Carole Collet's publication took the form of a folder containing a number of documents in different formats and printed on different paper stocks. All are reproduced on the following pages at 80% actual size (if this document is printed A4). Graphic design: Phil Baines

ual: central saint martins

Design & Living Systems LAB

University of the Arts London
Professorial Platform 2017

Designing for the biocentury

Carole Collet
Professor
in Design for Sustainable Futures

Covers (outside) folded to 240 x 180mm

Designing for the Biocentury 4 July 2017

Lecture abstract

Professor Carole Collet explores the interface of biological sciences and design to challenge established paradigms and envision new sustainable materials and forms of production for the future. Collet will be discussing her research work, at the intersection of design and biology, and her investigation into new ways of making informed by bio-fabrication, botany, biomimicry and synthetic biology. How do we evolve design protocols from the hand-made and the man-made to the 'grow-made'? What kind of design species do we become? The lecture will unravel the story behind selected research projects and discuss a new framework for 'designing with the living' which helps define how designers can engage with the emerging bio-circular economy.

Carole Collet has dedicated her career to developing a new vision for design, and pioneered the discipline of Textile Futures at Central Saint Martins in 2000. She is now Professor in Design for Sustainable Futures, Director of the Design & Living Systems Lab, and LVMH CSM Director of Sustainable Innovation at Central Saint Martins, University of the Arts. Her design research focuses on exploring the intersection of biology and design to develop reflective and disruptive sustainable design proposals. Collet's ambition is to elevate the status of design to become a powerful tool that contributes to developing innovative paths to achieve the 'one planet lifestyle'. Her recent curation of 'Alive, New Design Frontiers' (www.thisisalive.com) questions the emerging role of the designer when working with living materials and technologies such as synthetic biology, and establishes an original framework for designing with the living via the lens of sustainability. One of Collet's characteristics is that she takes on different research roles, from designer, to curator and educator. This enables her to develop an informed critique of both the design outputs and the design contexts, from making knowledge to framing knowledge. Her work has been featured in international exhibitions and she regularly contributes to conferences on the subject of textile futures, biodesign, biomimicry, synthetic biology, future manufacturing and bio-materiality, sustainable design and climate change.

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University of the Arts London is Europe's largest specialist art and design university and a vibrant world centre for innovation drawing together six distinctive and distinguished Colleges with international reputations in art, design, fashion, communications and performing arts: Camberwell College of Arts, Central Saint Martins, Chelsea College of Arts, London College of Communication, London College of Fashion, and Wimbledon College of Arts. Proudly associated with some of the most original thinkers and practitioners in the arts, the University continues to innovate, challenge convention, and nurture exceptional talents. One of our goals is to sustain and develop a world-class research culture that supports and informs the university's academic profile. As a leader in the arts and design sector, we aim to clearly articulate the practice-based nature of much of our research, and in doing so to demonstrate the importance of the creative arts to scholarly research. The Professorial Platforms series is an opportunity for University colleagues and associates, as well as invited members of the public to learn more about the research undertaken in the University. The Platforms enable Professors to highlight their field of interest and the University, in turn, to recognise and commemorate their successes to date.

Graphic design: Phil Baines
Printing: Artquarters Press

Covers (inside) folded to 240 x 180mm

University of the Arts London Professorial Platform 2017

Designing for the biocentury

Carole Collet Professor

in Design for Sustainable Futures

Catalogue contents
(in no particular order)

List, 100 x 200mm, double-sided

From biomimicry to biofacture:
A framework for designing with living systems

(Towards a new hierarchy of design relationships with the natural world.)

Nature as a model	Nature as a co-worker	Nature as a 'hackable' system
biomimicry principles	husbandry principles	bioengineering principles
'natural' Nature	'natural' Nature	'synthetic' Nature
designer	designer cultivator	designer biologist

Botanical Craft

(Work in progress)

Botanical Craft is a design research project that revisits the traditional craft of gourd moulding as found in China under the Qing dynasty in the 18th century. By investigating botanical techniques to grow products instead of materials, the project explores the concept of 'slow horticulturing' versus rapid manufacturing.

Each 180 x 140mm, single-sided, on trace

Basil No.5

(Ocimum Basilicum Rosa)

