BOOKS & ARTS

The life of a sage

J. D. Bernal was a multifaceted crystallographer who laid the foundations of molecular biology.

J. D. Bernal: The Sage of Science
by Andrew Brown
Oxford University Press: 2005. 576 pp. £25

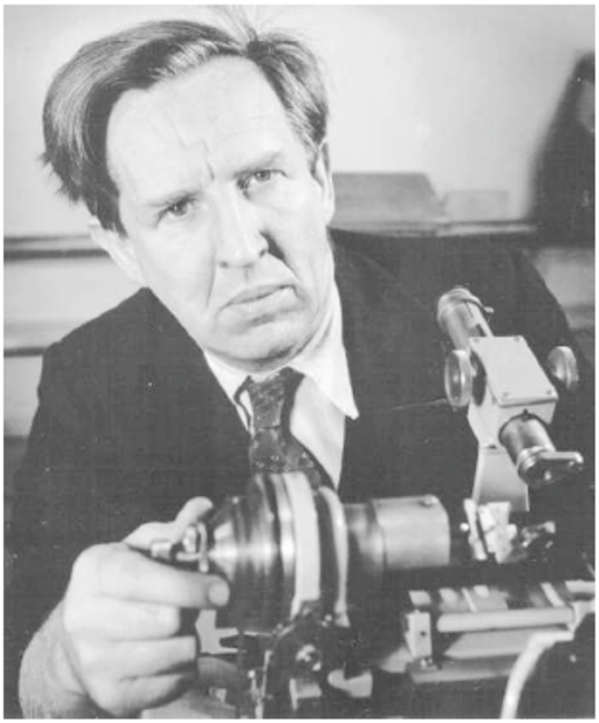
Kenneth C. Holmes

J. D. Bernal, who died in 1971, was one of the most influential scientists of the past century. Andrew Brown's fascinating book on this extraordinary man deepens one's appreciation of this powerful and complex personality who, in addition to his science, was involved in many contemporary political and sociological developments.

Bernal was born in Ireland in 1901 to a truly remarkable woman, Bessie. A tall and beautiful Californian, she was one of the first students at Stanford University. A woman of wide interests, she spoke fluent French (acquired with the appropriate accent in New Orleans) and undertook the Grand Tour, on which she met and married Samuel George Bernal, a moderately prosperous Irish dairy farmer. The daughter of a protestant clergyman, she converted to Catholicism when she married. Her son, John Desmond, grew up a devout Catholic, speaking French and English in rural Ireland, with strong family connections to aunts, uncles and cousins in the United States.

His early passion for science led to his being sent away to Bedford School in England, where he was moderately uncomfortable but studied science and read profusely. He was awarded a scholarship to Emmanuel College, Cambridge, where he read mathematics before switching to natural sciences. Cambridge was in ferment. Young soldiers were returning from the First World War, and a strong sense of disillusion prevailed. Bernal spent countless hours discussing politics and much more besides, thereby earning himself the nickname 'Sage'. In his final undergraduate year, as well as deriving the 230 crystallographic space groups using quaternion notation (and taking his degree), Bernal rowed in the Emmanuel first boat, and spent many happy hours punting to Grantchester with Eileen Sprague, whom he married. As Dorothy Hodgkin remarked in her scientific biography, Sage lived life to the full.

In 1923, on the basis of his extraordinary student tour de force with the space groups and a recommendation from Arthur Hutchinson, Bernal was taken on as a doctoral student by William Bragg, director of the Royal Institution in London, and joined his group of outstanding young crystallographers. But Bernal soon realized that measuring the intensity of X-ray diffraction data with a gold-leaf electroscope was not for him. So he developed the X-ray film method, involving a rotation camera. He also invented the Ewald sphere before Paul Peter Ewald published it (it was essential for making sense of the X-ray photos), but with characteristic generosity he insisted on giving all the credit to Ewald. And he developed the methodology that enabled the X-ray crystal-structure determination of complex molecules.



Through the lens of history: J. D. Bernal, photographed in 1949.

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The Bernals were enjoying their short time in London, living in Bloomsbury, and both joined the Communist Party and the Holborn Labour party. But they returned to Cambridge in 1927, when Bernal was appointed lecturer in structural crystallography in Hutchinson's department at the university. Bernal's laboratory, housed in the old Cavendish lab, quickly became an international centre. His work on the structures of steroids was important and, in retrospect, he narrowly missed receiving a Nobel prize.

