



Anna Dumitriu, Plague Dress (2018).

Hidden Stories of Awe and Terror

Anna Dumitriu

For Anna Dumitriu, there is both awe and terror in the impact of bacterial life on human health. This bacterial sublime is one that always invites, but ultimately resists, our full comprehension of it. In this interview, we explore what it means to work at the forefront of collaborative practices that might just have serious consequences for your health.

Working with living media is an essential part of your work. That relationship, however, is far from utilitarian: You have invoked the idea of the 'bacterial sublime' as an expression of that engagement. What is it about working with living materials that drives you?

I work mainly with bacteria. In fact, they are central to my interests in human health and disease. Bacteria are wonderful, complex organisms, and the more I learn (indeed, the more that Science learns) about them, the more fascinating they become. The notion of the bacterial sublime combines the feelings of terror and awe that we feel when reflecting on the impact these minute organisms have on human life (an impact we are only now beginning to understand). It draws on a tradition of valuing terror as an aesthetic pleasure in art and nature originating with Edmund Burke's classic text 'A Philosophical Enquiry into the Origins of Ideas of the Sublime and Beautiful' (1). The fact is that the full impact of bacterial disease on humanity is only now emerging, as whole genome sequencing allows us to look at the minute changes disease interaction has made to our genomes since the dawn of mankind. Our changing

behaviours – such as our original descent from the trees, our domestication of animals, our changing diet (from herbivore to omnivore), and forced or voluntary large-scale migrations – have driven an exposure to unfamiliar diseases or zoonoses (those that can be naturally transmitted between animals and humans), transporting them into fresh populations of ‘victims’ that lack any form of immunity . But it is wrong to think of disease as something outside of ourselves – as the ‘other’. In fact, our co-evolution with disease is an integral part of what it means to be human.

Through an intense focus of working artistically with bacteria, I have built up a level of experience and expertise that enables me to work with infectious organisms. This is important as these are the bacteria that most significantly affect humanity – there are so many stories to be told about them. Using the same artistic methodology, I explore themes from microbiology, genomics, and synthetic biology: They all are part of a spectrum of research focussed on understanding the nature of life. In this way, I am interested in revealing hidden stories and investigating our impact on the natural world; I am interested in drawing out threads across time – from our history to our potential futures. Personally, I have worked with many different kinds of bacteria – from extremophiles that live in extreme environments (such as highly polluted sites or the Arctic Tundra) to dangerous organisms including *Mycobacterium tuberculosis* and MRSA . When I work with dangerous organisms, I collaborate with suitable laboratories to ensure all necessary safety and biocontainment requirements are met.

Through my work, there have been many important discoveries and learning experiences – both for me and the scientists around me. A real breakthrough in my own work came when I was collaborating with Dr. James Price: We discovered that we could impregnate textiles with bacteria and use chromogenic-selective agars to support their growth, and so pigment the cloth; by using things like antibiotic discs and silk embroideries treated with natural antimicrobial dyes, we could then alter these bacterial growth patterns. We found that these textiles retained their colours when

sterilised, which meant I could create artworks for public display that reveal how various treatments for infectious diseases work and show how chromogenic dyes can be used to diagnose different forms of bacterial disease. Another discovery was made during the development of my 'Engineered Antibody' synthetic biology work when my collaborator Xiang Li (University of California Irvine) commented: 'Working with Anna on the antibody necklace piece actually made me realise that I had an error in the sequence of my antibody that I am using in my research project. [To build the work] we had to compare my antibody sequence to the correct antibody sequence in a crystal structure, and I noticed that those sequences did not match. Since then, I have fixed the sequence of my antibody for my research project !'. This shows how working with an artist can force a kind of 'quality check' in science because I make my collaborators explain everything they do until it is clear to me – a necessary step if I am to make a practical, physical artistic response. By working with me to make an artwork, Xiang realised something did not sit right, and that is how he discovered his error. It takes an artist who does not just sit back when they do not understand something for such a situation to arise. I have built up my knowledge in the field over many years, and so I am able to engage with it quite deeply. I think it is more than just creating a space for reflection though – it is about working practically on an artwork that makes you think in different ways.

