**Written Testimony of Jason Kelly**
Co-Founder and CEO, Ginkgo Bioworks

**Growing Stakes: The Bioeconomy and American National Security**

House Select Committee on Strategic Competition Between the United States and the Chinese Communist Party
Field Hearing, Boston, MA
February 13, 2024

Chairman Gallagher, Ranking Member Krishnamoorthi, members of the Committee, thank you for the honor to speak today and to have hosted you at Ginkgo Bioworks yesterday.

My name is Jason Kelly. I am testifying today as the Co-Founder and CEO of Ginkgo Bioworks, and not in my capacity as Chair of the National Security Commission on Emerging Biotechnology.

Ginkgo is a fifteen year old company. We're publicly traded, and we have over 1,200 employees. Ginkgo is headquartered in Boston, and we also operate sites in California and in Europe.

This Committee is wise to view biotechnology as among the key technologies that stand to shape U.S. national security and economic competition. Biotech applications increasingly span the economy, with growing geopolitical and societal implications. Ginkgo's platform, for example, serves diverse markets, from food and agriculture to pharmaceuticals to industrial and specialty chemicals.

As this Committee considers the bioeconomy and implications for national security, I'd like to use my testimony to: speak to the Foundry as essential infrastructure at the core of a competitive bioeconomy; highlight the importance of biological data and generative AI for applying biotechnology; and share to priorities relating to safeguarding the emerging bioeconomy and strengthening biosecurity.

**A Foundry is Foundational to Growing the Bioeconomy**

Consider that, until relatively recently, the tools of biotechnology were not easily accessible or broadly commercially practical. Just to get started, you needed your own lab, with your own expensive equipment, as well as a team of highly-trained scientists to painstakingly conduct experiments and generate data effectively by-hand. This was absolutely the case when my co-founders and I were completing our PhDs at MIT in the early 2000's.

Progress was slow and expensive. In fact, using biotechnology for commercial R&D was so slow and so expensive that only companies with large budgets and long development timelines could even begin to tap into biotech. Hence, for most of us in this room, we probably most readily associate biotechnology with pharmaceutical innovations.

Were biotechnology still defined by such an artisanal approach, it is unlikely that this Committee would be meeting on the bioeconomy and national security. However, the field is transitioning from a fragmented landscape of expensive, commercially risky experimentation to a more integrated and standardized platform-based approach that supports scaling of biotech applications and the bioeconomy at large.

The transition very much resembles similar transformations that have accelerated other parts of the economy that are built on technologies similarly relevant to economic competition, such as cloud computing and semiconductors.

For example, in the case of cloud computing, platforms like Amazon Web Services, Microsoft Azure, and Google Cloud Platform emerged to meet the need for businesses to access scalable and flexible computing resources without the high costs and complexities of establishing and maintaining the workforce and physical infrastructure associated with on-site data storage. In the semiconductor space, the foundry approach at Taiwan Semiconductor Manufacturing Company (TSMC) provides the economies of scale and specialization required to provide chips the world relies on. The scale and flexibility that these platforms provide have been key to creating several $1 trillion market cap companies. Consider Nvidia, one of the latest $1 trillion market cap companies and the largest chip company: Nvidia doesn't make its own chips but instead leverages flexibility and scale offered by TSMC. Cloud computing and their related services support comparable dynamics and equally significant value creation.

Ginkgo is driving a similar transition in the biotechnology space. We do this by providing flexible, end-to-end R&D services so that customers across the economy can bring products to market more reliably, more quickly, and more affordably. Our platform services are built on flexible and highly automated lab infrastructure, which, along with proprietary software, comprises our Foundry. The Foundry both utilizes and generates our reusable biological data assets - our Codebase - which enables us to continually improve our services. Together, Foundry and Codebase create a scale economic which allows Ginkgo to perform more and more diverse research campaigns while the cost per campaign decreases.

In this regard, our platform effectively serves as "general infrastructure" to facilitate applications of biotechnology in companies large and small, and across the economy. As with general infrastructure in other technology stacks, our platform also reflects a substantial investment in physical capacity (over 300,000 square feet of highly automated labs) and essential data assets and tools. Ginkgo has invested over $1 billion to build out our platform. And, early next year, we will begin expanding into a brand new 250,000 square foot facility, increasing our capacity significantly. We will continue to invest so that more companies have access to the flexibility and scale required to more readily commercialize bio-based products.

Bending the R&D cost curve down, while also improving speed and probability of success, is what will permit more and more companies to use biotechnology, whether for the next breakthrough therapeutic, or, for agriculture or industrial applications that, for example, will contribute to more resilient supply chains, food security, or reductions in land use, water use, emissions, and reliance on fossil fuels or scarce natural resources. McKinsey Global Institute estimates that these applications of biotechnology could create a direct economic impact of $2

trillion to $4 trillion in the next 10 to 20 years — more than half of which is outside of the health sector. Likewise, Boston Consulting Group anticipates that, in the coming years, synthetic biology could account for more than a third of global output of manufacturing industries, representing almost $30 trillion in value.

