Engineering the future of medicine

"We are cracking the operating system of life. Our technology gives us precise control over cells that will allow us to create the next generation of medicines"

***Florian Schuster,** Bit.bio*

It was in 2014 when Florian Schuster, co-founder of Bit.bio, decided he needed a change in direction. He was at Harvard on a three-month executive programme, as part of his role as an investment banker. But it left him cold. He realised success in the banking world was not going to give him the fulfilment he wanted. So he wrote down a question: "If I could dedicate the remaining hours of my life to a single cause, to make it a life well lived, what would that cause be?"

The answer, it turned out, was redefining healthcare and curing cancer. Which is how he ended up co-founding Bit.bio, the cell-coding company, whose goal is to create unlimited batches of every human cell. And it all happened after a chance meeting with an old friend from university in Austria – Dr Mark Kotter – at a reunion lunch in Cambridge back in 2018. "I was working at Tessa Therapeutics, which I'd joined right after that 'aha' moment during the Harvard course," says Schuster. "Another delegate on the course was telling me about a research breakthrough he'd made and asked if I would like to help him turn it into a business. So I'd literally packed a few bags and moved to Singapore, where he was based, and decided to develop cell therapies for cancer. It was going really well. After just three years, we'd built Tessa to a company of more than 200 people with multiple assets in the clinic. And we were running one of the biggest cell therapies in cancer trials in the world. But then I met Mark at this lunch. And everything changed again."

Kotter and Schuster had been in the same undergraduate scholarship programme in Austria before going their separate ways. Schuster remembers Kotter as the medical student who wanted to be a neurosurgeon and Kotter thought Schuster, who studied physics, was still in banking. So at that reunion lunch, it was a real surprise to discover they were now both working in remarkably similar fields and had very similar goals.

As well as being a neurosurgeon, Kotter had built a career as a stem-cell researcher at the University of Cambridge. He was trying to solve a tricky problem regarding the cells that wrap around the connections between neurons to make them more stable and which can get destroyed by multiple sclerosis. In the process, he discovered the key to unlocking the potential to stem cells – a technology that could directly reprogram stem cells into any other human cell type with consistency and at scale. Schuster immediately recognised the breakthrough that Kotter had made.

"Having spent three years in a cell-therapy start up, I knew that the big bottleneck was access to reliable and unlimited supplies of cells," says Schuster. "It took me two minutes to realise that my old friend had invented the solution. My wife noticed that a very special partnership was already forming. I asked her on the train back if she could see herself moving from Singapore to Cambridge. Which is what we then did, with our five-month-old daughter." It was another leap of faith in pursuit of that goal to change healthcare.

As co-founder of Bit.bio, Schuster brought his physics principles to rapidly restructure the company. "In physics we allow ourselves the freedom to challenge everything and don't take the status quo as the unassailable truth," he says. "We also start from a very empirical place when approaching problems. Those are things that are still true of the culture of Bit.bio today and why we have such a strong ambition and vision."

Within weeks, high-profile investors began to assemble; far-sighted entrepreneurs who could already recognise the potential of Bit.bio's technology. They could see that this direct reprogramming approach was something that could have dramatic consequences for the treatment of cancer and neuro-degenerative diseases and could ultimately lead to breakthroughs regarding the growth of human organs. It could even be used to stop the degeneration caused by ageing.

"We are cracking the operating system of life," says Schuster. "Our technology gives us precise control over cells that will allow us to create the next generation of medicines that could improve the lives of every person. It allows us to precision-engineer command codes directly into the DNA of cells and then press enter to run the programs we want. It presents an approach to cells that is much more like engineering. We can produce cells with consistency, high purity, speed and at scale."

Schuster has a formidable sense of vision and scale. His ambition for Bit.bio is to become like Microsoft and Intel – companies that are so integral to their industry that their industry is unimaginable without them. Behind his desk at his house in Cambridge, UK, Bit.bio's hometown, he keeps a photograph of astronauts Neil Armstrong, Buzz Aldrin and

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Michael Collins. "They give me inspiration," he says. "The Apollo programme was the biggest achievement in humanity in the 20th century. I want Bit.bio to do something similar for human biology in the 21st."

As an experienced investor, Schuster also has the foresight to see where the company might go longer term. The founders have already convened an ethics board, in anticipation of some of the issues that may be raised five or ten years down the line. Not many new companies think that far ahead, or in such world-changing terms. "The results we see from our core technology and the feedback we get from the researchers who are already beta testing our cells are mind-blowing," says Schuster. "And it's because we are looking at biology in a different way. We see cells as running this sort of software so we can directly reprogram them. And it's working."

The potential of Bit.bio's discovery has drawn major investors from the US West Coast. More than $50 million has been secured, including significant investment in spring 2020 from a fund led by Richard Klausner, whose former roles include Director of the National Cancer Institute, presidential advisor and Executive Director of the Bill & Melinda Gates Foundation. "Bit.bio's approach represents a paradigm shift in biology that will enable a new generation of cell therapies, improving the lives of millions," Klausner has said. With Klausner came other heavyweight biotech investors such as Foresite Capital, Blueyard Capital and Arch Venture Partners.

Early applications of Bit.bio's technology have been in the field of drug development. Previously, the development of drugs and vaccines has often stalled at the clinical stage because the human biological system differs in vital ways from the mice, rats and monkeys on which new medicine is tested. Bit.bio's engineered cells allow clinical research to take place on human models, something that has the potential to revolutionise the industry.

A key ally is the London Institute of Mathematical Sciences, a private non-profit organisation that is self-funding through research grants and donations. "As well as having the technology to precision engineer cells, we also need to crack the operating system of life, to find the codes for every cell type," says Schuster. "For that, you need to invent new science and new mathematics and that is what we are doing with the London Institute of Mathematical Sciences. We haven't discovered the operating system of life yet but we have a few commands that will take us on the way, such as the command that turns a stem cell into a neuron and the one that turns a stem cell into a muscle cell. Behind that we have a huge pile of other cells that will be coming to the market."

After this will come therapeutic medicine, cures for cancer, and neurological diseases and the means to combat ageing. Bit.bio's technology may allow for the growth of human organs. And the company is already thinking about the potential application of its cells beyond healthcare: a sister company, Meatable, is already making major progress where it comes to growing animal cells for food consumption. "That is a sign of our ambition," says Schuster. "If you think about how pervasive biology is, we can potentially program and precisely control everything around us for the first time. The scope for the impact this could have on human health and the health of our planet is almost too big to think about. But we are sure that what we are doing can help change the world for the better."

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