

# BIOFACTURING

---

*SOLVING THE WORLD'S BIGGEST PROBLEMS  
BY PARTNERING WITH NATURE*

---

Jack Torrance, Trainee Client Service Manager



---

## RISK FACTORS

---

The views expressed in this article are those of Jack Torrance and should not be considered as advice or a recommendation to buy, sell or hold a particular investment. They reflect personal opinion and should not be taken as statements of fact nor should any reliance be placed on them when making investment decisions. This communication was produced and approved in December 2020 and has not been updated subsequently. It represents views held at the time of writing and may not reflect current thinking.

### **Potential for Profit and Loss**

All investment strategies have the potential for profit and loss, your or your clients' capital may be at risk. Past performance is not a guide to future returns.

### **Stock Examples**

Any stock examples and images used in this article are not intended to represent recommendations to buy or sell, neither is it implied that they will prove profitable in the future. It is not known whether they will feature in any future portfolio produced by us. Any individual examples will represent only a small part of the overall portfolio and are inserted purely to help illustrate our investment style.

This article contains information on investments which does not constitute independent research. Accordingly, it is not subject to the protections afforded to independent research, and Baillie Gifford and its staff may have dealt in the investments concerned.

All information is sourced from Baillie Gifford & Co and is current unless otherwise stated.

The images used in this article are for illustrative purposes only.

DECEMBER 2020

---

# BIOFACTURING

---

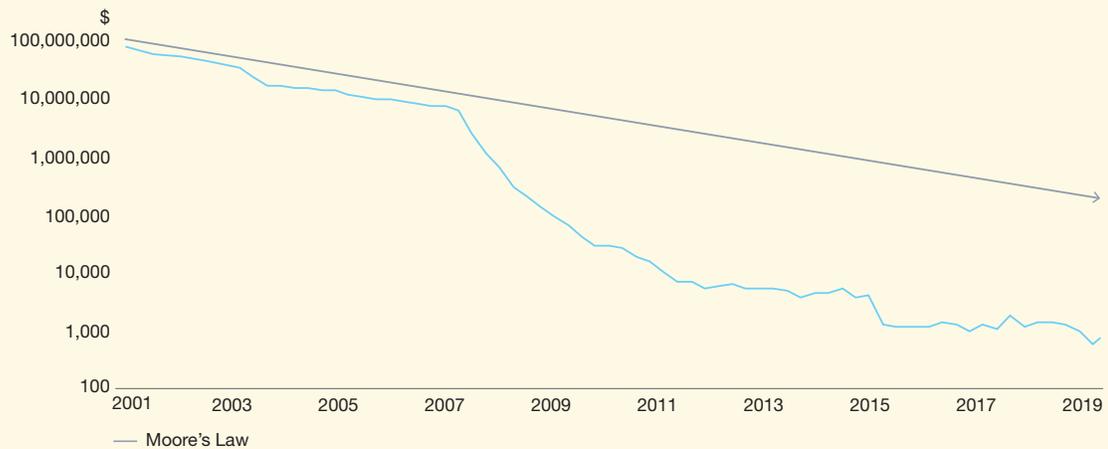
*Synthetic biology conjures images of Frankenstein's monster, with mad scientists poring over boiling beakers to bring to life the beast. The reality of modern labs is significantly different. Truly remarkable progress is being made in solving some of the world's biggest problems by unlocking nature at its most granular level.*



How will we reduce plastic waste or protect crops from ever more volatile and extreme weather brought about by climate change? Is there a different way to lessen the impact of insect borne disease, such as malaria, which remains one of the biggest causes of death worldwide? Whilst populations and consumption grow, we must seek innovation to tackle these huge issues, and the building blocks of these solutions are often being provided by the natural world, albeit with some tweaking and tuning.

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. Advances in gene sequencing, driven by companies like Illumina, have made the mapping and understanding of DNA more prevalent with their next generation sequencing (NGS) devices. This is shining a light on the possibilities in fields as varied as materials science, agriculture and nutrition. The declining cost of NGS has accelerated far quicker than Moore's law, speeding the propagation into other areas.

Cost per Human Genome



Source: <https://www.genome.gov/about-genomics/fact-sheets/DNA-Sequencing-Costs-Data>

Innovation in areas such as robotics, machine learning and 3D printing has converged with the quantum leaps in understanding brought about by NGS, allowing us to get under the bonnet of the code of life and tune it for other purposes.



