

It is a delightful paradox that the normally invisible has an enduring influence on what can be our most profound visual experiences. In this context, the effect of microbes on the visual arts is antithetic in that their activities provide inspiration for the artist, yet they are also capable of destroying some of our most important artistic heritage. Whilst any painting is potentially at risk, perhaps the most poignant example of this is the microbial destruction of the Lascaux Cave paintings, which date back to 15,000 BC and are some of humanity's earliest forays into art.

Long before their empirical revelation, microbes influenced the sensibility of many artists, perhaps most notably in Nicolas Poussin's *The Plague at Ashdod* and Raphael's *Il Morbetto*. Then as the microscope began to reveal a previously hidden world, artists and scientists alike were quick to appreciate that microbiology is also able to produce depictions of great beauty. Indeed, in some of the earliest representations of micro-organisms it is often difficult to differentiate between technical representation and art. The aesthetic nature of microbes can be readily seen in Hooke's

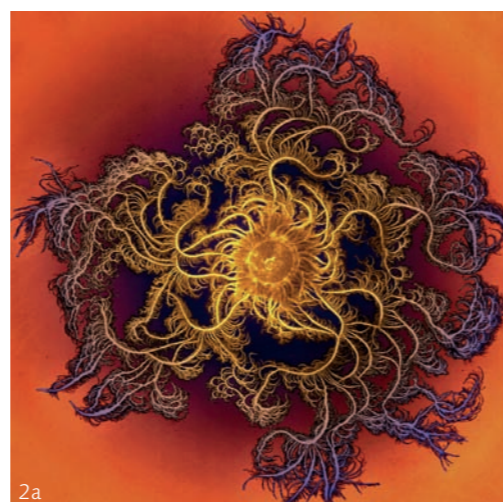
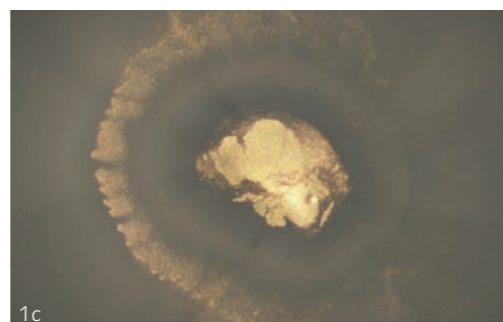
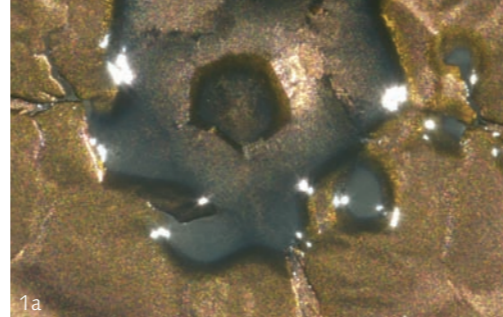
*Micrographia*, Sergei Winogradsky's hand-coloured drawings from *Microbiologie du Sol*, Henriëtte Beijerinck's paintings, and Ernst Haeckel's *Kunstformen der Natur*. Micro-organisms have also featured in more obvious examples of art, for instance in Hieronymus Bosch's *Garden of Earthly Delights*, in which there appear to be representations of at least 22 species of slime moulds.

Today, at a time when many micro-organisms have been rendered into the very still life of a DNA genome sequence on a computer screen, our over-familiarity with the microscopic life forms means that the aesthetic nature of microbiology is often overlooked. However, cross-disciplinary projects involving scientists and artists are becoming increasingly common and the microbe is being reinvigorated as an art form. Artists are now beginning, with some understanding of the science, to exploit the vast conceptual palette that microbiology offers, and in a manner that seeks to blur boundaries between art and science. We are approaching an artistic microbiological renaissance, where the microbe is taking centre stage, and starting in forms of art where the medium is living matter itself.

► Fig. 1. Sample images from *Microcosmos*, an audio/visual installation that resulted from a collaboration between myself, Pattie Hendrie, BBC cameraman Steve Downer and composer Milton Mermikides from the Royal Academy of Music that explores the often unappreciated beauty and significance of bacterial colonies. (a, b) *Vogesella indigofera*; (c) *Pseudomonas aeruginosa*. S. Park

► Fig. 2. *The Bacteria Art Exhibition* – some examples of Eshel Ben-Jacob's work with *Paenibacillus* colonies. © Eshel Ben-Jacob

► Fig. 3 (opposite). *Mushroom Circle* – one of a number of artworks by land artist Chris Drury in which the nucleus of a fungal spore print is surrounded by minutely inscribed names that echo the patterns formed from the deposited spores. © Chris Drury



# The aesthetic microbe: ProkaryArt and EukaryArt

**Simon Park** takes inspiration from the beauty of micro-organisms and shows how they can be used to bridge the divide between art and science.

