Vignettes: Public Opinion

I saw the results of a poll conducted by the South Carolina Department of Health and Environmental Control (DHEC). . . . One startling conclusion of DHEC's poll was that the group of people trusted the most on environmental issues was the medical profession. Nurses and doctors received the highest rating. I had assumed that scientists in general and ecologists in particular would have been the most credible groups. I learned the explanation for this apparent anomaly when I called the DHEC unit that organized the survey: Neither ecologists nor scientists were listed as choices on the survey.

—*Whit Gibbons*, in *Keeping All the Pieces: Perspectives on Natural History and the Environment* (Smithsonian Institution Press)

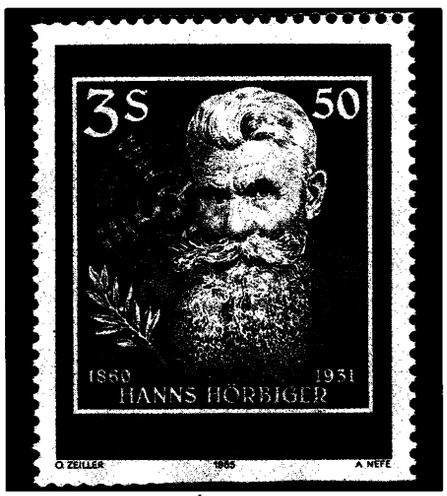
One may seek comfort in the fact that even though only less than half of the U.S. adult population believes in the evolutionary descent of human beings from earlier species, and even though half has trouble finding one side of a square when given one of the other sides, the U.S. public at large reports to pollsters a greater level of belief in the potential of science and technology as a force for the good (at least in the abstract) than equivalent tests have shown for other major industrial countries, such as France and Japan.

—*Gerald Holton*, in *Science and Anti-Science* (Harvard University Press)

the United States. The theory reached its apogee during the Third Reich, when the Sturmabteilung (SA) or Brownshirts promoted it as compatible with ancient Nordic myths and National Socialist ideology. "Hörbigerism" lingered on after World War II, only to die out in the 1970s.

Robert Bowen's *Universal Ice* is the first historical study of this obscure, fascinating, and potentially illuminating topic. Unfortunately, that is the only good thing that can be said about this book. Most of the space it devotes to the WEL consists of two badly written and opaque summaries: first of Hörbiger and Fauth's views, then of a 1937 book by a Nazi pseudoscience popularizer. Bowen does not cover the numerous other "Hörbigerist" authors and publications listed in his bibliography, nor does he provide any proof for his assertion that the theory acquired over a million adherents worldwide. Instead, a large fraction of this slim book is given over to ramblings on topics such as the fate of the Mormons in the Third Reich or the relationship of Martin Heidegger to the Nazis.

Even the relevant parts of *Universal Ice* are terribly flawed. Bowen, a geologist, apparently researched the book in isolation from the disciplines of history and history of science. Notwithstanding a large and subtle literature on National Socialism, he depicts "the Nazis" as a monolithic force with a coherent ideology. He does not seem to understand that the SA's endorsement of the WEL in the mid-'30s does not by any means indicate endorsement by the National Socialist movement as a whole or by the state. The SA was politically impotent after the bloody purge of June 1934, and the Third Reich was a heterogeneous collection of competing Nazi organizations and state bodies. Bowen also provides no evidence to back his claim that Hitler and Himmler were adherents of the WEL. In spite of attempts to depict the WEL as "malignant" and more influential than Lysenkoism in the Soviet Union, he does not prove that the theory was anything but a minor phenomenon in the Third Reich. Equally unconvincing is his conjecture that Hörbiger would have been "a powerful scientific overlord" (p. ix) had he lived.



Hanns Hörbiger. "The Austrian Post Office issued this commemorative stamp in 1985 to mark the 125th anniversary of Hörbiger's birth. The design incorporates a diagram of his patent valve." [From *Universal Ice*; National Postal Museum, Smithsonian Institution, Washington, DC]

This hand-wringing notwithstanding, *Universal Ice* actually bolsters comforting myths about science in Hitler's Germany by depicting "the Nazis" as crackpot persecutors of the scientific community. Bowen gives the usual example of "Aryan physics," which he characterizes as "supported by" the physicists Philipp Lenard and Johannes Stark (p. 115), its two main protagonists. In fact, Lenard and Stark were discredited by 1941, and the physics community had made its peace with the regime to help the war effort and protect itself. In spite of real persecution and the efflorescence of some pseudoscientific theories, the dominant story of science in the Third Reich was one of willing accommodation with National Socialism and its policies.

