

## SCIENCE, TECHNOLOGY, AND SOCIETY

## Reflections for Looking Forward

Edward J. Hackett

“[T]echnology is always disruptive of traditional social forms and creates a crisis for culture. The ground on which the battle is fought is nature.”

—Daniel Bell (2)

Bell's ringing call to action is one voice in a choir of concern about the potentially unsettling consequences of technological innovation, harmonizing with those of Lewis Mumford (megatechnics), Joseph Schumpeter (creative destruction), Langdon Winner (technological somnambulism), and the many scholars concerned with varieties of technological determinism (3). Their voices create an essential counterpoint to melodies of technological optimism. With *Insatiable Curiosity*, her latest book about innovation, Helga Nowotny (vice president of the European Research Council and an eminent scholar of science, technology, and society) has added a voice of distinctive elegance, clarity, and sophistication to the choir. Her central motif is the paradox of innovation: Innovations arise from the past, take form in the present, and shape the future. They are at once a source of societal advantage and vulnerability, certain to unsettle us in unpredictable ways. With this slim volume, Nowotny invites us to contemplate “innovation in a fragile future” and provides the means and occasion for doing so.

The invitation is timely, welcome, and consequential: Despite the predictable disruptions and disorders it brings, technological innovation is avidly pursued as a matter of national policy and cultural commitment in the United States and elsewhere. Federal agencies and private foundations that support science, technology, and medicine have sought to catalyze transformative ideas and now seek systematic tools for promoting, managing, and measuring the performance of the national innovation system. Marking a stage in the journey new technologies travel from policy through laboratory

to popular consciousness, the 14 December 2008 *New York Times Magazine* celebrated the “Year in Ideas,” the eighth in an annual series of reflections on innovations. This year, the ideas ranged from an automated anesthesia system and a cloth car to strategies for educating, investing, taxing, and deciding whether to wait for the bus or walk. (Many of them were based on behavioral, economic, or social science.) The issue's spirit is captured by a seasonal red cover featuring the famous photographic portrait of Albert Einstein with his tongue sticking

**Insatiable Curiosity**  
Innovation in a Fragile Future

by Helga Nowotny

Translated from the German (1)  
by Mitch Cohen. MIT Press,  
Cambridge, MA, 2008. 193 pp.  
\$30, £19.95. ISBN 9780262141031.

effect through an intricate negotiation with existing social forms and cultural understandings: Transformatively new innovations “have to be embraced in already existing organizational forms, social structures, and biographies. ... they must be accepted and altered in such a way that they identify and meet latently present needs.” So the shock of the new is conveyed and modulated through the arrangements and understandings of the old. Innovation is a process of mutual accommodation, its success dependent

as much on societal receptivity and the quality of communication and integration with existing social forms as on the sacred spark of its inventor. Darwin knew this surpassingly well, as Gillian Beer has shown (4), and Nowotny extends the process to characterize the socio-cultural negotiations through which a society makes the “collective wager on the future” that is called innovation.

“Paths of curiosity,” the topic of the second chapter, are the routes people travel in pursuit of epistemic things (the “objects of knowledge,” such as reaction mechanisms, ecological processes, and biological structures and functions, that science aims to understand) that are attained through the application of research technologies. (These are experimental systems, model organisms, assays, instruments, and such that range in scale from tabletop procedures and microscopes to the Laser Interferometer Gravitational-Wave Observatory and the Large Hadron Collider.) Research technologies and the knowledge they yield are necessary but not sufficient for innovation. Also crucial are the institutional context and socio-cultural environment that motivate, shape, integrate, regulate, deploy, and lend meaning to

new ideas and new ways of doing things. For example, the structure of the DNA molecule certainly implies a mechanism of replication. But innovations employing that mechanism arose from decades of related studies (some strikingly original in their own right) and from an institutional context that joins transformative ideas and technologies to social purposes, cultural values, and capital in its various forms (cultural, economic, human, and social).

For decades the U.S. government has sought, through legislation, policy, funding, and other means, to accelerate and guide the innovation system. After thinking things over, aided by this book, I remain an open-minded



Patricia Piccinini's *Nest* (2006).

out. Innovation, serious and playful, is central to our strategies, our cultures, and our selves: we need it yet we fear it.

A little book full of big ideas, *Insatiable Curiosity* is something to think with and through. It is not a book to skim for a sense of central claims and arguments, but one that rewards rumination and reflection. Nowotny offers a meditation, in three parts, on the nature and origins of innovation and its place in the human future.

The first chapter, concerned with “the emergence of the new,” explains how radically original ideas and technologies—Darwin's theory is given as an example—take form and

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skeptic about the likely success of the endeavor. Precisely because new ideas and technologies become innovations through a process of rich interactions with diverse social groups, cultural values, and institutional arrangements, investments in the supply side of originality must be complemented by deeper engagement with users, patients, customers, and others of the general public in order to shape technologies to human needs. We are still inventing ways to accomplish and benefit from such engagements.

