plementary readings that provide overviews of competing viewpoints may be helpful. Fortunately, the author provides suggestions for further reading at the end of each chapter, including descriptions of how each reading would supplement the information presented in that chapter.

All things considered, this is a fantastic volume for advanced scholars interested in a complete overview of the field of canine science, but may require supplemental reading for more novice students. The book provides a positive contribution to this growing field, and we have no doubt that when Miklósi pens the third edition, some of his thoughtfully proposed questions will have been answered.

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NEUROBIOLOGY

SINGLE NEURON STUDIES OF THE HUMAN BRAIN: PROBING COGNITION.

Edited by Itzhak Fried, Ueli Rutishauser, Moran Cerf, and Gabriel Kreiman. Cambridge (Massachusetts): MIT Press. $60.00. viii + 365 p. + 17 pl.; ill.; index. ISBN: 978-0-262-02720-5. 2014.

MOLECULAR AND CELLULAR PHYSIOLOGY OF NEURONS. *Second Edition.*

By Gordon L. Fain; with Thomas J. O'Dell; illustrated by Margery J. Fain. Cambridge (Massachusetts): Harvard University Press. $79.95. xiii + 735 p. + 16 pl.; ill.; index. ISBN: 978-0-674-59921-5. 2014.

ANATOMY AND PHYSIOLOGY

THE VERTEBRATE INTEGUMENT. *Volume 1: Origin and Evolution.*

By Theagarten Lingham-Soliar. Heidelberg (Germany) and New York: Springer. $189.00. xiii + 268 p.; ill.; index. ISBN: 978-3-642-53747-9 (hc); 978-3-642-53748-6 (eb). 2014.

THE VERTEBRATE INTEGUMENT. *Volume 2: Structure, Design and Function.*

By Theagarten Lingham-Soliar. Heidelberg (Germany) and New York: Springer. $179.00. xiii + 348 p.; ill.; index. ISBN: 978-3-662-46004-7 (hc); 978-3-662-46005-4 (eb). 2015.

These two excellent textbooks demonstrate that functional and morphological innovations and complexities (including evolutionary convergence) are vital considerations for reliable reconstructions of evolution. The author's own research covers neontology (sharks and birds), paleontology (ichthyosaurs and dinosaurs), and vertebrate taphonomy. Reading both volumes is essential to appreciating his perspective on structure and function, especially as it applies to currently controversial subjects. The books are well illustrated with photographs, diagrams, and drawings and should help undergraduate biology majors, graduate students, and researchers understand both this underappreciated subject matter and the dynamics of how science progresses.

In Volume 1, Lingham-Soliar begins 450 million years ago (MYA) with the jawless ostracoderms. Did ostracoderms evolve in fresh or salt water, and did bone evolve as protection against predators, or was it an adaptation for the storage of phosphate? The next major step was the evolution of jaws, in placoderms, from the anterior gill arches. With jaws and more active feeding came the innovations that led to modern fishes—paired fins, lightweight dermal scales, sophisticated locomotion, and elegant mechano- and electroreceptors. Conquest of land may have begun about 390 MYA with the fish-like *Tiktaalik* and forelimbs each with four main axial elements—the humerus, ulna, ulnare, and manual digit IV. Surprisingly, the date of the fish-tetrapod transition has now been unsettled by quadrupedal trackways found in Poland that are 18 million years older; workers must now reappraise which group of fishes led to present-day tetrapods.

Two innovations that came with early reptiles were the amniotic egg and an outer protective layer, the epidermis, which gave rise to scales, composed mostly of an entirely new material, beta-keratin, the toughest natural elastomeric material known.

Scales, teeth, feathers, and hair are very different structures, but their developmental molecular pathways are related. Lingham-Soliar's research is at the microscopic and macroscopic levels, not the molecular level. Striking convergences are apparent in both fields.

