RIA NOVOSTI/SPL

J. D. Bernal (third from left) helped to define the 'science of science' as a discipline.

IN RETROSPECT

The Social Function of Science

Roger Pielke Jr assesses the legacy of J. D. Bernal's science-policy classic on its 75th anniversary.

In 2011 Tom Coburn, the Republican Senator for Oklahoma, issued a report focused on helping the US National Science Foundation to better conduct research that "can transform and improve our lives, advance our understanding of the world, and create meaningful new jobs". It is ironic that this conservative Republican's demands that research be carefully planned and focused on social objectives can be traced directly to the writings of an Irish-born communist crystallographer 75 years ago.

Such is the wholesale acceptance of John Desmond Bernal's views in his 1939 treatise *The Social Function of Science* — covering the organization of research to science and its social role — that they are now part of the fabric of science-policy debates across the political spectrum. For Bernal, usefulness was more than an aspiration: it was the central objective of the scientific enterprise and the desired end of state support of science.

He was among the first to recognize that all public engagement is ultimately political, although his vision of scientists as stalwarts resisting partisan politics might now seem naive: "The scientist … sees the social, economic and political situation as a problem to which a solution must first be found and then applied, not as a battleground of personalities, careers and vested interests."

Bernal was the first to compile estimates of government-wide spending on science, several years before the first gauges of gross domestic product in the early 1940s. On the basis of such estimates, he concluded presciently that the United States was poised to take a long-term leadership role in science. Today, much discussion of science policy (some would say too much) hinges on this kind of number-crunching; 75 years ago, it provided a fundamentally new lens through which to view the scientific enterprise.

Bernal was born in Ireland in 1901. His formative years were marked by the First World War and the 1917 Russian revolution, which, along with the Great Depression in the 1930s, had a lasting negative influence on his view of capitalism. After earning a degree in mathematics and science at the University of Cambridge, UK, in 1922, Bernal did his postgraduate training in X-ray crystallography before joining the Cambridge faculty in 1927. He became part of Britain's left-wing intellectual elite, joining zoologist Solly Zuckerman's dining club Tots and Quots (a reference to Roman playwright Terence's "*Quot homines, tot sententiae*", meaning 'so many men, so many opinions') with biologists Julian Huxley and J. B. S. Haldane, among others. Zuckerman became Britain's first chief scientific adviser in 1964.

The Social Function of Science
J. D. BERNAL
George Routledge and Sons: 1939

Bernal started to write *The Social Function of Science* in 1938 after having "achieved a certain standing in the scientific community", according to his biographer Andrew Brown (*The Sage of Science*; Oxford University Press, 2007). He was far from the first to explore the nexus of science and society. For instance, the theme of the 1936 meeting of the British Science Association was 'Science and Social Welfare', and in 1937 the American Association for the Advancement of Science added "an examination of the profound effects of science upon society" as one of its objectives. Even so, Bernal's book helped to define a new discipline: the science of science.

The book was controversial for two reasons. First, Bernal was presenting a view of science that was directly at odds with the 'pure science' ideal, in which scientists were expected to keep their distance from public affairs. Second was Bernal's vision of science fulfilling its social function by supporting a centrally planned society. He even stated that "science is communism" and argued that the Soviet Union "was one State where the proper function of science was being realized".

In the debates that raged in scientific and other circles, which pitted scientific planning against freedom — essentially, socialist versus capitalist stances — Bernal's arguments were often conflated with his support for the Soviet Union, frequently with his encouragement. A 1946 *Nature* Editorial sought, and largely failed, to find a middle ground: "for though we claim that the impact of science on society is now achieving such importance as to command constant study which is bound to result in conscious planning, we are equally as convinced that it is the man of science who must be allowed to do the planning in consultation with others. In this way his freedom need not be impaired" (*Nature* **158,** 565–567; 1946).

Bernal's great intellectual adversary was Michael Polanyi, a Hungarian chemist who was opposed to Soviet ideals. Polanyi's classic 1962 journal article 'The Republic of Science: Its Political and Economic Theory' (*Minerva* **1,** 54–73; 1962) posits that individual scientists pursuing truth led to the most efficient social outcomes. The parallels with Adam Smith's "invisible hand" guiding capitalist economies could not have been accidental.

The decades-long debate between Bernal and Polanyi played out in many contexts. ▶

For instance, in 1943, when a more-organized approach to government-supported science was first being mooted in the United States, a Democratic Senator for West Virginia, Harvey Kilgore, proposed creating an office to "mobilize the scientific and technical resources of the nation". A correspondence in *The New York Times* warned that this suggestion for government-directed science represented "the latent germs of a form of communism that is most foreign to the ideals which our peoples are fighting to support". After the Second World War, engineer Vannevar Bush, who oversaw the seminal 1945 report *Science — The Endless Frontier* on US science policies, echoed Polanyi's thinking, arguing for public resources with little public accountability.

In the late 1940s, Bernal's career began to fade with his endorsement of the theory of agricultural genetics propounded by Russian agronomist Trofim Lysenko. This was elevated to Soviet policy, yet quickly discredited by scientists in the West. In 1948, Bernal debated against Polanyi on BBC radio, with Polanyi pointing to the suppression of science under Lysenkoism as evidence of the shortfalls of the state planning of science. The BBC's subsequent investigation revealed that nine Soviet geneticists had been put to death for expressing alternative views. Bernal's continuing defence of the theory, and his glowing 1953 obituary of Joseph Stalin in the magazine *Modern Quarterly*, contributed to his diminishing relevance.

