I found the authors' approach too leisurely. I sometimes felt that I didn't need the peripherals, I just wanted to get the points more quickly, with simpler arguments. Even so, I learned many new things from this book. So my advice to the reader is: be patient and enjoy this deeply scientific and superbly artistic book. ■

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Winning the fight against liver disease

Hepatitis B: The Hunt for a Killer Virus
by Baruch S. Blumberg
Princeton University Press: 2002. 272 pp. $27.95, £19.95

Arie J. Zuckerman

Looking back: Baruch Blumberg's research on hepatitis B drew on earlier fieldwork in Suriname.

Hepatitis B is a common viral infection of the liver and a major global public-health problem. More than 2 billion people alive today — over a third of the world's population — have been infected with the hepatitis B virus, and of these about 350 million will become carriers of the virus. Some 20–25% of carriers will progress to serious liver disease, including chronic active hepatitis, cirrhosis and primary liver cancer. Primary liver cancer is the seventh most common cancer in males and the ninth most common in females, and the hepatitis B virus is second only to tobacco among the known human carcinogens. Although the precise molecular mechanisms by which the virus induces malignancy remain largely unknown, it is the cause of 80% of the world's primary liver cancer, which is one of the three most common causes of cancer deaths in males in east and Southeast Asia, the Pacific Basin and sub-Saharan Africa.

The discovery by Baruch Blumberg of the Australia antigen, a specific viral marker of the hepatitis B virus, was one of the most important advances in medical knowledge during the past 50 years and had huge implications for preventive medicine. This inspiring book is an intensely personal and interesting account of the work of Blumberg and his close associates who, after discovering the Australia antigen, continued to work on hepatitis B and devised the first-generation vaccine for this infection.

Because of this personal focus, there is relatively little mention of the contributions made by many researchers across the world and the crucial role of the World Health Organization in the unfolding story of the five different types of viral hepatitis and the implementation of universal immunization against hepatitis B in over 100 countries. Rates of liver cancer have fallen significantly in regions that have immunization programmes, such as Taiwan. If immunization is introduced universally, the hepatitis B virus could be eradicated within 20–50 years.

Blumberg was born in Brooklyn, New York, and attended a yeshiva, the intellectual powerhouse of traditional Jewish education. He continued his education at Far Rockaway School in New York, a public high school that counts three Nobel laureates, including Blumberg, among its alumni. He read medicine at Columbia University College of Physicians and Surgeons before leaving New York to read biochemistry at Balliol College, Oxford, UK.

The discovery of the Australia antigen was based on Blumberg's interest in genetic variation and specific susceptibility to disease, and his use of the Ouchterlony double-gel diffusion test to detect antigen–antibody interactions by the formation of precipitin lines in a gel. Blumberg did not set out to find a marker for hepatitis B — his interest was in inherited polymorphic traits. He conducted a systematic search of sera from multiply transfused patients to find antisera that could detect new antigenic polymorphisms among low-density lipoproteins and other proteins. He also used sera obtained from Australian Aborigines as part of a collaborative study.

The antibody used to find the antigen was serum obtained from New York patients with haemophilia, who had received many transfusions (and thus almost inevitably contracted hepatitis B). The rest, of course, is history, and is narrated in an eloquent and engaging style. The paper on the association between the Australia antigen and hepatitis was initially rejected by the *Annals of Internal Medicine* in 1967 because the reviewer was reluctant to risk another false claim for the identification of the elusive hepatitis virus(es). But it was published in the end, and Blumberg received the Nobel prize in Physiology or Medicine in 1976.

The book is a gem, though it is a pity about the title, which was borrowed from an overworked newspaper headline. It is essential reading for all aspiring scientists, the faceless bureaucrats who control the budgets for medical research, and devotees of the Research Assessment Exercise (it is doubtful if Blumberg's work would have attained a significant score). And it should be read by the thousands of people who work on the control and eradication of the hepatitis B virus. ■

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A philosophical liberator

Invariances: The Structure of the Objective World
by Robert Nozick
Harvard University Press: 2001. 432 pp. $35, £23.95, 40.30 euros

Hans-Johann Glock

Philosophers generally have one of three distinct attitudes towards natural science. Some, like Blaise Pascal and Martin Heidegger, hold science in contempt, on the grounds that philosophy, religion and the arts provide superior insights into the nature of the world and the human condition. Others, such as Bertrand Russell, Willard Van Orman Quine and most contemporary analytic philosophers, take their lead from the results and methods of science, and tend to regard philosophy as a part of, or at least continuous with, science. Philosophers of a third type also treat science with great respect but insist that philosophy is qualitatively distinct from science, because it is a second-order discipline that, rather than describing reality, reflects on the concepts used, for example, in scientific descriptions of reality. Following Immanuel Kant, this stance can be labelled 'critical', because it allows philosophy to question scientists about anything that is conceptually unclear and about inconsistencies that might mar the expression of their factual discoveries.

The Harvard philosopher Robert Nozick is very much of the second, scientific variety. Although *Invariances* stops short of dissolving philosophy into science, it seeks to transform philosophical problems into empirical, factual ones. Its topic, the structure of the objective world, is clearly scientific, but the focus is distinctively philosophical. Nozick is less interested in exploring specific objective phenomena than in the question of what constitutes objectivity. His answer, in a nutshell, is that a phenomenon is objective to the extent to which it is invariant under a range of possible transformations.

At the same time, he deplores the typical philosophical stance according to which many statements are necessary and invariant across all possible worlds. "Too often, philosophers insist that things must be a certain way, and they make it their business to close off possibilities," writes Nozick. By contrast, he seeks to open up surprising new conceptual possibilities.