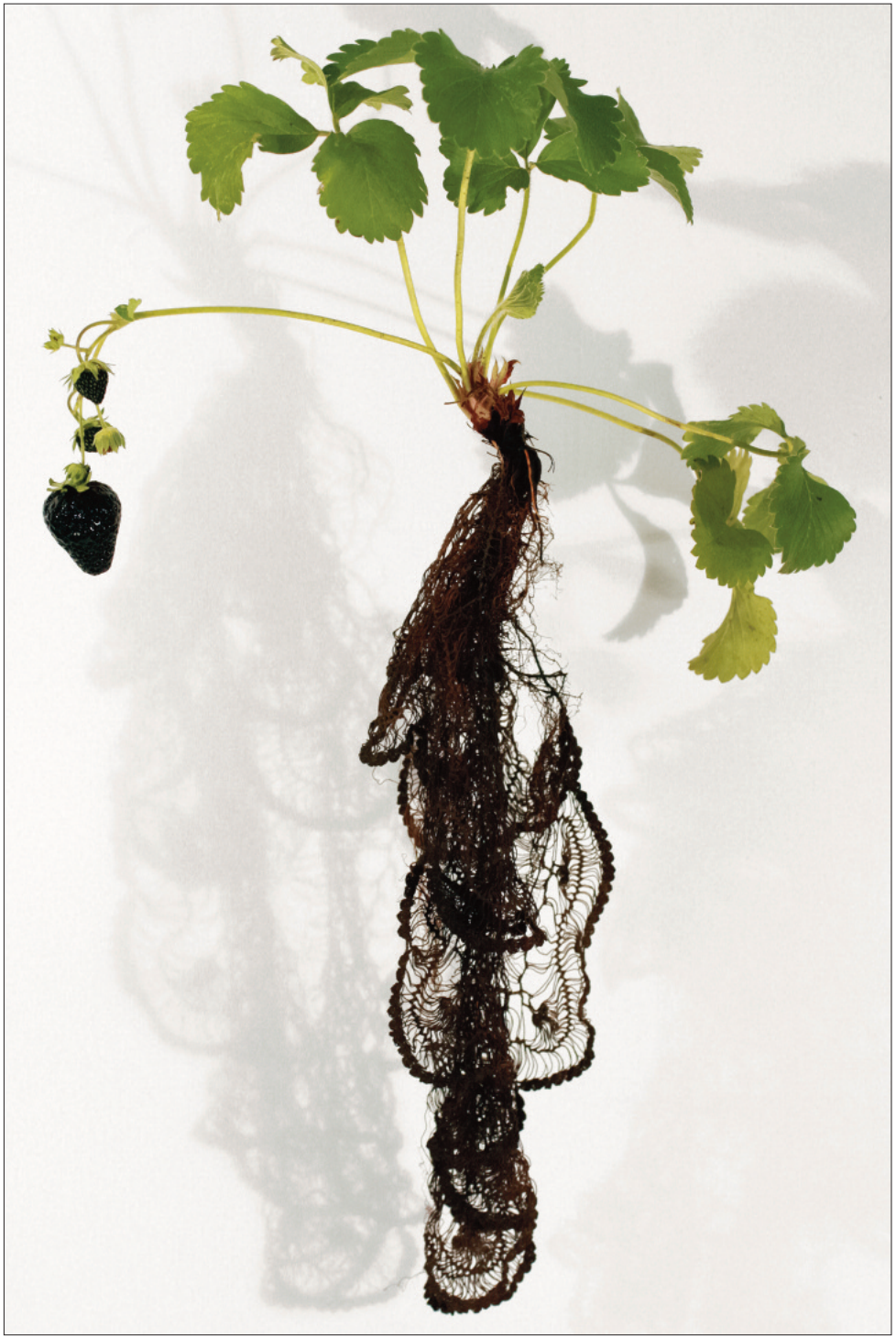
Produces perfumed lace for luxury fashion trimmings, culinary herb and anti viral medicine.

Strawberry Noir

(Fragaria Fusca Tenebris)

Produces black strawberries with high levels of anthocyanin and Vitamin C, and black lace doilies for the fashion market.

Strawberry Noir, part of the *Biolace* series © Carole Collet 2012



2/3 cards, each 240 x 180mm

Raccoon and Lynx Fungi

Crossing the animal, vegetal and mineral divide for alternative fur production, a hypothesis.

Part of the *Future Hybrids* series © Carole Collet 2014

3/3 cards, each 240 x 180mm

University of the Arts London Professorial Platform 2017

Designing for the biocentury

Carole Collet, Professor

in Design for Sustainable Futures
Director, Design & Living Systems Lab

The enthusiasm with which Collet embraces science is pioneering an exciting new direction for design practice. As she straddles the divide between nature and science, moves between playful expression and intellectual discourse and works within a vast repertoire of materials, Collet seems to be creating a new discipline where design, science and sustainability meet.

Bradley Quinn, 2010[1]

Design research in not a linear process, but an interconnected series of experiments, questions, and hypotheses manifested through shapes and forms, speculations and provocations. I deliberately chose to organise this Professorial Platform publication in what may seem at first a disorderly manner, but is effectively a means to map fragments of my research journey over the past decade. Each research question has led to another. Each design proposition has opened up new interrogations. Each publication and exhibition has led to a new set of encounters. Every bit of new knowledge echoes a previous one and resonates with the next. Hence why I am inviting the readers of this publication to choose their own point of entry into my research practice by simply selecting a card or a text at random.

