Book Reviews

Developmental Instability: Causes and Consequences. Edited by Michal Polak. xvi + 459 pp. New York: Oxford University Press. 2003. $95.00 (cloth).

The study of developmental instability and its main index, fluctuating asymmetry, has been touted by some as a scientific revolution and by others as an example of scientific sloppiness. As is common in many new or trendy fields of scientific inquiry, there are many controversies regarding the definition of the phenomenon, its measurement, its origin, its relationship with other phenomena, and its importance. This book, containing 24 chapters by different authors actively involved in the study of developmental instability, presents empirical and conceptual work addressing all of these issues.

The first section covers definitions and concepts. Perhaps one of the greatest challenges for an observer of this field is to get a clear understanding of the concept of developmental instability. Is it a process or an outcome? Is it a property of organisms or something that happens to them? How is it different from canalization, from homeostasis? Not everyone uses these terms the same way. The editor does an excellent job keeping the 45 contributors on the same page on this (and other) issues. Nevertheless, my grasp of the definition of developmental instability remained somewhat uncertain as I read through the first section. Two other important questions are addressed in this section: is developmental instability, as indexed by fluctuating asymmetry, heritable? Is asymmetry an organism-wide or trait-specific phenomenon? The answers appear to be "probably," and "a little of both," respectively.

The second section is on the genetic causes of developmental instability. Chapter 7 provides an excellent historical overview of research on this question, discussing arguments by many important figures in biology. Other chapters include discussions of genomic co-adaptation, the optimal degree of heterozygosity, the role of single genes (as in the oft-mentioned effect of a gene conferring insecticide resistance in the Australian sheep blowfly *Lucilia cuprina*, but disturbing genetic co-adaptation, resulting in higher asymmetry), and the additive and nonadditive effects of multiple genes. It seems that additive variance in fluctuating asymmetry is real but small, and methods to detect epistatic and genetic dominance are needed. The much-debated link between developmental instability and fitness is addressed again. One interesting question is the role of fluctuating asymmetry in communication, bringing up a parallel question, also addressed by other contributors, of whether fluctuating asymmetry has a signal value (e.g., as an unfakeable sign of good health) or is simply an assay of some other property (e.g., not easily noticeable underlying developmental disturbances).

The third section, on statistical issues, is quite complex and sophisticated, perhaps to a greater extent than is needed. Biologists have only recently become familiar with meta-analytic techniques, issues of statistical power and effect sizes, and it shows at times. A new researcher in the field without an extensive statistical background would be hard pressed to know what to make of the disparate suggestions for measurement and analysis of fluctuating asymmetry. One strength of this section (and of the book) is the end of chapter appendices (many found on a dedicated website), which allow the resolute reader to investigate the details of the analyses and conclusions offered by the contributors.

The last section covers the role of environmental stress and is extremely interesting. Although this research is fairly new, and there are few clear demonstrations that fluctuating asymmetry is affected by environmental stress, there are some indications that high fluctuating asymmetry may be an early sign that a population is under significant stress. Unfortunately, there are no chapters devoted to studies investigating the role of prenatal stress as a cause of developmental instability, or the role of fluctuating asymmetry in human mate choice.

It is easy to see why fluctuating asymmetry is so attractive to biologists; it is one of the few things researchers can measure in the same way for any species on earth. This book is a major accomplishment and a must-read for anyone interested in this field. It is tough going at times, but perseverance is rewarded. The field of developmental instability, despite being seen as new, has an honorable history, and appears to be truly *consilient*, to use E.O. Wilson's (1999) term. It draws on ideas and concepts from different fields of inquiry and necessitates different levels of analysis. Despite the controversies, the sometimes

nasty critiques, and the systematic inattention to the contributions of some researchers, I foresee great innovations coming out of this scientific revolution. In a chapter near the end of the book the Russian biologist V.M. Zakharov reminds everyone of some simple facts about the intellectual enterprise we call science: "The factors determining the power and potential of any approach include success in solving methodological problems and adequate views in the cause-and-effect relationships that determine parameters under consideration" (p. 412).