Many artistic practices involve living material that can be readily generated in a home environment. Your practice, in contrast, has also brought you into direct engagement with MRSA and Tuberculosis DNA, amongst others. In what is essentially a field of innovation, how has your work demanded new types of collaboration between different disciplines, institutional activities, legal frameworks, and so on?

I work closely with trained microbiologists and scientists, i.e., embedded in laboratory settings, and have done so for many years (working in this

way since the late 1990s). I collaborate in this way not only because it is necessary but also because these interactions inspire me. All sorts of things drive me in this work, not only the physicality of the media we work with (the bacteria, the agar, etc .) but also the conversations we have whilst working in the lab, whether about the history of bacteria, experiences of conducting experiments, or new research that is planned. All my work is made by me (hands-on in the lab), so I make sure I am compliant with all legal requirements (and undertake all necessary health and safety training) during the research and development stage of my work; I cannot develop and exhibit new work unless it is safe to do so.

I have learned ‘on the job’ so to speak ; so my knowledge of this field has developed over many years, with lots of support coming from the scientific community. In this way, I have learned about the interrelated legal, health, and safety aspects of this work, and how, for example, regulations differ between countries. There is legislation governing biocontainment in the UK, for example, that means you need a separate license to work with genetically modified organisms; this makes it very difficult to exhibit live, genetically modified bacteria outside of the laboratory. My knowledge and experience of working with these organisms has also evolved as research has evolved. In fact, I have experienced the development of sequencing technology in infectious diseases first-hand through my collaboration with the ‘Modernising Medical Microbiology’ project, seeing directly how it has impacted our understanding of the mechanisms of infection and epidemiology, and how it has led to an explosion in the field of synthetic biology.

Regulations can impinge on artistic intentions. Sometimes the display of such organisms requires a certain form of containment or regulation, and in these cases, I work with all necessary parties to understand what is needed and ensure that it happens. These include the scientific collaborators, the senior supervisor of the research in question, the curators involved, the

venue, and even, potentially, representatives from Environmental Health or the Health and Safety Executive. All have been very supportive in my experience, working with me to ensure that I can carry out my work whilst ensuring all regulations and requirements are maintained. I rather enjoy the challenge of trying to get work shown, and, in those cases where I try to do things that have never been done before, I engage the opinions of lots of scientists over how to do it safely. Recently I have been trying to develop sculptures containing wild antibiotic resistance plasmids – mobile elements of DNA that contain genes that provide bacteria with a kind of upgrade to be resistant to antibiotics. I say ‘wild’ because they are from the environment rather than a lab-engineered plasmid. Normally, the lab-engineered plasmids do not confer resistance to the antibiotics used in human healthcare. Legally speaking, displaying DNA is not a problem, but it is not clear if there is a risk that bacteria in the environment could take up these resistance genes and become superbugs. Since I first proposed the artwork, the wild antibiotic resistance plasmids that I want to use have appeared in the UK population and so are no longer something we risk releasing. Without bacterial hosts, plasmids are hard to put into bacteria outside the lab, so transfer into a suitable bacterium (if present) would be extremely rare, if it occurs at all. In fact, the answer is not yet known to Science.

Your work is conducted in a safe environment, with measures put in place to minimise risk to both yourself and others. Nonetheless, what is the experience of working with pathogenic microorganisms?

It is as simple as working in the correct types of labs, with their normal health and safety requirements, and with the correct types of bio containment. Occasionally, I have been offered, or required to have, vaccinations: For example, to work with faecal samples from patients, I had

to be vaccinated against Typhoid. There are three categories of labs for the handling of bacteria (numbered from one to three), with level-3 supporting work with the most dangerous kinds of bacteria. I have worked with bacteria up to biocontainment level 3 and have received plenty of training: This has included lab inductions (some very intense), training courses, hands-on experience, and a lot of ‘on the job’ instruction (2). I have, for example, worked with *Yersinia pestis* (the organism that causes plague), which requires a very secure category 3 lab; I have not yet made any actual artworks with this medium but aim to do some work with it at some point soon – the development of my work sometimes takes many years.

