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## Artlink

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### Alba Stephen and Rachel Buckeridge

Circumnavigate Kandos "Fried Egg Dress", 2019 Model: David Ryan. Photo: Ian Hobbs. Image courtesy of Rachel Buckeridge. Disclaimer: The cover image for this issue of Artlink was selected by the magazine. Guest editor, author and Kandos host of From the Clothes Rack to the Wearer: Circumnavigate Kandos, Ann Finegan did not take part in this decision.

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# Issue 41:1\_\_April 2021\_\_ Fashion. Performance. Industry.



- 08\_\_\_ Editorial
- 12\_\_\_ What is Transorientalism?

  Adam Geczy
- 24\_\_\_ Walkabout style:Dreams and visions of Indigenous fashionTristen Harwood
- 30\_\_\_ #IMadeMyClothes:
  The Ethics and Practices of
  Home Dressmaking
  Madeleine C. Seys
- 34\_\_\_ Green Plastics Blue Ocean:

  The future of biopolymer plastics and textiles

  Niki Sperou
- 40\_\_\_ The Mangkaja x Gorman Collection:
  A new wave of Indigenous art and
  fashion collaboration

  Belinda Cook
- 48\_\_\_ Melanie Jame Wolf's Pop-Cultural Drag:
  The Chronopolitics of Labour,
  Libido and Image

  Daniel Mudie Cunningham
- 56\_\_\_ Sarah Rodigari:
  Redressing the vernacular
  Abigail Moncrieff

- 62\_\_\_ From the clothes rack to the body of the wearer:
  Circumnavigate Kandos in our clothes
  Ann Finegan
- 68\_\_\_ On art, fashion, purpose and more

  Peggy Griffiths-Madij and Jan Griffiths
  in conversation with Alana Hunt
- 74\_\_ Cigdem Aydemir: Like a Prayer Sumaiya Muyeen
- 80\_\_\_ Michaela Stark: On Control and Beauty
  Alison Kubler
- 84\_\_\_ Apprehending the Multiverse:

   A Costumed Allegory for Four Percussionists
   Michaela Gleave's Cosmic Time

   Ann Finegan
- 91\_\_\_ Reviews

More reviews and online archive at artlink.com.au

## Green Plastics – Blue Ocean

# The future of biopolymer plastics and textiles



Niki Sperou

Niki Sperou Guilt 5, 2020 from the series Plastics Memento Mori ANAT Synapse 2020 residency at CMBD Photo courtesy the artist We are living in the age of the Capitalocene, an epoch of environmental crisis resulting from capitalist commerce and industry. According to finance website Business Insider, in 2019 the fashion industry accounted for 10% of humanity's total global carbon emissions. Nathaniel Otjen, in When Things Hail: The Material Encounter in Anthropocene Literature, concedes that "We recognize we are now 'being acted upon' by material agents of our own creation". This realisation is driving a movement toward eco-conscious endeavours.

The Green Plastics - Blue Ocean project, supported by the ANAT 2020 Residency and Copyright Agency Fund, was a response to the global petroleum-based plastics waste problem. Through interdisciplinary collaboration between myself, artist in residence at Flinders University's Department of Medical Biotechnology and the Centre for Marine Bioproducts Development (CMBD) since 2006, CMBD Director Professor Wei Zhang, biotechnologist Peng Su and the CMBD team, the potential for biodegradable seaweed biopolymers was explored while probing the world's biggest ethical, environmental

and technological challenges towards a more sustainable future.

Plastics are useful and ubiquitous, and demand for them is rising. Processing of plastic waste is difficult and expensive. By 2050, plastic waste is predicted to be nearing 12 billion tonnes, with approximately 79% of that entering the environment. Microplastic health-related concerns are increasing due to food chain entry and toxic bioaccumulation. The need to reduce or to replace fossil-fuel plastic is urgent. The 2025 National Packaging Targets aim for 100% of Australia's packaging to be reusable, recyclable or compostable.

Early plastics were produced with the best of intentions. Seen as cheaper, more democratic and accessible to the masses, petroleum plastics replaced rare and finite materials sourced from wild and domesticated organisms. For burgeoning industry, they were an exciting new product. Due to their stable chemistry, petroleum plastics take centuries to degrade. The unforeseen problem was the waste.

How can we deal with the human-created mess? Can we reduce the future impact of petroleum plastics on society with next-generation materials? If clean-up is currently

impossible, how can we design a circular economy with zero waste as our goal? How can we create cultural shifts to promote change and influence policy? How can we do better?

Our Green Plastics - Blue Ocean project utilises marine technology for innovative options. Seaweed is probably one of the most prolific and underutilised renewable resources on the planet. It grows faster than any land plant, benefits the environment by absorbing atmospheric carbon dioxide emissions and does not compete for fresh water or arable land. Seaweed biopolymers have unique film-forming properties unparalleled by terrestrial plant starch-based plastics.

