MAKE DO AND MEND, ANNA DUMITRIU

1/ ***MAKE DO AND MEND*, AN ARTWORK COMPOSED OF SEVERAL ELEMENTS**

2/ **«REPAIRED» *E.COLI* BACTERIA GROWN ONTO SILK PATCHES**

3/ **FRAME WITH COVER FROM WORLD WAR II LEAFLET & PATCHES**

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1/ MAKE DO AND MEND, AN ARTWORK COMPOSED OF SEVERAL ELEMENTS

Make Do and Mend, FEAT exhibition at LifeSpace, Dundee, April 2017 – Photo Annick Bureaud

- A mannequin with a woman suit from the Second World War marked with the tag *CC41* (Controlled Commodity 1941) that meant it conformed to the government's austerity regulations of the time.
- *E.coli* bacteria where its genome has been modified by the artist using CRISPR/cas9 biotechnology techniques grown onto silk pieces of fabrics.
- 4 frames with pages from an original 'Make Do and Mend' leaflet from the Second World War, pages from a leaflet about penicillin, lab devices and the 'repaired-modified» bacteria grown onto silk.
- A toy « Singer » sewing machine, from the 1940's.

Close up of one of the patches, sewn on the suit. Photo Annick Bureaud

2/ «REPAIRED» *E.COLI* BACTERIA GROWN ONTO SILK PATCHES

The holes and stains in the suit have been patched and embroidered with silk patterned with *E. coli* bacteria grown using a dye-containing growth medium, forming pigmented colonies or spots.

The genomes of these *E. coli* bacteria have been edited using a technique called CRISPR to remove an ampicillin antibiotic resistance gene and repaired using a technique called homologous recombination to scarlessly patch the break with a fragment of DNA encoding the WWII slogan "Make Do and Mend».

Photo Anna Dumitriu

3/ FRAME WITH COVER FROM WORLD WAR II LEAFLET & PATCHES

This frame includes on the left, the cover of the 'Make Do and Mend' World War II leaflet and on the right ampicillin antibiotic susceptibility fabric grown with patients samples of gut microbiomes whose diversity has been impacted by antibiotic use. This element has been done in collaboration with Dr Nicola Fawcett at the University of Oxford.

Photos Anna Dumitriu

4/ FRAME WITH PAGE FROM WORLD WAR II LEAFLET & PATCHES

This frame includes on the left, a page from the 'Make Do and Mend' World War II leaflet with the metaphor of being a «doctor» to one's own clothes when repairing them and, on the right, a series of silk patches onto which were grown the «repaired» *E.coli* bacteria. The *CC41* logo, sewed with the silk patches and original darned *CC41* cloth fragments, links time, science, process and metaphors.