© Ginkgo Bioworks

Ginkgo Bioworks has identified that for average lab protocols, 80 per cent of the cost is scientist labour, prohibiting economies of scale. In their ‘foundry’ their significant use of automation and software enables 10-15 staff to match the output of 100 PhDs. This allows them to produce customisable enzymes at scale for industrial purposes as varied as flavourings and fragrances and insect control, reducing the spread of diseases such as malaria and dengue fever, where mosquitoes and flies act as vectors, and traditional pesticides and insect repellents can be harmful to the wider environment.

Beyond this automation, Ginkgo’s additional edge lies in their ‘codebase’ – an encyclopaedia of genetic data to speed up the accuracy and applicability of synthetic biology solutions. This is the equivalent of a proprietary software library which is written in DNA. The potential competitive advantage of Ginkgo Bioworks lies in their licensing model, which means that virtually all licensing revenue should fall to the bottom line. The management team’s focus on automation creates an opportunity to scale significantly, at speed, without significantly increasing labour costs. This has the potential to create highly successful business.

### Bolt Threads Technology

WE STUDY SILK PROTEINS SPUN BY SPIDERS TO DETERMINE WHAT GIVES THEM THEIR INCREDIBLE PROPERTIES.



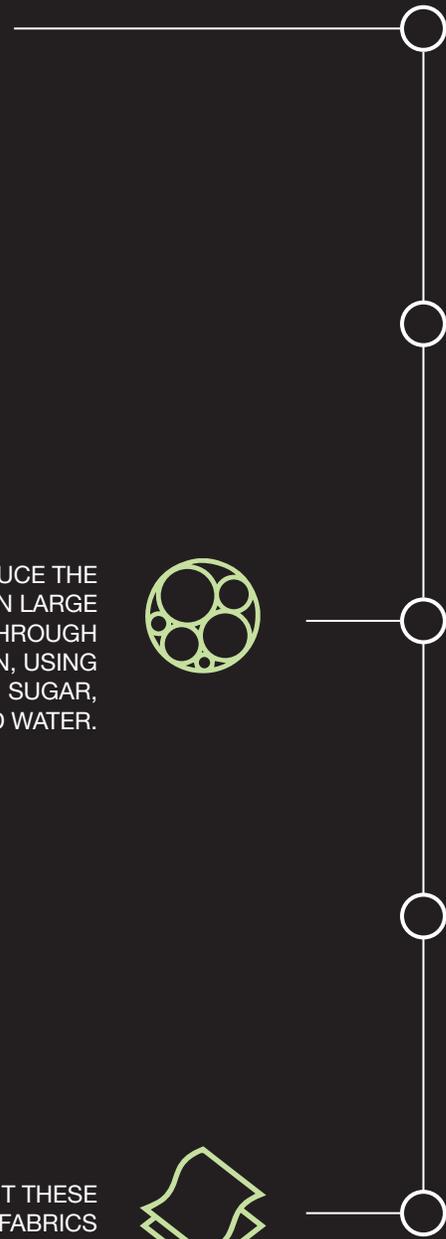
Synthetic biology is poised to play a crucial role in the energy transition, helping us to reimagine the composition of many goods that are currently produced from petrochemical derivatives, and in turn helping to reduce our reliance on fossil fuels.

Bolt Threads is a materials solutions company, which seeks to reduce the impact of traditional materials manufacturing. Most of the innovations in textiles over the last 85 years have come from petrochemicals; Gore-Tex, Nylon and Lycra are all familiar household names; however, these textiles rely on manufacturing processes and raw materials that are harmful to the planet, and they are also unable to bio-degrade at the end of their useful life. Bolt Threads has sought to address these issues by synthesising *Microsilks*® from yeast – coded to spider silk proteins, and grown in a bioreactor to provide high tensile strength, elasticity, durability and softness.

WE PRODUCE THE PROTEIN IN LARGE QUANTITIES THROUGH FERMENTATION, USING YEAST, SUGAR, AND WATER.



WE KNIT THESE FIBERS INTO FABRICS AND GARMENTS.





WE DEVELOP PROTEINS  
INSPIRED BY THESE  
NATURAL SILKS BY USING  
BIOENGINEERING TO PUT  
GENES INTO YEAST.



WE ISOLATE AND PURIFY  
THE SILK PROTEIN, THEN  
SPIN IT INTO FIBERS,  
SIMILAR TO THOSE LIKE  
RAYON AND ACRYLIC.