In the chapter that includes the dinosaur integument, the author avoids such polarized questions as the origin of birds, but he summarizes his extensive studies of feathers in birds and the structures being called "protofeathers" in dinosaurs. In the most famous example, *Sinosauropteryx*, a coelurosaurian theropod, he demonstrates that the purported protofeathers resemble collagen fibers. His conclusion, based on several lines of evidence, is that, contra the current consensus, the "protofeathers" in *Sinosauropteryx* and numerous other taxa, whether collagenous or keratinous, are unlikely to be homologous with modern feathers in birds and that use of the term itself is an empty assertion.

The discovery that the microstructure of soft tissue can be preserved in mineralized fossils is among the most exciting in recent paleontology. An excellent example is collagen, the most common structural protein in animals. Lingham-Soliar's research has revealed remarkable convergences in the skins of various fishes, reptiles, and mammals, where both stiffness and resilience are achieved by means of special cross-fibered layers of collagen fibers. Such structures are especially well developed in high-speed swimmers such as thunniform sharks, tuna, and cetaceans and, on land, in an ornithopod dinosaur, *Psittacosaurus*. For reports of melanosomes in fossils as evidence of color, the author agrees with those who say that microstructures can only be definitively diagnosed when morphological evidence from scanning electron microscopy is combined with sound geochemical evidence involving sophisticated methods such as synchrotron rapid scanning and X-ray fluorescence, but they must be underscored by objectivity. Volume 1 concludes with chapters on the ancestry of mammals and the three groups of reptiles that remarkably returned to the sea.

Volume 2 begins with some fundamental principles of physics, including applications of Newton's three laws of motion to studies of vertebrate movement in fluids. Lingham-Soliar addresses the biomechanics of swimming in marine vertebrates and of aerial flight, first in vertebrate gliders and then in powered fliers (i.e., bats, pterosaurs, and birds). He argues that the preponderance of evidence indicates that the classic urvogel *Archaeopteryx* was probably capable of incipient flapping flight. We know that fully modern-type pennaceous feathers occurred in at least three groups of maniraptoran theropod dinosaurs (Dromaeosauridae, Troodontidae, and Oviraptorosauria). Some researchers, including myself, think these taxa probably had flying ancestors and were more advanced toward modern birds than was *Archaeopteryx*.

For me, the highlight of this volume is the description of a new microstructural fiber model of a modern feather rachis and barbs (see Figure 5.69). The cortex is made of "dog-bone" shaped syncytial barbules surrounding a foam-filled medullary pith, whereas the epicortex shows for the first time a crossed-fibered architecture, not only for the feather but for keratin per se. This model, the first to explain a crack-stopping mechanism in the feather, also underscores the evolutionary convergence of biomaterials for similar functions.

Lingham-Soliar's frustration with some of the recent literature on feathers in dinosaurs, including concerns regarding a fair peer-review system, is understandable. I agree that, regrettably, elements of prejudice have been interfering with the way healthy debates in science are supposed to work. These books are important contributions to the dialogue about the integument, a topic that seems to be on the cusp of major new discoveries.

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The Physiological Measurement Handbook. *Series in Medical Physics and Biomedical Engineering.*

Edited by John G. Webster. Boca Raton (Florida): CRC Press (Taylor & Francis Group). $134.96. xv + 600 p.; ill.; index. ISBN: 978-1-4398-0847-4. 2015.

Hypsodonty in Mammals: Evolution, Geomorphology, and the Role of Earth Surface Processes.

By Richard H. Madden. Cambridge and New York: Cambridge University Press. $130.00. xx + 423 p.; ill.; index. ISBN: 978-1-107-01293-6. 2015.

Mammals need their teeth—a lot. Our high metabolism is made possible by a system of precise occlusion between upper and lower molars that, in herbivorous taxa, enables us to grind down food into fine particles for more efficient digestion. Thus, unlike many vertebrates, mammals do not continuously make, lose, and replace teeth. Rather, most mammals have a small set of "baby" teeth, followed by a single set of adult or "permanent" teeth that must serve them throughout their adult life. When individuals lose their permanent teeth, through either damage or wear, they usually die.

Many mammalian taxa in different orders, usually grazers, have dealt with the inevitable problem of tooth wear by evolving chewing teeth (molars and premolars) with very high crowns (hypsodonty), thus prolonging the life of the teeth. Some