In this respect, the Foundry, and platform services to access its capabilities, is a critical enabler of a vibrant and competitive bioeconomy. Ginkgo's Foundry stands to be integral for both companies and countries competing in the bioeconomy. Leadership in the bioeconomy and securing access to the economic and security benefits of its products will flow from the Foundry.

We're all very familiar with the advantages of leadership in the digital economy - in the world of bits. The Foundry provides the lever for leadership in the physical economy - the world of atoms - and carries with it considerable influence over so much of what underpins our security and well-being. Our health, agriculture, food, and the future of industrial manufacturing.

Beyond that, also in terms of national and economic security, the Foundry itself is also interesting insofar as the core tools and technologies of the bio-revolution come together inside the Foundry. Sequencing and synthesis capabilities, as well as technologies for automation, liquid handling, and bioinformatics, are used extensively in the Foundry. In many cases, Ginkgo is the largest customer for providers of these technologies, helping to provide demand and support innovation in these areas.

Similarly, a productive Foundry also contributes to reliable demand for other elements of the bioeconomy, including relating to feedstocks and bio-manufacturing. Work in the Foundry both meets and reflects demands and evolutions of the bioeconomy overall.

In a very real way, the Foundry stands to be a national asset for competing in the bioeconomy, mirroring the way, for example, SpaceX meets US space requirements or that TSMC serves the world's electronic industry. We are not aware of any other facility of similar scale and function, though we understand that China is investing to compete.

**The Foundry as a Data Factory to Power Generative AI**

As infrastructure, the Foundry has taken on additional national security relevance in light of new generative AI capabilities. Generative AI stands to be a significant accelerant for biotechnology R&D, offering pathways to breakthroughs in biopharma and across the economy. In that context, biological data is of renewed and particular importance.

Generative AI tools require large data sets. Consider the English language models built by OpenAI and others. Training data for these models included Library of Congress data, social media data, and other widely available written language. Over time, using that data, and by training the neural network using reinforcement learning, the model learned English.

Actually, biology, like English, is another sequential language. The DNA sequence that forms a gene is read from start to finish, much like a paragraph. Just like letters become words, words become sentences, and so on, all of biology is composed of digital code in the form of DNA, the sequence of which contributes to function. But there is no Library of Congress of biological data.

Those sequences exist in nature. Microbial biological data from the natural environment is an important source of data for the bioeconomy. Beyond natural sources of biological data, experimentally generated biological data is also critical to building effective AI applications for biotechnology.

In that sense, one way to view a biofoundry is essentially a world-leading biological “data factory” to support Generative AI. The Foundry provides critical scale to systematically learn from natural microbial data and generate experimental data, including by applying automation and related capabilities to efficiently conduct reinforcement learning to train large language models (LLMs) for biology. We are in early days, but we shouldn’t be surprised if LLMs for biology unlock breakthroughs in biotechnology R&D. Data will drive these applications, and, as we expand into our new facility, we stand to increase our biological data generation capacity by at least 10x.

To this end, last summer, Ginkgo announced a strategic partnership with Google Cloud aimed at leveraging Ginkgo’s Foundry and large biological data assets to develop new, state-of-the-art LLMs. These models are meant to help Ginkgo's customers accelerate innovation and discovery in fields as diverse as drug discovery, agriculture, industrial manufacturing, and biosecurity.

Fundamentally, like in other AI applications, leadership in the bioeconomy will necessitate leading in the development of these AI models.

**Building Biosecurity for the Bioeconomy and a World of Increasing Biological Threats**

Much in the same way that cybersecurity protects the digital economy, the bioeconomy will also require biosecurity. Particularly given that biological threats can overwhelm societies and disrupt governments and economies.

Increasing travel and trade, urbanization, and deforestation are combining to make it more likely that biological events occur more frequently. In fact, our epidemiological team recently published research that suggests that both the frequency and severity of naturally-emerging pandemic events is far from a “once in a century” risk.  At the same time, advancements in biotechnology and AI technologies also raise concerns about new biological risks, whether accidental or intentional.

The evolution of cybersecurity offers a useful roadmap for the bioeconomy. Initially, much like traditional biotech, the Information Technology landscape was marked by isolated systems and diverse software applications, together creating a fragmented - and often difficult to secure - environment. The shift towards more scalable and flexible platforms not only accelerated the digital economy, but also proved instrumental in mitigating cyber risks. For example, major digital platforms and service providers provide security through standardized protocols, regular updates, and controlled access, consistently deploying advanced security measures and comprehensive threat detection systems.