Source: <https://boltthreads.com/technology/microsilks/>

Whilst the potential for spider silk is exciting, it could not be tapped without the skillset and infrastructure that Bolt Threads have built. Bolt Threads already have agreements with Stella McCartney and Patagonia to incorporate *Microsilks*® into their clothing, but as they continue to scour flora and fauna for specific qualities, they are looking to produce highly customised and durable materials for a much broader spectrum of applications, with sustainable alternatives to oil based. To give a feel for the potential scale of impact, in 2019 average global spend on apparel (spanning all 7.7 billion of earth's inhabitants) was a remarkable US\$231. Capturing even a very thin slice of this addressable market, could translate into exceptional outcomes not only for Bolt Threads, but also for the environment.

The co-founder of Ginkgo Bioworks, Tom Knight, thinks '*predicting the future of synthetic biology is like asking Bardeen, the inventor of the transistor, to predict the iPhone in 1948*'. We are at the dawn of a new industry; which is beginning to provide solutions to some of society's most wicked problems.

Enabled by technologies that we have already seen flourish synthetic biology capitalises on their convergence to unlock and tweak the strengths of nature.

We are struck by the strength of developments and the degree of exponential change in the area, but the opportunities in this exciting area reside entirely within the private markets.

---

## RISK FACTORS

---

Baillie Gifford & Co and Baillie Gifford & Co Limited are authorised and regulated by the Financial Conduct Authority (FCA). Baillie Gifford & Co Limited is an Authorised Corporate Director of OEICs.

Baillie Gifford Overseas Limited provides investment management and advisory services to non-UK Professional/ Institutional clients only. Baillie Gifford Overseas Limited is wholly owned by Baillie Gifford & Co. Baillie Gifford & Co and Baillie Gifford Overseas Limited are authorised and regulated by the FCA in the UK.

Persons resident or domiciled outside the UK should consult with their professional advisers as to whether they require any governmental or other consents in order to enable them to invest, and with their tax advisers for advice relevant to their own particular circumstances.

Baillie Gifford Investment Management (Europe) Limited provides investment management and advisory services to European (excluding UK) clients. It was incorporated in Ireland in May 2018 and is authorised by the Central Bank of Ireland. Through its MiFID passport, it has established Baillie Gifford Investment Management (Europe)

Limited (Frankfurt Branch) to market its investment management and advisory services and distribute Baillie Gifford Worldwide Funds plc in Germany. Baillie Gifford Investment Management (Europe) Limited also has a representative office in Zurich, Switzerland pursuant to Art. 58 of the Federal Act on Financial Institutions (“FinIA”). It does not constitute a branch and therefore does not have authority to commit Baillie Gifford Investment Management (Europe) Limited. It is the intention to ask for the authorisation by the Swiss Financial Market Supervisory Authority (FINMA) to maintain this representative office of a foreign asset manager of collective assets in Switzerland pursuant to the applicable transitional provisions of FinIA. Baillie Gifford Investment Management (Europe) Limited is a wholly owned subsidiary of Baillie Gifford Overseas Limited, which is wholly owned by Baillie Gifford & Co.

Baillie Gifford Investment Management (Shanghai) Limited 柏基投资管理(上海)有限公司 is wholly owned by Baillie Gifford Overseas Limited and may provide investment research to the Baillie Gifford Group pursuant to applicable laws. Baillie Gifford Investment Management (Shanghai) Limited

柏基投资管理(上海)有限公司 is incorporated in Shanghai in the People’s Republic of China (PRC) as a wholly foreign-owned limited liability company under the Company Law of the PRC, the Foreign Investment Law of the PRC and its implementing rules, and other relevant laws and regulations of the PRC. Baillie Gifford Investment Management (Shanghai) Limited 柏基投资管理(上海)有限公司 is registered with the Shanghai Municipal Administration for Market Regulation, with a unified social credit code of 91310000MA1FL6KQ30, with its registered office at Unit 4203-04, One Museum Place, 669 Xin Zha Road, Jing An District, Shanghai 200041, China. Baillie Gifford Investment Management (Shanghai) Limited

柏基投资管理(上海)有限公司 is a registered Private Fund Manager with the Asset Management Association of China and manages private security investment fund in the PRC, with a registration code of P1071226.

### Hong Kong

Baillie Gifford Asia (Hong Kong) Limited 柏基亞洲(香港)有限公司 is wholly owned by Baillie Gifford Overseas Limited and holds a Type 1 and a Type 2 licence from the Securities & Futures Commission of Hong Kong to market and distribute Baillie Gifford’s range of collective investment schemes to professional investors in Hong Kong. Baillie Gifford Asia (Hong Kong) Limited 柏基亞洲(香港)有限公司 can be contacted at Room 3009-3010, One International Finance Centre, 1 Harbour View Street, Central, Hong Kong. Telephone +852 3756 5700.

