VOLUME 1:
COLLABORATIVE PROJECTS

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TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

I conducted a series of six collaborative projects to examine the role and potential for a fashion-led researcher within collaborative fashion and biology projects, from a first-hand perspective. The collaborative projects were undertaken with myself operating as a fashion-led researcher working with biologists, bacteria, fabric and garments. I initiated or worked from the outset of each project as an active practitioner-researcher – a fashion-led researcher. Volume 1 shares my account of each project and documents the key roles and tasks of myself as a fashion-led researcher in the projects. This is to understand how a fashion-led collaborative approach with biologists can operate and how the roles of a fashion-led researcher shifted throughout the projects. The collaborative projects comprised:

- *Lo Lamento*
- *Azazel*
- *Living Light Dress*
- *Living Lace*
- *Oscillatoria Sutured*
- *Aequorea*

LO LAMENTO

Figure 5: *Lo Lamento* (2016). Victoria Geaney, Bernardo Pollak and Anton Kan. Media: bioluminescent *Photobacterium kishitanni* bacteria dress and orbs exhibited at University of Cambridge.

I initiated email contact with the University of Cambridge, who invited me to give a presentation on synthetic biology and fashion, my work with Imperial College iGEM 2014 and the early stages of this research enquiry. The presentation I gave centred on examples of collaborative practice and the potential for producing new materials created using synthetic biology. After the talk, I visited the University of Cambridge Department of Plant Sciences Haseloff Laboratory and conducted a series of unstructured interviews with the PhD candidate synthetic biologists Anton Kan and Bernardo Pollak. This gave me a chance to ask the synthetic biologists about their research and the possibilities and useful properties of bacterial

cellulose and bioluminescent bacteria, and to establish whether there could be opportunities to collaborate.

An opportunity to collaborate emerged when the synthetic biologists informed me that they had funding to produce an art project. One of the attendees at my talk was Alessandra Caggiano, who asked if I could produce a piece for the E-Luminate Festival. Merging these two opportunities led to informal conversations and collaborative ideation regarding a bioluminescent bacterial installation. The synthetic biologists and I spoke about types of bacteria, their properties and how they could be used to produce an artwork. We talked about concepts and the respiration of the bacteria, which could prompt bursts of bioluminescence. The festival provided a shared focus, with a set deadline and public showcase for the project.

We held shared discussions and ideation sessions on concept, logistical and design considerations. We centred in on three alternative concepts, before narrowing down to one in terms of its practicality: combining a central glowing bacterial garment with flowing orbs containing liquid nutrient solution with *Photobacterium kishitanni*.

I produced the designs for the orb system and display case using a computer aided design (CAD) programme to visualise the installation to show the synthetic biologists. Both the synthetic biologists and I worked to test various materials for bacterial growth. I sent them fabric samples and, in the fashion design studio, I tested two different agar solutions: one at 1.5% agar, and one prepared according to the instructions (one tablespoon to 240ml water). I dipped various materials into the agar to see which would retain moisture once coated with the substance.

Our experiments demonstrated that absorbent materials, such as felt and cotton terry towelling, retained greater amounts of the wet agar. Separately, we each found the higher concentration of agar to be more effective. Further, increasing the surface area by using fabrics such as terry towelling, woven with a loop yarn, helped to maintain moisture and encourage bacterial growth. Kan and Pollak sent me photographs showing the fabrics coated in agar and yeast growth medium, inoculated with bacteria. They also noted that layering the fabrics enabled moisture absorption and retention, which made the bacteria glow brighter.

In response, I selected absorbent and natural materials, and I chose white materials to enable the best visibility for the bacterial glow. The primary fabric was raw wool, as this is highly absorbent and is relatively unprocessed. Other materials included white wool felt, medium weight cotton drill, pinstripe polyester acrylic and wool underlay. Layering the parts of the garments allowed for air spaces and areas for retention of the wet media solution, to promote bacterial colonisation as well as for ease of layering and dismantling the garment on the mannequin. Practically, it was also easier to dismantle if one layer were to shrink or not absorb the bacteria. The process and development of garment production followed a typical fashion design process: draping, shaping, machine stitching, reworking, fitting to a mannequin and then a human model, and creating the final design of the garment. This studio-based fashion practice included reflecting on and reworking the garment according to critiques from fashion and textile researchers and following a garment fitting on a human model in the fashion studio.

Timing, making and funding constraints meant that we were unable to test a full-scale garment prior to the festival. The smaller, more absorbent fabric samples had successfully enabled colonisation of the bioluminescent bacteria and thus they glowed. The festival provided an experimental platform to see whether we could successfully reproduce the process at a large scale.

I took the finished garment to Cambridge, where the synthetic biologists produced the nutrient medium from which the garment was to feed, and the garment was autoclaved in the laboratory. This was to sterilise the material to remove all the existing microbes, either transferred by me or from the fabric itself, to prevent mould growth. We worked collaboratively to set up the installation for the festival and carried out the following processes on site to avoid the health and safety issues involved in moving a bacterially coated garment. We coated the dress in agar, waited for it to solidify and then sprayed the garment with liquid medium containing bacteria. We built it and then left it inside an acrylic display case to try to prevent bacterial contamination. We poured further agar and liquid media onto the dress, to ensure it was completely moist and to give the bacteria the best possible chance to grow.

We left the installation overnight, to allow 10 to 15 hours to multiply and grow, and returned the next day to find that the large-scale experiment had worked, and the garment and the orbs were glowing.

During the festival, the synthetic biologists and I spoke to the public about the installation. Various opportunities arose both during and after our collaboration. The festival promoted our project on BBC Radio Cambridge, and we were interviewed about our project. On the first day of the exhibition we filmed interviews organised by the festival, and part of the interview was featured on an online science television show. I wrote to *Design Exchange*, who then featured an article about the work (Plough, 2016), and the work was also featured in an article for the *FashNerd* website (Kapfunde, 2016). These different examples of dissemination highlight how the work sits between two disciplines and was therefore of interest to both design and science audiences.

