Book Reviews

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The first three books reviewed here share something: they were originally intended, or could be used in conjunction with, science courses for non-science majors. There are several important realities of these courses in the USA. Sometimes, non-science majors courses attract less-than-motivated students eager to get those required courses "out of the way". Also, the pervasive influence of creationism makes anything older than 6000-7000 years questionable unless the Bible says otherwise as "nobody was there". Somehow, many people seem to live in peace holding obviously conflicting beliefs in fundamental issues. The first two books, *The Tangled Bank* and *The Story of the Human Body* are examples of books with a strong evolutionary component. In all cases, the authors commented on my reviews. To all of them my wholehearted thanks.

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The Tangled Bank: An Introduction to Evolution (Second Edition)

by Carl Zimmer. 2013. Roberts and Company Publishers. Greenwood Village, Colorado, USA. 452 pp. ISBN-978-1-9362214-4-8 (softbound, in English)

"It is interesting to contemplate a tangled bank … and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us. These laws, taken in the largest sense, being Growth with reproduction; Inheritance which is almost implied by reproduction; Variability from the indirect and direct action of the conditions of life, and from use and disuse; a Ratio of Increase so high as to lead to a Struggle for Life, and as a consequence to Natural Selection, entailing Divergence of Character and the Extinction of less improved forms." From *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* by Charles Darwin (1859) http://www.age-of-the-sage.org/charles_darwins/quotes/tangled_bank.html

About a year ago, I placed a request in two major biological listerservers for textbook titles of possible use in a non-science majors college course on form and function of organisms. For my first iteration of the course, I used selected chapters on evolution followed by chapters on biodiversity, both from an introductory biology text for majors. As I wanted a better learning experience for the non-science majors, I resumed my search for scholarly resources written

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in a straightforward language conducive to long-life learning. This Spring 2014 semester, I have the same opportunity and have decided to embroider the previously selected resources within the most important theory in biology - evolution, or descent with hereditary modifications - using the second edition of Carl Zimmer's, *The Tangled Bank*.

Although there are many pro- and antievolution books, many intended for non-scientists, *The Tangled Bank* has several additional pluses. It has 15 relatively brief chapters, conveniently approximating the duration, in weeks, of a semester's course in many colleges and universities in the USA. Also, the book introduces topics to non-science majors using beautifully illustrated narratives that contain abundant end of chapter references. In this review, I provide some highlights of the book, chapter by chapter, hoping that this piece will serve as an *hors d'oeuvre* to reading the book.

In Chapter 1, Zimmer uses the one-to-one similarities between whales and dolphins (Figures 1.2, 1.7), or hypothesized homologies, the relationship between their evolution and development, sometimes called "evo-devo" (Figure 1.8), their biodiversity through time (Figure 1.10) to make his case for evolution. Homologies are based on relative position and, beyond the molecular level, also on special qualities, and/or the presence of intermediate states. Grave concerns about modern marine mammals (Figures 1.11 and 1.12) conclude this chapter.

Chapter 2 introduces readers to the history of evolutionary thought. Zimmer points out two major endeavors of science: to discern patterns and to uncover the potentially responsible processes. Like many of the more comprehensive and computer-assisted efforts of today, Linnaeus tried to find patterns, organizing the living things known to him in the mid-18th century into progressively larger groups (Figure 2.3). However, discovering the phenomena behind those patterns required a true revolution in the way we think: to look for natural causes and to allow for much larger amounts of time for those processes to occur. This revolution culminated in Darwin's mid-19th century key insight: evolution (Figure 2.13), mainly through natural selection, has produced our magnificent biodiversity. In order for a trait to be selected, it must vary, that variation has to have a genetic component, and the selected variant must confer some reproductive advantage to the organism possessing to become more common in the lineage. A valuable final section on misconceptions about evolution (Figure 2.18) reminded me of the famous 2005 case, Kitzmiller *versus* Dover Area School District, recreated in the NOVA video, *Intelligent Design on Trial*.

Chapter 3 lucidly explains how modern evolutionary theory depends on a robust combination of different lines of evidence. These force us to reconsider what counts an observation. When we realize that to observe is more than simply seeing something with our eyeballs, we open ourselves to the possibility of reconstructing life on Earth. For instance, the use of different unstable radioactive isotopes, or weight variants of different elements, permits scientists to convergently and quite accurately date fossils (Figure 1, p. 51). In some other instances, chemically stable molecules are almost certainly fingerprints, or biomarkers, of their manufacturers or of chemical processes (Figures 3.7-3.8). These and other tools have allowed scientists to reconstruct the possible evolution and some biological features of life eons old (Figures 3.9, 3.18-3.19).

