Book Review: Bones, Inside and Out


In *Bones, Inside and Out* (2020), author Roy A. Meals covers a diverse smattering of osteological knowledge pulled from orthopedics, history, anthropology, biology, and paleontology. Utilizing vivid metaphors to aid comprehension, Meals presents complex concepts in simplified ways that are accessible to a non-academic audience and maintains a convivial writing style throughout. In his introduction, Dr. Meals asserts that “By the end of the book, you’ll be convinced that it [bone] is the world’s best building material” (p. x). After reading this book, a person who was previously only peripherally familiar with bones would likely not only agree with that statement, but also understand how bones grow and repair themselves, medical issues and treatments relating to bone, how orthopedics and imaging has evolved through time, what bones can tell us about the past, and about their cultural, utilitarian, and economic significance through time. Due to the multidisciplinary nature of this book, even professionals who deal with bone on a regular basis are sure to learn something new. Additionally, Meals intersperses fascinating examples, humor, and personal anecdotes from his career as an orthopedic surgeon throughout, making the 259 pages of this book (not counting the bibliography and index) fly by for readers of all types.

This book is broken down into two parts. In the first half, *Bone Concealed*, Meals begins by discussing the unique structural properties of bone. He presents complex biochemical and biomechanical explanations of collagen and hydroxyapatite, osteoblasts and osteoclasts, and loading forces using easy to understand metaphors. Afterwards, he applies these concepts to typical bone growth and maintenance as well as popular

examples where disruptions have occurred such as scurvy, astronauts’ loss of bone density, skull shaping, and many others. He also discusses other associated tissues (e.g., cartilage, teeth, ivory, hooves, claws, fingernails, baleen), variations across skeletal Bauplans, and how bones compare to exoskeletons made of shell or chitin.

After discussing the composition of bone, Meals moves on to talking about how bones can become fractured, how they repair themselves, and interventions such as ultrasound waves and bone grafts that may be implemented to aid healing. Beyond traumatic injuries, Meals briefly covers congenital, infectious, neoplastic, degenerative, vascular, and metabolic/immune conditions that can impact bone as well as modern treatment options for each. Nestled within this section is a candid discussion of what motivates individuals to pursue orthopedics and the training medical students must endure as they progress from “unconsciously incompetent” to “consciously incompetent” to “unconsciously competent” (p.79). Although he is referencing medical school specifically, this discussion resonates with many pursuing higher education in general.

Meals also describes the historic progression it took to reach our modern standards beginning as far back as ancient Egypt around 2900 BCE. In particular, he highlights individuals from around the globe who made monumental contributions to the field of orthopedics by developing novel treatment techniques, such as Hugh Owen Thomas, Robert Jones, John Charnley, Gavriil Ilizarov, Masaki Watanabe, and Paul Harrington, or breakthroughs in research, such as Marshall Urist and Jacquelin Perry. Furthermore, Meals recounts how the depiction and viewing of bones has changed over time, from early anatomy drawings sketched during dissections to modern imaging techniques like radiographs, CT scans, MRI, ultrasound, and microscopy; he discusses both the social circumstances surrounding these changes as well as provides prefatory explanations for how each type of imaging works. Meals ends this section of the book with some predictions for developments to come, prognosticating further advances in osteoporosis treatment, gene therapy, tissue transplantation, artificial intelligence, minimally invasive surgery, improved orthopedic implants, limb regeneration, and possibly measures to counter bone loss of astronauts in space.

In the second part of this book, Bone Revealed, Meals addresses what happens to bone when it is no longer part of a living organism. The author starts by discussing how bone can become fossilized or otherwise preserved and later discovered. He explains what information paleoanthropologists or paleontologists can gleam from fragmentary, fossilized remains, as well as instances where hoaxes (e.g., Charles Dawson’s ‘Piltdown Man’) or feuds (e.g., Cope versus Marsh) have interfered with the gaining of new knowledge. He also explains how the mortuary practices of past humans, or artifacts crafted from bone (human or animal), can inform scientists about culture and abstract thought. Meals provides myriad descriptions of these practices and artifacts, relates them to booming historical industries, such as the mass collection of bison bones for fertilizer or hair pipes, and discusses the social and economic implications of these events.

One field that was not mentioned in the second half was forensic anthropology, which could have greatly enhanced this section. This field is topical and combines many aspects of postmortem skeletal examination that Meals touches upon in the first section of the book, such as how features of an individual’s biological profile (e.g., age) can be determined from their skeleton, or how we can distinguish types and patterns of trauma. It would also be interesting for readers to learn about how medical devices, like the

orthopedic implants Meals discusses, can have forensic significance. This being said, I do admit I am a bit biased as someone who studies forensic anthropology.

This book is primarily textual, but does also include a fair number of photographs, radiographs or scans, and illustrations to complement his explanations, especially of particular traumas, pathologies, and orthopedic interventions. In one part of the book where he describes a rotationplasty, Meals tells his readers to enter “Van Nes rotationplasty” into Youtube for video clips to clarify the process further. If you would prefer to listen to the text without any graphics this book is also available in audiobook format, narrated compellingly by L.J. Ganser. For those unaccustomed with osteology though, I would recommend reading the physical version because the graphics certainly aid in understanding particular features and procedures that non-osteologists may not be familiar with. The pictures of bone artifacts in part two are also much more impressive than their written descriptions alone.

Overall, this book is an interesting and informative for members of the general public and “bone wizards” (p. 17) alike, and definitely worth a read.