AZAZEL

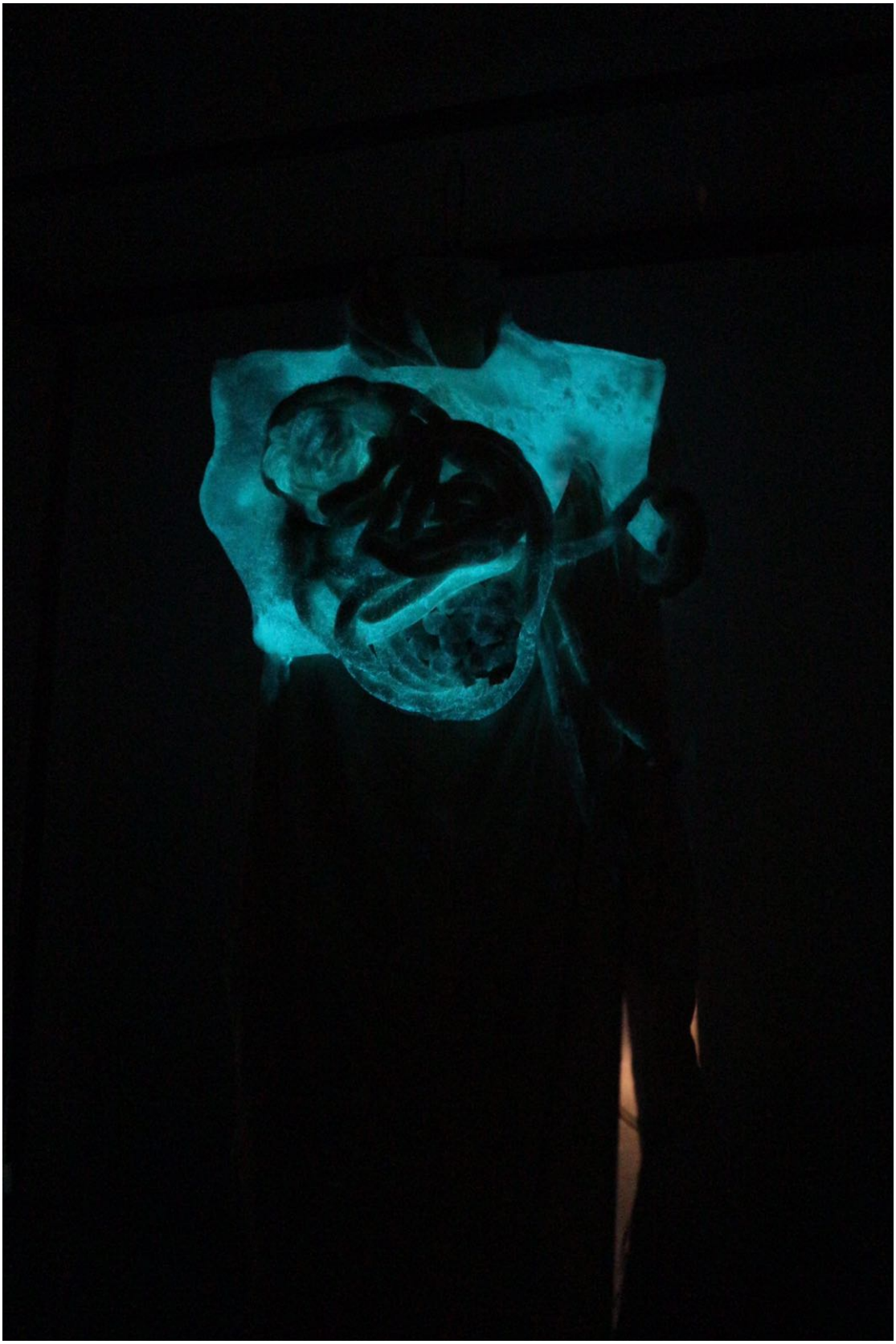

Figure 6: *Azazel* (2016). Victoria Geaney, Bernardo Pollak and Anton Kan. Media: bioluminescent *Photobacterium kishitanni* bacteria dress exhibited at Royal College of Art. Photographer: Teresa Kroenung

Lo Lamento showed the successful growth of bioluminescent bacteria on fabric and the production of a human-scale glowing bioluminesent bacterial dress. The project was positively received by the synthetic biologists, the funding body and the general public. The same process was replicated to create two more temporal installations. Differences occurred in the modes of display, location of installation, concept and purpose.

Azazel was a site-specific work produced for a research exhibition at the Royal College of Art. The exhibition featured the work of four PhD art and design researchers, principally from the School of Fine Art. For this reason, I felt that the expectations of the work had shifted from *Lo Lamento*, as this audience consisted mostly of fine art, design and research students and staff at the university.

The process of organising the exhibition was in itself a collaborative endeavour. I managed and organised the logistical aspects of the *S:Future* exhibition with the other researchers while simultaneously producing individual and collaborative site-specific outcomes to exhibit within it.

To me, the necessity for a strong art concept became important when shifting this work from a festival setting (*Lo Lamento*) to that of an art gallery (*Azazel*). I worked to research, shape, drape on the mannequin and produce computer aided designs. The concept centred on the question of why I wanted to work with living matter, asking questions about human reliance on the bacteria, as well as the bacteria's reliance on the human. This was articulated to the other researchers, my tutors and to the Dean of the School of Fine Art, along with images of the draped garment at the centre of the installation and examples of the computer aided designs.

During this project there was a conflict of intentions with the synthetic biologists, who perceived the name of the piece and the concept as problematic. When I shared the designs and narrative, the synthetic biologists were concerned about the religious connotations of the title. They also emphasised that the works should be credited equally, with the three human collaborators as co-authors. They suggested that a descriptive name would be more suitable. It became clear that there were different drivers behind our opinions and expectations for *Azazel*, in comparison to the shared vision and research questions for *Lo Lamento*.

