Military Patronage

Science and the Navy. The History of the Office of Naval Research. HARVEY M. SAPOLSKY. Princeton University Press, Princeton, NJ, 1990. xvi, 142 pp., illus. $34.95.

The Office of Naval Research (ONR) has a reputation in scientific circles as the most enlightened supporter of basic scientific research among the federal mission agencies. The reputation lingers from a golden age, 1946 to 1950, when ONR was waggishly called the Office of National Research. The National Science Foundation was struggling to be born, and the Navy took up the slack, providing munificent and virtually unrestricted support for basic science in America's leading universities.

Two explanations of ONR's behavior are usually advanced. Some argue that the Navy in World War II had come to see science as the reservoir of knowledge from which future technical advance would flow; it behooved all agencies of government to feed this reservoir. Others have argued, perhaps more cynically, that the Navy simply wanted to coopt a new source of power to serve its own institutional interests, that is, to militarize science.

Both views are myth, according to Harvey Sapolsky, professor of public policy and organization and director of the Defense and Arms Control Studies Program at the Massachusetts Institute of Technology. The real reason for ONR support of basic research, Sapolsky argues, was a "bureaucratic accident." Admiral Harold G. Bowen, the founder of ONR, wanted an institutional base from which to build a nuclear-powered fleet. The Army, which had controlled the development of nuclear power during the war, was guarding the new technology closely; Bowen hoped to get at the knowledge through the Manhattan Project scientists who were then returning to their universities. As it happened, Bowen was outmaneuvered bureaucratically within the Navy, but the staff that remained after his early retirement turned his institutional creation into an "enlightened, if initially purposeless" funding agency. The Navy failed to notice.

This kind of candid and revealing institutional history has become something of a hallmark of Sapolsky's work. His 1972 study *The Polaris System Development*, done like the present work under Navy sponsorship, revealed among other things that the highly touted and widely emulated PERT (Program Evaluation and Review Technique) system was more a public relations ploy to deflect meddling congressmen than a system for actually managing the development of large-scale technology. Comparable revelations grace this latest study.

But there are reasons to be disappointed with this book, as many students of government science no doubt will be. It is painfully brief. It is late, appearing a full decade after the research began. It relies on interviews with 250 scientists, military officers, and government officials, but gives no specific sources, promising only that Sapolsky's records of the interviews "will be preserved and made available for inspection by interested scholars" at some indeterminate future time. Finally, and perhaps most substantively, the book never makes clear exactly what ONR did, except distribute money. Chapter 5 promises to treat "the research successes and failures of ONR," but focuses instead on "managing naval science," providing a comparative study of ONR and other government programs in support of science. This is interesting and informed analysis, but not what many scholars will look for in a book with this title.

These shortcomings, however, are far outweighed by the book's virtues. Sapolsky casts his subject in the broadest context of science policy, a topic he knows well. He examines basic versus applied research, geographical distribution of research funds, the politicization of science, and the formulation and execution of science policy throughout the government since World War II. He reports with insight and candor how and why ONR and its related Naval Research Advisory Committee functioned as they did. And he reveals with his accustomed iconoclasm that the ONR experiment was both more and less than the legend that grew up around it. Along the way he has some home truths for scientists as well as for government bureaucrats and politicians.

Sapolsky argues that the military services were never convinced of the efficacy of science, not even in the warm afterglow of World War II. Whether they ever bought into technology is another question, but according to Sapolsky they established institutional connections with science that allowed them to keep the scientists and their work subordinated to military purposes as defined by the military. Vannevar Bush's idea of an autonomous science was never realized (fortunately, according to Sapolsky). And the scientists did precious little to resist the trend. When the political winds blew ONR toward more directed research, the scientists let it go. When university campuses turned on the military, the grantees who had benefited from ONR support went quietly to their offices to fill out grant applications to NSF or NIH. The two sides conspired to dig the chasm that Sapolsky now sees between science and the military, a hole into which free societies run the risk of falling.

Nor is the danger to society the only hazard in this record. Sapolsky believes that academic scientists have paid a high price for their estrangement from the military. They have ended up chasing other rationales for government largess—space exploration, the environment, energy, cancer, AIDS—engaged in "an endless search for objectives." It is not clear, Sapolsky argues, that these other objectives provide either motives or agendas for basic research that are superior to those of the military. Sapolsky's message, then, is not just a lament that the golden days of the ONR passed away, but that the scientific community was implicated in their passing and is much the poorer for the loss. That theme alone makes this thin book provocative and important beyond its size.

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Particle Astrophysics

The Early Universe. EDWARD W. KOLB and MICHAEL S. TURNER. Addison-Wesley, Redwood City, CA, 1990. xxii, 547 pp., illus. $48.50. Frontiers in Physics, 69.

Often remarked upon, by now to the point of becoming hackneyed, is the connection between physics at the very smallest scales—manifested in high energy particle theory and experiment—and physics at the very largest scales—theoretical and observational cosmology. Repetition makes this connection no less profound, however. Only dimly suspected a generation ago, it is now taken as fact by most cosmologists and particle physicists that the gross nature of the universe today, both its chemical composition and its aggregate structure, was determined at very early times by processes

whose study we would now conventionally assign to nuclear physics and high energy particle physics.

Correspondingly, there has developed a small community of "particle astrophysicists" whose efforts are tied to the development of this cosmic connection. Brave it is to choose an interdisciplinary field for one's work; braver yet to assert that an interdisciplinary enterprise is in fact a nascent discipline ready to assume inner-directed standards for its papers and the training of its Ph.D. students. That, approximately, is the current state of particle astrophysics. Chicago, boasting the University of Chicago's Fermi Institute and the astrophysics group at the Fermi Accelerator Laboratory, is in effect the mother church to this order. Kolb and Turner each hold joint appointments at these two institutions. Their own research is highly regarded by the international community and their students are propagating the faith worldwide.