Nowadays, modern lab procedures dominate the experience of working with bacteria. For me, *Yersinia pestis* is one of the most sublime bacteria, but when I was able to work with plague the first time, the processes associated with lab work overtook any aesthetic sensation of the sublime I was seeking. Instead, a whole range of other sensations overwhelmed me – from a sense of being privileged to have entered this space and to share it with others, of clumsiness (or fear of clumsiness at least), to inadequacy, but also a sense of achievement. Some sense of the ‘bacterial sublime’ is still with me, though, every time I step inside a microbiology lab, and it is an experience that I need to share through my art practice.

In all instances, any pathogenic quality in your work has been extinguished prior to an encounter with the public. How do people respond to your work? Does a lingering doubt as to their own safety remain – a memory of the living so to speak?

I do not think it is so much a lingering doubt about safety, as it is understood that all potential pathogens have been killed. Where traces of these organisms remain (e.g., in how they have grown on cloth and

stained it), they taint the object with that history – sometimes invisible and sometimes quite clearly showing their growth and interactions. The traces of these organisms play out artistically and relate to philosophical notions of the sublime, such as Kant’s position that an experience of the sublime is situated in the mind of the observer rather than in the object, although the object is the trigger: There is nothing intrinsically sublime about cloth and bacteria alone, but together there arise interactions that can stimulate extraordinary imaginative possibilities.

Of course, it is not possible to say how much of the intention of the artist is included in the experience of the sublime; although I try to make my work affecting to the imagination, it depends on the viewer and how the work triggers their experience. To some extent, the works can also be appreciated on a ‘retinal level’ as aesthetic objects (I want my works to be visually impactful, after all), but I think the viewer cannot help but read some of the references I layer into my artworks. My artworks all have a strong conceptual sub layer to them that informs their initial creation and shapes their aesthetic impact. Although I cannot speak for all artists working in this field, I think it is quite common to focus on such conceptual elements. This is because we, as BioArtists, often work with invisible things that need to be made visible in some way. Ethical issues – often hidden in the work of the Sciences – are, for this reason, frequently explored in BioArt.

If an engagement with such work is heightened when the material used is still living (and, therefore ‘generative’ in some way), how far would you like to go in creating an artwork that brings an active pathogen and the general public into direct contact?

There is a connection between biosafety levels and the concept of the bacterial sublime: An element of terror is very important for a sublime

experience, although such an experience depends on the viewer's sensitivities. I have always wanted to create a biosafety level-2 lab in an art gallery. This would enable visitors (after the appropriate training and assessment) to participate in the handling of living pathogens and genetically modified organisms. An art gallery setting of this kind would enable visitors to engage in this experience aesthetically, attuning them to the sublime rather than allowing the structures of science to wholly supervene on their experience (as a scientific laboratory setting might). In such a setting, a visitor would only differ from a participant in whether they enter the lab or just observe it from the outside. The training needed would address more than just legal and health and safety issues: I think help in tuning into the aesthetic aspects of the experience would be an important part of the overall training process. The question of whether Science supervenes on the experience of viewing BioArt is something I explore in 'Confronting the Bacterial Sublime' (3) – part of my long running art/science ethics project 'Trust Me, I'm an Artist' (4).

What mainly stands in the way of creating a biosafety level-2 lab in an art gallery is that it is very expensive and that I have not found a suitable funder yet. Saying that, I have now worked with scientists to enable the display of (killed) pathogens in a science museum setting. Let us say I am still working on the plan, although its final instantiation might well evolve as my ideas evolve. Several people have suggested that using biosafety level-1 organisms in a gallery-based biosafety level-2 lab might be something that would be of benefit to both me and my work, whilst also being of educational value to a participating public. However, there would be little point to doing this, as the cost would still be very high for such a simple artifice. After all, a biosafety level-2 lab would allow me to work not only with pathogens but with genetically modified organisms as well; to these ends, my current efforts are to establish a 'gallery-lab' that would allow me to work with both.

Reflecting on this further, the artistic practices you describe are often used to challenge our understanding of the ethics surrounding artistic and scientific work. What are some of the lessons you have learned in this exploration of ethics?