Each project presented here is another facet of the same key research question: how can the intersection of biological sciences and design help challenge established design paradigms and explore new sustainable materials and forms of production for the future?

The design strategies vary from speculation, to innovative material development, and poetic interpretations. My quest is manifested in multifarious forms: from craft and design practice, to workshop facilitation, curation, and publication; and my research is informed by a range of disciplines which vary from textiles to botany, biomimicry and synthetic biology.

Originally educated as a textile designer, my foremost design skills involve the making of the everyday, the transformation of materials into fibres, surfaces and fabrics, and the indulgence of designing the poetics and aesthetics of our surroundings. Whilst textiles perform an understated key role in fashion and architecture, they can become an intelligent interface, embody a craft practice, and are a means to collect and express our cultures. Unfortunately, they are also the product of one of the most toxic industrial manufacturing models: 'Textiles is fourth in the ranking of product category which causes the greatest environmental impact, just after food & drinks, transport and housing'.[2] I am an ecologist. Reconciling my passion for textiles and design with sustainability has always been my focus within both my teaching and research practices. Below is a list of highlights and selected key ideas and projects that have shaped my career to date and my contribution to knowledge.

Textile Futures: The disobedient curriculum

2017 marks twenty years of my teaching role at Central Saint Martins from when I first embarked on shaping the foundations of a new Masters in Textile Futures, a disobedient curriculum with sustainability at its core. Breaking away from traditional approaches to textiles, in 2000 this new Masters established the discipline of Textile Futures, in which textiles is conceived as a research tool to evolve new ideas fit for the future, disrupting the design process and challenging production protocols. The course endorsed an exploration of creative processes and technologies informed by future predictions related to globalization, climate change, new technologies, scientific research and ecological production.

Design & Living Systems Lab

It is estimated that, as a global population, we are exploiting our raw planetary resources faster than they can regenerate, when they can indeed regenerate at all.[3] With a predicted additional three billion people alive in 2050, we urgently need to engage in a meaningful transition to a sustainable way of designing and manufacturing. Informed by biomimicry (the emulation of Nature's principles), some of

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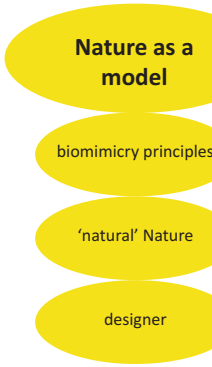
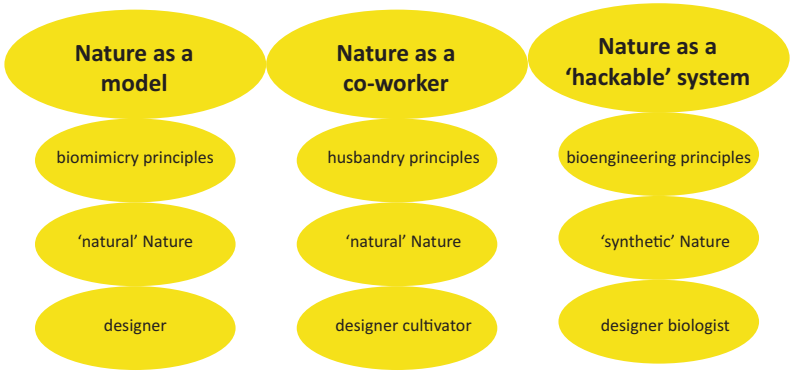


From Biomimicry to Biofactu
A framework for designing w
© Carole Collet, 2013

the most powerful answers are beginning to arise as a result of collaborations across design and biology. Not only have we acknowledged the advantage of biological systems in terms of zero waste and cyclic material and energy flows but, with synthetic biology, we are also beginning to develop means to bio-fabricate like 'Nature' does. By altering the DNA code or the environment of growth of living organisms, we can today 'design' and grow bespoke biomaterials. The role of design is shifting from working with inanimate matter such as plastic and wood to the use of animate living organisms such as mycelium. With biohacking, we can turn yeast and bacteria into tunable living factories. This paradigm shift promises to open up new possibilities for bio-fabricating future intelligent materials as well as for engaging with alternative sustainable processes. Driven by a recognition of our society's need to attain the 'one planet lifestyle', the Design & Living Systems Lab operates within this emerging bio-design landscape and refers to an original framework which establishes a new hierarchy of design relationships with living systems, as shown below.