I found Chapter 4 to be one of the most interesting in *The Tangled Bank*. Here, Zimmer discusses how scientists build genealogical trees, also known as phylogenies (Figures 4.3-4.4). Just like in a human genealogy, individuals are connected to others, forming progressively larger groups, ultimately based on homologous traits that uniquely define each group (Figures 4.5-4.6, p. 87). In another case alluded to in *Intelligent Design on Trial*, *Tiktaalik*, a late-Devonian (375 million years ago, mya or Ma) fossil, fits nicely in between the lobe-finned "fishes" and animals with four legs, or tetrapods, (Figures 4.9-4.12, 7.6; see also evolution of ear bones of animals known as synapsids, Figures 4.13-4.14). Evidence is also presented to support the assertion that, while dinosaurs are no longer with us, we share Earth with their descendants, the birds (Figures 4.15-4.17). Human evolution is briefly introduced (Figures 4.18-4.23) and it is further expanded in Chapters 14 and 15.

Traits that define groups are only meaningful for evolution if they are passed to the next generation. That is the subject of Chapter 5, which uses height to illustrate the phenomenon of variation. The central dogma of genetics uses the metaphor of languages to compare the flow of hereditary information. In most living things, the genetic information is encoded in the DNA molecule (Figure 5.3). Often (but not always, see Figure 5.7), that information is transcribed into the language of a similar molecule, known as RNA (Figure 5.4), and eventually translated into a different language, that of different molecules, proteins (Figures 5.5-5.6), which perform many vital functions in our bodies. If this machinery for the transmission of hereditary information works so faithfully in reproducing our DNA, our cells, and ourselves, how is variation formed at the genetic level? The answer is through hereditary accidental changes, called mutations (Figures 5.8-5.9). These variants in the genetic instructions, together with the environment, as well as the interactions of genes and the environment produce the raw material for the variation in all characteristics, such as height (Figures 5.13-5.17).

The forces of evolution at the population level include genetic drift, migration, mutation, assortative or non-random mating, and selection. Some mutations - the producers of the new raw variants for evolution - can be harmful, others can be beneficial, and many have no impact, or are neutral, on the survival of organisms. Chapter 6 explains what happens in what direction, if any, evolution goes and how fast with those new hereditary ingredients or mutations. In an ideal biological world of population genetics, every species have huge populations, there are no mutations, organisms do not migrate, individuals mate randomly, and no genetic variant offers an advantage over another. This would lead to no hereditary changes and no evolution. However, in the real world, all of those ideal conditions are violated. Some variants become slightly more abundant than expected because they confer advantage to the individual possessing them (Figures 6.3, 6.9-6.21, 6.29-6.30). Some of those beneficial mutations include the increased likelihood of survival if a human has one copy of the sickle cell anemia gene in regions of Africa where malaria is abundant (heterozygous advantage, Figure 15.9). In some cases, the molecular mechanism for the increased fitness, including coat color, ability to digest foods, and resistance to insecticides, has been documented (Figures 6.22-6.28). In other cases, populations are so small that, by chance, or drift, some variants become more abundant (Figures 6.4-6.6).

Molecular evolution is further elaborated in Chapter 7 (Figures 7.2-7.4) where Zimmer revisits the evolutionary cases of tetrapods (Figure 7.5, Chapter 4), human (Figure 7.7, Chapters 4, 14-15), Galápagos Islands “finches” (actually they are in the tanager family), and HIV (Figure 7.9, c.f. Chapter 15). Although the pursuit of the footprints of natural selection has dominated evolutionary discussions (Figure 7.12), many neutral mutations could have become fixed at a clockwise rate (Figures 7.10-7.11) by genetic drift.

One of the most daunting evolutionary puzzles – and a favorite of creationists - is the evolution of complex characteristics and adaptation. How can the early stages of a complex trait, such as venomosity, be of any use in a less than fully developed stage? Furthermore, what are the genetic bases for those developments? This subject is addressed on Chapters 8 and 12. The newly-developed gene is formed through mutations, including gene duplications, often acquiring novel functions. This assertion is supported through examples of venom on snakes and their allies (ca. 200 Ma to the present, Figures 8.2-8.7), the basic body plan to animals, as if they were Lego or Tinker Toy pieces (circa 570 Ma to the present, Figures 8.8-8.9), and the evolution of opsins and G-protein-coupled proteins (approximately 1Ba, Figures 8.12-8.15). Another mechanism for the development of innovations is the activation of a gene at two or more different spatiotemporal points, as in the case of fish fins vs. tetrapod limbs some 430 Ma (Figure 8.10). These adaptations are constrained by the laws of physics and, just like a path, by the evolutionary footsteps that have been taken before (Figures 8.16-8.17), sometimes yielding remarkable similarities, or convergences, in different lineages, (Figure 8.18).