As I recently discovered for myself, even the apparently mundane can have artistic potential. Given time, and if allowed to grow beyond the standard overnight incubation, bacterial colonies can develop into some remarkably beautiful structures. The images shown in Fig. 1 formed the basis of *Microcosmos*, an audio/video installation that presents these images together with a soundscape derived from the DNA sequences of bacteria. Eshel Ben-Jacob has also found artistic potential in colonies, but in this instance, in the striking organization of the colonial forms of *Paenibacillus dendritiformis* (Fig. 2). Both of these examples, which could be considered to be ProkaryArt, are visually appealing, yet they also carry a scientific message that reflects the nature of bacterial growth, pigment and antibiotic production, and the underlying social intelligence of bacteria. Of course, artists may choose to practice EukaryArt and land artist Chris Drury has produced some striking works based on fungal spore prints (Fig. 3).

The often unappreciated microbiology of the familiar has also provided inspiration for several modern artists. Anna Dumitriu has used the qualities





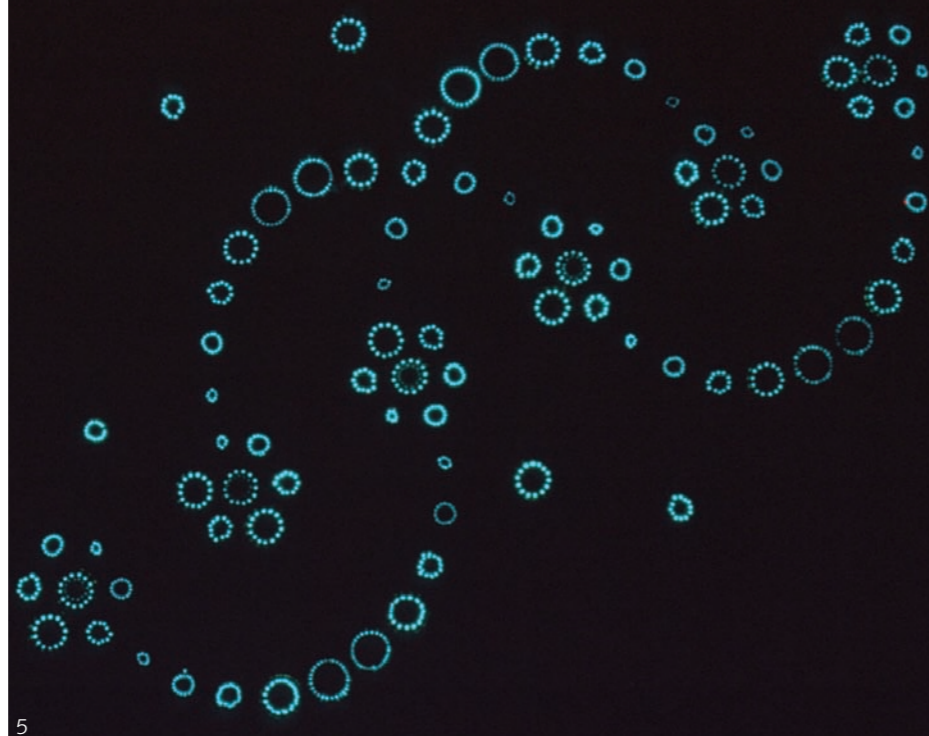
▲ Fig. 4. *Cutlery flora*. Artist Anna Dumitriu collaborated with Dr John Paul to explore the normal flora of household objects. Here a microscopic image of the normal flora of a cutlery set has been etched onto it.

▲ Fig. 5. An example from the *Bioglyphs* project, in which members of the Center for Biofilm Engineering and the Montana State University School of Art used bioluminescent bacteria to generate art forms. © MSU-Bozeman *Bioglyphs* Project 2002

► Fig. 6 (opposite). Peta Clancy's *Visible Human Bodies* exhibition. © Peta Clancy – courtesy thirtyseven° Contemporary Fine Art Gallery, Sydney, Australia

► Fig. 7. A sample image from *Sixty Days Goodbye Poems Of Ophelia*, a Wellcome Trust SciArt-funded project between myself, JoWonder, Steve Goss and Milton Mermikides (composers), and Steve Downer (cameraman) which will create a living interpretation of John Everett Millais' painting *Ophelia* using pigmented bacteria. © JoWonder