Finally, Bowen misses a valuable opportunity to examine "Hörbigerism" as a case in the history of heterodox scientific theories. The author appears naively confident in the existence of a fixed and easily determined boundary between science and pseudoscience or, as he would have it, "real" and "false" science. Historians and sociologists of science have shown this boundary to be unstable, negotiable, and permeable. Some theories and disciplines, such as evolutionary thought, have gone from pseudoscience to science, whereas others, such as eugenics, have moved in the opposite direction. Bowen could also have compared the history of the WEL with that of Velikovsky's theories or Lysenkoism, instead of merely mentioning them in an unconvincing attempt to assert the greater importance of "glacial cosmogony." All this is rather unfortunate, since the history of Hörbiger's theory is potentially both informative and entertaining.

Michael J. Neufeld
National Air and Space Museum, Washington, DC 20560

■

Nuclear Magic

Simple Models of Complex Nuclei. The Shell Model and Interacting Boson Model. IGAL TALMI. Harwood, Langhorne, PA, 1993. xx, 1074 pp., illus. $120 or £68; paper, $52 or £30. Contemporary Concepts in Physics, vol. 7.

Nuclear spectroscopy physics has enjoyed a renaissance in the last 20 years, owing mainly to the development of the interacting boson model (IBM). In this model the low-lying collective eigenstates of nuclei are composed primarily of monopole and quadrupole bosons, and these eigenstates

and their eigenvalues are determined by a Hamiltonian consisting of a single-boson mean field and two-body interactions between the bosons. The IBM has unified the understanding of nuclear collective behavior from spherical through transitional to axially symmetric deformed nuclei and has predicted new types of collective behavior. In its original incarnation Akito Arima and Franco Iachello, co-inventors of the model, were vague about the meaning of the bosons, and it was generally assumed that they resulted from the quantization of the quadrupole liquid drop model of Aage Bohr and Ben Mottelson. However, Igal Talmi quickly recognized that the bosons were pairs of neutrons and protons of angular momentum zero (monopole) and two (quadrupole), highly correlated so that they could be treated as bosons, and thus the IBM was a generalization of the pairing model to include quadrupole pairing. This insight made it possible to connect the IBM to the nuclear shell model. Hence when Talmi set out to revise his very popular *Nuclear Shell Theory*, written with Amos de-Shalit about 30 years ago, the result was this entirely new book.

Simple Models of Complex Nuclei: The Shell Model and Interacting Boson Model reflects the approach that Talmi has brought to nuclear structure physics throughout his very influential career. In his view, we can understand low-energy nuclear spectroscopy by assuming that the neutrons and protons inside a nucleus, like electrons in an atom, move in spherical orbits produced by a static central field. Whereas in atoms the central long-range Coulomb field is produced by protons in the nucleus, inside the nucleus the nuclear central field is a mean field the source of which is the very strong short-range, spin-dependent interactions between the nucleons themselves. As a result, in contrast with the atomic shell model, the nuclear shell model lacks a theoretical foundation for finite nuclei, and the "best proof for the validity of the shell model is the good agreement of its predictions with experiment" (p. 4). One of these predictions follows from the fact that the mean field produces sets of quasi-degenerate orbits separated by an energy gap. Because of the Pauli exclusion principle, the N neutrons and Z protons occupy the lowest N and Z orbitals, respectively, and at the N and Z for which the lowest quasi-degenerate orbits are filled the nucleus is particularly stable because of the energy gap. Such nuclei are called "doubly magic" and have been observed throughout the periodic table. The neighboring nuclei are then represented as having neutrons and protons (called valence nucleons) in the valence orbits outside the doubly magic core, and excited states are composed primarily of excitations within these orbits or from the core. The energy levels and eigenfunctions are calculated from a Hamiltonian that takes into account the energies of the orbitals and the effective two-body interactions between nucleons in these orbitals. Talmi extracts these orbital energies and effective interactions from the one- and two-valence nucleon systems and then predicts the many-nucleon system by diagonalizing the Hamiltonian matrix in a basis of antisymmetric wave functions with definite total angular momentum. He gives some examples of this approach and explains in detail the technology necessary for calculating the matrix elements for many-particle antisymmetric states with definite angular momentum.