Following the positive reaction to *Lo Lamento*, both in terms of its successful production and through its wider promotion following the festival, there was a higher expectation for *Azazel*. We knew we were able to successfully create a glowing bioluminescent bacterial installation; however, I was now asking new research questions regarding the meaning of doing so, whereas the synthetic biologists were keen to reproduce the first experiment. This shows a key difference in expectations, driven on my part by the shift in context to an art gallery. Whilst I was now exploring new ideas which had arisen in my own research through working with bacteria, the synthetic biologists were concerned with the wider perception of our final outcome as a reflection on themselves and their work. I knew we were able to produce a bioluminescent dress, so I was asking why and what this meant, in the light of the theoretical and contextual backdrop to this research.

My role at this point became one of mediator – responding to the concerns of the synthetic biologists regarding the attribution of the work, assuring them of the importance I felt in acknowledging all of our roles as collaborators and emphasising that this exhibition was motivated by art and fashion design research. I reassured them that there was no need to use the same name or concept for the work. I reiterated the importance of our shared outcome and showed a visual representation, using computer aided design technology, to highlight what that could look like.

Stakeholders became more important after the promotion, publicity and feedback from *Lo Lamento*. There was now an awareness that the project was of interest to a wider audience, encompassing the public, scientists, artists and designers. In the promotional materials for the exhibition I did not mention the title or concept, due to its religious connotations, as this was an area of disagreement between me and the synthetic biologists. I therefore referred to the work as a bioluminescent bacterial, or 'living light', dress. To me, the naming of the work is of great importance; however, this disagreement had led to a compromise on my part in order to continue the collaboration. This difference in opinion, and in the way that the work was seen, understood and articulated showed that creative control can be reduced when operating in a collaboration. This conflict was resolved when I agreed not to articulate my concept outside of the research context.

Evidence of bacterial agency was also more apparent in this piece, due to the choice of materials. I used a wool and cashmere blend for the lower part of the garment, and we covered

the piece fully in agar medium and inoculated it with bacteria; however, it did not grow, and thus did not glow, on the lower part. In this way the bacteria affected the process of the work, demonstrating a form of agency through non-growth, which affected the design. This reminded me that the bacteria is alive and exhibits agency through action or non-action, depending on our provocations.