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Growth, Maturation, and Physical Activity, 2nd edition. By Robert M. Malina, Claude Bouchard, and Oded Bar-Or. xiv + 712 pp. Champaign, IL: Human Kinetics. 2004. $69.00 (cloth).

A popular truism among my students is that "you don't take courses, you take professors." The same general principle holds true for *Growth, Maturation, and Physical Activity*. What distinguishes this book is not so much that it is one of the most comprehensive textbooks on growth and development to date in the field of sport and exercise science—which it is—but rather that it delivers the insights, critiques, interpretations, and the research findings of three of the very most productive and important growth and development scientists in the last three decades: Drs. (and Professors) Robert Malina, Claude Bouchard, and Oded Bar-Or.

Within the text, these authors' significant contributions to the growth and development field are integrated with a battery of other important work, including the Fels Longitudinal Study, Bogalusa Heart Study, Amsterdam Growth and Health Study, and Saskatchewan Bone Mineral Accrual Study. Using the research literature, the text explores biological growth and maturation, physical activity, and physical performance from the prenatal period into young adulthood. Predominantly grounded in human biology, the text is inclusive in that it introduces, although does not fully discuss, socioecologic factors essential for understanding growth and maturation. The authors are obviously well versed and appreciative of the contributions of past scientists and, while not central to the book, they provide a respectable history of growth and development as a distinct field of study with its own culture and perspective.

Much of the work discussed in *Growth, Maturation, and Physical Activity* was done using longitudinal (cohort) and mixed-longitudinal study designs. This is a noteworthy strength of the book, since carefully conducted longitudinal studies, unlike other study designs, clarify the time-order of relationships and allow for the complexity of dynamic changes in the biology of the child and his or her environmental exposures. These are, of course, critical factors for fully and accurately examining patterns of growth and maturation in relationship to physical activity, performance, and the normal variability inherent in children. The authors' reliance on longitudinal work also allows for solid discussions on stability and tracking, areas seldom covered in comparable textbooks, yet important for thoroughly appreciating early influences during childhood and adolescence on later health and disease outcomes. Throughout the book, relationships among growth, maturation, and physical activity summarizing the rate of development, typical patterns, and normal changes in response to activity as well as to other factors are illustrated with well-constructed and clearly labeled figures and tables. This is another noteworthy strength of the text. And, unlike the first edition, which provided a general bibliography, the second edition includes a full reference list at the end of each chapter. This improvement makes it useful not only as an undergraduate or graduate textbook, but also as a reference tool for scientists in sport and exercise science and in several outside areas such as human biology, nutrition, and public health. Representation by international studies including work in developing nations makes this book of unequivocal value for researchers with a strong appreciation for the impact of the environment on health outcomes.

The 29 chapters and 728 pages of *Growth, Maturation, and Physical Activity* are divided

into six sections. The first section presents the reader with introductory concepts and a general overview of prenatal growth. Section Two addresses postnatal growth including bone, muscle, and adipose tissue. These chapters on bone, muscle, and adipose tissue provide the necessary groundwork in mechanisms and help readers more fully appreciate earlier chapters on stature, weight, and models for estimating body composition. With respect to body composition, a wide variety of measurement issues and methods are discussed, including the most recent technological advances. Readers will leave this section having a clear sense of the limitations, advantages, and feasibility of the various approaches now available.

Building on the foundations created in preceding chapters, Section Three, Functional Development, moves the reader from "parts" to the integration of parts for sport and movement performance, thus providing a framework to interpret the research literature on strength, aerobic, and anaerobic performance. I found this section to be particularly good at considering measurement issues, e.g., scaling, without being overly mathematical or theoretical. This section is also successful at making connections with earlier chapters addressing stature, weight, and body composition. Biological maturation with an emphasis on assessment strategies and interpretation is covered in Section Four. (At this point in the text, readers should not be confused with the difference between growth and maturation and the implications inherent in the difference.)