From Biomimicry to Biofacture:
A framework for designing with living systems
© Carole Collet, 2013

Biolace:
Road-mapping future bio-textiles

Created between 2010 and 2012, Biolace is a speculative design-led research project that investigates the intersection of synthetic biology and textile design to propose alternative sustainable future fabrication for textiles. In 2010, synthetic biology was still a nascent discipline, particularly focused on developing new bio-fabrication techniques for medicine and energy, not textiles. Today, synthetic biology is beginning to pervade the textile industry as silk fibres grown from reprogrammed yeast are currently in commercial production. With Biolace, I also propose a new future textile nomenclature (circa 2050) which incorporates our current textile classification (differentiating natural, artificial and synthetics fibres) together with emergent new and future potential bio-fibres derived from synthetic biology:[4]

Natural Fibres (Agriculture)	Vegetal (cotton, linen, hemp, ramie, nettle...) and animal (wool, silk..) fibres.
Artificial Fibres (Manufacture)	Fibres made from cellulose – plant based material – (such as wood pulp) and then chemically processed. They include rayon, acetate, viscose.
Synthetic fibres (Manufacture)	Fibres made from petroleum derivatives. They include nylon, acrylic, polyester.
Synthetic Bio-fibres (Biofacture)	Any fibre from the previous three categories, but made by genetically engineered living organisms such as bacteria, yeast, algae and plants. These fibres are usually programmed with enhanced characteristics (such as anti-bacterial, anti-crease, colour changing, waterproof, fire proof.)
Synthetic Bio-fabrics (Biofacture)	Fabrics directly grown into constructed structures by synthetic living organisms such as bacteria, yeast, algae, plants. These living organisms are programmed to produce knitted, woven, or non-woven structures. They can also grow fabrics with smart characteristics and behaviours, such as shape-change, colour change, or climate control fabrics.

Textile Classification, *Horizon* 2050 © Carole Collet 2013

e...) and animal (wool, silk..)

l material – (such as wood
ey include rayon, acetate,

They include nylon, acrylic,

ries, but made by geneti-
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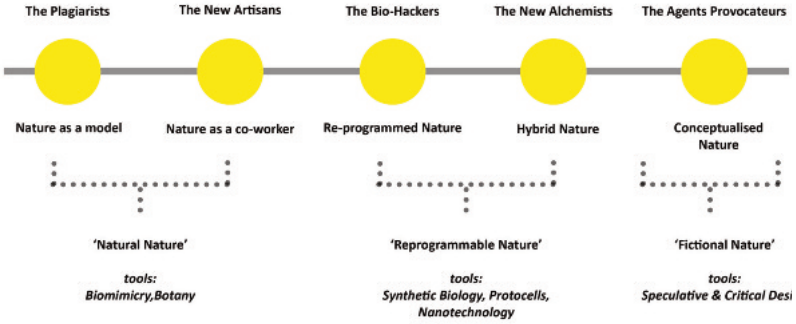
Alive, New Design Frontiers, Espace Fondation EDF, Paris.

With the emerging biological revolution and a set of extraordinary toolkits that allow us to engineer and program life from scratch, comes a need to re-evaluate the position and potential of design. Designers have begun either to embrace or rebel against this emerging bioengineered world and, as a result, new design directions are beginning to arise. I curated this exhibition in 2013 as a means to map this emergent bio-design landscape, where fragments of a possible programmable synthetic future are confronted with 'natural' alternative design perspectives. Alive, New Design Frontiers was the first international exhibition to showcase bio-design via a sustainable lens.



Curatorial Framework, *Alive, New Design Frontiers*, Carole Collet 2011

Mycelium Textiles:

For designers, controlling the morphogenesis of living materials as they grow enables a new form of expanded design practice. The research project Mycelium Textiles explores mycelium colonisation techniques to propose innovative sustainable textile patterning processes and slow-grown embellishments for fashion applications. 'Co-working with living organisms allows us to incorporate active and dynamic qualities to matter, which is not rendered 'victim' of a shape-forming activity, but rather becomes the enabler of the morphogenetic process'.[5]

In this project, I also ask how shifting from the hand-made and the man-made to the 'grow-made' can generate new protocols for design methodologies, and explore the values of slow-horticulture versus rapid-manufacturing.

Re-calibrating design for the bio-circular economy

How can design help transitioning towards an interconnected circular bio-economy? By embracing new bio-based low tech and high tech processes, designers can play a pivotal role in helping to shift from our current linear, power hungry and toxic industrial systems to local biological restorative and environmentally-friendly processes. Re-calibrating our creative tools to generate innovative bio-design propositions entails new educational models where biology and design can converge freely. A growing number of educational design institutions are now incorporating grow-lab spaces to facilitate the learning of bio-design and prepare the next generation of designers for the sustainable challenges of our century.