All BioArt is very much tied up with ethical issues. Often an exploration of the ethical implications of a certain technology or practice becomes the subject matter of the work or at least informs the subject. The project 'Trust Me, I'm an Artist' aims to teach artists how to deal with ethics committees so that they can make and display work without causing harm to themselves or the public: It helps curators understand how to support this process and exhibit work; gives them the tools to understand the implications of such work; enables institutions to feel more confident in exhibiting BioArt; and gives ethics committees advice on how to successfully work with artists. As part of 'Trust Me, I'm an Artist', we ran a series of performative ethics committees, using an event structure that I developed with Professor Bobbie Farsides to reveal their real inner workings. It is not so much a case of asking whether lessons have, or have not, been learned but about developing a shared journey towards a consensus on best practice; this is something that is continually developing. Often the things we explore, for example, my interest in displaying wild antibiotic resistance plasmids in my artwork, have never been tried before, so raise questions for which there are no clear scientific answers at present. At the moment, I am trying to find out how to make this particular project a reality, but as the idea behind it is somewhat ahead of scientific knowledge, I may well have to do the scientific experiments myself. Sometimes I think what we need are new ways of taking such questions forward, as they can fall into a crack between established forms of artistic and scientific practice. In the end, though, these sorts of collaborations are really mutually beneficial, with artists often raising new research questions, helping researchers to reflect on what they are doing, bringing ethical issues and debates to the foreground, and suggesting or proposing new uses for emerging technologies.

What is your favourite ethics committee biography from this project?

'Trust Me, I'm an Artist' was triggered in part by my own experiences with ethics committees, but also by a conversation I had with Neal White about his 'Self Experimenter' project – a subversive re-enacting of Yves Klein's 'La Vide'. The original piece consisted of an emptied exhibition space guarded by sentries painted blue; its contents were obscured until the space was entered. Non-invited participants were charged a large amount to enter the space; here, they were served Methylene Blue cocktails. Neal's piece focussed on these cocktails, which apparently would cause participants to have blue pee the next morning (a private artwork for them to enjoy). Concretely, Neal wanted to offer people Methylene Blue pills that they could take at their own risk – in light of research showing Methylene Blue can cross the blood – brain barrier. He wanted to perform the work in a medical research facility but was advised that it was not ethically possible to do it there. Instead, a member of their ethics committee recommended that he perform it in a gallery, where it would be permitted. There is a connection between self-experimentation or self-exploration, in the arts, but such work is no longer supposed to take place in the sciences.

With much of Klein's work, he tried to make his audience experience a state where an idea could simultaneously be *felt* as well as *understood*. The development of such conceptual strategies is important in bringing ethical issues to light for the public. I think I respond most to BioArt works that stem from this Fine Arts perspective; it is a kind of work that has a way of drawing the public into wider debates and different ways of thinking. We actually managed to do a 'Trust Me, I'm an Artist' event with Neal White, which I have written about and documented in my book. In the same vein, I really enjoyed events with Adam Zaretsky and, more recently, with Kira O' Reilly and Jennifer Willet, events that questioned the relationships we draw between species and environments – the laboratory as a natural ecology and the wilderness as a laboratory. They each raised interesting

ethical concerns, explored issues of biocontainment in different ways, and questioned current research practices in Science.

In the work you describe, there is often a foreshadowing of new relationships between disciplines and practices demanded by changing times. What are some of the most interesting, far-horizon challenges that may come to preoccupy artists, designers, and scientists in the future?

A lot of my work is about drawing threads across time from the history of science and medicine to emerging technologies and paradigms. What seems clear to me is that our understanding changes very rapidly and that medical procedures, scientific beliefs, and ethical approaches are often in a huge state of flux: What seems logical at one time can seem ridiculous or barbaric even twenty years later. One far-horizon challenge that is particularly interesting to me, and highlights this point, is the future of antibiotics. A number of my pieces look at issues around the current and future impact of antibiotic resistance, exploring the consequences of how we have misused antibiotic drugs since their discovery. This is particularly relevant to tuberculosis care – artificial pneumothorax (a treatment to collapse the lung) used to provide a ‘rest’ cure for tuberculosis patients prior to the advent of anti-tuberculosis medication; strangely, with the present issue around antibiotic resistance, it may be that we will need to look again at such treatments. Two works of mine that look at this issue are ‘Make Do and Mend’ and ‘The Hypersymbiont Dress’.