After setting the stage in Section Four, the authors move on to the factors that influence and interact to regulate maturation (Section Five) and consider these processes in the context of physical activity and performance. I particularly appreciated their discussion of genetic regulation of maturation and performance. In fact, I left that chapter feeling updated in an area that is new for me and fairly confident that I could now read more intelligently about genetic advances in pediatric exercise science. In addition, this section is notable for its expansion into what are traditionally considered to be public health areas such as the impact of undernutrition in developing countries and obesity in developed countries. In the final section, Applications, earlier concepts are reconsidered as they pertain to children with clinical conditions, chronic conditions, and those participating in elite sport. The section should be a valuable asset to practitioners because it provides clear "how-to" recommendations for implementing physical activity programs for children with a myriad of needs and talents.

In the end, *Growth, Maturation, and Physical Activity* delivers a comprehensive picture of how children develop and how various processes influence and are influenced by physical activity. The perspectives provided by the authors and the breadth of factors considered make this an important first book for students in the growth and development field and a standard reference tool for the rest of us.

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Reflections of Our Past. How Human History Is Revealed in Our Genes. By John H. Relethford. xi + 257 pp. Boulder, CO: Westview Press. 2003. $26.00 (cloth).

A palimpsest is a surface that has been repeatedly used and erased such that what remains is actually the combination of many different past events. This analogy is familiar to archaeologists as a cautionary tale illustrating that things are much more complex than they might appear, and that the past leaves an imprint on ensuing developments. The same, Relethford explains in *Reflections of Our Past*, can be said of a population gene pool, which retains elements of its origins, has erasures caused by genetic drift and selection, and is resurfaced by migration and mutation.

Relethford's book is an articulate and witty conversation about human genetics and what we can, and cannot, say about ourselves as biological entities. The book is instructive for those who are already familiar with the dynamics of anthropological genetics, as well as readers who are simply curious about human biological history. Specialists in the field will find that Relethford provides new and effective ways to explain basic concepts to their undergraduate students. General readers will learn about the big questions in human evolution and how genetic data can illuminate those issues. They will also come to

appreciate that our ancestral migrations and interactions leave their mark on the present generation. I wish I had had a book like this for my family to read when I was trying to explain just what it is that a biological anthropologist tries to do.

Reflections of Our Past is effective in describing the role of genetics in understanding human biological history because it has a beautifully simple, straightforward structure. The text moves from the general to the specific, but most of the later chapters can be read independently. Some very complex concepts and analyses are presented in ways that are accessible to general readers. The first section introduces basic ways of thinking about ancestral relationships, ranging from individuals and their immediate kin to lineages, populations, and species. Relethford then examines humans in relation to other taxa, highlighting the recent work on the origins of hominins. Subsequent chapters are devoted to human species diversity, the origin(s) of modern humans, and the contributions of those pesky Neandertals to modern populations. Relethford emphasizes the importance of combining nuclear, mitochondrial, and Y chromosome DNA evidence when investigating these critical questions. The second half of the book details the spread of agriculture across Europe, the evolutionary history of Irish, Polynesian, Native American, and Jewish populations, and the complex role of admixture in the formation of modern American cultural identities. There is something to whet everyone's curiosity.

The strengths of this highly recommended book, in addition to its entertaining and highly readable style, are its balanced discussions of some very contentious issues. Where did modern humans evolve? Mostly in Africa. Are Neandertals our ancestors? Still unresolved, but no reason to rule them out entirely at present. In arriving at these well-reasoned answers, Relethford presents the genetic-based arguments, points out their shortcomings or the limitations of the data, and then demonstrates how paleontological and historical information can add to our understanding of these age-old questions.

