books

Physics in the service of national security

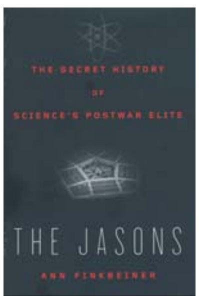
The Jasons

The Secret History of Science's Postwar Elite

Ann Finkbeiner
Viking, New York, 2006. $27.95 (304 pp.). ISBN 0-670-03489-4

Reviewed by Wolfgang K. H. Panofsky

Ann Finkbeiner's *The Jasons: The Secret History of Science's Postwar Elite* is an excellent book that not only thoughtfully recites the history of the JASON group but also identifies the conflict of values faced to this day by physicists who become involved in national security affairs while at the same time they try to preserve their independence. The subtitle of the book, however, is misleading: The author relates a great deal of detailed information without breaking any "secrets." JASON members are generally less than eager to talk about their association and work with the group, and the majority of JASON reports are classified. Finkbeiner recounts some of the critical events without completing the story, which is more in deference to the wishes of those she interviewed during the process of generating her book than it is to maintaining secrecy.



During World War II, US physicists demonstrated that they could get things done if they were well supported but not directed by the federal government; accomplishments include developments in nuclear energy and weapons, radar, and rockets. Subsequently, most physicists involved in the war effort returned to their academic pursuits after the war ended. In an unorganized way, several of them continued to consult with government or industry on military matters, and some rotated between academia and industry. After *Sputnik 1* was launched in 1957, the government promoted science advice to the presidential level and made a commitment to revitalize American science. Physicists themselves, mainly under the leadership of John A. Wheeler, attempted to create a full-time organization for military research, but their endeavors inspired little enthusiasm.

Separately, a small group, principally Marvin "Murph" Goldberger, Ken Watson, and Keith Brueckner, proposed to establish the JASON group to pursue national security work compatible with full-time academic duties. The name JASON, inspired by the Greek mythological hero who led the Argonauts in the search for the Golden Fleece, was suggested by Goldberger's wife. The group was supported by Charles Townes, who at the time headed the Institute for Defense Analyses. In turn, IDA was supported by the Advanced Research Projects Agency (ARPA), which was under the leadership of Herbert York and reported to the newly created Directorate of Defense Research and Engineering (DDR&E) at the Pentagon. The entire lineup of JASON and the research agencies was populated by physicists who had been colleagues on the Manhattan Project. The contractor handling the administrative work, such as travel, security, and financial matters, shifted from IDA to SRI International to the MITRE Corporation.

JASON members have had a love–hate relationship with ARPA and its successor, the Defense Advanced Research Projects Agency (DARPA). Incoming heads of the agency generally resented the independence of JASON, but Finkbeiner reports that after some experience, each director recognized that the value generated by the JASONs exceeded their "nuisance." The matter came to a climax under the administration of President George W. Bush, when in 2001 the incoming head of DARPA, Anthony Tether, demanded that JASON add to its ranks two nonacademics and one academic prescribed by the administration. Traditionally, members had been selected by the JASON steering committee; thus the JASONs objected to the administration's plans, and DARPA cancelled their contract. However, the contract was later reinstated by DDR&E through a process not recounted by the author in polite deference to the administration.

During its history JASON made many technical contributions to military research, in addition to serving as a reviewer of frequently dubious initiatives from the military establishment. It made the concept of adaptive optics practical by proposing the use of a laser-generated, artificial guide star. JASON showed that ceasing nuclear tests of any nuclear yield would not harm security any more than permitting very small undetectable nuclear explosions. The work of JASON also diversified to include engineering, oceanography, climatology, computer and information sciences, and more recently biological issues with security implications.

The most controversial JASON contribution, which was developed during the Vietnam War, was the electronic barrier, whose origin and final demise is ably described in Finkbeiner's book. The barrier required US sensors to be airdropped along potential infiltration routes. The goal of the sensors was to detect infiltrators on those routes for the US to bomb, thus discouraging the incursion of North Vietnamese troops along the Ho Chi Minh Trail. A JASON study had shown that the bombing campaigns in Vietnam were ineffective. The barrier was intended to decrease the level of violence, but it was never fully deployed. The instruments were instead diverted by the US Air Force to relieve the siege of Khe Sanh and assist the continued bombing campaign. The role of the JASONs in originating the electronic barrier became public and—notwithstanding their constructive intent—led to extensive protests, some of which were quite ugly, against JASON members on their home campuses.

The episode illustrates the tensions inherent in having academic physicists engage in military research. I believe that most JASON members, in conformance with the views of most fellow academics, are for arms control at heart

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and basically strive for a de-emphasis of violence as a means for settling international conflicts. At the same time, they make their skills available to the military establishment as independent scientists, maintaining with merit that the objective analyses will lead to more rationality in the military arena. The military is well aware of the basic outlook of most JASONs but appreciates their talents and objectivity.