Chapter 9 discusses sex with an evolutionary twist. These ideas go under the rubric of sexual selection leading to different forms of non-random mating, a powerful evolutionary force. Why, amidst a world in which many species multiply astronomically asexually (Figure 9.2), and without the hassles of finding a mate, so many species reproduce sexually? There has to be some sort of evolutionary advantage for sex, such as the spreading of beneficial mutations (Figures 9.3-4) or surviving parasites (Figures 9.5-9.6). In evolutionary theory, the differences in the investment of the sexes (i.e. males’ generally smaller and numerous sperm cells as compared with the generally larger and scarcer female gametes) seem to drive the widely diverging reproductive strategies of the sexes familiar to us. Males tend to sire as many offspring as possible; females tend to be choosier in mating, as only they have the hard work of motherhood (Figures 9.7-9.9, but note exceptions in jacana bird and sea horses fish, Figures 9.21-9.22). Before females exercise their choices, they collect information on males' attractiveness and – ideally – true quality, as reflected in their fascinatingly diverse courtship displays (Figures 9.10-9.13). Sometimes, females "upgrade" their odds of passing their genes by having a steady social partner and several sexual partners (Figure 9.14). Strongly promiscuous species tend to have strategies to secure that their genetic investment is passed to the next generation, such as scoops to remove other males' sperm, bigger testicles for greater sperm production, and larger penises. Females reply in kind (Figures 9.15-9.17) spreading their genes and making it harder for males to spread theirs. In addition to biological constraints, species can adjust their overall reproductive strategy (e.g. many, low quality vs. fewer, higher quality progeny), depending on the likelihood of survival of the newborns (Figures 9.18-9.25). Abortion, cannibalism and menopause, may acquire a new interpretation when seen from an evolutionary perspective.

If any of us were dropped in the modern African savannah, what tall mammal would we likely first recognize? As Chapter 10 suggests, many of us would answer, "giraffe", as if it were a single species but recent studies suggest there are six species of this iconic animal with us today(Figure 10.1)! How could all of this wondrous biodiversity have developed? Although there is no universal species concept, at least for modern organisms that we can study, when gene flow between populations ceases, they become isolated, via a number of possible mechanisms (e.g. temporal, visual), we can think of them as different species (Figures 10.2-10.5). When the reproductive isolation mechanisms are laid over the geographical landscape, those mechanisms arise when populations are apart (Figures 10.6-10.9). This way of making new species is known as allopatric (meaning different homelands) speciation. In contrast, there are species where no such obvious geographical barrier appears to be necessary for speciation to occur. Instead, the genetic variation appears to be present and, when the environmental opportunity is available, as in the case of different host plants for *Rhagoletis* flies, some of the organisms do better in the novel environment (Figure 10.10). Although in *Drosophila* flies reproductive isolation may take "hundreds of thousands of years" (Figure 10.11), in flowering plants, accidents in the making of sex cells, or gametes, speciation may take just a few generations (Figures 10.12-10.13). Formerly cryptic species, like giraffes (Figure 10.14) or some Central American skippers (Lepidoptera, Figure 10.15), are being detected with the awesome power of sequencing technologies and bioinformatics. Defining more precisely what is a species for organisms that reproduce asexually or for those that reproduce through different sexual means, such as horizontal gene transfer, is more challenging (Figures 10.16-10.17).

