BOOK REVIEWS

The Cancer Field

Racing to the Beginning of the Road. The Search for the Origin of Cancer. ROBERT A. WEINBERG. Crown, New York, 1996. xvi, 271 pp., illus. $27.50 or C$38.50. ISBN 0-517-59118-9.

Robert Weinberg is one of the leading experimentalists in molecular cancer biology. His book will make this complex field understandable for a wide range of readers, even though the non-specialist may not follow all the details. Like James Watson's *Double Helix*, Weinberg's book is a highly personal story that succeeds in transmitting a great deal of scientific information. The narrative is richly interspersed with amusing anecdotes about the great and the not so great. It conveys the excitement of discovery and the stresses of competition. It portrays the special features of the cancer field with the sinusoid oscillations of optimism and pessimism, the changing fashions, the rapidly surfacing and disappearing bandwagons, and the black-and-white pronouncements of some leading researchers who want to keep their colleagues on "the track" they happen to believe in. The field is a notorious roller coaster. It requires strong personalities.

Weinberg describes the discoveries of his group in accurate detail, and with more than customary modesty. The biases of the greatest are handled with critical affection. They include the Teutonic arrogance of Otto Warburg while promulgating his "solution of the cancer problem" and the hubris of the panvirologists who believed that all cancers are caused by viruses and who succeeded in casting their spell, at least temporarily, even on such a great and modest scientist as Peyton Rous, prompting him to throw out the mutational theory of cancer as categorically as viral carcinogenesis had been thrown out during the preceding decades. We see how the equally great founder of mouse cancer genetics, C. C. Little, sells his soul to the tobacco industry, and we follow the tragic fate of Sol Spiegelman, one of the fathers of modern molecular biology, described with equal doses of admiration, compassionate empathy, and relentless criticism. The unavoidable fanfares that accompany this field are exemplified by the statement of the *New York Times* in 1964 that the cancer problem was about to be solved and by the highly respected journal *Nature's* offer of its services for the quick advertisement of new discoveries after the publication of the *ras* mutations in 1982, in obvious expectation of decisive findings. We see how the vast but misguided enthusiasm around tumor virology in the '60s and the expected discovery of many human tumor viruses generated a white elephant, Building 41 at the National Institutes of Health, and how the inflated balloon suddenly collapsed, but not before hatching the cuckoo egg, the cellular oncogenes. Cancer biology became respectable, and the cell biologist took the driver's seat while the panvirologists quietly faded out.

The discoveries of the Weinberg group, from the successful tumor DNA transfection experiments through the unprecedented identification of the *ras* oncogene mutations and up to the cloning of the retinoblastoma gene, well deserve the space they get. In contrast, I would have preferred to read much less about a number of spectacular fraud stories. Some of the ephemeral "hypotheses" based on "experiments" that have never been performed are shown in detail, with figures, circuitry, and all. Not that they are not entertaining, but they show nothing beyond the principle that only some people can be fooled and only for some of the time. In the aftermath of the recent collapse of misconceived attempts to police scientific research by lay authority, they may at least illustrate that the self-cleansing of the scientific community is the only reliable safeguard against these spectacular but fortunately quite rare forms of mischief.

Some areas such as tumor immunology, angiogenesis, and research on invasion and metastasis are given less attention than they deserve. The same is true for the strongly reduced but highly vital residue of viral oncology that is mentioned but not properly explored and explained. It is particularly surprising that the book fails to deal in depth with the remarkable convergent evolution of the DNA tumor viruses whose transforming proteins were shown to cancel the function of the two most prominent tumor suppressor proteins, Rb and p53. This experiment of nature goes a long way in proving that the two suppressor proteins play pivotal roles in the control of cell growth and division and are not merely a few among many equally or more important regulators. Before this discovery, it could have been thought that cancer biologists have overemphasized the significance of the two paradigmatic suppressor proteins, reasoning on the basis of the early evidence that has filtered down through the tortuous routes of unexpected but startling findings. Viruses don't read the literature and are immune to such mistakes.

I would also have liked to see more detail on the role of the now numerous tumor suppressor proteins in cell cycle regulation, particularly since Weinberg has been one of the main contributors and protagonists of this field. It would have added more complexity, but the author is known for his ability to deal with that, as is also apparent from this book.

