the process can be used to perturb and shift imaginaries of use and transformation of matter, living or otherwise. We take a research through design approach and build the argument using two interventions made in the context of *Living Ashes*, a project developed by the authors and that explores semi-living matter through protocells. The first intervention produces recorded moving image of protocells, using intercutting to connect events across scales. The second intervention prompts discussion on issues of agency in generating image with/of nonhumans.



Figure 1: Part of the workshops in Making Life, constructing DIY laboratory equipment. Image: *The Bioartsociety*

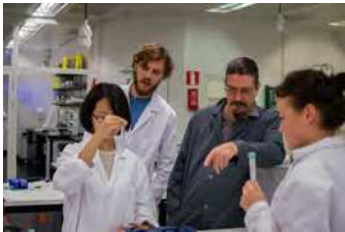


Figure 2: Laboratory session as part of Making Life. Image: *The Bioartsociety*



Figure 3: Workshop session on protocells facilitated by Martin Hanczyc. Image: *The Bioartsociety*

## Introduction

*At 18:16 on the 21st of May 2016, a group of protocells performed in front of an audience in Helsingør, Denmark. An assemblage of chemistries, olive oil, and paper money lye came together and formed, initially, a droplet which quickly fragmented into three protocells. Laying still for three seconds, they jittered and began a slow clamber following an invisible chemical gradient. As they did, remnants of ashes in the lye solution began to swirl around, following their metabolism.*

In this paper, we engage with issues of the bio-image body. We use a research through design approach to discuss a collaborative, creative exploration which explores the materiality of protocells. We weave an argument addressing image production of semi-living systems, and identify the mechanisms by which the microscopic is engaged with by a range of audiences. Our aim is, ultimately, to interrogate assumptions of who is in charge when generating images of nonhumans.

There is an alternative account of the event above.

*At 18:16 on the 21st of May 2016, three people stand still behind three tables in a dark hall in front of an audience in Helsingør, Denmark. Wearing white overall defenders and gas masks, they perform a production line — transmuting so-called inert matter into animation and back. They hack, torn and burn matter to produce ashes, fats, and oils, and combine them to produce protocells. As they do, they stream microscopic images of protocells onto a screen.*

We are interested in how images are used to mediate with the biological unseen, and how the process can be used to perturb and shift imaginaries of use and transformation. We propose that a crucial aspect to this is the model of agency we operate by — is it us, the human performers, producing images of the non-human? Or is it an act *beyond* us? We propose that by admitting that matter, living or otherwise, has an agency of its own, we might begin to counter contemporary narratives of biotechnologies that call to conquer life.

## Living Ashes

*Living Ashes* is a collaborative creative project initially developed in the context of *Making Life*: a series of events organised by *the Finnish Society of Bioart* intended to question the socio-cultural, political, and ethical complexities of synthetic biology, as well as to take a critical approach to the underlying discourses in biotechnologies to tame and manufacture life. Each *Making Life* event took place over the course of a week and involved a series of practical lectures, debates, and hands-on workshops. These enabled a group of creative practitioners and scientists to come together and collaborate using the facilities provided by *Biofilia* — *Base of Biological Arts*, a biology laboratory managed by Aalto University's *School of Arts, Design and Architecture* and hosted in the *School of Chemical Engineering*.

In its first edition, *Living Ashes* explored protocells as a platform to challenge notions of life and matter in contemporary biotechnologies. The project brought



Figure 4: Lye prepared by soaking banana husk ashes in rainwater. Image: Carolina Ramirez-Figueroa



Figure 5: Ashes produced by burning Joss paper money. Image: Carolina Ramirez-Figueroa

together a group of practitioners and scientist from a diverse set of backgrounds. Carolina Ramirez-Figueroa, with a background in architecture and a focus on research by creative practice; Pei-Ying Lin, with a degree in life sciences and practicing artist; Charli Clark, who at the time was studying the environmental art MA at Aalto University; Helena Shomar, a PhD candidate in synthetic biology; Johanna Rotko, a visual artist and photographer based in Helsinki; and Luis Hernan, also a creative practice researcher. The group was collaborating with Martin Hanczyc, head of the *Laboratory for Artificial Biology* at the University of Trent specialising in Protocells as a model to study interfacial dynamics, complex chemistries, and artificial life. The outcome of *Living Ashes I* was presented as part of the group exhibition of *Making Life*, held at *Lasipalatsi Nayttely* gallery in Helsinki, from the 21st to the 31st of May, 2015.

Protocells are microscopic chemical units that result from releasing highly alkaline droplets in a fat-rich environment. They can be understood as '*chemical models of living cells that possess some of their properties, such as metabolism, movement, replication, information, and evolution, but are not necessarily alive*' [7:27]. The Butschli method shares name with its author, who was interested in producing an artificial amoeba with pseudopodia that mimicked some of the behaviours of living protists [1]. The protocol involves adding a few droplets of potash to olive oil, triggering a

saponification reaction in which the molecules of triglycerides are split into fatty acid salts and glycerol. Chemical transactions make droplets react by migrating through the olive oil and break up into smaller droplets. In a large scale, the chemical reaction results in the production of soap. In a microscopic scale though, the interface between droplets and the oily medium produces behaviours that resemble those of amoebas.