The purpose of his 'philosophical forays' is to challenge presumed necessities, and thereby our intuitions and our received conceptual framework, by invoking unheard-of possibilities raised by modern science. This challenge includes statements such as: "Water is H_2O". Saul Kripke and Hilary Putnam have argued that the term 'water' does not refer to a substance with certain perceptible properties (such as being a colourless and odourless liquid). Rather, they say it refers in any possible world to the substance that has the same microstructure as the stuff we call water in the actual world. Empirical scientific investigation is needed to establish what that structure is. However, in any possible world, only that which is H_2O can be water, so it is a metaphysical necessity that water is H_2O. Nozick disputes this celebrated reasoning. If there is a possible world in which H_2O is a green and smelly substance, that substance must be water. But this is not an intrinsic necessity about that world, it is 'imported' from the fact that in our actual world we use 'water' to refer to all substances with a certain microstructure.

Nozick is commendably undogmatic in his discussions of dissenting positions, and his policy of conceptual laissez-faire is undoubtedly attractive. But it brings with it the danger of the kind of conceptual confusions and unacknowledged terminological shifts that the critical tradition warned against. It goes without saying that scientists and scientifically minded philosophers have every right to introduce new conceptual instruments to explain new empirical findings. But if we are to understand these instruments properly, then we must clarify their connection to established (scientific or ordinary) concepts. Nozick seems to think that such explanation is unnecessary, and that new terminology can never be faulted as long as it is interesting.

But his own explorations do not always bear out this confidence. Science can have undesirable philosophical admirers — people who appeal to scientific findings and theories in an irresponsible and uncontrolled way. An example of this is the 1996 'Sokal hoax', in which the physicist Alan Sokal wrote a spoof article riddled with scientific nonsense and persuaded a leading cultural-studies journal to publish it. Nobody could accuse Nozick of the kind of ignorance and fraudulence betokened by some postmodernist thinkers — his discussions are exceedingly well-informed, intelligent and illuminating. As a guide to how scientific findings impinge on philosophical orthodoxies in various fields. the book is highly recommended. However, it often sacrifices clarity and argumentative rigour in its quest for suggestive link-ups with science.

This is evident in Nozick's uncritical acceptance of 'evolutionary cosmology', the highly speculative and extremely metaphorical application of genetic and evolutionary terms to whole universes, and his discussion of truth and relativism. Nozick does recognize that his laissez-faire attitude is close to postmodern relativism, and he attempts to show that relativism is not just coherent but partly true. But his defence is flawed: postmodernists cannot avoid local charges of inconsistency by abandoning all of our received concepts and theories at once, as this will simply leave them without anything intelligible to say.

Furthermore, Nozick invokes quantum mechanics and special relativity to establish that truth is relative to both time and place (a statement is not absolutely true, but only for a certain time and in a certain place). Quantum mechanics shows that whether an event occurs at a certain time is not fixed and determined absolutely. However, there is a difference between being true and being causally determined. It is true that event e occurred at time t if, and only if, event e occurred at time t, irrespective of whether e was predetermined at an earlier time or measurable at a later time. Nozick simply wants us to ignore this point and to assimilate being true with what he calls 'determinately holding'. But this revision leads him to reject the most basic conceptual truth about truth: that it is true that p if, and only if, p. Anyone who rejects this equivalence is simply no longer talking about truth. (Indeed, Nozick himself relies on this equivalence when he points out that "it is true that p" does not mean the same as "it is believed that p").

Finally, Nozick demands far too much from an 'illuminating' theory of truth, because he confuses the question "What is truth?" with the question "What is true?". Answering the latter requires a scientific solution to the riddles of the universe, whereas answering the former requires 'only' an analysis of the concept of truth as used by scientists and laypeople. The role of conceptual policeman is less attractive than the role of conceptual liberator that Nozick occupies to such striking effect. But both are required if philosophy and science are to benefit from one another. ■

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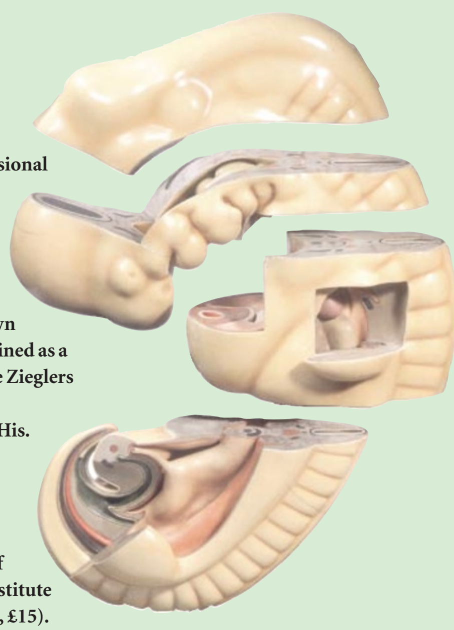
Medical models



Wax models of embryos and other biological specimens were widely used by anatomists in the latter half of the nineteenth century. Researchers produced their own three-dimensional models to help them understand the structures they observed, and commercially prepared models were widely used in teaching. Some of the finest and most widely used wax models, such as that of a human embryo in several pieces shown here, were produced by Adolf Ziegler, who trained as a doctor of medicine, and his son Friedrich. The Zieglers acted as 'wax publishers' for scientists such as Alexander Ecker, Ernst Haeckel and Wilhelm His. The history of the Ziegler models and their impact on embryological research is told in the lavishly illustrated book *Embryos in Wax: Models from the Ziegler Studio* by Nick Hopwood (Whipple Museum of the History of Sciences, University of Cambridge, and the Institute of the History of Medicine, University of Bern, £15).