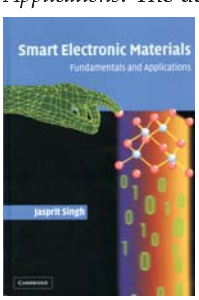
To demonstrate JASON's dilemma, Finkbeiner cites the well-known anecdote about three people, one of whom is a physicist, sentenced to death by guillotine. During the first two attempted executions, the blade gets stuck, and the two are freed. But the physicist takes a look at the guillotine and says, "I think I can tell you what's wrong with it." The correspondence to JASON's activities may not be too remote.

Today, independent scientific advice on national security has largely been eliminated in the top levels of government. Thus the independence of outsiders who operate on the inside, like the JASONs, is a unique asset today in the national security arena. This fact is duly noted and documented in Finkbeiner's very readable book.

Smart Electronic Materials
Fundamentals and Applications

Jasprit Singh
Cambridge U. Press, New York, 2005. $80.00 (408 pp.).
ISBN 0-521-85027-4

A day in the life of a fictitious salesman for a medical company introduces the topics discussed in Jasprit Singh's *Smart Electronic Materials: Fundamentals and Applications*. The author offers examples of the diversity of "smart" materials currently employed in high-technology devices that are used daily by all of us without our spending a thought on the complexity and rich physics involved in understanding their functions. The term smart has been used to describe materials—such as artificially made piezoelectric foams, ferroelectric polymers, and liquid crystals—that uniquely respond to an external stimulus, providing input–output decision capabilities and coupling the analog world to the digital world of information systems.



Smart materials can be found in all devices that are advancing information technology, with applications in electronics, optoelectronics, sensors and actuators, memories, and other areas (see the article by Siegfried Bauer, Reimund Gerhard-Multhaupt, and Gerhard M. Sessler, PHYSICS TODAY, February 2004, page 37). Yet we do not prepare graduate students in applied physics, materials science, and engineering to understand and fully explore the diversity of materials used, for example, in laptop computers, mobile phones, MP3 players, and similar popular high-technology items.

To illustrate the fascinating world of smart materials, Singh has chosen semiconductors, dielectrics, ferroelectrics, and ferromagnets. Intended for first-year graduate students, the book covers structural issues of crystalline and noncrystalline materials, including artificial structures, surfaces, and interfaces; electronic and transport properties; effects related to the polarization in ferroelectrics; optoelectrical effects; magnetic properties; and how these structures and properties are related to real-world applications. Many important materials and devices could not be included in the book because of limited space. For instance, Singh does not discuss flash memories, liquid crystals, and organic displays, all of which are extensively used in mobile electronic devices. The text, however, contains a wealth of information that can be used in graduate courses, such as the summary tables at the end of each chapter and the many illustrative figures.

Simple exercise problems are provided at the end of each chapter to familiarize students with the topics discussed and to give them a feel for the typical numbers involved. More challenging problems are not included in the text, but such an omission might have been Singh's intent in his introductory book. Obviously, in about 400 pages the author cannot cover in depth all aspects of smart materials. He uses space to discuss topics that can be found in most introductory physics books, information that might be useful to undergraduate students of engineering and materials science who have less knowledge of basic physics.

Smart Electronic Materials is a valuable guide for instructors who want to design their own courses on smart materials. Additional books on the subject can be used in conjunction with Singh's if students and instructors desire more depth and accuracy. Examples include *The Structure of Materials* (Wiley, 1999) by Samuel M. Allen and Edwin L. Thomas, the second edition of *Physics of Semiconductor Devices* (Wiley, 1981) by Simon M. Sze, the reprinted version of the excellent textbook *Principles and Applications of Ferroelectrics and Related Materials* (Oxford U. Press, 2001) by Malcolm E. Lines and Alastair M. Glass, and *Fundamentals of Photonics* (Wiley, 1991) by Bahaa E. A. Saleh and Malvin C. Teich.

Smart Electronic Materials mostly succeeds in its aim of offering readers basic skills to understand properties of diverse materials relevant in today's information-technology–based society. The sometimes sloppy and even incorrect use of scientific terms—for example, Singh's use of photocurrent when he means pyroelectric current—does not detract significantly from the book's usefulness. The few inaccuracies in scientific content are also not too surprising: A single author cannot have profound expert knowledge in all the diverse fields of applied sciences covered in Singh's book.

Overall, I do not know of any other text that tries to cover such a wide range of topics. I would like to see a second, revised edition with more in-depth discussions of smart materials and with fewer topics that are already thoroughly discussed in standard texts on physics.

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J. Robert Oppenheimer
A Life

Abraham Pais, with supplemental material by Robert P. Crease
Oxford U. Press, New York, 2006. $30.00 (353 pp.).
ISBN 0-19-516673-6

As one of the iconic scientists of the past turbulent century, J. Robert Oppenheimer (1904–67) has been a central character of books, conferences, plays, films, and even an opera, *Doctor Atomic*, which debuted in 2005. Naturally, several new biographies have appeared near Oppenheimer's centennial year. Robert P. Crease has completed and supplemented the unfinished biography *J. Robert Oppenheimer: A Life* by the