Potash is produced by soaking wood ashes in rainwater leaving the mixture to react for a week, promoting the release of potassium from the ashes and producing a solution rich in potassium hydroxide. We modified the original protocol and experimented with how different sources of fats and ashes might result in different behaviours. We drew ashes from an array of sources — paper, bananas peels, cigarettes, and human hair — and combined them with different forms of fats — olive oil, beeswax, poppy oil, lard, goose fat. We were interested in how each permutation would result in different behaviours, with protocells of different metabolism rates and locomotion. Pairings also trigger cultural associations. We mix banana ashes with canola oil, both symbols of agricultural practices of modification and reminiscent of monocultures. We force the encounter of pork fat and Joss paper, both central parts of Taiwanese religious rituals. Beeswax with birch ashes, routinely commodified by honey and paper industries. Fish oil and cigarette ashes, binary opposites revolving around health and wellness.



Figure 6: Part of the exhibition of Living Ashes I, showing samples of the material exploration, including ashes from Joss paper money, fats, lye and soap. *Image: Carolina Ramirez-Figueroa*

On a conceptual level, we were interested on how different combination of chemistries might be interpreted as constituting vibrancies, referencing the work of Jane Bennett who argues against the 'partition of the sensible' [2]: the artificial separation between intelligent life and inanimate matter. The partition lies at the core of consumerist society, Bennett argues, and constructs an asymmetrical power relationship. It renders matter as resource to be used freely by humans, who are granted

a higher status. Instead, Bennett proposes a vibrant materialism which operates on the principle that all matter, sentient or otherwise, has a degree of agency, or vibrancy, and should be assigned the same importance. Saponification offers a poetic rendering of fluctuation of vibrancies in everyday material transactions. So-called inert matter is transformed and recombined to produce droplets which, for a split-second, become almost alive, only to stabilise and transform into soap. Extending the analysis further back, rendering



Figure 7: Microscope session during Making Life. Part of the preparation for Living Ashes I. Image: *The Bioartsociety*



Figure 8: Final exhibition for Making Life I. Edited videos are shown in parallel screens alongside samples of the material exploration. Image: *Carolina Ramirez-Figueroa*

the building blocks requires reducing animate life into inanimate matter through sudden acts of transformation such as tearing, hacking, and burning. Matter climbs and descends a ladder of liveliness.

#### *Producing images of semi-living matter*

The material transactions involved in protocells occur across a continuum of scales. At the macroscopic, producing ashes involves burning potassium-rich matter. Ashes are soaked in rainwater, which releases potassium to produce lye. Oils, on the other hand, are produced by different methods that include hacking, tearing, grinding, and boiling animal or plant matter. The second set of transactions occur at a microscopic scale, too small to be seen by the naked eye. A droplet of lye is suspended in oil, breaking into smaller droplets that move and interact with its milieu as if they were alive.

Documenting these material transactions involve a combination of image-making techniques. On the macroscopic scale, it involves using video cameras to document acts of hacking, tearing, boiling, and burning involved in producing ashes and rendering fatty compounds (see figure 4 & 5). On the microscopic, it requires the use micro-cinematography to magnify the stage of a Petri dish, capturing the production and decay of protocells into soap fragments (figure 7). To explore how material transactions across these scales connect, and the way they illustrate the ladder of liveliness, we set out to produce a series of videos combining macro and microscopic actions. They were edited and synchronised to be shown in parallel monitors, enabling the audience to compare protocells and their behaviours. Together, these videos acted as a background to an exhibition that showed instruments and products of the material exploration, including samples of raw

sources, rendered fat, oils, ashes, and soap (see figure 8).

The video editing references Friedrich W. Murnau's use of montage in *Nosferatu, eine Symphonie des Grauens* [13]. Gunning [6] has analysed how the film uses montage to stitch imagery from two instruments. Intercutting is used to weave events across a wide range of millieux— asylum cells, laboratory benches, lecture theatres, sea vessels, coffins — with those occurring microscopically — the flow of blood from insects to rodents to humans to vampires. Gunning emphasises how the editing techniques are successful in establishing a material chain of events across scales, enabling the director to weave a tapestry of symbolic resonances and metaphorical connections.

In *Living Ashes*, we were interested in how the articulation of camera and microscope enables a form of *hapticity*, to borrow Laura Marks term [11], connecting images to their bodily experience. Viewers can intuit the texture and smell of wood bark as it encounters fire, or the touch of ashes as the camera zooms in. The sensuous proximity is augmented by intercutting, providing the audience with situational awareness of their body in relation to these material transactions. They approximate, for example, the size of the cauldron used to boil a leg of pork. Other sensuous cues, like the sound of fire or water trickling through ashes, mediate a transition of scale from tactile matter into an invisible, microscopic realm. As the image intercuts to the circular frame of the microscopic lens, it shows the transition of droplets into lively protocells that swim about, come together, and dance as they go down a chemical stream and congeal into soap particles. The sequence of images parallels the changing relationship between the