“Innovation in a fragile future,” the theme of the third chapter, aptly describes our mission and our fate. We are driven to innovate, not only by virtue of innate and institutionalized “insatiable curiosity” but also by necessity: sustaining our existence and our fragile planet depend on it. Yet innovation will occur in circumstances of growing complexity and consequent uncertainty because the shape, character, and effect of an innovation are determined by forces beyond the imagining of its inventor. In a self-exemplifying fashion that the author could not have anticipated, this lesson is powerfully conveyed in a passage near the end of the book:

By betting on human action, innovation should broadcast the calming message that the unforeseeable will nonetheless be manageable. Dealing with risks? Not a real problem, for if needed, there is the precautionary principle. Instead of being intimidated by the apocalyptic warnings of the risk society, the decision can be made in favor of a “modern risk culture,” as prevails in the global financial markets.

The risk culture of global financial markets has been exposed as flawed in various ways—some systemic, some tragic, some venal. An observer as wise, knowledgeable, and well positioned as the author could not foresee the unraveling interdependencies that undermined the risk calculus of the modern risk culture. Yet innovation is still the best bet around; we must remain calm, and the unforeseeable will, somehow, be managed.

#### References

1. H. Nowotny, *Unersättliche Neugier: Innovation in einer fragilen Zukunft* (Kulturverlag Kadmos, Berlin, 2005).
2. D. Bell, *Am. Scholar* 42, 385 (1973).
3. M. R. Smith, L. Marx, Eds., *Does Technology Drive History? The Dilemmas of Technological Determinism* (MIT Press, Cambridge, MA, 1994).
4. G. Beer, in *Innovation: Kreativität in Kunst und Wissenschaft. Ergebnisse des Initiativ-Workshops*, H. Nowotny, Ed. (IFK Materialien, Vienna, 1994), pp. 15–19.

## BROWSINGS

**Chocolate: Pathway to the Gods.** Meredith L. Dreiss and Sharon Edgar Greenhill. University of Arizona Press, Tucson, 2008. 208 pp + 60-minute DVD. \$30. ISBN 9780816524648.

The generic name of the cacao tree, *Theobroma cacao*, means “food of the gods.” However, the tree’s fresh seeds are bitter and astringent and do not taste like chocolate. In the traditional, manual preparation of that delicacy, the beans (seeds) are removed from cacao pods, fermented for three days, dried, roasted, and ground on a stone metate. Drawing on archaeological and ethnographic research, the authors discuss the religious, social, cultural, and medicinal roles that chocolate has played in the lives of Mesoamericans for some 3500 years. For example, this clay figurine of a warrior clad in cacao armor (Late Classic Maya from Campeche, Mexico; right) reflects beliefs that one is energized and strengthened by chocolate. The profusely illustrated book grew out of the authors’ 2005 documentary film (provided on the DVD): They had gathered far too many striking still photographs of ceramics, carvings, murals, monuments, and codices to incorporate in the film.



**The Princeton Companion to Mathematics.** Timothy Gowers, Ed.; June Barrow-Green and Imre Leader, Associate Eds. Princeton University Press, Princeton, NJ, 2008. 1056 pp. \$99, £60. ISBN 9780691118802.

Focusing on “modern, pure mathematics,” the editors and their 132 authors aim to provide “a large and representative sample of the ideas that mathematicians are grappling with ... in as attractive and accessible a way as possible.” Four introductory articles sketch mathematics’ main branches, its language and grammar, fundamental definitions, and research goals. Seven historical chapters trace developments from numbers and number systems through the 1920s crisis in the foundations of mathematics. The next three sections of the volume cover 99 concepts (e.g., the axiom of choice); 26 branches of mathematics (e.g., operator algebras); and 35 theorems, paradoxes, and problems (e.g., the Weil conjectures). Brief biographies summarize the lives and accomplishments of 96 famous mathematicians, from the legendary Pythagoras through the collective “Nicolas Bourbaki.” Fourteen chapters explore the influence of mathematics on other fields, such as chemistry, biology, economics, philosophy, music, and art. The volume concludes with several “reflections about the nature of mathematics and mathematical life”—which might be the best place for many readers to start. Although the editors’ original goal of text that could be understood by anyone with a good background in high school mathematics proved short-lived, this wide-ranging account should reward undergraduate and graduate students and anyone curious about math as well as help research mathematicians understand the work of their colleagues in other specialties. The editors note some advantages a carefully organized printed reference may enjoy over a collection of Web pages, and this impressive volume supports their claims.

**Where Our Food Comes From: Retracing Nikolay Vavilov’s Quest to End Famine.**

Gary Paul Nabhan. Island, Washington, DC, 2008. 251 pp. \$24.95, £21.50. ISBN 9781597263993.

The renowned botanist and geneticist Vavilov ran afoul of T. D. Lysenko, was made a scapegoat for Stalin’s disastrous farm policies, and died of starvation in a Soviet prison during World War II. Before his downfall, he had traveled the world collecting hundreds of thousands of samples of seeds, roots, and fruits in his efforts to identify the centers of agricultural diversity and to improve food security. Following in Vavilov’s footsteps, ethnobotanist and conservationist Nabhan journeys to nine agricultural landscapes, including the grain fields of the Pamirs, the farms of Italy’s Po Valley, date palm oases of North Africa’s Maghreb, and the maize and beans *milpas* of Mexico’s Sierra Madre. He discusses how the traditional practices described by Vavilov have been affected by irrigation, mechanized agriculture, urban sprawl, changing climate, and political turmoil. Noting the drawbacks of global standardization of agriculture, the author argues that preserving a diversity of crop varieties and the accompanying practices of land use and food preparation is essential to shielding humanity from widespread hunger.

10.1126/science.1167600