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Genetic and Cultural Evolution of Cooperation. Edited by Peter Hammerstein. xiv + 485 pp. Cambridge, MA: M.I.T. Press (in cooperation with Dahlem University Press). 2003. $45.00 (cloth).

The purpose of this book is to elucidate mechanisms and processes that promote the emergence of cooperation in systems ranging from molecules to societies. It is effectively the proceedings of the 90th Dahlem Workshop, held in Berlin in 2002, and attended by 40 researchers whose disciplines range from genetics and cell biology to evolutionary anthropology and behavioral economics.

The goal of all such Dahlem workshops is to promote an interdisciplinary exchange of ideas and cooperation among international scientists, and so their published reports aim to differ from other conference proceedings in several ways, but especially by emphasizing open questions and existing controversies in a field. This book is unquestionably faithful to its sponsors' goal. It is divided into four parts, each consisting of several essays by different participants on a problem-oriented workshop theme, followed by a group report to which every essayist has contributed. The group reports (Chapters 7, 13, 18, and 23) consolidate directions for future research identified at the workshop.

Part I treats the role in cooperation of cognitive and emotional mechanisms. Daniel Fessler and Kevin Haley (Chap. 2) argue that emotions are the keys to humans' complexity, efficacy, and remarkable ability to cooperate; Joan Silk (Chap. 3) describes how friendship fails to accommodate the logic of reciprocity; Ernst Fehr and Joseph Henrich (Chap. 4) discuss how existing theories of cooperation fail to explain "strong reciprocity" (defined to arise when one is willing to incur long-term net costs from helping in response to kindness) satisfactorily; Peter Hammerstein (Chap. 5) asks why reciprocity is so rare in social animals; and Edward Hagen (Chap. 6) argues that depression, far from being a mental illness, may be an adaptive emotional strategy. The group report, whose rapporteur is Richard McElreath, acknowledges that the workshop has not even come close to exhausting all possible mechanisms for cooperation, and concludes by suggesting that "ingenious theoreticians will no doubt see many promising modeling possibilities that we have missed" (p. 149).

In Part II, on markets and exploitation in mutualism and symbiosis, the emphasis switches from humans to other organisms, and from intraspecific to interspecific cooperation. Samuel Bowles and Hammerstein (Chap. 8) discuss market theory in relation to biology; Redouan Bshary and Ronald Nöe (Chap. 9) and Judith Bronstein (Chap. 10) highlight the importance of model systems; Olof Leimar and Richard Connor (Chap. 11) discuss "pseudoreciprocity"; and Carl Bergstrom and Michael Lachmann (Chap. 12) argue that slowly evolving species are likely to gain a disproportionate fraction of a surplus generated through mutualism.

The focus switches all the way from interspecific to intercellular in Part III. Rolf Hoekstra (Chap. 14) discusses mechanisms that prevent or promote genomic parasitism; Eörs Szathmáry and Lewis Wolpert (Chap. 15) discuss the transition from single cells to multicellular organisms; conflict mediation during the transition is Richard Michod's topic (Chap. 16); and Neil Blackstone and Thomas Kirkwood (Chap. 17) discuss the capacity of programmed death to restrain the selfish replicatory potential of individual cells in multicellular groups.

Part IV, on cooperation in human societies, picks up where Part I left off. Peter Richerson, Robert Boyd, and Henrich (Chap. 19) propose that group selection on cultural variation is at the heart of human cooperation; Peyton Young (Chap. 20) describes how social norms can coalesce from the decentralized, uncoordinated choices of many interacting individuals; Eric Smith (Chap. 21) stresses the importance of language's role in human cooperation; and Bowles and Herbert Gintis (Chap. 22) discuss a special mechanism for human cooperation that stresses the role of gene-culture coevolution in group dynamics.