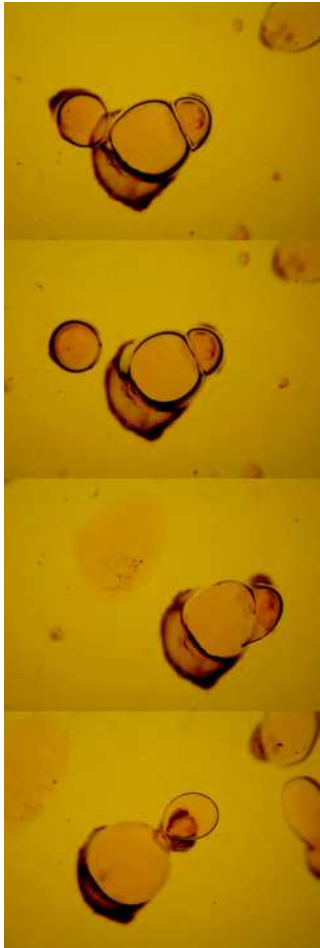


Figure 9: The sequence shows the interaction between three protocells as they merge and break apart. Image: Carolina Ramirez-Figueroa, Pei-Ying Lin, Luis Hernan

body of the operator and the different devices: from the film camera that connects closely to the field of view of their eyes, to the microscope that forces the technician in a more enclosed space, and an extremely narrow field of view.

### Image as live performance

Situational awareness afforded by camera and montage stops at the scale of the microscope. The audience is aware of the transition from the macro to the micro — it has enough cues in textures, sounds and embodied experience to understand the material exchanges that occur to produce ashes and fatty acids. Understanding, however, how a protocell interacts with its milieu requires a shifting in magnification scales — closing in and moving out within the realm of microscopic lenses. A magnification, for example, of 10x enables to get a general understanding of the initial droplet forming when lye is released in fatty acid. A 40x magnification shows interactions occurring across the membrane, providing a picture of how protocells ‘speak’ with their surroundings. A further 100x provides a hypnotic image of the vortex generated by their metabolism. Understanding protocells involves shifting constantly between the different scales to capture the process of formation, its evolution, and its eventual degradation into soap.

Constant magnification shifts, however, are difficult to grasp for a non-scientific audience. Interpretation of microscopic imagery is connected to an embodied experience of the microscope itself. In an optical microscope, shifting magnifications involves rotating a revolver of lens objectives, as well as adjusting stage and focusing knobs. For the operator, there are clear tactile cues of scale shifts: the knurling pattern of the focusing knob, the mechanical clicking of the lenses as they

align into place, the textures of the different metallic and plastic components. The cues are connected to a choreography of movements involved in mixing chemistries and following protocells as they transition from initial droplet, to fragmentation, to locomotion, to chemical membrane transactions, to slowdown, to consolidation.

To the general viewer though, these cues aren’t there. There are no previous experiences of microscopes they can draw on to understand the changes in magnification, and how they manifest in droplets’ apparent shift in size. Nor do they have the benefit of performing the image by manipulating the instrument and embody the shifts.

### *Living Ashes II*

The disconnect between microscopic image and situated awareness motivated us to explore a further edition of the project in *Living Ashes II*. A number of the original collaborators, Carolina Ramirez-Figueroa, Pei-Ying Lin and Luis Hernan, set out to explore how a live performance might enable different experiences of matter and liveliness in the audience. The performance was developed as part of the 2016 edition of *Click Festival*, an annual event hosted by *KulturVerftet*, a cultural centre located in the former shipyard of Helsingør, Denmark. Starting in 2011, the festival set out to embrace ‘the future by exploring the field between art, science and technology’ [5] and involves a mix of conferences, workshop, music concerts, talks, and art performances intended to offer a wide array of creative appropriations of technology. The 2016 edition of the festival was structured around the theme of ‘*Embrace New Territories, Explore New Maps*’ aimed at exploring the intersection of biological and digital arts.