‘Make Do and Mend’ (5) references the 75th anniversary of the first use of penicillin in a human patient in 1941. It takes the form of an altered vintage wartime woman’s suit marked with the British Board of Trade’s utility logo CC41 (‘Controlled Commodity 1941’, meaning that the use of materials had been deemed to meet the government’s austerity regulations). I patched the holes and stains in the suit with silk patterned with genetically

modified *E. coli* bacteria. These were created with Dr. Sarah Goldberg using a cutting-edge technique called CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) allowing researchers to cut and paste DNA. By removing the gene responsible for resistance to the antibiotic ampicillin and then scarlessly patching the bacterium's DNA to encode the World War II slogan 'Make Do and Mend', we were able to 'mend' the organism back to its pre-1941, pre-antibiotic era state. The suit is accompanied by a series of framed works combining WWII CC41 textiles, altered WWII leaflets that inspired the piece, relics from the CRISPR experiment, and a child's toy sewing machine (that my mother used to play with during WWII) shown stitching a silk gown with modified bacteria. In making that piece, it seemed somehow right to include this toy, although that decision was made quite instinctively. The theorist Annick Bureauud has raised the point that the use of the sewing machine suggests we are still 'playing' with these techniques and that we are still not sure what the consequences of their use might be.

The second piece – 'Hypersymbiont Dress' (6) – plays with this idea further by asking how new technologies might enable forms of interaction with our own bacterial flora (or even foreign infectious diseases), a move that could enhance us as organisms and drive our evolution at a cellular level. This project has involved extensive collaborative work, first with Kevin Cole and Dr . John Paul, Dr. James Price, and Dr. Rosie Sedgwick, then further work with Alex May, Dr. Daire Cantillon and Professor Martyn Llewellyn. The piece takes the form of a dress both stained and video mapped with forms of bacterial life that could turn us into human super-organisms – with improved creativity, improved health, and even improved personalities. The dress is stained with normal environmental bacteria, but also *Mycobacterium vaccae* (a soil bacterium that enhances cognitive function by increasing serotonin levels, as tested and proven in rats), MRSA (which can interface with the human nervous system and affect how we feel pain), and *Bacillus Calmette Guerin* (BCG; a form of attenuated Bovine

Tuberculosis that has been strongly linked to creativity throughout history). The video mapping on the dress was created from a film of my own blood fighting, *in vitro*, an infection with BCG.

It is undeniable that the development of new technologies carries potential risks and may lead to unpredictable consequences. However, I do not think art has to be about identifying or solving those problems; for me, it is about raising deeper questions about what it means to be stupid, fleshy, rotting bodies facing the world that confronts us, enabling us to reflect on the complexity of our biology, its aesthetics, and our failure to fully comprehend it. In my work, I want to give people tools to think critically about what they read and hear in terms of new technologies, to be able to tell the hype from the reality, and to provide a way of understanding scientific and technological ambiguities rather than just expecting black and white answers – the world has few of those.

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Artist Biography

Anna Dumitriu is an artist working at the forefront of collaborative practice between the arts and sciences, focussing primarily on human health and disease. Her installations, interventions, and performances use a range of biological, digital, and traditional media; these include live bacteria, robotics, and textiles. Her work has been shown at The Picasso Museum in Barcelona, ZKM Center for Art and Media in Karlsruhe, The Science Gallery Dublin, The Museum of Contemporary Art Taipei, The Guangdong Museum of Art, and The Victoria & Albert Museum in London; her work is held in several major collections, including the Science Museum in London and the Eden Project, UK. She is Artist-in-Residence on the Modernising Medical Microbiology Project at The University of Oxford and with the National Collection of Type Cultures at Public Health England. More on her work can be found at <http://annadumitriu.tumblr.com/>