This book identifies numerous gaps in both empirical and theoretical knowledge of cooperation in a wide variety of organisms, but with a special emphasis on cooperation among humans and on psychological factors that need to be absorbed into future models. Taken together, the book's 23 chapters (or, for readers in a hurry, even the four group reports) paint an honest and illuminating picture of how much, or rather how little, we understand today about the evolution of cooperation. For anyone who is working in this field or even who is contemplating entry, this timely monograph will prove essential reading—not only as a state-of-the-art overview, but also as an informed agenda for future research.

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The Biology of Death: Origins of Mortality. By André Klarsfeld and Frédéric Revah. Translated from the French by Lydia Brady. 211 pp. Ithaca, NY: Cornell University Press. 2004. $29.95 (cloth).

Klarsfeld and Revah have written what could be called a popular book about an unpopular topic—death. *Biologie de la Mort*—the title of the French language edition (Odile Jacob, janvier 2000) addresses the biological processes of mortality. The authors provide an intriguing subtitle: *Origins of Mortality*—a title that echoes some famous others; for example, Charles Darwin's *On The Origin of Species* (Murray, 1859) and Stuart Kauffman's *Origins of Order* (Oxford, 1992). The plural noun in *Origins of Mortality* is significant. There is no single program for my death, and there is no single "death gene" in the human genome; although there are rare genetic senescent phenotypes such as Werner syndrome (a segmental progeroid syndrome) and autosomal dominant Alzheimer's disease (a unimodal progeroid syndrome) (Martin, 2001).

The process of my mortality will be complex, and in its causes, both proximate (mechanistic and stochastic) and distal (biological and evolutionary), I am likely to experience the arbitrary and the absurd. The authors resolutely reject both utility and virtue in my pending death and they will not use the corresponding biological data that describe the process to create a moral vision for human death. They leave that to our religions and other human enterprises. Klarsfeld and Revah do honor the practices of palliative terminal care and the right to die with dignity, and they do recognize that death has its place as an essential event in our life-view. Since most industrialized societies have transformed themselves into a steadily aging demographic, it is an important context for Klarsfeld and Revah.

Accordingly, they set out to describe natural death and to make us aware that we are linked to the process of natural selection.

Unicellular organisms are perishable and one tends not to call their demise a death. On the other hand, multicellular organisms experience death at two levels: cellular and the whole organism. The multicellular organism experiences differentiation during development, where programmed cell death (or apoptosis) is part of development. While apoptosis is part of becoming and being, cellular death could not have been known until Schleiden and Schwann (in 1839) showed the cell to be the basic unit of living organisms. August Weismann (Poulton et al., 1993) would later surmise that normal cells have a limited capacity to multiply, a phenomenon eventually ensconced in the Hayflick number of doublings, related to the shortening of chromosome telomeres. Weismann would also recognize that germline cells and somatic cells have different life histories and that bodies need not be immortal.

What will happen to the species if its members must die? Fortunately, it turns out that mortality of my soma is simply an accessory because the DNA molecules in my germ cells are immortal when they are transmitted to the next generation. Weismann (1889) was the first to propose the idea of the immortal germline. A century later, Kirkwood and Halliday (1979) used the term "disposable soma" to limn the process. Meantime, Weissman's hypothesis has lived and flourished in writings on aging and death by Medawar (1952), Williams (1957), Hamilton (1996), Finch (1990), Austad (1997), and Martin (2001), among others.

The DNA molecule is an "eternal molecule" when transmitted through the germline (Campbell and Dennis, 2003). It is the materialistic form of biological immortality. When bodies are recognized as vehicles for passing on DNA to the next generation, it is (perhaps) easier to accept Hamilton's jolly message "live now, pay later" (1996). After reproduction, bodies are more or less redundant. Klarsfeld and Revah describe in detail the processes by which the soma is jettisoned. They elucidate the "origins of mortality." They describe *how* we age and die.