► Fig. 8 (opposite). *Clairvoyance*. An example of a 'biotope' from Eduardo Kac's *Specimen of Secrecy about Marvelous Discoveries*, a series of works of visually striking, self-sustaining microbial ecologies that change in response to environmental conditions. © Eduardo Kac



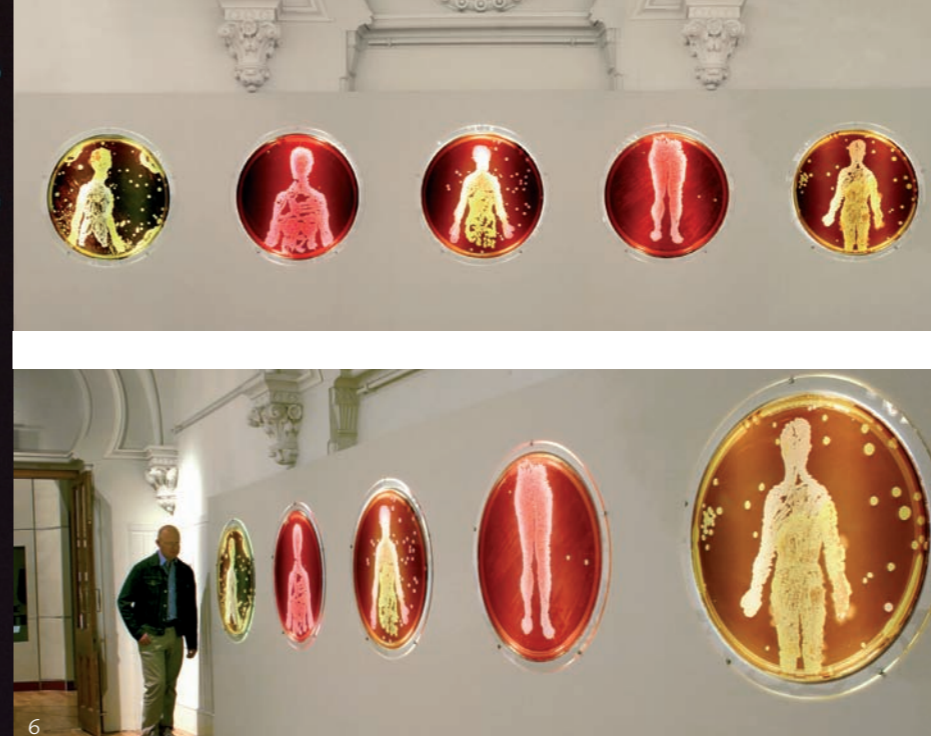
of the normal microflora of common objects as the basis of a number of artworks ranging from mobile phone wallpapers, to household objects onto which microscopic images of their microflora has been transposed (Fig. 4). Polona Tratnik has explored a similar theme, but through a more direct approach in which the growth of the normal flora *in situ* on household objects provided the basis for her artistic inspiration. An intriguing variation of this theme is Peter Germin Hoffmann's *Mikroben bei Kandinsky*, in which the microflora of a Wassily Kandinsky painting was exhibited as a finished artwork.

### BioArt

One of the most challenging areas of art involving micro-organisms is BioArt, in which the medium used by the artist is living biological matter. Alexander

Fleming was amongst the first to recognize the potential of microbes in this context when he famously made use of coloured bacterial colonies in his 'germ paintings'. Modern variations of this concept include the *Bioglyphs* project in which bioluminescent bacteria form the basis of some enthralling artworks (Fig. 5), and Peta Clancy's *Visible Human Bodies* (Fig. 6), which consist of images of bodies made from bacteria grown in Petri dishes. My own foray into BioArt is a Wellcome Trust-funded collaboration between myself and artist JoWonder, the aim of which is to create a living and contemporary interpretation of John Everett Millais's painting *Ophelia* using pigmented bacteria as the medium. The project is still ongoing but its potential can hopefully be seen in Fig. 7.

Most recently BioArt has shown the capacity to incorporate and com-



municate some of the complexity of modern microbiology. Eduardo Kac's work *Genesis* operates in this context as it involved the insertion of a synthetic gene sequence, derived from a sentence from the bible, into *E. coli*. *Specimen of Secrecy about Marvelous Discoveries*, another of his works, is a series of visually striking, self-sustaining microbiological ecologies (Fig. 8), that, like Winogradsky columns in the laboratory, reveal the hidden complexity of the microbial world, but in an art gallery. Jenifer Wightman has also explored this concept in an interpretation of Mark Rothko's paintings using bacterial ecologies. Other examples of this genre include: bioluminescent furniture and glass vessels; Steven Wilson's interactive microscope installations in which humans can compete with protozoa or interact with their own microflora; a signature of human intelligence that has been embedded into the genome of *Bacillus subtilis*; an audio microscope; pictures made from *E. coli* expressing green fluorescent protein; and Adam Zaretsky's *E. coli* which were monitored, not surprisingly, for signs of stress after being exposed to Engelbert Humperdinck's *Greatest Hits* for 48 hours!

