

## Book Review

### ***The Biologist's Imagination: Innovation in the Biosciences***

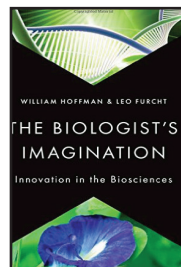
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The role of technology in fostering economic growth of nations and enhancing their industrial competitiveness has been widely recognised, through its domineering influence over industrial productivity. The practice of technological innovation in the industrial era – the systematic application of ideas, inventions and technology to markets, trade, and social systems – is now being joined with the code of life in the DNA of chromosomes, and the basic unit of life, the cell. Many will agree that our economy moved from industrial to automation with the transistor invention and it is now claimed that we are entering an era marked by the information economy and the growth of the bio-economy fuelled by innovation in biosciences.

William Hoffman and Leo Furcht's book *The Biologist's Imagination: Innovation in the Biosciences*, published by Oxford University Press, examines the history and current state of innovation in the biosciences. It tracks biological and technological innovation from its earliest days in an effort to shed light on current trends and expected future developments. From premolecular biology and immunology to the current advances in genomics, proteomics, and metabolomics, the book discusses innovative trends in areas like agriculture, biofuels, and genetics, drawing conclusions on how to create more effective models for innovation. With an emphasis on the development of bioscience in the United States over the past 50 years, the book forays into how innovations in biosciences have evolved over the years through collaborative endeavour, both among different scientific disciplines and between various actors in the innovation ecosystem landscape holding the potential for transitioning to a sustainable development pathway as well as catalysing economic and technological convergence between East and West.

The book has seven chapters excluding the introductory and the concluding chapters. Chapter 1 discusses the history of innovation in the biosciences from the late eighteenth century to the present, including the rise of the biotechnology industry in the second half of the twentieth century. It traces the roots of technological innovation both in myth and in the observations of pre-Socratic natural philosophers. Citing the short history of the self-proclaimed “Lunaticks” of Birmingham, England’s Lunar Society, which linked science, industry and society, the book provides an interesting insight of how collaborative networks have fueled Industrial Revolution setting the stage for a technology-driven modern economy.

Chapter 2 focuses on how the globalisation of innovation in field of biotechnology and the rise in offshoring in the biopharmaceutical industry has opened up tremendous opportunity for the emerging economies of China and India. These countries are poised to become the innovation hotspots, innovating and developing products on their own for their population as well as the populations in advanced industrial economies. It opines that the improved socio-economic conditions and public health in the emerging economies shall translate into greater demand for biosciences innovation. However, the globalization of technological innovation has to be equally supported by institutional innovations in the countries, for example, in clinical trials wherein participating drug companies are obligated to deal with domestic and foreign regulatory guidelines, ethical norms and different national health care systems.

Chapter 3 highlights the fact that even in the era of global innovation networks, the world is not flat but spiky in the case of biosciences innovation. Geographical proximity has been observed to facilitate avenues for collaboration with most of the startups showing strong tendency to cluster in specific regions with strong research networks. Raising questions on the sustainability of these ‘factories’ of the ‘modern world’ it raises some important pointer on the effect of M&A, budgetary constraints on the regional innovation ecosystems. The field of biosciences is in the midst of its own convergence with information technology, nanotechnology, microelectronics, materials, artificial intelligence, robotics, architecture, and design. Such convergent activities have started revolutionising the way we think about human health, diseases and hold prospects for an environmentally sustainable economic growth. Chapter 4 elucidates how

technological innovations in plant breeding and genetics, beginning from Gregor Mendel's studies on the genetics of peas, as well as rapid sequencing technologies, have eventually led to addressing not only the problems of defining genetic alterations affecting human health, novel methods of enhancing agricultural productivity, and future energy generation but also the associated problems that are yet unseen and could result from their long-term development and use.