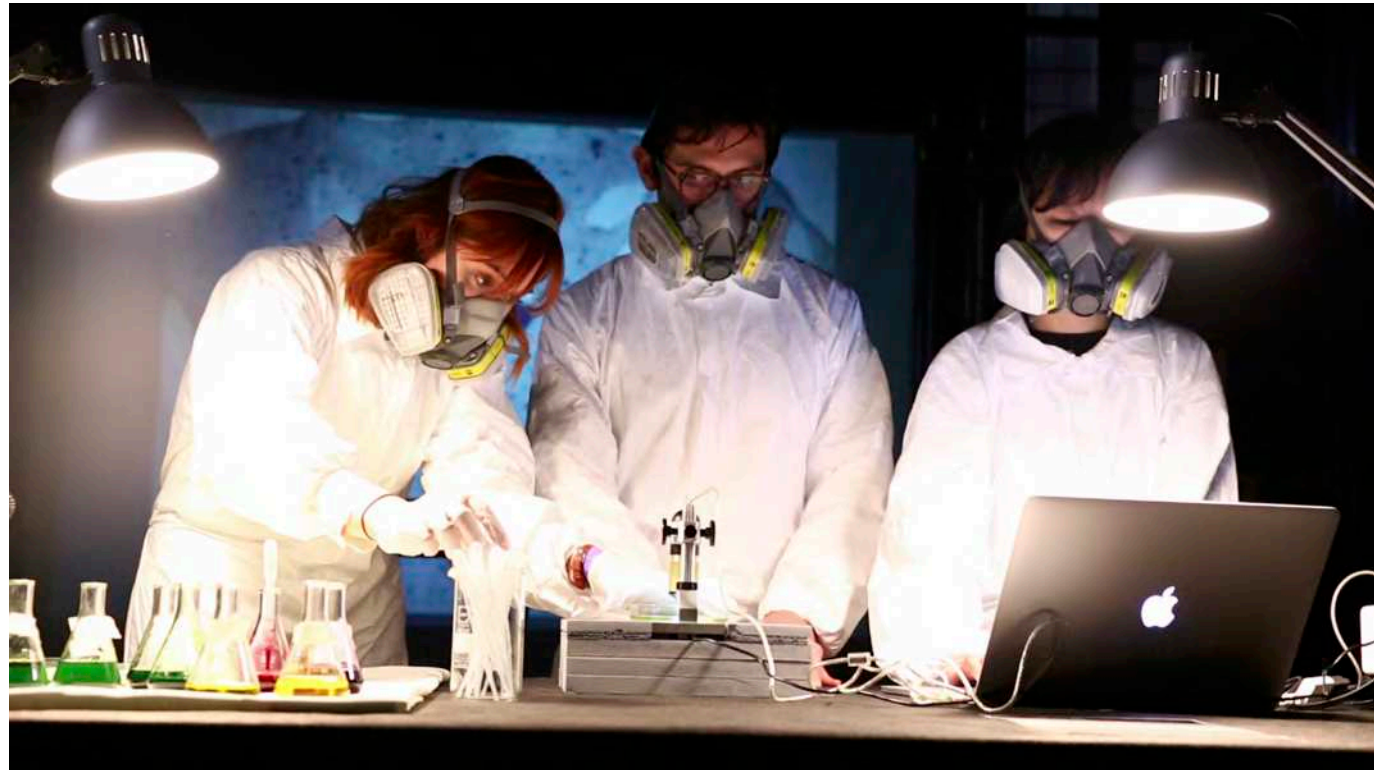


Figure 10: Still captured during the performance of Making Life II. Image: *Carolina Ramirez-Figueroa, Pei-Ying Lin, Luis Hernan*

The performance was designed to use the stage as a production line, in which three performers enact the transformation of inert matter into animation. Three tables were arranged in a line and prepared into small working areas with overhead lamps. Three aspects are prioritised: image, sound, and body movements. The tables are set against a ten-metre-wide screen used to project images. An array of uni-directional microphones

is set around the tables to pick up the sounds of the actions performed. Body movement are exaggerated, drawing on notions of physical theatre to highlight the relationship of the body and its actions in transforming matter.

#### *Account of the Performance*

The performance was delivered on 21st of May, 2016 at 18:03. *Three performers, dressed in white overall*



Figure 11: The sequence shows some of the transactions involved in producing protocells, as described in the text. Images: Carolina Ramirez-Figueroa, Pei-Ying Lin, Luis Hernan

guards and respirator masks, stand behind three tables. The stage is at the end of a dark industrial hall, audience gathering to their front. Action begins on the left table. One of the performers turns the overhead lamp to reveal a working area arranged with trunk slices, timber, poppy plants, pieces of pork meat and bananas. She picks a serrated blade, strikes the trunk once, and follows with a back-and-forth movement until chunks begin to chip off. She reaches for the pork meat, lifts the knife as much as she can and strikes repeatedly to slice it, doing the same to hack away bananas and poppy flowers. She reaches out and turns the overhead lamp off. As she drops the knife, images appear on the screen, flashing words— fire, energy, floating, sacrifice, transition, opium, melting, inanimate, amoeba, vibrant, origin, collision, bio-thaumaturgy, saponification, preparation, gradience. Sounds picked up by the microphones are streamed to the speakers, mixed with a sine tone that picks up pace gradually.

A second performer switches on the overhead light on the right-hand table. He picks up a sheet of paper money from a pile, carefully folds it into interlocking triangles, and places it into a metal bucket. After repeating the action a few times, he slowly puts on a pair of orange gloves. He reaches for the bucket and burner, clicks the ignition and after a few failed starts, sets the contents of the bucket on fire. He then places the bucket on the table, stokes the fire, and looks on until it dies off. He switches off the overhead lamp.

The first performer switches on the overhead lamp on the near end of the left table to reveal an assembly of glass beakers and funnels. She picks one of the containers full of rain water and pours it into a second one connected to a funnel. The process sieves the solution as the action is repeated across a number of containers. She grabs a handful of ashes, puts them in an empty beaker and soaks them with filtered water. She grabs a smaller beaker with lye, examines it to the light and swirls. She puts the container down on the table and switches off the light.

The second performer switches on the light on the near end of the right table to reveal a hot plate, a sauce pan, glass plates and petri dishes. He picks lard, puts it into the sauce pan and then on the hot plate. Bubbling sounds quickly build up as it melts. The performer transfers the melting lard onto the dishes, replaces the sauce pan, turns off the hot plate and switches off the overhead light.