LIVING LIGHT DRESS

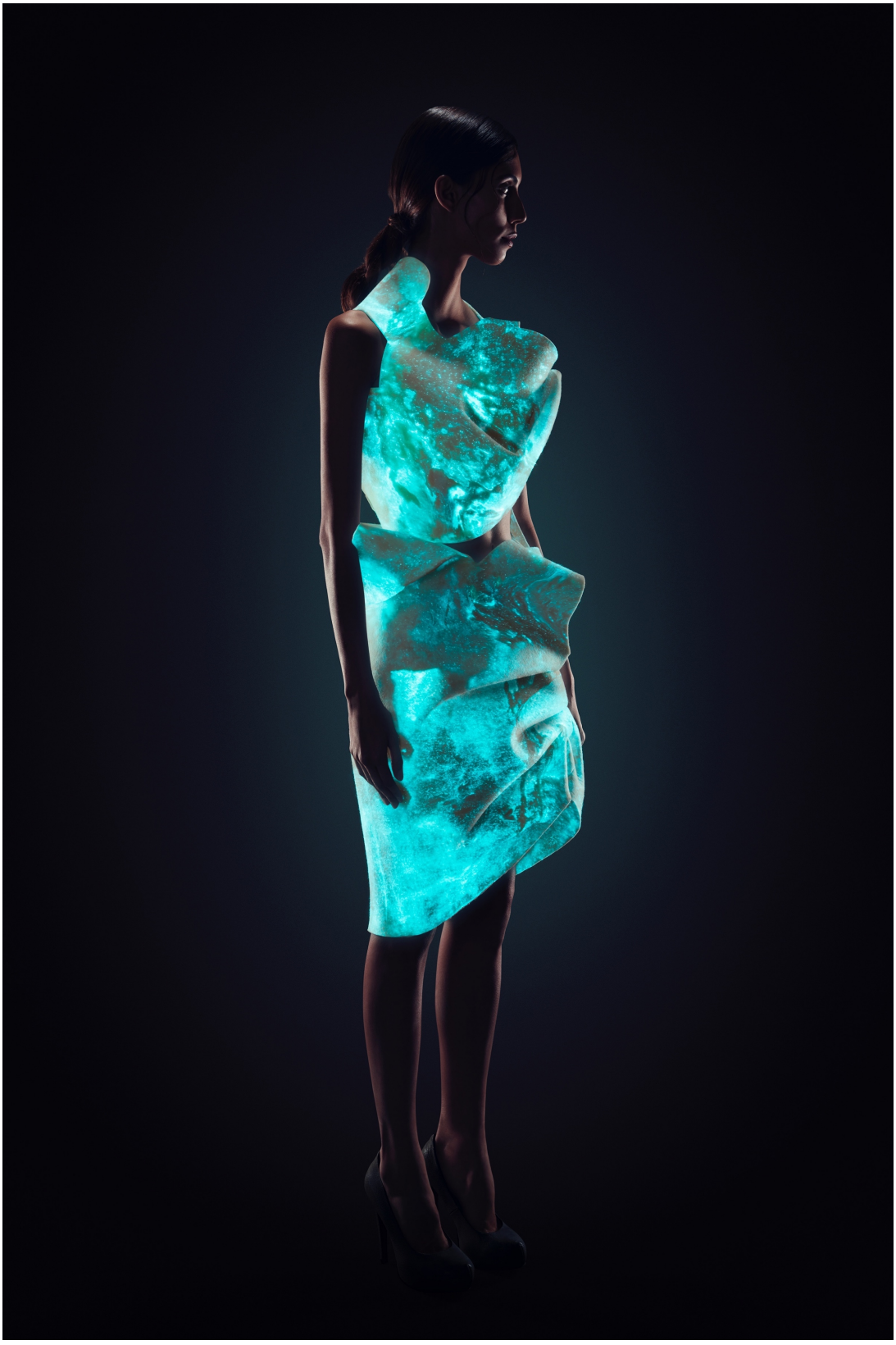

Figure 7: *Living Light Dress* (2017). Victoria Geaney, Bernardo Pollak and Anton Kan. Media: *Photobacterium kishitanni* dress for Wired Magazine, February 2017. Photographer: Chris Hoare. Model: Manuella Gomide at d1 Models. Hair and make-up: Victoria Winfield. © Victoria Geaney, Bernardo Pollak and Anton Kan, all rights reserved, photography by Chris Hoare.

The *Living Light Dress* was produced for a magazine photoshoot and was the third collaboration produced with the University of Cambridge.

My initial role was as convener: co-ordinating, organising, managing and facilitating the project. In addition, I worked to publicise our projects by emailing details, images and information to many publications. During my early research, and on my initial entry looking into the areas of biotechnology and synthetic biology, I was aware of *Wired* magazine as a key publication focusing on advances in technology and science, and therefore it was felt that the project would be of interest to the magazine (Lott-Lavigna, R., 2017). This led to a photoshoot for *Wired*, which was organised in tandem with the magazine, a photographer and a synthetic biologist. The magazine organised the model and photographer and I operated between the agents, bringing the different actors together in the space. The magazine embraced the fashion aspect of the work, with its role in highlighting an opening for new audiences in technology-based editorial spaces.

My primary role then shifted to fashion design researcher, working individually and drawing on fashion design methods that included studio-based fashion practice, draping on the mannequin, designing, stitching and fitting the garment. I used raw wool, as the bacteria had grown effectively on this fabric during *Lo Lamento* and *Azazel*. I placed a strong emphasis on displaying my work, according to fashion design methods, and I wanted to showcase the aesthetic of the glowing bioluminescent bacteria.

The outcome was also partly affected by the bacteria, and our placement of the nutrient-enriched agar and areas of inoculation, which, as the synthetic biologist noted, contributed to the aesthetic of the design:

> At the macro scale on the fabric the bacteria were doing interesting stuff (patterning due to colonization preference and bioluminescence level due to moisture content of the fabric for instance) (Pollak, B., 2016).

In viewing the bacteria as a co-creator in these collaborations, the notion of the colonisation of the material being affected by living microbes is particularly interesting. The consideration of the bacteria, by both myself and the synthetic biologists, elevates this nonhuman actor arguably

to a similar agential role of an end-user or client. A bacteria-centred driven, or nonhuman, design approach poses a range of questions about authorship, co-creation, bioethics and sustainability.

As display is important as an inherent part of fashion practice, I arranged to work with a hair and make-up artist, so that the model and photographs would look professional and resemble a fashion photoshoot. The public outcome of the design, for distribution in a national magazine, meant that I felt there was also a perceived importance in the project in terms of its promotion of myself as a fashion maker and fashion design researcher. This caused tension in my making process which led me to ask the opinion of Tristan Webber, Senior Tutor of the Masters in Fashion programme in the fashion studio at the Royal College of Art, for approval of the design before submitting it to the magazine. To me, this intradisciplinary collaborative approach enabled an engagement within the fashion design discipline, which I then felt confident to take outside of the discipline for inclusion in the magazine, to be viewed by a science and technology-oriented audience.

During the photoshoot, I worked collaboratively, liaising between collaborators, including the make-up artist, model and photographer. This was to ensure that the model and the garment were both displayed in the style of current fashion imagery. I had gathered a selection of fashion images to discuss with the make-up artist so that we could work on a shared vision for the overall look of the photoshoot.

At the end of the first day of shooting the garment on the human model, my role shifted. When the synthetic biologist arrived, he and I undertook a collaborative working method which we had developed over the previous projects (*Lo Lamento* and *Azazel*), to prepare the garment for bacterial inoculation. We worked together to antibacterially clean the studio area and the mannequin. We coated the garment in heated agar medium solution and draped the mannequin with the garment. Thus a blurring of the roles of the synthetic biologist and fashion-led researcher occured at this point although I was still preoccupied with the display of the outcome, whereas the synthetic biologist was focused on the logistics of the task of coverage and bacterial inoculation. I padded the mannequin to achieve a similar shape to that of the human model, aiming to match the shape of the wet agar-coated garment on the mannequin to that of the photograph of the model. Although never explicitly discussed, a recurring task

carried out by the synthetic biologist for each of the experiments was to inoculate the garment with the bacteria.

Kan and Pollak produced large quantities of the nutrient medium solution required for the bacteria, as well as culturing and studying the bacteria to the point where they were able to predict when the bioluminescent bacterial glow would start to occur, or 'switch on'. This research led to great accuracy, which enabled the scheduling of the photoshoot on the second day to coincide perfectly with the time of the brightest glow of the bacteria.

The photoshoot was carried out over a period of two days: on the first day a professional model was able to wear the garment without the application of the bacteria, and on the second day the garment was prepared on the mannequin, having been coated in agar and inoculated with the *Photobacterium kishitanni* the evening before. The luminescent glow began at around 11am on the second day, and the photographer was able to capture this biological effect on camera. The image was then put together and superimposed, placing the bioluminescent effect onto the image of the live model from day 1.