It is now being increasingly recognised that innovation takes place through a complex set of interactions and relationships among government, industry and academia. Chapter 5 examines the role of universities in the innovation process starting from the University of Bologna in the Emilia Romagna region of Italy to the so-called "triple helix" of university–industry–government cooperation. It opines that the universities have undergone fundamental transformation in terms of their role in society, mode of operation, and economic structure and value. Aligning the interest of actors in the innovation network through institutional innovation is emphasised upon citing the case of the BioPontis Alliance headquartered in North Carolina's successful Research Triangle Park cluster.

In the globalised era, intellectual property rights (IPRs) have emerged as the primary regulatory institution influencing the process of innovation and are being increasingly driven by private/commercial interests. The signals emanating from the institutional regime of IPR may provide an incentive or act as a barrier in the process of innovation. In the early 1980s, the US government brought about extensive changes in antitrust and intellectual property rights regulation and a series of legislative actions starting with the Patent and Trademark Act Amendments of 1980 (more popularly known as the Bayh-Dole Act) were authorised. This created a uniform patent policy in the US among the many federal agencies that fund research, enabling universities and businesses, operating with federal contracts, to patent materials and products they invent under federal funding. It encouraged universities to set up Technological Transfer Offices (TTOs) to manage and promote their patents. The contracting universities and businesses are permitted to exclusively license the inventions to other parties. The patent laws and their limitation in defining and protecting the products of the nature are covered in Chapter 6. The conflict between proprietary interest and the practice of medicine and public health vis-à-vis gene patenting has

been brought out in the chapter. The current intellectual property regime, characterised by the heavily patented nature of knowledge is gradually giving way to a new regime, with greater stress on sharing and collaboration instead of greater protection. According to the authors, such institutional changes including open-source and pre-competitive collaborations are further contributing to innovation in biosciences.

Chapter 7 deals with the evolution of institutions, organisations and innovation networks. It provides useful insights into the relationships between science, technology and society – how science and the practice of science is unfolding in the present context where society instead of the laboratory has become the site for experimentation, and in which research and innovation is undertaken not only by scientists but also public. The authors posit that the transformational social change from the biosciences will be brought about by four factors – “supporting the emergence of new biological technologies, exploring the nature of entrepreneurship and the ‘innovative brain’, sourcing talent wherever it exists, and developing bioscience educational programs, particularly those that link discovery with innovation and production”.

The human race is now sitting on a huge biological knowledge bank equipped with tools and techniques enabling a wide range of actors in the innovation ecosystem to experiment and innovate in diverse ways. “The Biologist’s Imagination” on innovation in biosciences which is about the path biology is taking as it becomes more and more of an engineering discipline, holding promise of potential benefits along with limited knowledge about impacts and nature of risks, make the fabric of governance of biosciences innovation more complex with a greater role for a diverse set of actors and stakeholders in this area. The realisation of the Biologist’s imagination on innovation in biosciences would be contingent upon anticipation of how science, technology and innovation need to be governed in this ever changing world making it more need based and responsible. This calls for a broader ‘societal imagination’ to engage with innovations in biosciences in a responsible and effective manner. Institutions can play an enabling role by promoting certainty and stability in social interactions and economic transactions at critical stages in the emergence of biosciences innovation. They may also be critical in influencing the rate and direction of

innovation activities as they may stimulate and/or constrain how innovation stakeholders behave and operate.

The book, which is much about the history and a methodical description of the present state of biosciences, prompts the readers to imagine a relatively near future and the platforms upon which the next century of innovators will build. If the reader is looking for a detailed futuristic vision in biosciences from the book having “imagination” in the title, the imaginative expeditions are rather modest. Readers who are more interested on critiques of technology progress on environment and development will not find the book insightful enough. The issue of malicious use of scientific advancements in the biological world gets barely a mention. Overall the book displays remarkable insights that Hoffman and Furcht have developed working in this field. The authors’ engaging narrative style makes the book an interesting read and encourages the readers to stretch their imagination in biosciences. The rich content and breadth of discussion, as well as the extensive list of references that accompany each chapter will benefit the novices as well as the professionals alike.

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