Both performers walk to a central table, and switch on overhead lights on either side to reveal an array of beakers, a digital microscope, and a third performer behind a computer. The second performer places his hands on the dials on either side of the microscope. The first picks a petri dish prepared with oil and places it under the microscope. The video feed on the screen shows the microscope stage as she picks a plastic pipette, lifts lye from one of the beakers, places a few drops on the plate, and gestures to lower down the



Figure 12: Still captured during the performance of Making Life II and that shows the production of protocells in stage. Image: Carolina Ramirez-Figueroa, Pei-Ying Lin, Luis Hernan

*microscope. The second performer turns both dials in opposite directions to magnify and adjust the focus at the same time. The projected image shows a droplet that begins to break away, creating smaller ones that slowly wobbles and moves. The first performer signals to magnify, which reveals a fluttering membrane. Another protocell enters the image and seems to flicker*

*back in response. The synthesised sound picks up rhythm, and the list of words flashes on top of the image. The first performer moves the dish to hunt for the protocell which has left the image. The second performer signals and the image zooms out. As the microscope goes up, the protocell shrinks and goes in and out of focus.*

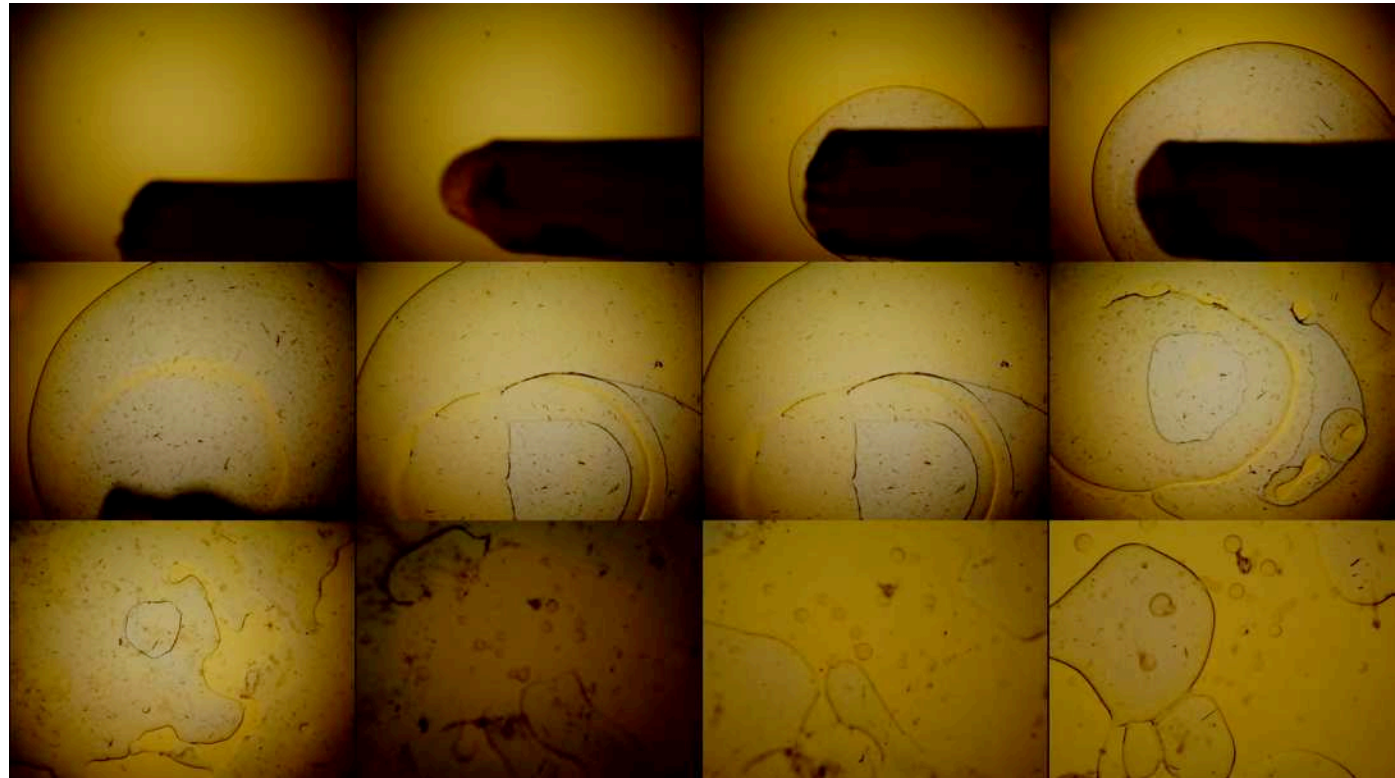


Figure 13: Sequence of images showing key events in the production of protocells, as seen under the microscope. It begins by dropping lye solution on the oily media, and the initial fragmentation into smaller protocells. Image: *Carolina Ramirez-Figueroa, Pei-Ying Lin, Luis Hernan*

*The image goes in and out of the plate's frame, showing protocells shrinking and growing in size, constantly coming in and out of focus. After performing three petri dishes, the lights in the hall go on. The tables bear traces of used glassware and smear surfaces. The performers remove their masks and address the audience.*

