

science is big physics, almost all of the essays deal with big physics spectacles, big physics institutions and big physics personalities—Ernest Lawrence's early cyclotrons, Pief Panofsky's SLAC, CERN, Tsukuba, Los Alamos, the space telescope, the Gravity B Relativity Gyroscope Program and the Plutonium Project. The essays are grouped into three parts: "The Big Physics of Small Particles," "Sponsored Research and External Interests" and "Big Science and National Security." As in many multi-authored collections, the essays vary in quality. My favorite was a spritely account of the Gravity B Relativity Program by a participant, W. Francis Everitt. Indeed, the essays written by historians sometimes seemed to me to lack verisimilitude as compared to those written by actual protagonists such as Everitt.

I found Panofsky's essay on the history and politics of SLAC to be especially insightful, largely because he tries to address what I regarded in 1961 as the central social problems of big physics: its enormous expense, its effect on the ethos and style of science and its relation to and justification in comparison with "little science." Panofsky insists that the concern that big physics would become too journalistic (in other words, that new discoveries would be announced by the press *before* being peer reviewed for a scholarly journal) has not been borne out by events. Standards of scientific quality are at least as high in big physics as in less expensive undertakings. Though conceding that big physics is expensive, Panofsky points out first that support for little physics tends to parallel support for big physics. Secondly, he asks, "if certain answers crucial to man's understanding of nature can be obtained only by large effort, is that sufficient reason for not seeking such answers?"

A recurring theme in several of the essays is the sometimes difficult relationship between physicists and engineers in big physics. This matter is explored in David Hounshell's essay on research and development at DuPont and DuPont's wartime role in the engineering of the Hanford plutonium-producing reactors. Hounshell had access to the yet-to-be-published wartime diaries of Crawford H. Greenewalt of DuPont who at the time was the chief of liaison between the Chicago physicists (mainly Eugene Wigner and Enrico Fermi) and the DuPont company. The essay clarifies the origins of the dispute between Wigner, the inventor of the Hanford reactors, and the DuPont engineers who actually built the

plant.

Historians of technology will have a field day comparing Wigner's memoirs of the Plutonium Project with Greenewalt's when both diaries become generally available. My own estimate is that although Wigner underestimated the required size of the Hanford project and DuPont underestimated the engineering, let alone scientific, genius of Wigner, both DuPont and Wigner were necessary for Hanford's success.

Galison and Hevly seek to make the history of big science a new subfield of the history of science. This book is a good start; it contains much to chew on for historians and for physicists who practice either big or little science.

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The Mind of God: The Scientific Basis for a Rational World

Paul Davies

Simon and Schuster, New York, 1992. 254 pp. \$22.00 hc ISBN 0-671-68787-5

The remarkable explanatory power of modern science hardly needs emphasis but is nevertheless a source of wonder. Scientific explanations of reality receive a ready acceptance in the most diverse cultures and are an intellectually unifying phenomenon of the present-day world. What can science tell us about the ultimate questions of human existence? Is a universally satisfying "theory of everything" possible?

Paul Davies confesses to having been dazzled by the explanatory power of science as a student. His earlier book *God and the New Physics* was an attempt to grapple with the clash of ideologies of science and religion in their explanations of the world; his present book is, in his own words, a more considered attempt.

His exploration of what may constitute an ultimate explanation of the world is fascinating reading. He writes in the lucid and delightful style his readers have come to expect and appreciate, reliably steering the non-technical person through the most difficult issues of quantum cosmology, applications of Gödel's theorem and the ontological status of physical laws. He recognizes, however, that the search for a closed logical scheme that provides a complete and self-consistent explanation for everything is doomed to failure. Gödel's theorem warns one that the axiomatic method

of making logical deductions from given assumptions cannot in general provide a system that is both provably complete and consistent. Davies concludes that if one perseveres with the principle of sufficient reason and demands a rational explanation for nature, then one has no choice but to seek that explanation in something beyond or outside the physical world. For convenience, the reason for the universe may be labeled God—whether one has in mind a person, a creative force, an ethical requirement or some concept not yet formulated.

Davies declares that it is not obvious that this postulated being who underpins the rationality of the world bears much relation to the personal God of religion, still less to the God of the Bible or the Koran. Many modern theologians would concur with his sentiments, albeit from a different perspective. For example, the biblical scholar José Miranda states that whereas according to ontology God first exists and then commands, the biblical God ceases to be God at the moment at which He is objectified into any representation and thus ceases to command (His command being perceived essentially as a demand for justice). A biblical notion of God, which has moral concern at its very core, cannot arise from the purely gnostic approach of the kind explored by Davies. At least from a Christian perspective, this is surely the main weakness of his study.

Nevertheless this exposition of traditional questions of the meaning of the world from the perspective of the latest developments in physics, so engagingly and clearly written, contains much to interest and inform. It is a book that deserves to be widely read.

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Impure Science: Fraud, Compromise and Political Influence in Scientific Research

Robert Bell

Wiley, New York, 1992. 291 pp. \$22.95 hc ISBN 0-471-42913-3

Science has been getting bad reviews. Highly publicized cases, including the cold fusion fiasco, false claims for the "Star Wars" x-ray laser program, fabricated data in the David Baltimore case, improper charges on research grants at Stanford and the growing reliance on pork-barrel funding of scientific research, have created a public perception that science,