Bernal started work on the structure of water after meeting R. H. Fowler on a visit to Moscow. He took on Dorothy Crowfoot (later Hodgkin) as a student and then, a little later, Max Perutz; both were to be awarded a Nobel prize. With Dorothy he showed that crystals of pepsin diffract to high resolution if maintained wet, so the molecules must be identical in structure. This simple observation made the prevailing colloid theories of proteins untenable. And Perutz began a 25-year study on the structure of haemoglobin — a demanding theme for a doctoral thesis. With Isidore Fankuchen, Bernal started work on viruses. He maintained that to understand life you needed to know about protein structures, which could be determined by X-ray crystallography. This was essentially the dawn of molecular biology.

In the 1930s, Bernal became committed to marxism. How a man with such a marvellous analytical mind could come to terms with dialectical materialism is still a subject of discussion — it seems to have been an act of faith, a substitute for Catholicism. Apparently, Bernal's epiphany took place at a meeting on the history of science in London in 1931. The Russian delegation, led by Nikolai Bukharin, arrived late and unannounced. They were given an extra morning to air their views and expounded a theory of the history of science that Bernal made his credo.

In 1938 Bernal was appointed professor of physics at Birkbeck College, London, but at the onset of the Second World War he was pressed into service. The politician John Anderson wanted Bernal as a scientific adviser in the Ministry of Home Security "even if he is as red as the flames of Hell". Together with his friend Solly Zuckerman, Bernal started work on operational research, and they gave bombing a quantitative basis. They had to convince the physicist Frederick Lindemann, a government adviser who proposed the carpet-bombing of German cities, that Bomber Command was

making wildly exaggerated claims about the effectiveness of Allied bombing. Later, Bernal, Patrick Blackett and Zuckerman advised against the bombing of German cities because it was a total waste of manpower and resources.

Bernal and Zuckerman were seconded to Louis Mountbatten's team, which was planning D-day. Bernal's great contribution was to chart the Normandy beaches in detail, identifying every rock, mine and weak spot. His charts turned out to be reliable and the tanks and trucks got ashore.

A strong friendship sprang up between Bernal and Mountbatten, who reported: "Bernal is one of the most engaging personalities I have ever known. Perhaps his most pleasant quality is his generosity. This may be why his great contribution to the war effort has not been properly appreciated." Bernal said of Mountbatten: "He had the habit that great commanders have of acting first and thinking afterwards." Late in the war, Mountbatten became supreme Allied commander in southeast Asia, and Bernal joined him in Ceylon on bomb trials for jungle clearance. He found himself working alongside John Kendrew and they fell to talking about the structure of proteins — a conversation that had considerable repercussions. Shortly afterwards, Kendrew turned up in Cambridge to work with Perutz on haemoglobin and myoglobin, and Bernal's ideas were later very influential in the founding of the European Molecular Biology Laboratory.

After the war, Bernal resumed his professorial duties at Birkbeck, setting up the Biomolecular Research Laboratory in 1948. As well as groups working on organic crystals and proteins, he had others working on computers, the structure of cements (buildings and building materials were a life-long interest), and the structure of water. Rosalind Franklin later joined him to start work on virus structure, which she continued with Aaron Klug.

Bernal continued his enthusiastic support for the Soviet Union. But he was heavily criticized for his support of Trofim Lysenko, whose ideas were completely incompatible with mainstream genetics. This lapse of judgement on Bernal's part is difficult to understand.

The prospect of nuclear war horrified Bernal, particularly as one of his last acts before leaving government service at the end of the war had been to estimate the cost of destroying the Soviet Union — and of the Soviet Union destroying Britain. Along with Frédéric Joliot-Curie he founded the World Peace Council, which became a vehicle for Soviet propaganda but which might in the end have fulfilled its mission by exercising a restraining influence on Nikita Khrushchev during the Cuban missile crisis.

Bernal wrote profusely on science and society, and many of his revolutionary ideas on science planning are now commonplace. Towards the end of his life he became involved in planning for the Labour party, but his work was cut short by ill health. Repeated strokes left him incapacitated and practically incommunicado — a sad end for a man whose life was based on communication.

