Biotechnology

Definition: **biotechnology** from *Dictionary of Virology*

Industrial processes requiring the use of biological systems, including genetic engineering, fermentation technology, hybridoma technology, and agricultural technology.

Summary Article: **Biotechnology**

from *Sociology of Work: An Encyclopedia*

Scientific discoveries in molecular biology in the early 1970s helped launch the knowledge-intensive field of biotechnology. Biotechnology is a multidisciplinary field with applications that span a range of multibillion-dollar industries, including medicine and agriculture. Work in the field of biotechnology requires the integration of a wide stock of existing and emerging scientific knowledge that cannot be embodied by any one individual or organization. Researchers and organizations therefore routinely form partnerships to access knowledge and expertise. Many of these partnerships cross traditional institutional domains, challenging distinctions between scientific work in academic and commercial settings. Scholars have examined the spatial clustering of biotechnology firms in a relatively small number of U.S. regions.

Some regions, such as California's San Francisco Bay area and Cambridge, Massachusetts, are particularly robust. Despite the fact that knowledge and capital are not bound to any particular location, deliberate attempts to create regional biotechnology hubs have experienced limited success. Walter Powell and colleagues have analyzed the forms of institutional infrastructure that facilitate the formation of dense local ties between a diverse network of for-profit, nonprofit, and public organizations engaged in biotechnology-related work.

They observe how careers, professional identities, and organizational practices are transformed within these self-reinforcing relational networks. Inter-firm and cross-institutional job mobility is highly characteristic of the field of biotechnology. Scientists routinely move between academic and industry employment over the course of their careers. Researchers who retain their academic positions often serve on scientific advisory boards or as consultants for biotechnology firms. Financial, legal, and managerial professionals with biotechnology-industry expertise are also engaged in these relational networks and may similarly shift occupational roles. For example, successful biotechnology entrepreneurs might establish venture capital firms, and employees of venture capital firms might take on executive roles at biotechnology start-up companies.

Much of the foundational research in biotechnology was conducted in university laboratories in the United States, supported with grants from federal agencies like the National Science Foundation and the National Institutes of Health. For example, Herbert Boyer and Stanley Cohen's breakthrough discovery of recombinant DNA methods occurred when they were faculty at U.C. San Francisco and Stanford University, respectively. These early discoveries had a natural excludability. The tacit nature of this complex, embodied knowledge necessitated face-to-face interaction between scientists. Early biotechnology firms sought to locate in close proximity to the universities where these scientists worked.

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Steven Vallas and colleagues assert that industry-friendly policies and abundant public investment fostered the emergence and growth of biotechnology in the United States. For example, they find that among 15 blockbuster biotechnology drugs—each with U.S. sales exceeding $1 billion in 2006–13 were developed with federal support for initial drug discovery and preclinical development or for clinical trials to obtain drug safety and efficacy data. In addition to public support for biotechnology research, the U.S. federal government developed a regulatory infrastructure that was highly favorable to the growth of the biotechnology industry. The 1980 *Diamond v. Chakrabarty* U.S. Supreme Court decision deemed living organisms to be patentable. The 1980 Bayh-Dole Act, a national policy that allows universities, nonprofit organizations, and small businesses to retain property rights to inventions developed with federal research funding, encouraged federal grant recipients to patent and commercialize discoveries made with public funds. The Stevenson-Wydler Technology Innovation Act of 1980 encouraged the transfer of scientific discoveries made in university and government laboratories to private industry.

Jerry Tuskan of the Oak Ridge National Laboratory was named 2012 Forest Biotechnologist of the Year by the Institute of Forest Biotechnology. The field of biotechnology spans a broad range of industries, including genomics, agriculture, and medicine.

**Biotechnology Today**

Today, biotechnology is an area of research in which academic entrepreneurship has become highly institutionalized, particularly in the United States. Technology licensing offices and their attendant personnel have become the norm at many U.S. research universities. Patents, in addition to scholarly research publications, are key measures of scientific research productivity that are monitored by university administrators and venture capitalists alike. Some have worried that commercial interests threaten the traditional autonomy of university researchers and perceive a blurring of the institutional boundary between academic and commercial science.

Steven Vallas and Daniel Kleinman argue that scientists working in biotechnology firms increasingly experience working conditions once thought typical of academia, while scientists in universities increasingly face commercial pressures. As firms compete for top scientists, corporate managers shift away from hierarchical controls in favor of work arrangements that afford industry scientists greater autonomy. As universities increase their interaction with industry, they come to adopt a more
proprietary orientation to the work outputs of academic scientists.

Sociologists have examined how scientists working in these institutional domains construct their professional identity. Laurel Smith-Doerr analyzed how scientists explain their decisions to work in the biotechnology industry rather than pursue an academic career. She found that industry scientists could justify their employment in biotechnology firms in ways that did not discredit the traditional academic career path. They tended to emphasize the resources available to support their work, the cutting-edge nature of their work, and their ties to credible scientists who influenced their employment decision.

Dina Biscotti and colleagues have argued that academic scientists who collaborate with industry experience normative pressures to signal their alignment with scientific over commercial interests. They find that academic scientists describe using research money from public agencies and private companies in different ways. Industry money is routinely framed as supplemental to the essential grant funding that academic scientists seek to support their work. Biscotti and colleagues also find that university policies specifying acceptable delays in public disclosure of research discoveries to accommodate patent filings help standardize relations between scientists working in institutional milieus with different orientations to the outcomes of scientific work.

See Also:

Boundaries between Home and Market, Blurred

Health Care Professions

Identity at Work

Knowledge Workers

Networked Organizations

Tacit Skills

Technology

Further Readings


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