Although Bernal lost the intellectual battle over cold-war politics, his ideas on the social function of science have triumphed on nearly every count. The larger and more significant effect of *The Social Function of Science* has been to anticipate and help the ideal of 'pure science' to reach mythical status, ushering in an era of science focused on societal needs, today characterized as 'grand challenges' by scientists and politicians.

Bernal, looking back at the book 25 years after its publication, emphasized that such needs implied more systematic thinking about science itself: "We need a strategy for research which must be based on a science of science." Today, whether it is a US senator, a British prime minister or a Chinese president expressing a view that science must serve society, each is reflecting Bernal's big idea. Seventy-five years on, that global influence on science-policy thinking is his classic's great legacy. ■

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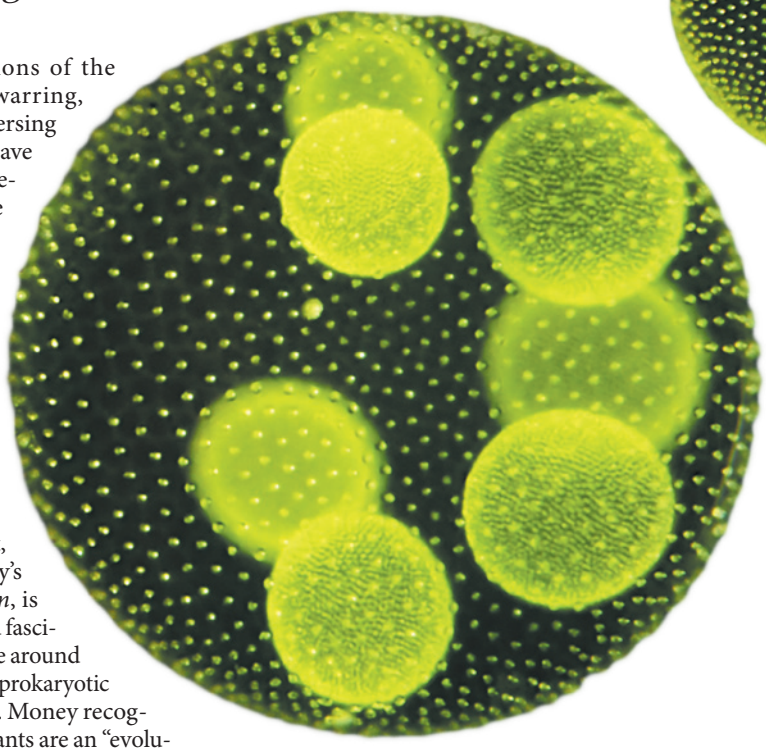
MICROBIOLOGY

Majority rule

Mark O. Martin relishes a stimulating tour of 'little lives', from fungi to bacteria.



Colonies of *Volvox aureus* algae, pregnant with daughter colonies.

LEBENDKULTUREN.DE/SHUTTERSTOCK

The vast populations of the microscopic — warring, cooperating, dispersing and communicating — have a dizzying array of strategies and forms. These denizens of the universe at the far end of a microscope have much to teach humanity, their roles ranging from the digestion of food to the cycling of carbon and nitrogen in Earth's atmosphere. Several books have championed matters microbial in recent years. The latest, biologist Nicholas Money's *The Amoeba in the Room*, is filled with an impassioned fascination for microscopic life around and within us, in both the prokaryotic and eukaryotic domains. Money recognizes that animals and plants are an "evolutionary afterthought" — as he writes, "the least part of life".

My interests tend toward the bacterial, viral and archaeal. Money covers this territory thoroughly, and goes beyond to sing the praises of fungi, algae and protists. Among others, he evocatively describes the water mould *Haptoglossa*, which uses microbial artillery to attack and consume nematode worms; *Cryptomonas*, a "Russian nesting doll" of an alga, evolved from four different organisms; and *Polychaos dubium*, a huge amoeba with perhaps the largest amount of DNA to be found in a nucleus. Overall, Money delivers a heady mixture of history, philosophy, art and even poetry: the chapters are prefaced with lines from John Milton's *Paradise Lost*.

The Amoeba in the Room: Lives of the Microbes
NICHOLAS P. MONEY
Oxford University Press: 2014.

Money begins with a 'macro' view of his garden pond, then dives into intricate details of the microbial populations in and around it. The seemingly uninhabited water swarms with communities as complex as any seen with the naked eye, and a tree branch is revealed as home to populations of interacting microbes. Money's point is that the diversity of life is clear enough on the macroscopic scale, but the organismal diversity of the microbial world is staggering. I particularly appreciated reading about the eight supergroups of microbial eukaryotes, including some familiar "animalcules" (such as the mitochondria-free pathogen *Giardia*, found among the Excavata).

A chapter on microscopy takes the reader from Assyrian craftsmen to familiar names such as seventeenth-century microbiological pioneers Robert Hooke and Antoni van Leeuwenhoek, as well as characters with whom I was not familiar. Bénédict Prévost, for instance, presented evidence that microbes can cause disease 50 years before Louis Pasteur, whereas Henry Baker popularized the use of microscopes to observe tiny wonders in 1742. We meet Ed Ricketts, US marine biologist and co-author of *Between Pacific Tides* (1939), as well as sculpture-like coccolithophores, numerous *Prochlorococcus* and ubiquitous marine bacteriophages. As in the rest of the book, Money enthusiastically presents evidence of diversity everywhere, no matter the magnification.