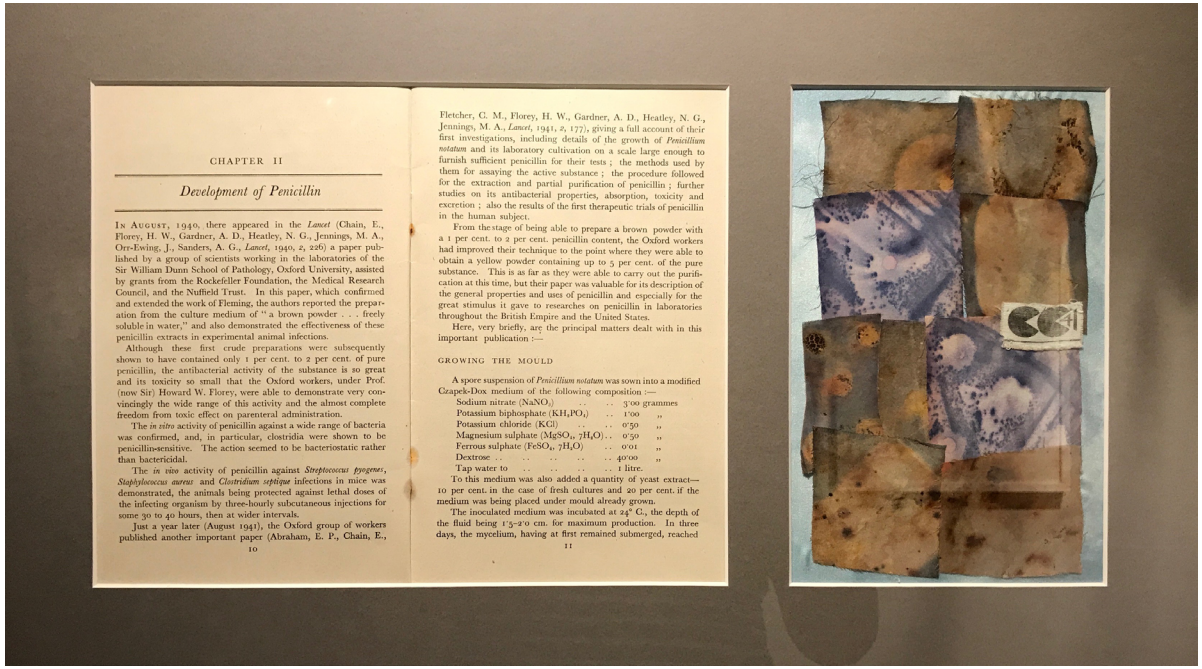
Photo Anna Dumitriu

5/ FRAME WITH PAGE FROM WORLD WAR II LEAFLET & ELECTROPORATION CUVETTES

This frame includes on the left, a page from World War II leaflet 'Make Do and Mend' explaining how to repair clothing using patching techniques. On the right, are three electroporation cuvettes covered with silk dyed with the modified bacteria on chromogenic agar, tied with embroidery silk. Electroporation is a technique in which an electrical field is applied to cells in order to increase the permeability of the membrane to introduce chemicals, drugs or DNA.

In the making of *Make Do and Mend*, electroporation cuvettes were used to electric shock the bacteria to take up the CRISPR/Cas9 and repair fragment plasmid DNA.

Resource :
https://en.wikipedia.org/wiki/Electroporation



CHAPTER II

Development of Penicillin

In August, 1940, there appeared in the *Lancet* (Chain, E., Florey, H. W., Gardner, A. D., Heatley, N. G., Jennings, M. A., Orr-Ewing, J., Sanders, A. G., *Lancet*, 1940, 2, 226) a paper published by a group of scientists working in the laboratories of the Sir William Dunn School of Pathology, Oxford University, assisted by grants from the Rockefeller Foundation, the Medical Research Council, and the Nuffield Trust. In this paper, which confirmed and extended the work of Fleming, the authors reported the preparation from the culture medium of "a brown powder . . . freely soluble in water," and also demonstrated the effectiveness of these penicillin extracts in experimental animal infections.

Although these first crude preparations were subsequently shown to have contained only 1 per cent. to 2 per cent. of pure penicillin, the antibacterial activity of the substance is so great and its toxicity so small that the Oxford workers, under Prof. (now Sir) Howard W. Florey, were able to demonstrate very convincingly the wide range of this activity and the almost complete freedom from toxic effect on parenteral administration.

The *in vitro* activity of penicillin against a wide range of bacteria was confirmed, and, in particular, clostridia were shown to be penicillin-sensitive. The action seemed to be bacteriostatic rather than bactericidal.

The *in vivo* activity of penicillin against *Streptococcus pyogenes*, *Staphylococcus aureus* and *Clostridium septique* infections in mice was demonstrated, the animals being protected against lethal doses of the infecting organism by three-hourly subcutaneous injections for some 30 to 40 hours, then at wider intervals.