### **Ways of seeing**

The performance brings into relief a number of themes relevant to image production of semi-living matter, suggesting a discrepancy in the ways of seeing connected to movement across scales. At the macroscopic scale, we capture the trace of photons hitting bodies to delineate boundaries that produce a visual entity. When

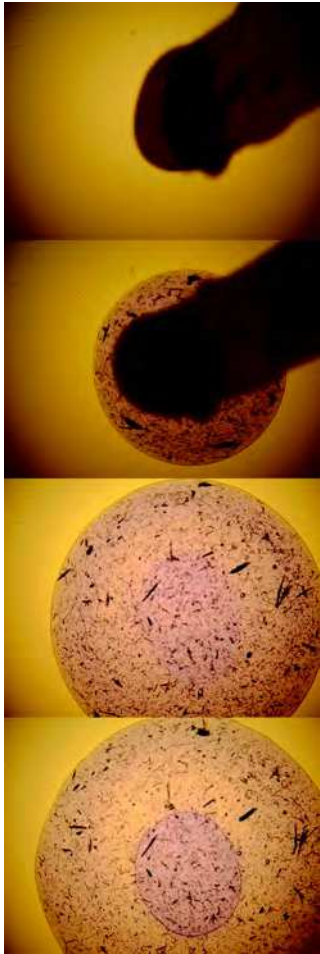


Figure 14: Sequence of images showing a protocell with suspended ashes. Image: Carolina Ramirez-Figueroa, Pei-Ying Lin, Luis Hernan

used at the microscopic scale though, this way of seeing loses efficacy. When applied to protocells, it provides a rough notion of the boundaries along the membrane, where exchanges between the exterior and the interior of the protocell occur.

As we prepared for the performance, we stumbled upon techniques that suggest alternative ways of seeing. The original Butschli protocol involves the production of lye by soaking ashes in rain water. The solution is left to rest for a week, and then filtered to extract a pure lye solution. We built an improvised laboratory to test how the chemistries performed, and to choreograph our movements to the rhythm of protocells. The filtering process left traces of ashes which, when used to produce protocells, revealed to be a good agent to show vortices generated in the interior of the protocell membrane, tracing a primitive form of metabolism. We modified our protocol to leave enough ashes in the solution to visualise the metabolism of the protocell but not too much to change PH significantly, or to cause too much drag on locomotion (see figure 14 & 15).

Shifting from recorded to live image also made relevant complexities involved in synchronising acts performed by humans and nonhumans. Editing the video for *Living Ashes I* involved manipulating the frame rate of the protocell clips. The source material used in the video was captured during a number of microscope sessions performed throughout a week in which we refined a choreography to 'follow' protocells with the microscope: a process in which the operator refined their sense of when to shift magnification on the objective carousel, and how to move the petri dish in the stage as protocells left the scene. This tuning and exploration process was captured in the videos but edited in the final

cut. In some instances, movements of protocells had different rhythms owing to the composition of the fatty media. Using beeswax, for example, was especially challenging as it required heating up to 60 degrees. Once under the microscope, the media would only stay liquid for two to four minutes and would form protocells with slow motility.

Live image, however, does not have the advantages of *staged* time. Instead, the rhythm of the performance had to be indexed to the performative time of protocells. During the preparation phase, we *auditioned* lye/fatty acid pairings to discard those that would be too difficult to handle or that had slow locomotion. We selected two fatty media, olive and poppy oil, and two lye solutions, paper money and banana, and set out to devise a script of the performance alongside protocells [14] — we used experiments as rehearsals to understand the rhythm of each pairing, and time our actions to those of the protocell. As a result, we defined a choreography in which we would place a plate on the microscope's stage, release a droplet of lye, wait for the first protocells to emerge, and follow one of them across the stage, increasing magnification for a few seconds. We would then reduce magnification and haunt for any fluttering between protocells, then change plates and repeat.

### Engaging Matter

In January 2015, BBC Two broadcasted *'Attenborough's Paradise Birds'*, in which David Attenborough examines *Paradisaea* bird from Papua New Guinea [12]. The documentary is composed of voice-over footage, and carefully orchestrated clips in which the presenter interacts with birds while reciting bite-sized zoology. One clip reserved as 'web exclusive' shows Attenborough



Figure 15: Protocoils showing green colorant and ash traces. Image: Carolina Ramirez-Figueroa, Pei-Ying Lin, Luis Hernan

looking to camera framed on the lower third band. As he looks up to a branch squinting, he launches on his presentation— *'This surely (...)'*— pausing midway as the bird on the branch chirps away. The scene repeats, with the presenter now able to string five words together — *'This surely is one of (...)'* before the bird cuts in, chattering and shrieking, jumping, and turning while flapping its wings in a flamboyant display. Attenborough grimaces and closes his eyes before looking back at the camera. The exchange repeats with minute differences — *'close up, the plumes are truly exquisite. A gauze in colour (...)'* the bird looks intently at Attenborough and trills before turning its back on the presenter, flapping its wings. *'Of course, by the 18<sup>th</sup> century naturalists realised the birds of paradise did have legs'*. The bird stilts on the branch, left to right and back, chattering and trilling, flapping its wings and facing the presenter. Attenborough looks confused. Attenborough drops his jaw. The eighty-four second clip was posted to one of the BBC social media profiles with a caption *'That time Sir David Attenborough got upstaged by a bird'*

