REAL EXCITEMENT ABOUT SYNTHETIC BIOLOGY

Kirsty Gibson, Investment Manager. Fourth Quarter 2018

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Cover Image: Illustrated DNA strand.

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THE IMPORTANCE OF RESEARCH

Collecting routine information and fishing in a shared pool of knowledge will never enable us to deliver better-than-average returns. Therefore, we need to find a different pond in which to fish; a large pond that few of our rival investors know about; and build our knowledge before it becomes over-analysed and noise takes hold. Consequently, attending standard industry conferences is not high on our priority list. Instead, the US Equities team prefers extended research trips, with all the investment managers on the team having undertaken long periods out of the office over the last few years.

We believe that this sort of extended research trip offers us the opportunity to think differently; meeting with companies and experts in their fields, whilst immersing ourselves in a less familiar part of the world. Given we are all generalists, an extended trip provides us with the opportunity to pursue specific areas of interest in far more detail. Space to think away from the normal environment is incredibly valuable in making connections and, ultimately, generating new ideas.

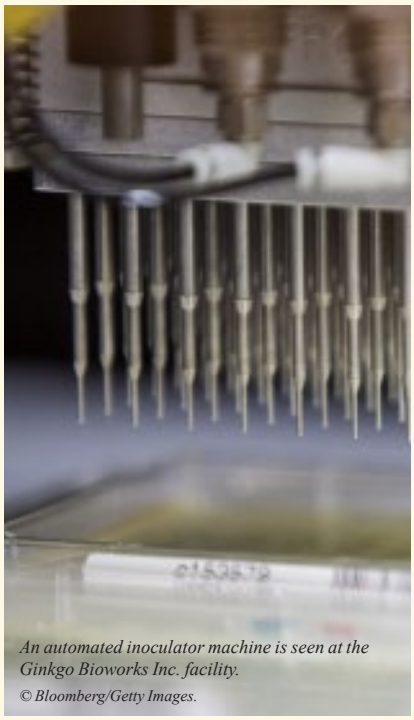
REAL EXCITEMENT ABOUT SYNTHETIC BIOLOGY

BY KIRSTY GIBSON

I recently spent three weeks exploring a number of interesting public and private companies on the East Coast of the US, meeting management and industry experts. I spent much of my field trip exploring a topic of particular interest to me: synthetic biology. This involves the application of engineering principles to biology. It is about designing, redesigning and fabricating biological components and systems which exist in the natural world but would not appear organically.

Synthetic biology is a loose term for a group of genetic engineering techniques which edit the DNA of an existing organism to produce a desired product. For example, re-engineering yeast cells to produce specific flavours or fragrances as opposed to its normal by-product, ethanol. These flavours and fragrances can then be used in perfumes or food production and potentially replace existing supply chains in these industries. As human understanding of biology has grown, aided by genetic sequencing and gene editing, so has our ability to programme biology. Consequently, as human knowledge and aptitude to manipulate chemical compounds increases, so does our capability to discover new materials and processes.

Biology could be described as the most incredible technology we can imagine, but current understanding is constraining its uses. However, some companies are making progress in the area.



An automated inoculator machine is seen at the Ginkgo Bioworks Inc. facility.
© Bloomberg/Getty Images.

Liquid leather samples being produced.
© ModernMeadow/Adam Fithers.

Petri dish with Bacteria Culture.

Ginkgo BioWorks, a private company based in Boston, is a self-defined 'organism design firm'. It genetically modifies yeast, and ferments it to produce a variety of products, from flavours and fragrances, to microbes for agriculture. It licenses the design to customers and takes a share of the profits.

Modern Meadow, a New Jersey-based private company, uses pichia yeast to produce animal-free collagen, from which it produces a form of bio-leather. The way this is produced means it can be moulded into any shape, take on any texture, and be liquid or solid, opening a huge range of use cases beyond what leather is currently utilised for.

Synlogic is a Boston-based small cap company, which is trying to bring 'living medicines' to patients by genetically programming bacteria to perform functions that an individual's body is not able to perform. Its first product helps sufferers of a rare disease called urea cyclic disorder. Sufferers cannot break down ammonia. Synlogic has developed bacteria which, when swallowed, are able to consume the ammonia, thus removing it from the body.