This hyperreal image shows a speculative fashion design, as the reality of wearing the live bacterial garment was deemed too hazardous by the synthetic biologists. Figure 7 shows the final photograph which appeared in the magazine. This manipulated image shows the body and dress acting as a scaffold for a living light bacterial system. The actuality is that this would be a lot messier and smellier as a wearable garment, as the dress is drenched in yeast, salt, agar and nutrients for the bacteria. The piece was also ephemeral, living only for three days, or as long as we continued to feed the colony, which showed us that it is living through its light emittance.

LIVING LACE

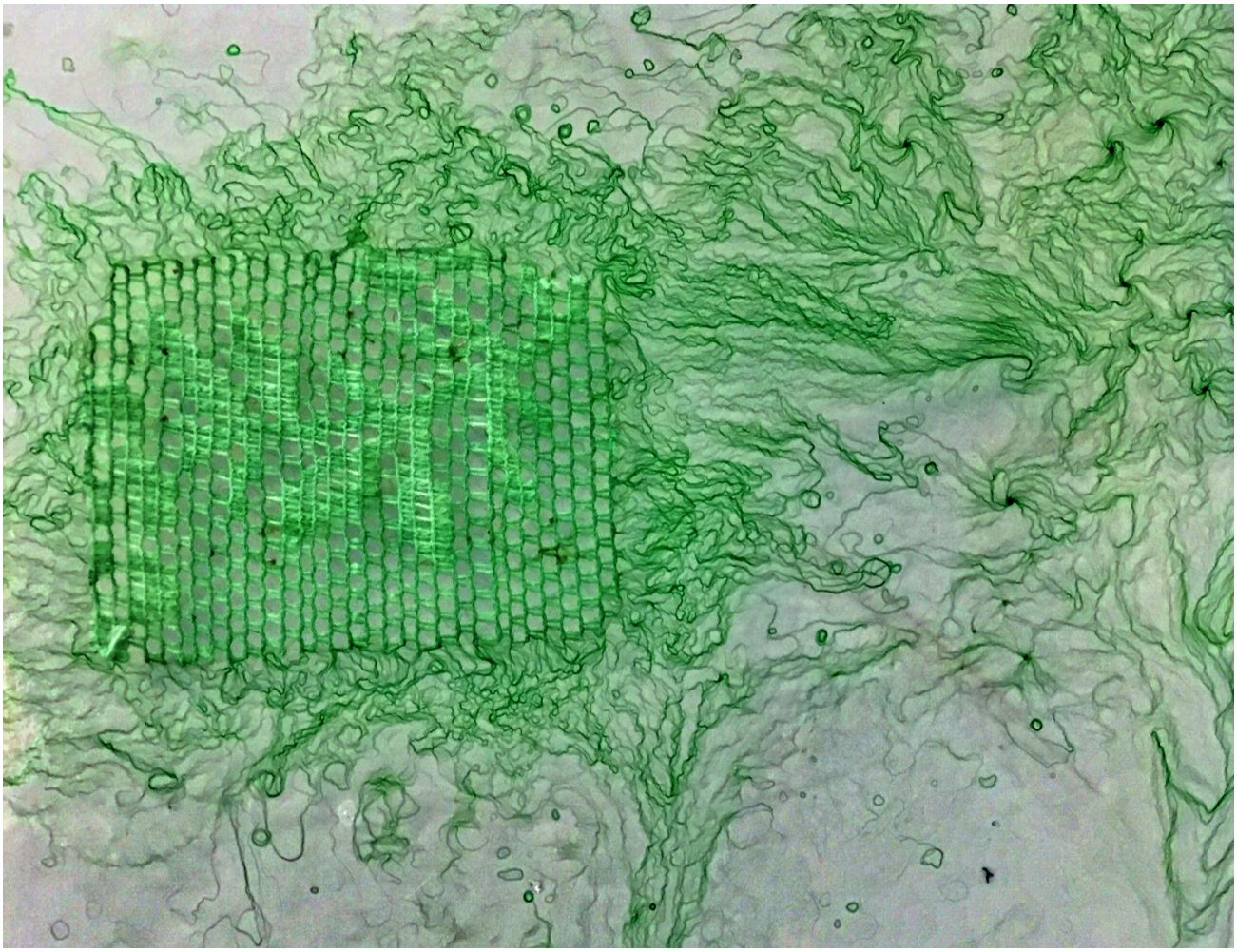

Figure 8: *Living Lace* (2016). Victoria Geaney and Dr Simon Park. Media: photosynthetic *Cyanobacteria oscillatoria* grown over cotton lace on agar plate.

During exploratory research into science and art and the use of bacteria, I started following the website on which the microbiologist Simon Park documents his experimental artistic practice that utilises many different types of bacteria (Exploring The Invisible, 2012). I wrote to him in order to ask to meet up and to interview him regarding his thoughts on collaborative practices between artists, designers and biologists, and to find out about his research into bioluminescent bacteria, bacteria and material possibilities and his thoughts on my early research questions.

In a similar method to the first set of experiments, I visited Park at the University of Surrey, conducting a semi-structured interview in order to find out more about his experiences of collaboration, his background in microbiology and working with bacteria, and his thoughts on

artistic practice in these areas. We spoke about possibilities for biotextiles, and in detail about cyanobacteria and its history and self-repairing and photosynthetic properties.

As with the Cambridge synthetic biologists, the initial interview with Park turned into an ideation session, exchanging insights and concepts in relation to biomaterials which could incorporate textiles and bacteria.

This led to new ideas regarding the possibility of a cyanobacterial textile, and an initial idea which I emailed Dr Park about:

> I have been thinking a lot more about the idea of the inflating 'garment' that can be suspended in the flask with the Helion, and I think it would be great to do some sort of a ghost mini installation - if you would be happy to collaborate on this? I have been researching into illusions and have come across the Pepper's Ghost experiment. I would like to slowly suspend and spin the mini and perhaps inflating or somehow expanding garment into the flask, and then to see how the Helion works to expand and contract with the piece. I think that I could film this and then project it as an installation combining with a fashion model (perhaps rotating) which would then enlarge the whole piece whilst making it look like a spectre or ghost.
>
> In this way, the piece is both real and living and yet simultaneously ethereal […] What do you think? I can send you some designs via the internet, and will try send you some fabrics in the post, if you wouldn't mind testing which ones the helion grows best on or prefers - would that be ok in terms of synthetic, natural or combinations of the two? If not, I can visit sometime in the next few weeks and work together to test? Anyway, please let me know what you think and if you like or don't like the idea? (Geaney, V., 2016e).