### **South Korea**

Baillie Gifford Overseas Limited is licensed with the Financial Services Commission in South Korea as a cross border Discretionary Investment Manager and Non-discretionary Investment Adviser.

### **Japan**

Mitsubishi UFJ Baillie Gifford Asset Management Limited ('MUBGAM') is a joint venture company between Mitsubishi UFJ Trust & Banking Corporation and Baillie Gifford Overseas Limited. MUBGAM is authorised and regulated by the Financial Conduct Authority.

### **Australia**

This material is provided on the basis that you are a wholesale client as defined within s761G of the Corporations Act 2001 (Cth). Baillie Gifford Overseas Limited (ARBN 118 567 178) is registered as a foreign company under the Corporations Act 2001 (Cth). It is exempt from the requirement to hold an Australian Financial Services License under the Corporations Act 2001 (Cth) in respect of these financial services provided to Australian wholesale clients. Baillie Gifford Overseas Limited is authorised and regulated by the Financial Conduct Authority under UK laws which differ from those applicable in Australia.

### **South Africa**

Baillie Gifford Overseas Limited is registered as a Foreign Financial Services Provider with the Financial Sector Conduct Authority in South Africa.

### **North America**

Baillie Gifford International LLC is wholly owned by Baillie Gifford Overseas Limited; it was formed in Delaware in 2005 and is registered with the SEC. It is the legal entity through which Baillie Gifford Overseas Limited provides client service and marketing functions in North America. Baillie Gifford Overseas Limited is registered with the SEC in the United States of America.

The Manager is not resident in Canada, its head office and principal place of business is in Edinburgh, Scotland. Baillie Gifford Overseas Limited is regulated in Canada as a portfolio manager and exempt market dealer with the Ontario Securities Commission ('OSC'). Its portfolio manager licence is currently passported into Alberta, Quebec, Saskatchewan, Manitoba and Newfoundland & Labrador whereas the exempt market dealer licence is passported across all Canadian provinces and territories. Baillie Gifford International LLC is regulated by the OSC as an exempt market and its licence is passported across all Canadian provinces and territories. Baillie Gifford Investment Management (Europe) Limited ('BGE') relies on the International Investment Fund Manager Exemption in the provinces of Ontario and Quebec.

## **Oman**

Baillie Gifford Overseas Limited (“BGO”) neither has a registered business presence nor a representative office in Oman and does not undertake banking business or provide financial services in Oman. Consequently, BGO is not regulated by either the Central Bank of Oman or Oman’s Capital Market Authority. No authorization, licence or approval has been received from the Capital Market Authority of Oman or any other regulatory authority in Oman, to provide such advice or service within Oman.

BGO does not solicit business in Oman and does not market, offer, sell or distribute any financial or investment products or services in Oman and no subscription to any securities, products or financial services may or will be consummated within Oman. The recipient of this document represents that it is a financial institution or a sophisticated investor (as described in Article 139 of the Executive Regulations of the Capital Market Law) and that its officers/employees have such experience in business and financial matters that they are capable of evaluating the merits and risks of investments.

## **Qatar**

This strategy is only being offered to a limited number of investors who are willing and able to conduct an independent investigation of the risks involved. This does not constitute an offer to the public and is for the use only of the named addressee and should not be given or shown to any other person (other than employees, agents, or consultants in connection with the addressee’s consideration thereof). Baillie Gifford Overseas Limited has not been and will not be registered with Qatar Central Bank or under any laws of the State of Qatar. No transactions will be concluded in your jurisdiction and any inquiries regarding the strategy should be made to Baillie Gifford.

## **Israel**

Baillie Gifford Overseas is not licensed under Israel’s Regulation of Investment Advising, Investment Marketing and Portfolio Management Law, 5755-1995 (the Advice Law) and does not carry insurance pursuant to the Advice Law. This document is only intended for those categories of Israeli residents who are qualified clients listed on the First Addendum to the Advice Law.

---

## ABOUT THE AUTHOR

---



### **JACK TORRANCE**

*Client Service Manager (Trainee)*

Jack joined Baillie Gifford in July 2019 and is a Client Service Manager in the Clients Department. Prior to joining Baillie Gifford, he was an Infantry Officer in the British Army for 8 years. Jack graduated BA in Middle Eastern Studies from the University of Exeter in 2011.

# **CURIOUS ABOUT THE WORLD**

**[bailliegifford.com/thinking](http://bailliegifford.com/thinking)**