South Australia has been identified as a global hotspot for marine macroalgae. Australia does not currently farm seaweed, although the potential for this to expand into a major industry is significant. The recently released 'Australian Seaweed Industry Blueprint', commissioned by AgriFutures Australia, predicts growth potential for a \$1.5 billion industry by 2040 and a 10% emissions reduction target. By utilising beach-cast seaweed from South Australia's south-eastern coastline, we worked towards the transition from petrochemistry



to green chemistry, producing biodegradable materials that allow nature to complete the carbon cycle.

Developing the technology was not the stand-alone focus of this project. We aimed to develop questions and communicate unconventional ideas, metaphors and realities, allowing us to rethink our relationship with plastics. Societal needs, trends and mindsets were examined. We sought insight into how the replacement of existing dependence on petrochemical products requires cultural understanding and acceptance, and we needed to

better comprehend the drivers of the human impetus for change.

A series of memento mori photographic images, titled *Guilt*, was inspired by Anthropocene literature and online images of victims of plastic waste. In these images, my body was used to represent animals engulfed in plastic to create effect and reinforce that we too are impacted by plastic waste.

Seaweed polymers were produced in numerous forms: gels, fibres, 2D films and 3D foams/matrix/scaffolds. A broad range of prototypes were made for art, fashion and textiles,

as well as cosmetics, medicine, nutrition and other applications that included medical scaffolds in bone regeneration, prostheses and implants, biodegradable agricultural films, and biodegradable food-packing materials that are edible and antimicrobial. Functional compounds from seaweed can be extracted for antioxidant, antimicrobial, antiviral, anticancer, antitumour, immunomodulatory activity, antidiabetic, anti-STD, anti-inflammatory and anticoagulant properties, and also for blood lipid and cholesterol reduction and dietary fibre prebiotic activity.

Drawing on experience in the area of dress design and garment construction, water-soluble seaweed polymers and films were tested as ecofriendly fabric stabilisers to support delicate fabrics, open-work embroidery and appliqués. This was followed by the trialling of various technologies and composites to develop the film's water-resistant properties. A challenge was to avoid partial petroleum-based constituents as with other eco-plastics on the market. In this research, seaweed biopolymer skin was made as a prototype nutraceutical cosmetic, then tested for its adherent and film-forming



Above:
Niki Sperou
marine macroalgal biodegradable plastic film
ANAT Synapse 2020 residency at CMBD
Photo courtesy the artist

Opposite:
Niki Sperou
Marine algal (seaweed) biopolymer plastic
ANAT Synapse 2020 residency at CMBD
Photo courtesy the artist



Above:
Niki Sperou
Crisis Mask
biodegradable polymer
ANAT Synapse 2020
residency at CMBD
Photo courtesy the artist

Opposite:
Niki Sperou
dissolvable film for fabric
stabiliser (after washing)
ANAT Synapse 2020
residency at CMBD
Photo courtesy the artist

tendencies over a 3D form. The production of a biomimetic Seaweed *Biopolymer Leather – FYKI* followed.

This vegan leather can be cut like traditional textiles and leathers, but can also be poured or computer printed into shape, avoiding offcuts—a step closer to zero waste design. Our product was named FYKI after the Greek word for seaweed. With society increasingly aware of the ecological and ethical issues related to breeding, raising, killing, tanning, resource consumption and methane generation associated with livestock industries, the option of vegan leather satisfies the moral and environmental imperative for change.

The artwork Crisis Mask was made out of this biodegradable antiviral marine biopolymer leather and served as a response to two current and related problems. The first was the plastics pollution problem recently exacerbated by medical waste, gloves and masks, generated by the COVID-19 pandemic. Fashioned after intriguing masks worn by 17th-century plague doctors, Crisis Mask was crafted from seaweed leather that mimics the colour, texture and handling of animal-derived leather. In turn, the Crisis Mask concept prompted research into breathable

nanopore textile prototypes with seaweed's innate anti-viral properties.

The production of a biopolymer leather was inspired by Canadian artist and sci-fi religious mythmaker Michael Dudeck, who contacted me with the dream of a bible made out of leather from his own skin. Towards future collaboration, a seaweed leather infused with Dudeck's cells was proposed. This creative endeavour fitted nicely with CMBD research, and my longstanding production of fleshy chimeras, matrices for the methodologies of science, human-plant hybrids and ancient Greek myth and ritual. The concept for Skin Bible was presented at the TTT (Taboo - Transgression - Transcendence) 2020 conference in Vienna. The work embraces the broader field of laboratory-grown textiles and materials. Examples are the cell-seeded scaffolds of Ear Mouse, Vacanti; Extra Ear, Stelarc; Victimless Leather, Tissue Culture & Art; Spray on Skin, burns specialist Fiona Wood; rePurposed, Andrew Pelling; and, in the area of vegan bio-leathers, Fermented Fashion of cellulose "scoby" biofilm textiles by Garry Cass and Donna Franklin.

Why do we do this? Artists are essential to how we imagine



and shape our future. For me, the probing of technological problems, responsibility, potential futures and the rethinking of plastics evokes hope.

Niki Sperou is an Australian artist working at the nexus of art and science since 2001. Niki presents artwork, bio-art workshops and conference papers in Australia and internationally. She is the artist-in-residence at the Department of Medical Biotechnology and the Centre for Marine Bioproducts Development, School of Medicine, Flinders University.