This reveals that through his collaboration with a fashion-led researcher, for the first time Park considered growing bacteria over or onto pre-existing materials. These bacterial-material hybrids signalled a shift in his own thinking towards a consideration of how biotextiles could operate, and led to the successful production of material samples. This reveals that the influence of different modes of thinking between fashion practitioners and biologists can lead to novel methods and outcomes.

For the first experiments Park and I worked upon, we used a suspended culture of cyanobacteria in a BG11 broth liquid medium freshwater solution. Park used a Bunsen burner to sterilize the work surface, then an inoculating loop to transfer cyanobacterial cells to the growth medium. We placed a number of fabric samples in the liquid medium: cotton lace, felt, polyester and nylon spacer mesh fabric backed neoprene, various silks, organza, and white cotton shirting. We selected mostly white-coloured materials in order to offer the widest distinction between the green colour of the bacteria, and to show the cyanobacterial growth on the materials. After just four days, Park reported: 'Some slight greening of some of your textiles so Helion 14 looks to be colonising some of them' (Park, 2016a). After nine days, and in response to my question about whether the cyanobacteria preferred particular materials, Park responded that the bacteria was 'spreading generally and quite green now' (Park, 2016b).

After a few weeks, I visited the laboratory and, on inspection of the materials, found that the cyanobacteria had colonised the edges of various fabrics. The sample of organza had become almost entirely coated, and therefore offered an example of a hybrid bacterial-material. The liquid medium allowed the bacteria to feed and grow in order to form, whilst fully immersed. I took photographs and filmed the bacterial-material hybrid inside a liquid medium, whilst circulating its glass container. The cyanobacteria and its photosynthetic properties meant that it was respiring and living, the material providing a surface, or scaffold, for the biomaterial. To me, this hybrid biomaterial signified a body without a body – something which was living, although not human. The experiment was performative and alive, expanding fashion practices to incorporate the role of provocateur and, to me, it acted to question our understanding of what fashion-led research and thinking is, and can be. The experiment was characterised by the absence of typical fashion design methods such as sewing, draping, use of a mannequin or human form and commercial applications. Instead, although the performance is provoked by the human, the 'body' here becomes the bacteria – the material woven by the cyanobacteria. To me, this early exploratory work questioned our understanding of fashion and moved it towards new forms of design; these new co-creations can occur when working with bacteria and allowing their own properties to contribute to the piece. The self-weaving nature of the cyanobacteria removes the requirement for stitching and pulling into the shape of a human body. The placing of the bacteria in a liquid medium eliminates the human from the experiment: this piece survived and thrived underwater. The material acts as a scaffold to support the bacteria – operating as a fabric structure, a surface layer, a second skin.

In order to test whether the biomaterial could grow effectively outside of the liquid medium, Park and I placed cotton lace samples on an assay tray filled with agar. The agar provided a nutrient base which the bacteria could feed from and thus grow, and we wanted to see whether we could produce a photosynthetic biotextile. This, in turn, could lead to the potential production of larger forms, such as a garment. Park inoculated the tray and lace sample with the cyanobacteria, and placed the lid back onto the tray. We left the cyanobacteria to form over the cotton lace, which led to the production of *Living Lace*.

To me the naming of the work was important, mainly due to its relevance and the fact that an identifying title was needed when showcasing the project on platforms of dissemination such as websites and during presentations. The names of the projects were usually connected to the concept; however, here *Living Lace* was titled in an explanatory manner, as the work was the result of sampling rather than a specific concept.

Cyanobacteria is a type of photosynthetic bacteria converting sunlight into energy for respiration, turning carbon dioxide into oxygen. These experimental textiles investigate both the speculative potential of photosynthetic materials and the symbiotic relationship between humans and nonhumans. This blurring or entangled co-authorship is characterised through mutual respiration: the humans (microbiologist and fashion-led researcher) expending carbon dioxide and thus inhaling the oxygen produced by the bacterial 'other'. The piece, then, becomes both an artwork and a symbolic exchange for an interdependency and a mode of communication with other life forms, beyond language. The material merely highlights the human intervention, and in fact shows that the design of the bacteria itself is far more complex and beautiful than the lace scaffold we aimed to hybridise it with.

Speculatively these materials, which combine cyanobacteria and cotton lace, are interesting to consider in terms of future material developments. This is because, like plants, they only require sunlight, water and carbon dioxide. For example, genetic engineering and synthetic biology could one day lead to the adaptation of plants with a dual purpose, in a similar way to Carole Collet's speculative 'Biolace' designs, to incorporate the growth of fruit and lace respectively in one engineered plant (Collet, 2012a:6–7).

In the *Living Lace* pieces the cyanobacteria responds to and respires in sunlight, so using this photosynthesis as a property could enable a novel way of patterning hybrid living and non-living textiles. The bacteria grow towards the light source and so by covering parts, or moving the light source, different patterns and effects could be achieved.