Just a year later (August 1941), the Oxford group of workers published another important paper (Abraham, E. P., Chain, E.,

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Fletcher, C. M., Florey, H. W., Gardner, A. D., Heatley, N. G., Jennings, M. A., *Lancet*, 1941, 2, 177), giving a full account of their first investigations, including details of the growth of *Penicillium notatum* and its laboratory cultivation on a scale large enough to furnish sufficient penicillin for their tests ; the methods used by them for assaying the active substance ; the procedure followed for the extraction and partial purification of penicillin ; further studies on its antibacterial properties, absorption, toxicity and excretion ; also the results of the first therapeutic trials of penicillin in the human subject.

From the stage of being able to prepare a brown powder with a 1 per cent. to 2 per cent. penicillin content, the Oxford workers had improved their technique to the point where they were able to obtain a yellow powder containing up to 5 per cent. of the pure substance. This is as far as they were able to carry out the purification at this time, but their paper was valuable for its description of the general properties and uses of penicillin and especially for the great stimulus it gave to researches on penicillin in laboratories throughout the British Empire and the United States.

Here, very briefly, are the principal matters dealt with in this important publication :—

GROWING THE MOULD

A spore suspension of *Penicillium notatum* was sown into a modified Czapek-Dox medium of the following composition :—

Sodium nitrate ($NaNO_3$)	..	3·00 grammes
Potassium biphosphate (KH_2PO_4)	..	1·00 ,,
Potassium chloride (KCl)	..	0·50 ,,
Magnesium sulphate ($MgSO_4$, $7H_2O$)	..	0·50 ,,
Ferrous sulphate ($FeSO_4$, $7H_2O$)	..	0·01 ,,
Dextrose	..	40·00 ,,
Tap water to	..	1 litre.

To this medium was also added a quantity of yeast extract—10 per cent. in the case of fresh cultures and 20 per cent. if the medium was being placed under mould already grown.

The inoculated medium was incubated at 24° C., the depth of the fluid being 1·5–2·0 cm. for maximum production. In three days, the mycelium, having at first remained submerged, reached

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Photo Anna Dumitriu

6/ FRAME WITH ARTICLE ABOUT PENICILLIN & PATCHES

This frame includes on the left a page from a leaflet about the development of Penicillin and on the right a series of silk patches onto which were grown the «repaired» *E.coli* bacteria. The *CC41* logo, sewed with the patches, acts as a link between time, science, process and metaphors.

Photo Anna Dumitriu

7/ THE TOY SEWING MACHINE

Toy « Singer » sewing machine dating from WWII, and which had belonged to the artist's mother, with one of the patches bearing engineered bacteria ready to be sewn.

8/ MAKE DO AND MEND, MIRRORED AND ENMESHED STORYLINES

Make Do and Mend is embodying several storylines and issues that are echoing each other through the different elements that compose the artwork.

Make Do and Mend **: connecting social-political history to history of biomedical science, over time.**

The Year 1941, a pivotal reference in the work, and the Second World War time are confronted with the 2010's, our present and potential future.

In 1941, the leaflet «Make Do and Mend» was published in the United Kingdom to help people, and more specifically women, through the restrictions and the shortage in goods due to the war.

Today, people are suggested again to «mend» goods, this time in order to have a lesser impact on the environment. It is called «upcycling» and has even become trendy and fashionable.

In 1941, a patient was treated for the first time in the UK with penicillin. Antibiotic appeared to be the ultimate solution to previously deadly bacterial infections.

Today genome editing, and new molecular tools such as CRISPR/Cas9 are sometimes considered the ultimate solution not only to some of the diseases we are facing but also to repair the mess we have created by over-using antibiotic.

- Can/should we imagine 'mending' the genome as we have been 'mending' clothes during the Second World War?
- Can we really 'go back in time' to a 'pre-antibiotic' era or a 'pre-polluted'/'pre-global warming' environment?
- Is it wise and ethical to think that our (new/next) technology will repair our mistakes from the past (use of a previous) technology? Will history repeat itself?
- How could/should we work with the CRISPR biotechnological tool beyond the lab and use it safely in the wider environment, in/for artworks like in this project?
- How do we know that we are using gene editing in a 'safe' and 'good' way?

CREDITS

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