Similarly, while Ginkgo’s platform delivers more scalable, reliable biotechnology R&D services, we also see an urgency and responsibility to leverage our capabilities and position to build

biosecurity tools that not only safeguard the bioeconomy, but also help mitigate risk and impacts associated with biological threats of any origin.

In that context, Ginkgo has partnered with the Intelligence Advanced Research Projects Activity (IARPA) to improve biodetection and biosurveillance capabilities, specifically by developing an AI-enabled tool that assesses if a microbe is engineered and identifies the location of the genetic engineering anomaly. A genetically engineered virus – as opposed to a naturally emerging one – would indicate that the pathogen may have originated in a lab or was intentionally produced.

We are also working with IARPA to create an advanced biosensor that can continuously record and store gene expression data in chronological order within a microbial genome, as well as processes to retrieve this data to be able to reconstruct the exposure history of a microbe. This tool would allow users to monitor the lab conditions and processes to which the cell was subjected. This cellular "flight recorder" would function as a synthetic memory device, registering cellular histories to support investigations into origination, attribution, and specific use (e.g., contact with other substances).

Globally, we are partnering to deploy bioradars for detection. Our global network of bioradars persistently and pervasively monitor for biological risks. By collecting biological signals regarding potential threats and the places they emerge, we provide a reliable stream of data to support decision-making.

To be clear, these bioradars are absolutely essential to biosecurity. Detection enables response. At the moment, many countries - including countries that the US considers to be partners - rely on Chinese companies for fundamental biosurveillance and detection. We know, because as we work internationally, we see BGI everywhere - Israel, for example, relied on BGI to scale COVID testing in the urgent, early days of the pandemic. Ultimately, every indication is that they're providing equipment and services for free, and too many countries have accepted, likely to China's benefit, but seemingly also to the detriment of those countries and to global biosecurity. Biological risks are too critical for the US or the world to rely on untrusted partners for detection.

For our part, we have partnered with Illumina to accelerate the expansion of the pathogen monitoring network in a way that empowers countries, as well as increases the scale and scope of pathogen genomic surveillance globally. Ginkgo and Illumina are working together to enhance early warning of emerging and novel pathogens and fill gaps in global biosurveillance infrastructure.

Ginkgo has deployed our first bioradars to airports to use travelers as early-warning sentinels of biothreats. These airport-based bioradars can detect biothreats coming into the US to help inform mitigation and response before they spread widely. By sequencing biothreats from aircraft wastewater at six U.S. airports, we identified a COVID-19 variant entering the country 42 days before it appeared in U.S. clinical settings. This demonstrates the potential to catch threats before they spread widely.

We also have active bioradar programs with governments or airlines based in Ukraine, Qatar, and Rwanda, enabling the collection of insights into over 105 countries, including China, Russia, and Iran. We average over 150 samples a week from airplanes and municipal wastewater and analyze it using bioinformatics within 48 hours from data receipt.

These bioradars can be strategically deployed to collect data from airports, conflict zones, high biosafety level (BSL) labs, refugee camps, and mass gatherings and can provide insight into whether countries are leaking biothreats or the sophistication of biological research programs. By combining broad and targeted testing for pathogens of high-consequence, we are establishing environmental baselines to better recognize and characterize anomalous biology.

After the point of detection and characterization of a biothreat, Ginkgo can leverage our Foundry and join with partners to accelerate discovery, development, and at-scale manufacturing of vaccines and therapeutic solutions. For example, Ginkgo's platform is or has been applied to support Pfizer's work on RNA therapeutics; manufacturing of Merck's APIs; drug discovery for Roche/Genentech and Boehringer Ingelheim; and scale-up of Moderna's mRNA COVID vaccine. Today, these same capabilities are ready to support response to a biological emergency, including for vaccine design and production, API manufacturing, antibody optimization and production, and protective microbe discovery.

**Values Matter - Biology Affects All of Us**

When it comes to national security, it would be unwise for the U.S. or its partners to rely on China to provide fundamental R&D services or essential biosecurity tools and capabilities. The economic security argument for maintaining U.S. leadership in biotechnology is very strong.

There is yet another important dimension, though. Specifically, a core principle undergirding Ginkgo's platform design is that "technology isn't neutral." Our values and biases are embedded in the technologies we make, in the applications we consider, and in the ways we address problems. We embrace the complexity of determining how our beliefs are reflected in design decisions, how to direct our platform towards solving the most important challenges, and how to approach our projects and partners with care both today and into the future.

In many ways, this is also an American ideal. Today, with growing public attention to biotechnology, we are in a critical moment for imagining what futures are possible and preferred, and forming capabilities and coalitions to affirmatively deliver those futures.

Here, I would suggest that it is strongly in the national security interests of the United States and its like minded partners to lead in the bioeconomy. Not only in the pursuit of economic and geopolitical interests, but also to shape the norms and values associated with such a transformational technology.

Thank you for your time and for your continued leadership in ensuring a vibrant bioeconomy in the U.S.