However, designers cannot do it alone. The promises of the bio-economy can only succeed if we alter our current consumption patterns, and fundamentally rethink the notion of progress 'to create a new bio-modernity that is inclusive, interconnected and mindful'.[6]

1 Quinn, B. *Textile Futures*, Berg 2010, p.144
2 ec.europa.eu/environment/industry/retail/pdf/issue_paper_textiles.pdf
3 http://www.footprintnetwork.org/en/index.php/GFN/page/world_footprint/
4 Collet, C. 'The New Synthetics, could synthetic biology lead to sustainable textile manufacturing?' in Kate Fletcher & Mathilda Tham (eds.)*Routledge Handbook of Sustainability and Fashion*, , Routledge, 2014, p.194
5 Collet, C. Grow-Made Textiles. Conference proceedings, EKSIG 2017, *Alive. Active. Adaptive. International Conference on Experiential Knowledge and Emerging Materials*.
6 Collet, C. *Re-calibrating Design for the Bio-economy*. MA Material Futures catalogue 2017

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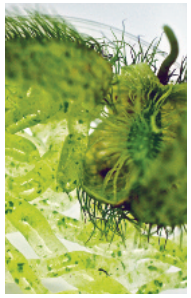
With thanks to Central Saint Martins UAL for their continuing support.
With thanks to all my students for what they taught me.
With thanks to all my colleagues and collaborators for their enlightenment.

Biolace,
The making-of (2010–12)

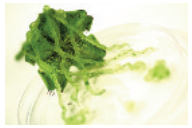
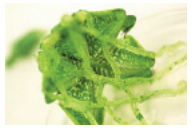
Design research is above all a process, a journey into the unknown. To date, the Biolace project has been exhibited in twenty six international exhibitions and has been featured in many books and press articles. Yet few people know the full story behind Biolace. Here is a very short compilation of the design development that took place over two years; a window into the design thinking that informed the research question and the making of the final artefacts.

Biolace is a speculative design-led research project that investigates the intersection of synthetic biology and textile design to propose future fabrication processes for textiles. The motivation behind this research lies in the hypothesis that living technologies could foster a new approach to address some of the key sustainable challenges of the 21st century. Biolace aims at a) probing the potential of a biological manufacturing future by exploring the cellular programming of morphogenesis in plant systems; b) translating the potential of synthetic biology into accessible design scenarios to explore the societal implications of these new emerging biotechnologies and to test their validity in the context of future sustainable textiles.



1 Biolace, Probe 1, Carole Collet 2010

Biolace was developed intermittently over a period of two years, when I alternated literature research, writing, and design making to evolve the final artefacts: a series of four photographs, a lace doily, and a short animation. I began working with a literature review a few months before Craig Venter published his research into the creation of the first synthetic life form, 'Synthia'. This was April 2010, and at the time the promises of synthetic biology were to develop new applications for medicine and energy, textiles was not included in that technological landscape. My first step was to try and develop a design vocabulary that could translate the nano workings of complex biological experiments. With Biolace, Probes 1, I attempted to give materiality to the idea of a fabric structure born in a petri dish. (**1**). Using sections of plants, and molecular cooking techniques I created a series of photographs that expressed the spectacle of a textile life form growing in a lab (**2 & 3**).

2 & 3 Biolace, Probe 1, Carole Collet 2010



4, 5 & 6 Biolace, Probe 1, Carole Collet 2010


As much as these photographs began to substantiate my research question, I also felt they were too predictable in terms of using the visual reference of a petri dish to translate the idea of genetically coded plant systems. I further developed my understanding of synthetic biology by meeting with biologists and continuing to read science papers. I then began to work directly with plant root systems, imagining a scenario where the morphogenesis of root systems could be genetically coded. Using traditional lace techniques, I began to lace with living roots (**4, 5, 6**).

This led to publishing a paper at a conference (*Ambience* 2011) followed by a publication in the *Journal of Studies in Material Thinking* (Vol.07, 2012). The final concept for Biolace emerged from this iterative process between reading, conversing, writing, and making. The four final photographs of the Biolace series are located in the

7 Strawberry Noir,
8 Basil No.5
9 GoldNano Spinach
10 Factor 50 tomatoe


11 Harvest of strawberry noir and black lace trimmings, 25 May 2050

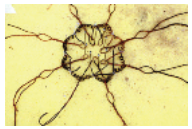
year 2050, in urban hydroponic greenhouses that harvest food and textiles at the same time (**7, 8, 9, 10**).

The genetically programmed multifunctional plants embody an extreme biotechnological future where urban farming goes beyond food production (**11**).

The series was also accompanied by a lace doily made of fresh strawberry roots grown in a hydroponic system and using a traditional lace making technique (**12, 13, 14**). The doily was also used as a prop to create a series of photographs that contribute to the narrative (**15**). The original digital drawing for the doily was executed using an app: SpawnSym (**16**). The doily was first showcased as part of the touring exhibition Futuro Textile 3 in October 2012.

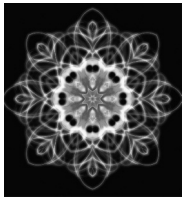
Biolace was completed by a short animation available at: https://vimeo.com/52572656.

With thanks to research assistants Amy Congdon, Ann-Kristin Abel, Natsai Chieza. Biolace animation and sound design by Immatters.