This approach is viable for a few valence nucleons and for light nuclei. However, for medium and heavy nuclei the number of basis states becomes too large to diagonalize, leading to models that isolate a few important degrees of freedom. One of these models is the generalized seniority model pioneered by Talmi that isolates the pairing degree of freedom. The motivation for this model is the observation that, for nuclei with an even number of either neutrons or protons filling the valence shells (that is, singly magic nuclei), the excitation energy of the excited states is constant as the number of valence nucleons changes by two, suggesting that the nucleons in the ground state have strong pairwise correlations and the excited state comes from the breaking of the last pair. The generalized seniority model assumes that the ground state of a singly magic nucleus is a condensate of N pairs of valence nucleons with angular momentum zero correlated over a major shell outside a doubly magic core. Talmi derives the conditions on the Hamiltonian such that this condensate is an eigenstate and that the excited states with one pair broken are also eigenstates. He then proves that such a Hamiltonian will have two-nucleon separation energies varying linearly with valence nucleon number, which has been observed in a number of singly magic nuclei, and will also lead to a constant excitation energy as the valence nucleon number is varied. For the nickel isotopes, where shell model calculations have determined the ground state wave functions, these wave functions are well approximated by the generalized seniority wave functions; for the heavier nuclei such as the tin isotopes no such shell model calculations are available to test the generalized seniority wave functions.

When protons and neutrons are filling the same valence orbitals, the long-range effective neutron and proton interaction produces deformed nuclei and the ground state is no longer a condensate of correlated angular momentum zero pairs. It is for these nuclei that the IBM had its great success. In fact, describing generalized seniority as a condensate of angular momentum zero pairs suggests that one can approximate these correlated pairs as bosons, since it is bosons that condense. Adding a quadrupole correlated pair or boson furthers our understanding of the connection between nuclear collective motion and the shell model. Talmi gives a fluent description of the IBM, including many details about Hamiltonians, transition operators, symmetries, spectra, and applications to real nuclei. He also discusses fermion shell model Hamiltonians that have a subset of eigenstates with only monopole and quadrupole pairs. Using these models he gives a rudimentary description of how to map the fermion shell model Hamiltonian to the boson Hamiltonian—rudimentary because this relationship between the shell model and the IBM is not yet fully understood.

Simple Models of Complex Nuclei, which includes an updated and revised version of the very useful appendix to *Nuclear Shell Theory*, will make a good graduate textbook or research reference. The concept of bosonization of a fermion system has found applications in other fields of physics, and researchers now believe that quadrupole pairing may be essential for understanding high-temperature superconductivity in condensed-matter physics.

Joseph N. Ginocchio
Los Alamos National Laboratory,
Los Alamos, NM 87545

■

Other Books of Interest

Methods in Arabidopsis Research. CSABA KONCZ, NAM-HAI CHUA, and JEFF SCHELL, Eds. World Scientific, River Edge, NJ, 1992. xii, 482 pp., illus. $86 or £61; paper, $34 or £24.

Plant biology has many star performers, among them soybean, maize, tobacco, tomato, and wheat. Now *Arabidopsis thaliana*, a plant of no agronomic importance, has come to center stage. *Arabidopsis* is not a newcomer to botanical research, but it has been rediscovered recently because of its small genome, short generation time, established genetics, and amenability to genome analysis. There are now probably a thousand research groups working with *Arabidopsis*. *Methods in Arabidopsis Research* describes how to work with this crucifer. The book is more than just a book of protocols. Its 18 chapters cover a wide range of topics, from the history of *Arabidopsis* research, to yeast artificial chromosome cloning strategies, to subtractive library construction, to mutagenesis and cultivation.