The disposable soma has three distal origins in evolution. First, in the separation of germline and somatic genomes; second, in the declining force of natural selection on the somatic genome with age; third, when the intrinsic properties of the organism interact with the declining force of natural selection (which can only act on the germline DNA) to yield age-specific effects, and a resultant decline in the capacity for reproduction (notably in the female) and survival. Joseph Campbell (1991) suggested that our constant search for meaning of life (and the avoidance of death) intrudes on our ability to share in the rapture of living. Nonetheless, it may be difficult to experience that rapture when the aging process introduces unpleasant states of unhealth at the end of our lifespan.

The processes undermining life as we age are pervasive. They include, for example, the telomeric shortening that limits capacity for cellular renewal, and the accumulation of mutations in the somatic genome that lead to cancers. There are systems for repair of somatic damage but they come at a price, and a significant portion of an organism's energy budget is invested in repair (Stearns, 1992). The investment is in three areas: to cope with oxidative stress, to provide quality control of protein synthesis and turnover, and to moderate telomeric shortening. In keeping with the understanding that death is a common complex trait (Scriver, 2002), and is actually a process of systems failure, it should be no surprise that disruptions of the DNA repair apparatus may also occur; or that mutation in one of the many classes of genes involved in maintenance against and repair of oxidative damage will forestall repair; or that disadaptive posttranslational modifications of proteins may interfere with function; or that the process of telomeric shortening itself may march to its own drum, whose pace is set by the host's genome.

Accordingly, *Homo modificans* will seek better health during aging; that is one project on the way to death, and an ever-growing "academy of gerontology" will search for opportunities whereby healthier longevity can be achieved. Prolonging human lifespan for its own sake is a different project.

Klarsfeld and Revah highlight an important thought posed by George Sacher (and used as the epigraph to Chapter 3): "The question is not so much why we [humans] die as why we live as long as we do" (p. 41). Most animals reproduce until they die but female humans can survive long after their reproduction ceases, and the plenitude of human grandparents is somewhat of an

enigma. Life-history theory (Stearns, 1992) predicts that there should be no selection for living beyond one's reproductive capacity. To the contrary, the "grandmother hypothesis" (Hawkes, 2003, 2004) predicts that natural selection will favor prolonged post-reproductive lifespan when it serves individuals to increase their fitness through assistance to their own offspring, who then reproduce successfully. A new study, appearing after Klarsfeld and Revah completed their book, addresses the grandmother hypothesis. Lahdenperä et al. (2004:178) show that grandmothers "enhance the lifetime reproductive success of their offspring by allowing them to breed earlier, more frequently and more successfully." The grandmother effect requires physical proximity between the generations and it becomes manifest only after the grandchild has been weaned. Old age, notably of women, emerges as a biological attribute acquired under natural selection, not simply as a by-product of better living conditions. Something one may be able to celebrate at the funeral.

The Biology of Death omits two significant and painful themes: the death of a young person from whatever cause, and death by suicide. While the age-specific incidence of unnatural death among infants and children, due to infections and accidents, for example, has declined dramatically over the past century in industrialized societies, deaths still occur in this age group and the event is no less painful. In these same societies, deaths by suicide and murder, both mysterious phenomena, have gained ever-higher profiles of concern.

A fundamental human question permeates the discussion by Klarsfeld and Revah: Why do we fear mortality? The authors focus on the science which describes and explains the processes of aging preceding death. Science is an assault on ignorance (Ridley, 1991) and in new knowledge, wisdom can follow. This book, written (and beautifully translated) in an open style, will facilitate public discussion and awareness. It has the potential to reduce ignorance, to bring wisdom, and to reduce fear. The epigraph to Chapter 1 is significant: "The fact that death is often feared like a monster we dare not look at square on is undoubtedly one of the reasons for the ignorance of science in this area" (Elie Metchnikoff, p. 4). To learn that programmed cell death is part of our becoming, and that death of the soma is a random universal and interpretable phenomenon, may help to dispel the fear. In their carefully detailed approach and reflections, Klarsfeld and Revah have served us bravely and well.

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DOI: 10.1002/ajhb.20054