These are very minor complaints that do not detract from the fact that Weinberg has written an authentic, informative, and thoroughly enjoyable book about the momentous scientific developments to which he has so richly contributed.

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Evolutionary Issues

Molecular Zoology. Advances, Strategies, and Protocols. JOAN D. FERRARIS and STEPHEN R. PALUMBI, Eds. Wiley-Liss, New York, 1996. xxxii, 580 pp., illus., $89.95 or £70, ISBN 0-471-14449-5; paper, $45 or £34.95, ISBN 0-471-14461-4. From a symposium, St. Louis, MO, Jan. 1995.

Biology is based on observation and comparison, and, as in any scientific discipline, advances are made through the proposal of new theories and the discovery of new facts. Charles Darwin's theories of organic evolution, especially those related to common descent and modification through natural selection, unified the biological sciences, and recent discoveries in biology have verified and elaborated those theories. Genetics (Mendelian genetics and theoretical population genetics), molecular biology, and developmental biology have clarified the principles and rules governing the genetic basis of change, and advances in population biology and phylogenetic systematics have heightened understanding of the genetic structure of populations, speciation, and the phylogeny of organisms.

Although recent discoveries in biology have helped clarify many of the issues Dar-

win raised concerning evolutionary patterns and processes, further elaboration is needed. *Molecular Zoology* is a compilation of information from diverse authors who use a common language (evolutionary theory) and common methodologies (genetics and molecular biology) to address the intricacies of the evolutionary process. The book emphasizes the application of molecular tools for the resolution of long-standing problems in zoology. Each chapter evaluates the usefulness of these molecular tools and provides experimental protocols for their application.

The book is subdivided according to four major subject areas: phylogenetics, population biology, developmental biology, and adaptational biology. Chapters within each section address questions related to either micro- (population) or macro-evolutionary (species and above) processes. If evolution is viewed as the transformation of diversity among individuals into discontinuity between populations and species, then the evolutionary dynamics of populations needs to be understood. Highly polymorphic genetic markers, described in this book, promote the study of the genetic structure of populations and the relationship of that structure to patterns of gene flow, mating systems, relatedness among individuals, the reproductive success of individuals, and differentiation within and between populations. One long-standing problem pertaining to population level processes is the dynamics of social interactions, especially those related to enhancing reproductive fitness. Robert Fleischer and Joan Strassmann and colleagues describe how molecular markers can be used both to determine genetic relatedness among individuals and to test hypotheses concerning altruism, kinship, and mating systems.

Since methods were developed to measure genetic variation within populations and species, the evolutionary significance of genetic variation has been debated. What role does selection play in maintaining genetic variation? Are polymorphisms at the level of genes and gene products adaptive? The neutralist theory was proposed as a counterargument to the view that all variation is subject to natural selection, and today many mutations involving nucleotide substitutions in DNA have been shown to be selectively neutral or slightly deleterious. Nevertheless, some genetic polymorphisms are clearly adaptive and can be related to ecological and physiological parameters of populations. Dennis Powers and Patricia Schulte provide an elegant summary of an ongoing research program on *Fundulus heteroclitus* that clearly demonstrates the success of a multidisciplinary approach for studying adaptation at both the molecular and the organismic levels.

One of the frontier issues in evolutionary biology is genetic control of development and how evolutionary novelty, especially morphological diversity above the species level, can arise as a result of changes in regulatory genes and timing of gene expression. The most fascinating chapters in this book discuss the use of model organisms and the comparative method in studies of gene expression and ontogeny. Raff and Popodi coin the term "evolutionary developmental biology" to describe the use of phylogenetic comparisons of development to investigate regions of the genome under strong developmental constraint, as well as how changes in gene expression can result in major morphological changes. From the chapters in this book it is clear that single genes can play a major role in the development of complex structures. For example, Swalla compares gene expression in closely related species (urochordates of the genus *Molgula*) to study morphological change. Recently, this research has demonstrated that disruption of expression in a single gene, *Manx*, can influence the development of the chordate larval phenotype (see *Science* **274**, 1205 [1996]). Holland *et al.* describe methods for establishing homology of body parts among distantly related organisms, such as the nerve cords of amphioxus and vertebrates. Comparison of gene expression patterns appears not to support the long-held view that the dorsal nerve cords are homologous.