OSCILLATORIA SUTURED

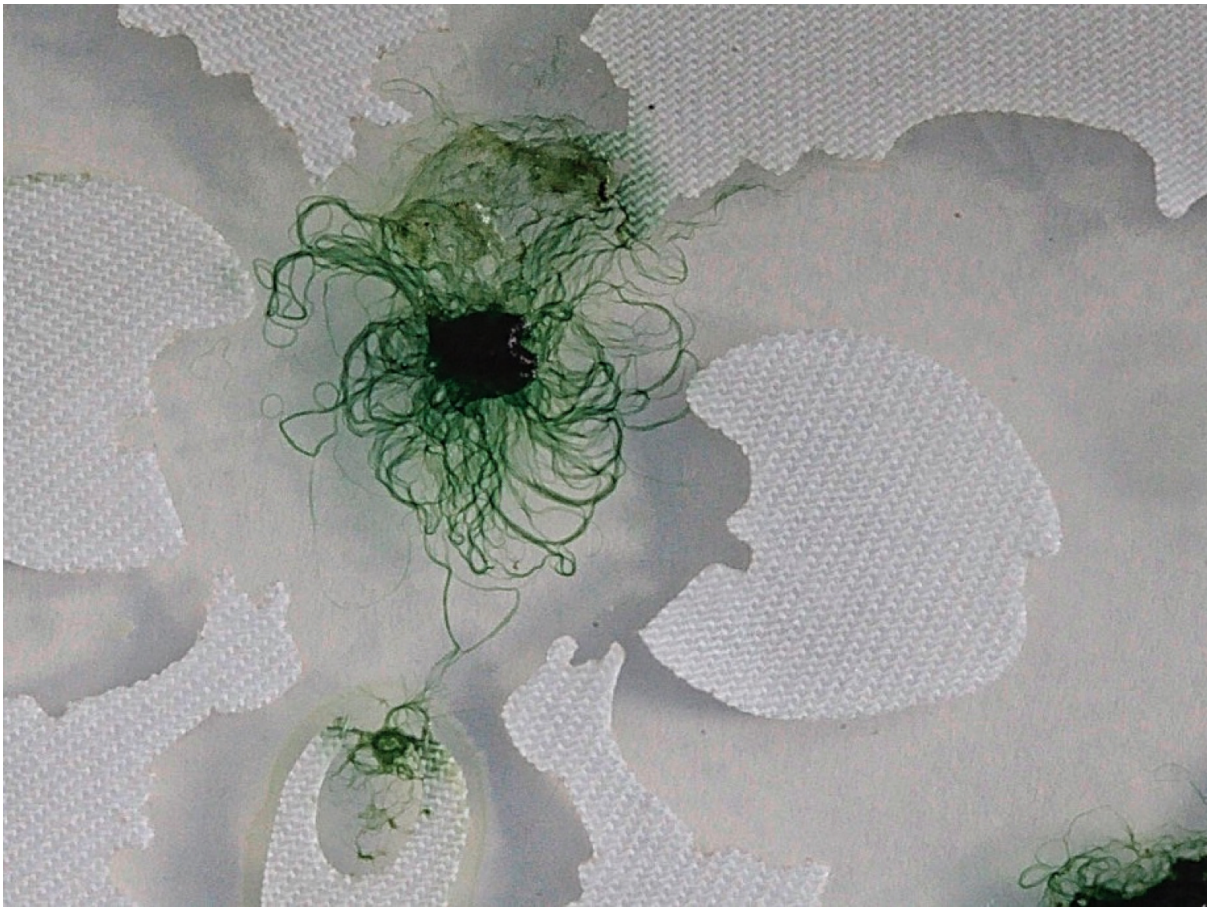

Figure 9: *Oscillatoria Sutured* (2016). Victoria Geaney and Dr Simon Park. Media: photosynthetic *Cyanobacteria oscillatoria* grown on agar plate with laser-cut cotton.

I worked with Park at the University of Surrey to understand more about cyanobacteria, which is a type of photosynthetic bacteria that produces oxygen and fixes nitrogen (see *Living Lace*). Park had been experimenting with the cyanobacteria inside liquid media forms, and had grown a form around a pipette. Unfortunately he dropped the container, managing not to spill the contents but causing the bacterial form to dismantle. However, what is interesting is that the bacteria reformed itself, in the same shape as he had left it (Exploring the Invisible, 2016). This ability to self-heal or self-repair is intriguing when working in an applied way in the context of materials.

In October 2016, Park and I produced an installation for the Biofaction exhibit at Vienna Design Week (Biofaction, 2016). Due to time and size restrictions, I was interested in exploring work situated away from the body. In *Oscillatoria Sutured*, 'oscillatoria' refers to

the type of bacteria and 'sutured' highlights the metaphoric cuts and rifts between humans and the bacterial world. Drawing on the self-repairing property of the bacteria, I laser-cut the fabric into a world map, a map of Pangea, a sutured skull, and a lace dress. Pangea was included as a reference to a connected world, where the boundaries of countries were eliminated to form one supercontinent; this is in contrast to the defined countries on our current world map, and to allude to these as divisions. The cyanobacteria was intended to conceptually 'heal' these divisions by reconnecting the countries, influenced by the ideas of self-repair and self-healing.

White cotton was used, as it is a natural fibre, and the light colour was selected to contrast and showcase the colour of the bacteria. The laser-cut pieces were placed in clear assay trays and acrylic globes.

I travelled to the University of Surrey, and Park prepared the heated agar solution. We both cleaned the assay trays and globes, and poured the agar and nutrients into them, and I inoculated the trays with samples of Park's cyanobacteria. My intention was that the cyanobacteria would start on either side of the agar channels, within the assay trays and globes, and would grow across thus closing or healing these rifts and sutures. The concept was to show, aesthetically, that these rifts can be healed quite perfectly and beautifully by nature or bacteria itself, and thus embodies the idea of reconnecting and healing through biodesign and biomaterials.