12, 13, 14 construction of lace doily using fresh strawberry roots-black lace trimmings

15 lace doily attached to strawberry plant



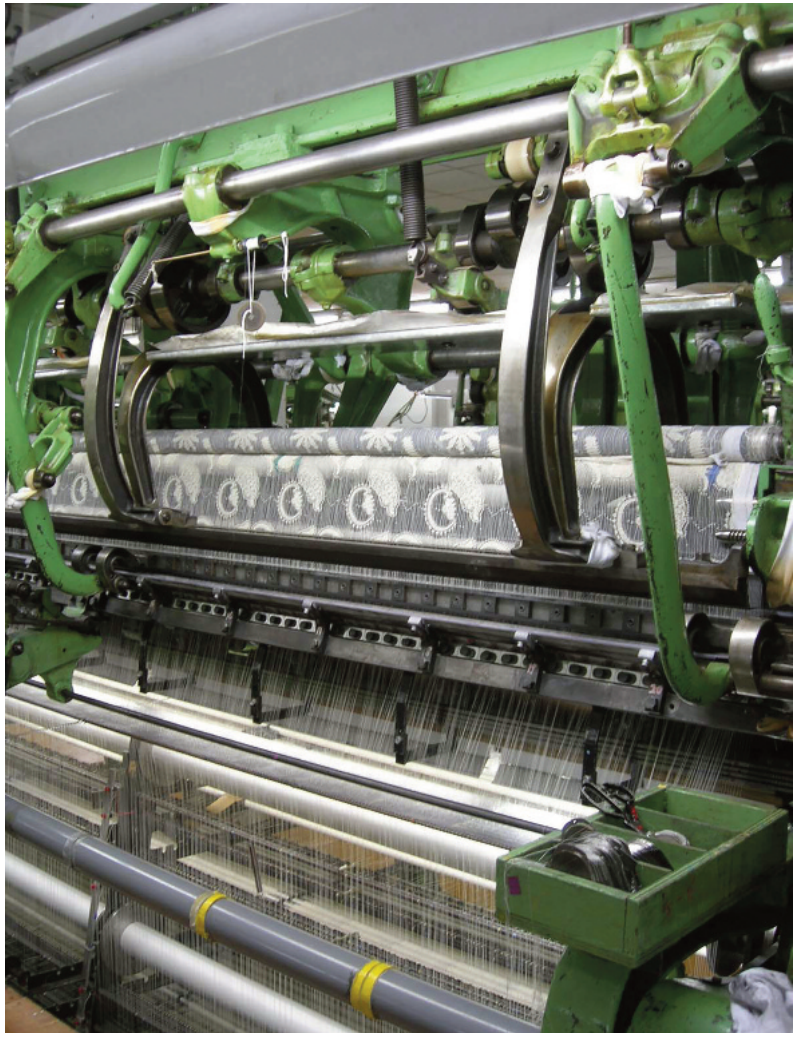
16 digital lace design

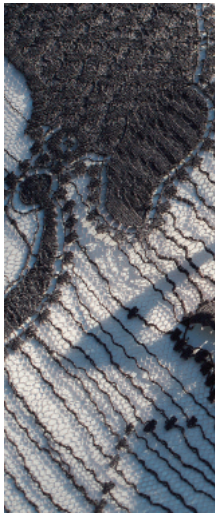
Pop Up Lace

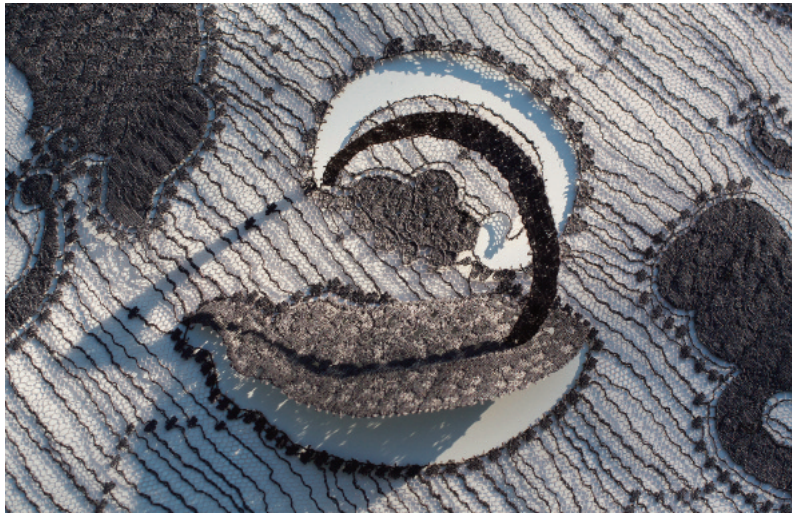
A collaboration with Sakae Lace, Pop Up Lace is the first industrially produced paper yarn lace, engineered to create pop up tea pots that can be sculpted directly from the tablecloth or the wall hanging and was manufactured by Sakae Lace as a one-off limited edition.