There is irony in a well-modulated, BBC accent in the manner of old, hurling an incantation of natural history minutiae teasingly cut in by the flapping, chirping, chattering, and trilling of a Paradise Bird with a flamboyant sense of humour. Protocoils also have wit, especially when a group of practitioners attempt to devise a performance with them. Some events proved to be more important than we had anticipated. For example, we added a few drops of food colouring to increase contrast of the lye solution. Depending on the specific colour that is used and manufacturer, tints might contain chemicals that, over time, react with lye changing its

PH. As a result, a lye solution prepared with banana ashes might work well immediately after green colouring has been added, but not after two hours. Other factors that have a bearing in the assemblage also include the difference in temperature and relative humidity between the rehearse space and the stage; or how fresh are the solutions at the time of the performance.

It is easy to frame these events as wrinkles to iron out. Doing so however betrays an anthropocentric bias. Barbara Bolt has suggested that artists and designer's fundamental mode to engage the world is based in notions of tools and materials. She writes that *'according to this view, the artist and craftsperson is the one who exercises mastery over his/her tools and materials to produce an artwork. In harnessing means to ends, the artist justifiably can sign her/his name as the one who has made or caused a work of art to come into being'* [3]. Admitting that the events enumerated above are not contingencies suggests a more interesting discussion on the agency of the performance itself, and ultimately, of image-making. Is it us, human performers, producing images of protocoils? Or is it protocoils producing their portrait? Or are the images product of an *assemblage*? Put in different terms, are these images our acts? Or, to paraphrase Jens Hauser [10], *acts beyond us*? Also, is it *Attenborough's Paradise Birds*? Or should it be *Paradise Birds' Attenborough*?

One way to frame the discussion is to say that the images don't have an individual author, but that are produced by a *creative assemblage* of humans and nonhumans. The word is derived from the French *agencement* [15], and has been popularised by the work of Deleuze and Guatari [4], who use it as a tool to