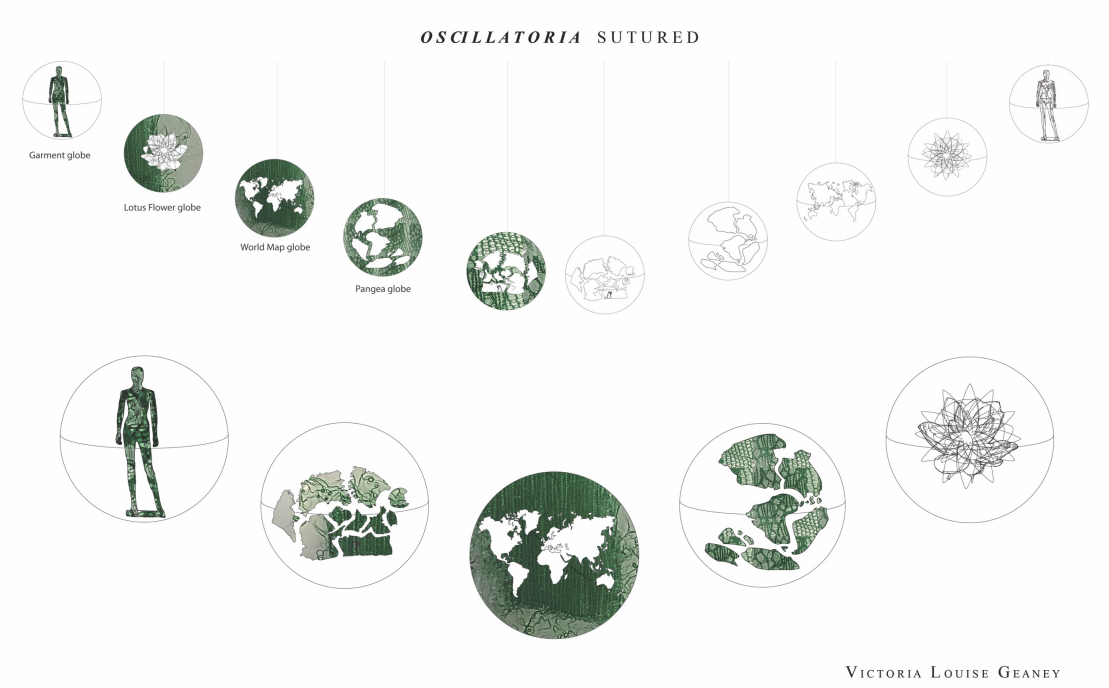

Figure 10: *Oscillatoria Sutured* working drawing (2016). Victoria Geaney. © Victoria Geaney, all rights reserved.

AEQUOREA

Figure 11: *Aequorea* (2016). Victoria Geaney, Phoebe Wang and Puraffinity. Media: laboratory-grown bacterial cellulose. Photographer: Teresa Kroenung. © Victoria Geaney, Phoebe Wang and Puraffinity, all rights reserved, photography by Teresa Kroenung

I previously worked with members of the 2014 Imperial College iGEM team, who went on to form a company – Puraffinity. The synthetic biologists initiated this project and set the brief. They asked if I could produce a project to showcase their functionalised bacterial cellulose material, which they had generated using synthetic biology techniques. They grew the cellulose in the laboratories at Imperial College and the piece was created using biomaterial samples for the October 2016 Imperial Fringe exhibition.

I worked with fashion PhD candidate and researcher Dr Phoebe Wang (Hong Kong Polytechnic) and we held meetings with the synthetic biologists at Imperial College in order to understand what they were looking for, and to collaboratively ideate with them regarding the final outcome. Wang and I focused on a garment, due to our shared backgrounds in fashion. We used samples of bacterial cellulose grown in the laboratory by the synthetic biologists, in response to our design requirements, requests, critique and feedback. The synthetic biologists were responsible for growing, treating and dyeing the materials and delivering samples to Wang and I.

Wang and I collaboratively draped the material samples over the mannequin to produce the final design. This meant that decisions were made collaboratively and materials were draped according to combined design choices. However, the making still involved each fashion design researcher working on their own section of material and therefore asserting their own agency in the final outcome. For example, Wang folded one of the lighter sheets into a fan-like shape, and I scrunched the indigo blue into an organic, floral form. In order to interrogate typical fashion design methods we made minimal use of the sewing machine and thread and we responded to the qualities of the bacterial cellulose material, which draped and held its own shape well. It bonded together well as a material, without the requirement for stitching or adhesives.

The cellulose sheets differed in grade, width and feel, with a larger piece cut horizontally into thinner sheets to produce divergent properties. The dark indigo fabric held its shape well and was quite similar in that respect to a shape memory material, retaining its shape when scrunched or formed into a shape. The white material used at the shoulder was papery in feel, light and could one day have applications in areas such as the production of an (expensive) alternative to plastic bags. The lighter blue material which was next to it had been dyed, and

held the dye well, although this began to discolour the materials around it, which could signal a problem of dye running if used for wearable garment production.

We used a mannequin to display the final outcome, and it was shaped to a female garment form. The piece alluded to a wearable garment however the samples were not large enough to produce a workable outcome, so the piece was created solely for display purposes. The use of the different textures of bacterial cellulose and the display of the mannequin at table height enabled visitors to touch and feel the material, which allowed feedback and interaction between the synthetic biologists, the fashion design researchers and the general public. For example, the yellowish-brown coloured material draped at the front of the piece was coated in a natural wax and, as such, was viewed as quite strange and almost skin-like in feel. This grade of the material was viewed as more controversial by visitors wanting to touch the biomaterials at the Imperial Fringe exhibition.

The final outcomes were principally a showcase of the biomaterial samples and project that had been initiated by the synthetic biologists. Wang and I were led by their brief; however, our feedback was used in order to aim to improve the material, to ultimately develop and explore the potential for bacterial cellulose utilising synthetic biology. These biomaterials are still at the development stage and these early iterations are useful to experiment with. Future iterations could be adapted with the potential for properties to be genetically designed using synthetic biology techniques. There is potential scope for the application of the natural waxes and oils that are used for leather, as well as adaptation at a genetic level for building in properties.