This is a very fine (and large) book. Much more than a biography, because of Bernal's involvement in so many sociological issues of his day, it takes the form of a social history of the first half of the twentieth century. ■

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In search of Prometheus

Bioethics and the New Embryology: Springboards for Debate
by Scott F. Gilbert, Anna L. Tyler & Emily J. Zackin
Sinauer: 2005. 280 pp. $14.95

James Bradley

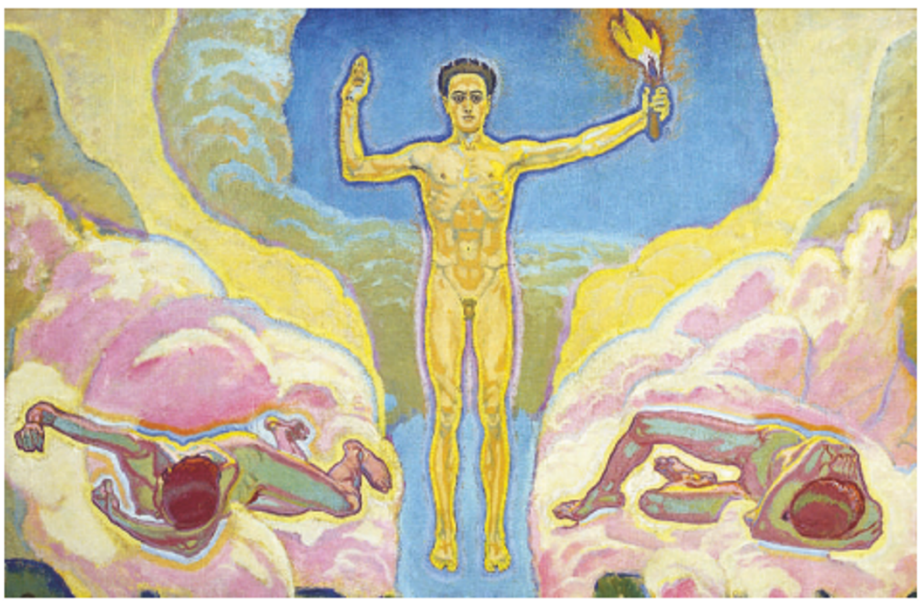
Modern biotechnology raises some difficult questions. What is a person? What ought to be the moral status of human embryos? How should we define 'normal' and 'human'? Should we genetically engineer future generations of humans? And what about human cloning? A first step towards finding answers to difficult questions is to get the facts. Most people, even well-educated ones, do not have the facts needed to develop informed opinions on these questions. In a university cell-biology class that I recently lectured, only one of 140 students knew the source of embryonic stem cells; a multidisciplinary group of ten professors did no better.

In a remarkably far-sighted book, *The Prometheus Project* (Doubleday, 1968), physicist Gerald Feinberg wrote about humanity's need to ponder questions like these. He warned that human genetic engineering, age retardation, chemical and electrical mind modification, and artificial-intelligence technologies would force upon us irreversible decisions that should be the focus of a Prometheus (from the Greek word for 'foresight') project that would draw on informed thought from all of Earth's peoples.

Decision time is here, but a consensus on who we are and where we are going is nowhere in sight. There has been no Prometheus project. National and state governments, private industry and even cults are going separate ways in research on embryonic stem cells, human cloning, and the creation and use of genetically modified organisms. And the strident voices of scientists, politicians and ethicists are urging us either to embrace the new biotechnologies for their potential benefits or to restrict them for fear of an undesirable future for our species.

Scott Gilbert, a respected developmental biologist and textbook author, has now entered the fray with a calm and rational voice. In *Bioethics and the New Embryology*, he and his two student co-authors provide information for students, other academics and the public about many of today's most urgent biotechnological issues.

Each of the book's seven sections explains the biology underlying a specific biotechnology and discusses the relevant ethical issues. Topics include early human development and personhood, assisted reproduction, sex selection, human cloning, stem cells, human genetic engineering, defining what is normal, genetic essentialism, and the ethics of using animals in research.



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Prometheus unfound? No project to explore what we want from biotechnology has been forthcoming.