EXPLORING FUTURE POSSIBILITIES

Synthetic biology has the potential to disrupt huge swathes of the companies listed on the stock market and could present a significant challenge to a number of industries in the long term. However, predicting the future of the industry is challenging. As Tom Knight, the 'father of synthetic biology', Ginkgo founder and expert put it: predicting the future of synthetic biology is like asking Bardeen, the inventor of the transistor, to predict the iPhone in 1948. However, there are several areas which look likely to come under threat first.

Modern Meadow Zoa t-shirt. Commissioned by The Museum of Modern Art, New York, on the occasion of the exhibition Items: Is Fashion Modern?

MATERIALS

As mentioned earlier, leather looks like a market ripe for disruption. Leather is a $100 billion market, and synthetic leather adds a further $50 billion. Producing leather using yeast enables increased flexibility of form (meaning it can be produced on a roll or as a liquid), increased design possibilities and a far lighter footprint on the planet, given tanning and livestock both consume large quantities of resources. Furthermore, if bio-leather is not constrained in its form, the uses for it may expand, causing disruption to the broader textile market. This could present significant opportunities for a sports apparel maker such as Under Armour to embrace new and innovative materials. Its supply chains could also be drastically altered – why would manufacturing in Vietnam or China make sense any more? The production of materials which might otherwise be outsourced to other countries could be brought onshore, grown in a vat and then finished by robots.

– In the future, harnessing biology may enable us to produce wood on demand, rather than having to grow forests from scratch or deforesting.

Another product that could be created via synthetic biology is wood: is it better to make wood in a controlled way, without knots or with a cuboid trunk? In the future, harnessing biology may enable us to produce wood on demand, rather than having to grow forests from scratch or deforesting.

The ability to produce more products locally and on demand would have some significant impacts; on shipping and the prices of the materials themselves; the requirement to ship long distances would likely fall, and supply chains would shorten. Additionally, consistency in the production of materials would result in more stable material commodity prices; for example, weather events would not have the same impact on prices.

FOOD

The simple fact is that plants are not designed to be eaten; they evolved to replicate themselves. Plants produce toxins to protect themselves from being eaten. If you can produce food products such as meat or milk in a fermenter, it would drastically reduce humanity's requirement for livestock and the negative externalities the livestock industry cause to the world, such as CO_2 and methane emissions. We might then ask ourselves how producing meat or food utilising synthetic biology would impact farmers or producers of animal feed. And would consumers accept this form of genetically-modified product?

ELECTRONICS

The way in which semiconductors and electronics are currently being made is coming to an end. GlobalFoundries recently gave up on its 7nm[1] chip and Intel is having problems with its 10nm chip. Semiconductor manufacturing has historically not been done with precision but has involved spraying atoms onto a chip and hoping enough land in the correct place. With increasingly smaller chips this is no longer effective. You need some way of precisely locating your atoms and thus the need to approach the chemists. As an example, certain proteins form a crystal lattice structure on top of bacteria, with a 13nm lattice constant (space between each is 13nm). This makes it possible to build a structure which is repetitive and precise.

What impact might this have on companies such as Nvidia, the graphic chip maker, and what might biology enable chip makers to do that is currently not possible?

The answers to all our questions may be years from being answered but are really important to us, given our long-term investment horizon.

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1. Nm – nanometre. One nanometre equals one millionth of a millimetre. A sheet of paper is about 100,000 nanometres thick.

CONCLUSION

We have been following this area for a number of years now and synthetic biology is well beyond the proof of concept stage. Cost and scale-up remain issues for many players in the area but some companies are beginning to overcome these start-up pains. It feels that we are on the cusp of another industrial revolution. Time frames are long, but we are beginning to define what role synthetic biology will play in our world. This creates an opportunity for those with patience and belief in this nascent industry.

Synthetic biology may not be a widely investable area for us currently, but we believe that putting in the research time now will place us in an enviable position when an investable opportunity does present itself. Furthermore, spending time developing our knowledge of an emerging area provides insights into potential threats to existing holdings or industries that others may have overlooked.

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Kirsty is an investment manager in the US Equities team. She graduated MA (Hons) in Economics from the University of Edinburgh in 2011 and MSc in Carbon Management also from the University of Edinburgh in 2012, before joining Baillie Gifford in the same year. Kirsty began her career on the US Equities team, before moving on to spend several years in small and large cap global equities departments, before returning to the US Equities team. Kirsty is also a member of the Positive Change Portfolio Construction Group.

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