There is a time in the development of a new field when a textbook or monograph is able not merely to summarize the field but to crystallize it. That is the case with *The Early Universe*. The book starts with three chapters that review what are now considered "standard" cosmological observations and formalisms: Hubble expansion, cosmic microwave background, elemental abundances, galactic rotation curves (indicating dark matter), large-scale structure, and Friedman models for the hot big bang. These, and two subsequent chapters on big-bang nucleosynthesis and thermodynamical processes in an expanding universe, serve as concise updates to Steven Weinberg's classic 1972 text *Gravitation and Cosmology*, which covered the same ground. The present treatment is far less self-contained than Weinberg's, however, so the reader will likely want to have that older work at his or her elbow.

With chapter 6, on baryogenesis (the question of whence our universe's preponderance of matter over antimatter), we begin the really modern material. Some familiarity with the culture, if not the details, of grand unified theories (GUTs) is presumed here. (A 25-page appendix attempts to summarize all of modern particle theory, but the authors recognize that they cannot do justice to all the necessary background.) Subsequent chapters are arranged in approximately increasing order of speculativeness: cosmological phase transitions (domain walls, cosmic strings, and others); inflation (nicely summarized, finally, as "a paradigm in search of a model"); the origin-of-structure problem; axions; and a final catch-all, "Toward the Planck epoch," wherein such issues as extra dimensions and the wave function of the universe are briefly raised.

All of the modern topics are treated at a high mathematical level, essentially that of the primary literature in the field. Though the discussion is quite readable and informal, the presentation is unfortunately too brief to include all the background steps. This is not a textbook where the student can be expected to fill in the details, therefore, but rather a field-manual guide to the literature. (Also available from the same publisher is a companion volume *Early Universe: Reprints* for the serious student who does not have ready access to a physics research library.)

The Early Universe is an important book, because it provides, right now, about the only published means of entry into the new discipline of particle astrophysics. Though favorable mention should be made of Gerhard Börner's 1988 book *The Early Universe: Facts and Fiction*, Kolb and Turner's monograph is more definitive and central to the field.

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Some Other Books of Interest

100 Years of Gypsy Studies. MATT T. SALO, Ed. Gypsy Lore Society, 5607 Greenleaf Road, Cheverly, MD, 1990. vi. 286 pp., illus. Paper, $20. Gypsy Lore Society Publication no. 5. From a meeting, Staten Island, NY, March 1988.

Scholarly concern with Gypsies may be traced, in the words of Angus Fraser, to "a favorable concatenation of circumstances" coming about in the 1870s, including the development of comparative philology and the emergence of an interest in folklore generally as well as the endeavors of several individual enthusiasts. In 1888 a Gypsy Lore Society was formally established, and in this volume stemming from a meeting marking its centennial a cross section of recent research on Gypsies (also referred to by such other names as Roma, Travellers, and Gitanos, depending on context) is presented. Antecedents of the current work are discussed in Fraser's opening paper, punningly entitled "A rum lot" in reference to the low repute in which the early workers are now held in light of the "new professionalism" that has emerged as sociologists and anthropologists have entered the field. Other papers in the opening section of the volume include discussions of representations of Gypsies in Italian and Dutch writings of earlier centuries and reports on studies of aspects of present-day Gypsy life—Roma perceptions of *găze* (non-Gypsy) behavior as represented on television in Italy, marriage among Travellers in Ireland, rituals of divination in Canada, dealings with welfare agencies in California, and a *kris* (dispute settlement) in Kansas. The rest of the volume is given over to sets of papers on three special topics. A set of four edited by Victor A. Friedman considers Romani linguistics, including phonological changes over time and borrowings from Balkan and other languages. Three papers headed Music in Eastern Europe under the editorship of Carol Silverman deal with Gypsy song, in particular with its variations among Gypsy groups and its relation to "mainstream" music. The final group, edited by Anita Volland, is devoted to the Flamenco tradition in Spain. These five papers consider the origins and current state of the tradition, the question of its distinctively Gypsy components, the development of the guitar as an element of performance, and how the Flamenco art is learned, with examinations also of the portrayal of Flamenca women in the theater of the 1880s and of the *carceleras* (prison songs) of the 18th century.—**K.L.**

Semelai Culture and Resin Technology. ROSEMARY GIANNO. Connecticut Academy of Arts and Sciences, New Haven, 1990. xxxiv, 238 pp., illus. $40. Memoirs of the Connecticut Academy of Arts and Sciences, vol. 22.

As natural products whose properties include adhesiveness, insolubility in water, plasticity, and resistance to decomposition, resins have found uses in many cultures "from time immemorial." Archeological interpretation based on them has, however, been limited by the lack of both technical and ethnographic information. The present volume reports on such a study of the practices of the Semelai people of the Malay Peninsula, who have collected, processed, and traded resins from *Dipterocarpus* trees since prehistoric times. The work opens with a brief review of archeological and ethnographic studies of resins (including chemical techniques for their identification and analysis) and of the Semelai themselves. The author then gives an ethnographic account of the present-day Semelai—demography, means of subsistence (hunting, foraging, and, more recently, swidden agriculture), trade, kinship and marriage customs, political relations, religion—before turning to the subject of resins *per se*. An overview of Semelai folk taxonomy precedes a more detailed discussion of the classification of resins and other plant fluids. The techniques by which trees are tapped (including the use of fire to increase the flow) for oleoresins and other substances are then described, along with attendant activities such as foraging for rattan and other useful