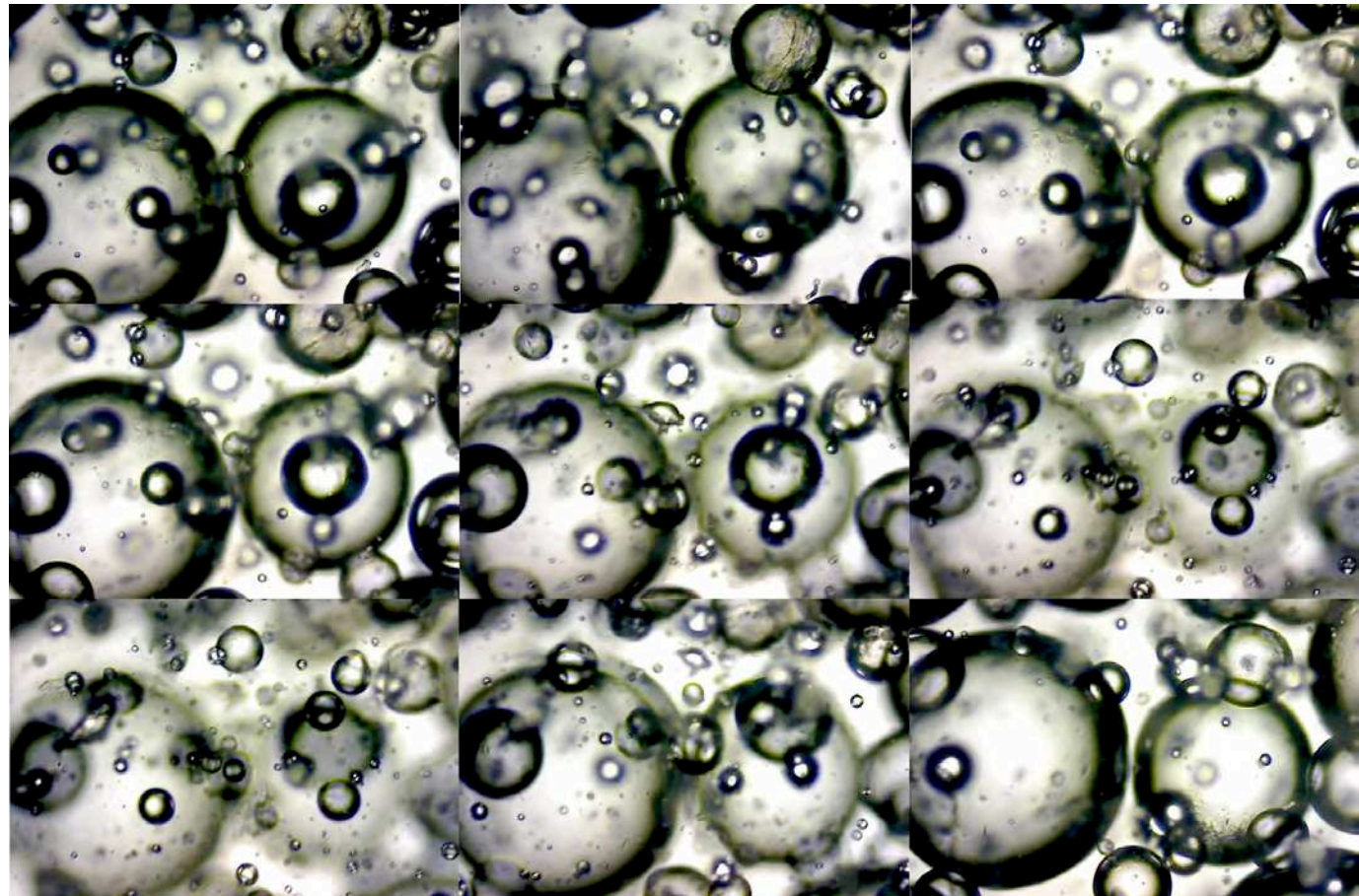


Figure 16: The sequence shows a series of protocoils at different depths, and that are visualized in the microscopic image by shifting focus. Image: *Carolina Ramirez-Figueroa, Pei-Ying Lin, Luis Hernan*

analyse and highlight the way heterogeneous elements come together in loose, reversible associations. Assumed in an understanding of assemblages is the possibility of agency beyond human beings — broadly defined as the capacity to affect change in the world. Jane Bennet defines assemblages as '*living, throbbing confederations that are able to function despite the persistent presence of energies that confound them from within*' [2]. She suggests that assemblages are characterised by the diversity of their members, which creates an uneven distribution of power and energy in its interior. As a result, no member in the assemblage can consistently influence or steer the behaviour of the whole. Instead, members interact in diverse ways, and the assemblage is constantly changing and reconfiguring. To admit that images of protocells are not solely produced by us, human performers, is to accept that all forms of matter have their own trajectories. Or to paraphrase Donna Haraway (2004; 2013), acknowledging that they have their own sense of humour.

Considering the biological body-image as assemblage has two consequences. For us as practitioners it suggests different approaches that might take into account fluid and shifting dynamics. It requires of us a form of *humbleness* to listen and adapt to a shifting meshwork producing the images, instead of prescribing the result. We prepared the performance by thinking of a neatly arranged sequence of events —put plate in stage, drop lye, show overall scene, zoom into one protocell, capture membrane fluttering, zoom out, follow second protocell, repeat. The logic in this sequence, however, drew heavily on the video produced for *Making Life I* and does not respond organically to our interactions with matter. Notions of assemblage and non-human agency invite a different approach to making images of

living and semi-living matter. It involves understanding the events that disturb the script of the performance, for example, as a way of encountering the creative assemblage. Instead of regaining control by tackling the issues, it invites us to listen to the assemblage and adapt to their changing energies and configurations. Considered more widely, it fosters a new understanding of matter and life.

Our framing of the question of agency also has wider consequences. Producing images with semi-living matter provides a tool to counter imaginaries in which life is linked to a marketable technology. In *Living Ashes*, we set out to counter and interrogate narratives of life and domination embedded within contemporary biotechnologies. Synthetic Biology is predicated on the notion of modifying and designing life using an engineering framework based on principles of modularity and efficiency. One consequence is the conceptualisation of life as something to be explored and conquered. The possibility of designing life plays on the same mechanics of power as those of domination in class, sexuality, and race. To be designed is to be conquered by the human will, which follows a binary conceptualization of the world: there is that which is outside of human agency, the natural; and that which has been conquered and appropriated, the artificial. Central to the discourse of appropriation and human industry is the criteria of what is considered to be alive. Historically, drawing the line between what is alive and what is not has led to human exceptionalism — our existence is aimed at taking control of 'nature' as resource. The same narrative repeats itself in biotechnologies — but now what is alive is a form of 'premium' matter. A form of highly intelligent, highly programmable and, in market dynamics, highly profitable form of matter. By



producing images through 'mundane' material transactions, such as the production of soap, we are disrupting the narrative. If everything is, potentially, alive to a degree, then everything is 'premium' matter. Or nothing is.

### Conclusions

In this paper, we have used a research through design approach to reflect on the issues at stake in the construction of the bio-image body. The argument draws on the development of two projects, *Living Ashes I* and *II*, which explore the production of recorded and live moving image of protocells. We describe the production of videos for *Living Ashes I* and reflected on how the use of intercutting enables connecting material events at two disparate scales. Central to connecting the macroscopic with the microscopic, however, is situational awareness. We argued that the video produces a form of *hapticity* which connects images with previous bodily experiences. In *Living Ashes II*, we set out to explore how an audience can be made aware of the relationship between their body and microscopic imagery.

The performance, however, revealed that engaging with semi-living matter through images raises more urgent questions other than situational awareness. We recount on a number of issues we encountered on the preparation of the performance, such as the difficulty of indexing our actions on stage to the material exchanges occurring under the microscope. Moreover, we have suggested that these complexities suggest a different understanding of what it means to produce image of semi-living matter. We argued that instead of contingencies that needed to be addressed before getting on stage, these exchanges with the microscopic required an understanding of matter that admitted non-

human agency. As a result, we have proposed that the production of the bio-image body supposes an assemblage that requires human humbleness to tune in and listen to its constantly changing configuration.

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