Pop Up Lace was commissioned for Warp Factor 09, a Central Saint Martins College Touring Exhibition, Tokyo–Guangzhou–London in 2009.

Images
Production of Pop Up Lace. Image courtesy of Sakae Lace
Pop Up Lace table cloth
Pop Up Lace detail







Nobel textiles: Suicidal Textiles, a tribute to C.Elegans

The Suicidal Textiles collection is inspired by the research of Nobel Laureate Sir John Sulston and translates the principles of Programme Cell Death (apoptosis) into a collection of outdoor textile artefacts.

The project was commissioned by the Medical Research Council's Clinical Sciences Centre and co-sponsored by the ICA and Central Saint Martins.

Overleaf: Suicidal Pouf in construction.

Card, 140 x 200mm

Edible Alchemy

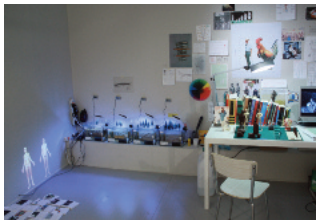
A collaboration with artist Bart Vandeput and FoAM as part of The Resilients Project, with the support of the EU Culture Programme (2007–13).

Overleaf: Edible Alchemy Aperolab © Carole Collet & Bart Vandeput 2013

Card, 140 x 200mm

Alive, New Design Frontiers

Exhibition curated by Carole Collet
April–September 2013, Espace Fondation EDF, Paris.
www.thisisalive.com



Previous page *Alive, New Design Frontiers.*

Above *The Incredible Shrinking Man,* Arne Hendriks.

The Rise, CITA.

HORTUS:PARIS.The Machinic Harvest, EcoLogicStudio

> View of a section of The New Artisans

>> *The Biocouture Shoe*, Suzanne Lee (art director), Liz Ciokajlo-Squire, Aaron Lampert,Thomas Makryniotis.

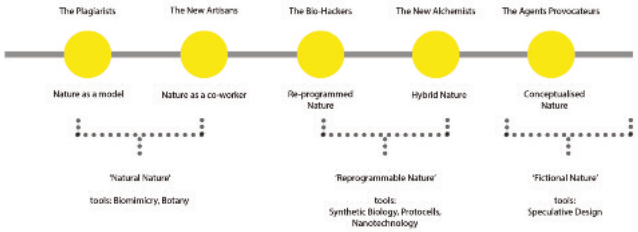
>>> *Post Natural History*, Vincent Fournier

> *Radiant Soil*, Philip Beesley

All Photography courtesy of Laurent Lecat/Fondation EDF

The exhibition *Alive, New Design Frontiers*, showcases a new design landscape, where fragments of a possible programmable 'synthetic' future are confronted with 'natural' alternative design perspectives. The quest for a new kind of ecological design model underpins the selection of projects, which range from potential sustainable solutions, to poetic interpretations and extreme provocations. Created and imagined by leading designers, architects and artists, the exhibits unravels a future hybrid world, where our everyday products and manufacturing tools will be 'alive'.

The 34 selected projects and commissions are organised around 5 themes:



The Plagiarists (Nature as a model): designers and architects who look to nature for inspiring role models and new engineering solutions. They work with biomimicry principles, imitating processes or behaviour found in the natural world, but working with man-made and digital technologies.

The New Artisans (Nature as a co-worker): these designers and architects collaborate with nature. They work with bees, fungi, bacteria, algae or plants and develop new techniques to grow and craft consumer goods. Here, design relates more to gardening and farming than to manufacturing.

The Bio-Hackers (Reprogrammed, 'synthetic' nature): these designers and artists work in collaboration with synthetic biologists or respond to cutting-edge scientific research in the field of extreme bioengineering. They imagine what the products and interfaces of the future could become with the use of engineered living organisms. Their ideas illustrate a possible future world.

The New Alchemists (Hybridised nature): here, designers, architects and artists propose to explore the merging of biology, chemistry, robotics and nanotechnology to create new hybrid organisms. They combine living (biological) with non-living (electronic and chemical) technology.

The Agents Provocateurs (Conceptualised and imagined nature): this final group of artists and designers explores a provocative far future. Their work encourages a debate around ethical issues related to living technology and high-tech sustainability.

Mycelium Textiles

(work in progress)

Mycelium Textiles is a design research project that explores the potential of mycelium growth as a new sustainable surface treatment for textiles. Phase one consists of developing a material archive by tuning the conditions of growth of the mycelium and aims to:

— produce both soft and structural textile qualities by experimenting with the environment of growth of the mycelium

— develop new biodegradable, compostable coatings for textiles that can replace current oil-based finishing processes

— develop protocols that encourage self-expression and self-patterning techniques in mycelium materials

A range of materials, from waste coffee grounds, to agar and natural textile fibres such as hemp, sisal, soya bean fibre, raw silk, organic cotton and linen are used as nutrients. These foundational materials provide a transformative grid that harnesses, supports or resists the life of the mycelium. Diet control informs shape-making and guides the process of food colonisation. Nurturing or starving mycelium becomes part of the design strategy to obtain a varied range of natural and biodegradable composites generated by the dynamic and adaptive properties of mycelium behaviours.