I should add a brief note of caution at this point in case any non-microbiologist reading this article should be inspired to practice BioArt. The use of microbes in art is not without risks to the artist. Steve Kurtz, an associate professor of art at the University at Buffalo, but not a microbiologist, is also a practitioner of ProkaryArt. He first came to the attention of the police in May 2004, not because of this, but when he reported the death of his wife due to heart failure. Investigators coincidentally discovered some of the mostly harmless biological specimens that he used for his work in the house, and whilst he never intended to cause harm with the bacteria, this did not prevent the FBI from detaining him under terrorism legislation. He now faces 20 years in prison for fraudulently obtaining bacterial cultures.

Hopefully, the examples in this article demonstrate the ways in which artists, perhaps for the first time, are embracing the true artistic potential of the microbe. Whilst their works are not intended to provide a rational understanding of microbiology, their art has become an important forum that can communicate, on an intuitive level, the sublime nature of the microbial world. In his philosophical *Enquiry*, Edmund Burke relates terror, obscurity and infinity to the aesthetic experience when he states that 'the passion caused by the great and

sublime in nature, when those causes operate most powerfully, is astonishment; and astonishment is that state of the soul, in which all its motions are suspended, with some degree of horror'. For artists who seek to reflect the sublime in their work, surely there is no better conceptual palette in nature than the microbe.

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### Websites

Henriëtte Beijerinck paintings – [www.bt.tudelft.nl/live/pagina.jsp?id=32be4f0b-1d69-4d6a-afdb-ac2984457da0&lang=en](http://www.bt.tudelft.nl/live/pagina.jsp?id=32be4f0b-1d69-4d6a-afdb-ac2984457da0&lang=en)  
Eshel Ben-Jacob images of filamentous bacterial colonies – <http://star.tau.ac.il/~eshel/gallery.html>

*Bioglyphs* project – [www.erc.montana.edu/Bioglyphs/default.htm](http://www.erc.montana.edu/Bioglyphs/default.htm)

André Brodyk – [www.ccc.newcastle.edu.au/profiles/andrebrodyk/index.html](http://www.ccc.newcastle.edu.au/profiles/andrebrodyk/index.html)

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Joe Davies – [www.viewingspace.com/genetics\\_culture/pages\\_genetics\\_culture/gc\\_w03/davis\\_joe.htm](http://www.viewingspace.com/genetics_culture/pages_genetics_culture/gc_w03/davis_joe.htm)

Chris Drury – [www.chrisdrury.co.uk/](http://www.chrisdrury.co.uk/)

Anna Dumitriu's *Normal Flora* project – <http://web.mac.com/annadumitriu/iWeb/NF/Home.html>

Fleming's germ paintings – [www.ingenious.org.uk/see/Scienceandtechnology/Biologyandbiotechnology/?target=SeeMedium&ObjectID=%7B8BD5DB43-88B4-1614-E952-09373D9AB461%7D&ss=S1&viewby=images&](http://www.ingenious.org.uk/see/Scienceandtechnology/Biologyandbiotechnology/?target=SeeMedium&ObjectID=%7B8BD5DB43-88B4-1614-E952-09373D9AB461%7D&ss=S1&viewby=images&)

Eduardo Kac's *Specimen of Secrecy about Marvelous Discoveries* – [www.ekac.org](http://www.ekac.org)

Polona Tratnik's *Microcosmos* – [www.ars-tratnik.si/Microcosmos.htm](http://www.ars-tratnik.si/Microcosmos.htm)

*Symbiotic Bacterial Light* project – [www.fusionmedia.net.au/sblp/luxcorp.html](http://www.fusionmedia.net.au/sblp/luxcorp.html)

Wellcome Trust Art Awards, promoting collaborations between artists and scientists – [www.wellcome.ac.uk/node2580.html](http://www.wellcome.ac.uk/node2580.html)

Steven Wilson's interactive microbiological installations – <http://userwww.sfsu.edu/~swilson/>

JoWonder – [www.jowonder.com/](http://www.jowonder.com/)