As zoologists, we should never forget the foundation of our discipline, which is comparative and organismically based. I agree with the statements in Maddison's chapter regarding the importance of organismic biology. Systematics provides the interpretative framework, the phylogeny and classification, for the comparison of evolutionary processes. Many systematists, including Huelsenbeck *et al.*, who contribute a chapter on "parametric bootstrapping," are dedicated to the development of objective criteria to test alternative phylogenetic hypotheses. Ultimately, all changes at the level of nucleotide sequences, gene products, and gene expression must be linked to organismic diversity and the evolutionary hierarchy of life. In this regard, all the authors in this book demonstrate a clear understanding of natural systems and relate their research to the broader issues in evolutionary biology that deal with the diversity of organisms and the explanation of natural phenomena.

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Browsings

Carbon Nanotubules. Preparation and Properties. Thomas W. Ebbesen, Ed. CRC Press, Boca Raton, FL, 1996. viii, 296 pp., illus. $99.95. ISBN 0-8493-9602-6.

Nine variously authored chapters beginning with a general introduction to carbon materials (Dresselhaus *et al.*) and then taking up the production, properties, and potential applications of these structures "at the crossroads of traditional carbon fiber and fullerenes."

From Lucy to Language. Donald Johanson and Blake Edgar. Principal photography by David Brill. Simon and Schuster, New York, 1996. 272 pp., illus. $50 or C$67. ISBN 0-684-81023-9.

Human evolution presented largely by way of commentaries on large color photographs of remains ranging from the earliest known fossils to Upper Paleolithic artifacts.

The Physics of Skiing. Skiing at the Triple Point. David Lind and Scott P. Sanders. AIP Press, Woodbury, NY, 1996. xvi, 268 pp., illus. Paper, $24.95. ISBN 1-56396-319-1.

Torsional vibration, centripetal acceleration, static equilibrium, and other such concepts expounded as they bear on a sport whose playing field reaches its ideal condition when the three possible states of water are able to coexist.

Relic, Icon or Hoax? Carbon Dating the Turin Shroud. H. E. Gove. Institute of Physics, Philadelphia, 1996. xvi, 336 pp., illus., + plates. $35 or £19.50. ISBN 0-7503-0398-0.

A first-person account, by an accelerator mass spectroscopist who was one of the principals, of the often torturous enterprise of dating the putative burial cloth of Jesus.

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Reprints of Books Previously Reviewed

Antoine Lavoisier. Science, Administration, and Revolution. Arthur Donovan. Cambridge University Press, New York. Paper, $69.95 or £40 (ISBN 0-521-56218-x); paper, $24.95 or £14.95 (ISBN 0-521-56672-x). *Reviewed* **266**, 1890 (1994).

Dynamics and Modelling of Ocean Waves. G. J. Komen *et al*. Cambridge University Press, New York, 1996. Paper, $34.95 or £24.95. ISBN 0-521-57781-0. *Reviewed* **270**, 320 (1995).

How Many People Can the Earth Support? Joel E. Cohen. Norton, New York, 1996. Paper, $14.95 or C$19.99. ISBN 0-393-31495-2. *Reviewed* **272**, 696 (1996).

Lowell and Mars. William Graves Hoyt. University of Arizona Press, Tucson, 1996. Paper, $24.95. ISBN 0-8165-0514-4. *Reviewed* **193**, 754 (1976).

Neptune's Gift. A History of Common Salt. Robert P. Multhauf. Johns Hopkins University Press, Baltimore, MD, 1996. Paper, $19.95. ISBN 0-8018-5469-5. *Reviewed* **205**, 778 (1979).

Power from Wind. A History of Windmill Technology. Richard L. Hills. Cambridge University Press, New York, 1996. Paper, $29.95 or £18.95. ISBN 0-521-56686-x. *Reviewed* **264**, 855 (1994).

Shadows of the Mind. A Search for the Missing Science of Consciousness. Roger Penrose. Oxford University Press, New York, 1996. Paper, $16.95. ISBN 0-19-510646-6. *Reviewed* **266**, 1737 (1994).