Examples include:

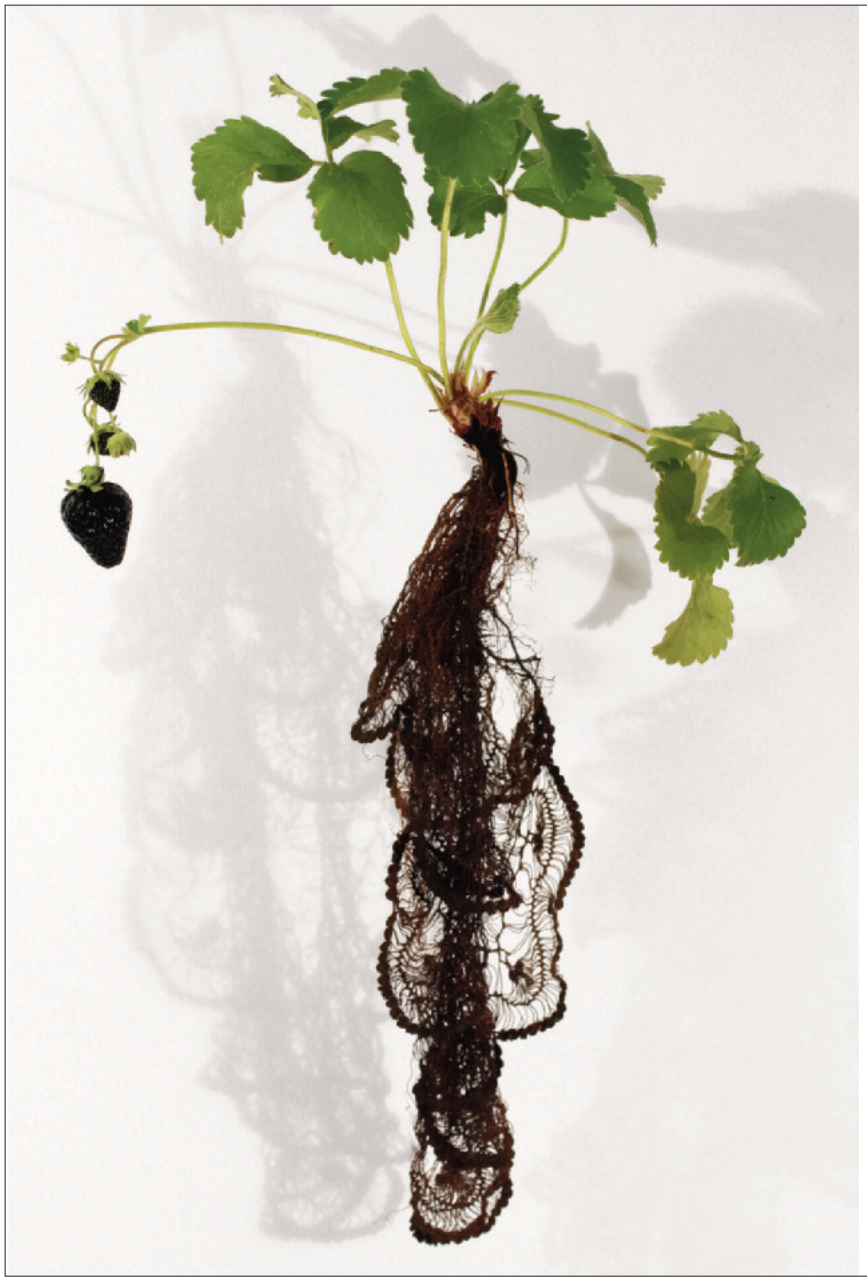
Self-patterned mycelium rubber: This sample is as flexible as rubber and exhibits floral patterns which are not the result of a moulding technique, but the evidence of a self-organised pattern behaviour which developed as the mycelium colonised a waste coffee based substrate during its growth.

Cover & opposite Self-patterned mycelium rubber © Carole Collet 2016

Mycelium lace: here the mycelium serves as a means to reinforce and mend the lace on which it has grown.

Overleaf Mycelium Lace © Carole Collet 2016

The next phase of the project will be to translate the results of this material archive into a collection of fashion accessories.



ual: central saint martins

Professorial Platform

Professor Carole Collet Designing for the biocentury

Tuesday 4 July 2017

6·30pm

Central Saint Martins

Platform Theatre

Closing by Professor Jeremy Till, Head of Central Saint Martins, Pro Vice-Chancellor, University of the Arts London

Registration from 6pm
Reception 7·30–8·30pm
Platform Theatre Foyer

RSVP https://is.gd/Collet

Invitation, A4 (sent digitally)