

sertation, records an attempt to test this hypothesis by detailed stratigraphic studies of peat sections at Bolton Fell Moss in northwestern England. The stratigraphy of 14 peat faces a few meters long and 50 to 100 centimeters deep, representing about the last 2000 years, was sketched in the field to show in detail the horizontal continuity of pool and hummock facies, and peat samples taken from 21 monoliths were analyzed microscopically to identify the different *Sphagnum* species diagnostic of various pool depths, as well as *Eriophorum* (cottongrass) and *Calluna* (heath), the principal plants of dry hummocks. A detailed pollen diagram prepared from one peat face was used to provide time control for pollen counts from other peat faces, along with radiocarbon dating.

No patterns of hummock-hollow alternation could be detected as a result of these studies. Instead, the author identifies changes from dry hummock communities to wet lawns, or from wet lawns to pool associations, as a result of a rising water table over the entire bog in response to climatic change. During dry intervals the peat becomes decomposed (humified), and the result is a "recurrence surface," long ago described by Granlund. By correlating these surfaces from one peat face to another with the aid of pollen analysis and radiocarbon dating, Barber places the wet intervals at A.D. 900 to 1100, 1320 to 1485, and 1745 to 1800, similar to the periods identified by Lamb on the basis of English historical records.

The book presents a great deal of descriptive detail on the stratigraphy of individual peat faces, but the sketches and stratigraphic diagrams are difficult to read because of small lettering and confusing symbols and are in an illogical order. The absence of an index and a list of illustrations requires repeated searching for cross-referenced comments. The text is also difficult to read because several interpretations and conclusions about paleoenvironments are reached before the major macrofossil evidence is presented. The taxonomy and ecology of *Sphagnum* taxa are incompletely presented in the chapter on methods, but they are more fully developed in the chapters on results and discussion. Bits of information on the ecology and historical phytogeography of *Sphagnum imbricatum* appear in four different parts of the book.

Proper identification of fossil *Sphagnum* species is essential in any studies of peat stratigraphy that attempt to reconstruct microhabitats. The methods used in the work reported in the book appar-

ently did not include staining and sectioning, which are the only satisfactory techniques for distinguishing pore patterns and other diagnostic anatomical characters of certain key species.

The book opens with a very long literature review on the history of Osvald's hummock-hollow hypothesis of peat growth in raised bogs. In many respects this is the best-written and most valuable part of the book. Otherwise, the study illustrates the advantage of multiple stratigraphic analyses of numerous peat faces (in contrast to cores) in reconstructing changing conditions of bog growth. It would seem to lay to rest the Osvald hypothesis for hummock-hollow regeneration and to indicate the high potential of raised bogs to record climatic fluctuations spaced a few centuries apart.

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High Energy Physics

Neutrino 81. Proceedings of a conference, Maui, Hawaii, July 1981. R. J. CENCE, E. MA, and A. ROBERTS, Eds. University of Hawaii Department of Physics and Astronomy, Honolulu, 1981. In two volumes. xviii, 510 pp., illus., and xiv, 512 pp., illus. Paper, \$35.

The summer of 1981 saw the eleventh in a series of international conferences on neutrino physics and astrophysics, a tradition that stretches back to Moscow in 1968. In contrast with the 1980 proceedings, which reported the (possible) detection of neutrino mass and neutrino oscillations, there are no exciting new experimental results reported on in the 1981 proceedings. In fact, despite the furor over and the importance of these phenomena, because of systematic problems there are still no conclusive answers in either case, and the status of the phenomena is discussed in the book in progress reports and review papers. Nonetheless, these experimental hints have prompted a large number of new theoretical calculations.

One of the important new theoretical accomplishments comes from the consideration of neutrino masses in cosmology. Here, they allow escape from an inconsistency in the hot big-bang model: The grand unified models that yield a net baryon number for the universe naturally predict only so-called adiabatic density perturbations (parallel in both matter and radiation), whereas cosmological nucleo-

synthesis requires a low baryon density in the universe to avoid the making of too much helium and not enough deuterium. Yet, the observed clumping of matter into galaxies and clusters seems to require a high density and large density fluctuations $\Delta\rho/\rho$ at the time of the decoupling of the background radiation, which implies temperature fluctuations $\Delta T/T$ in the microwave background larger than present observational limits. A neutrino mass in the range few to several tens of electron volts allows reconciliation of all these requirements, as is discussed in the section of the book on cosmology. The book contains some discussion of, not to say argument about, the status of solar neutrinos.

The book contains a major discussion of axions. The axion, which is a pseudo-scalar Goldstone boson from the breaking of a chiral symmetry that allows one to "understand" the strong limits on CP (charge-conjugation, parity) conservation in quantum chromodynamics (QCD), has been in and out of favor for some time. There is a new manifestation of the axion in the context of grand unification that avoids the problem the "standard" axion has with the stability of stars. Faissner reports on "Evidence for axions or something like that" at $m_a = 250 \pm 100$ keV, whereas from an independent search Zehnder concludes that axions with $m_a > 160$ keV are not allowed. The new axion is possibly important in supernovas.

High-energy neutrino experiments are continually refining our understanding of the structure of electroweak interactions. The refinement includes a more and more precise determination of the Weinberg angle in the $SU(2) \times U(1)$ model: $\sin^2\theta_w = 0.215 \pm 0.012$ experimentally (taking into account effects of electroweak radiative corrections). Meanwhile, in work on grand unification, calculations of the renormalized value of $\sin^2\theta_w$ have included two-loop diagrams and, in $SU(5)$, yield $0.197 < \sin^2\theta_w < 0.214$, the main uncertainty coming from the QCD scale parameter Λ . Also included in the proceedings is a report by Miyake on the Kolar Gold Field proton-decay candidate events and several other nucleon-decay experiments that have been proposed or are under construction. A significant trend seems to be nonaccelerator experiments, with emphasis on deep underground (or underwater) detectors. The exciting underwater possibilities were given particular focus at this meeting owing to Hawaii's being the site of the proposed DUMAND (Deep Underwater Muon and Neutrino Detector) development.

These two volumes present a nice balance of review and new results and make a useful addition to any library. A warning that the binding of the book is not of the highest quality is probably in order.

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