What are some aspects of the big picture of biodiversity through time? Chapter 11explains that there are many causes for extinctions, including death of individuals directly or through habitats loss (Figure 11.2). The number of genera of fossil marine invertebrates has had ups and downs through time but their numbers have doubled in the last 500 Ma (Figure 11.4). Large increases have happened for insects (Figure 11.5). By using arachnids, known as mite harvestmen, which do not move much through their lives, as representatives or vicars, of landmasses, scientists can trace the movements of their homeland continents. This idea is known as vicariance biogeography. Sometimes, even with more mobile organisms, such as marsupials, scientists can estimate their likely movements through time, based on fossil evidence and molecular information (Figure 11.7). How fast is evolution? Although nobody knows how fast the dominant mode is, one possibility is that evolutionary change occurs rapidly over relatively short spans of time (Figures 11.8-11.9; cases of rapid diversification, or adaptive radiation of closely related species, Figures 11.11-11.12; Cambrian "Explosion", Figures 11.13-11.15) followed by long periods of stasis. This idea is known as punctuated equilibrium. Concerning direction of evolutionary change, it seems that no change, or stasis, and random changes with no net obvious change, are the dominant modes (Figure 11.10). Animals as a group appear to be subdivided into three "evolutionary faunas", or assemblages, that characterize different portions of Earth history for the past 600 Ma. Just as solar radiation and temperature have been associated with increased biodiversity (Figures 11.17-11.18), extreme climatic conditions have punctuated life with mass extinctions (Figures 11.19-11.20). Perhaps humans are responsible, in part, for a modern extinction event on their way (Figures 11.22-11.25, see also Skeptical Science, http://www.skepticalscience.com/, and National Center for Science Education, http://ncse.com/).

All organisms are interconnected, although the nature of those connections varies (Figure 12.2). The strength of the relationships can vary genetically (Figure 12.3) and, as a shifting landscape (Figures 12.6-12.7), also spatiotemporally (Figures 12.4-12.5), as in the case of the toxic Rough-skinned Newt, *Taricha granulosa* (Skilton, 1849) and the Northwestern Garter Snake, *Thamnophis ordinoides* (Baird and Girard, 1852). For example, the biological control of rabbit pests using myxoma virus shows how the strength of a pathogenic relationship has varied with time (Figure 12.8). Many of these interconnections are so close that, as in the case of some mutualistic pollination syndromes (Figure 12.11), when one of the partners becomes uncommon, the other partner is also at peril. Another example of mutualism is that of tiny insects, called sharpshooters (Hemiptera: Cicadellidae), and their bacterial symbionts (Figures 12.12-12.13). Bacteria produce vitamins and amino acids needed for the insects; bacteria have room and board. Other deep-time bacterial-originating mutualisms are believed to be responsible for the presence of mitochondria (Figure 12.15), the powerhouses in most eukaryotes, plastids in eukaryotic photosynthesizers (Figure 12.15), as well as many fragments of retroviruses (Figure 12.16), and mobile genetic elements in our own human genome.

Although the study of behavior (Chapter 13) is dominated by those who have neurons (Figure 13.8), all living creatures behave, from the humble *Dictyostelium discoideum* Raper, 1935 (Figure 13.5, http://www.youtube.com/watch?v=bkVhLJLG7ug) to plants that use light or eat insects (Figures 13.6-13.7). In *D. discoideum*, typically only genetic relatives form part of the slugs from which many individuals will die and a few will make it to the next generation. One of the most fascinating behaviors is the use of tools, until relatively recently believed to be uniquely human (Figure 13.2). Behaviors can also be the target of selection, as exemplified by the classic experiments on behavior modification through selective breeding in *Vulpes vulpes* (Linnaeus, 1758), Siberian silver foxes (Figure 13.4). Amazingly, proteins associated with neurons have existed well before the neurons themselves existed (Figures 13.9-13.10). The first fossil evidence of a vertebrate nervous system can be seen in *Haikouichthys* (Figure 13.11). Thereafter, different parts of the brain have become more specialized (Figures 13.12-13.14). Some complex behaviors are innate (Figure 13.15); others are learned. At times, smarter individuals have shorter lives (Figure 13.16). It appears that selection at the level of the individual can undermine, the formation of groups, as in the case of *D. discoideum* cheater mutants that end disproportionally represented in the next generation. In spite of cheaters and the greater likelihood for the spread of parasites and pathogens (Fig. 13.18), we see groups everywhere. Kin selection theory predicts that closely related individuals are likely to increase the average individual fitness (Figures 13.19-13.21). In a few organisms, genes that appear to account for kin recognition at the molecular level have been detected.

At last, we come to humans and their evolution (Chapters 14-15). Humans belong to the primate lineage, which got started some 68 Ma. We are among the Old Word monkeys and apes (Figure 14.2). Walking upright could have facilitated cooling in australopithecines, members of the primate family Hominidae, or hominids, that were moving to the African savannas (Figure 14.5). Human-like primates most closely resembling us, placed in the subfamily Homininae (or hominines), began some 7Ma (Figure 14.4) and they eventually began making tools (Figure 14.6-14.7). The current consensus on the appearance of *Homo* is around 2Ma in Africa (Figures 14.8-14.9). A first wave of migrants (circa 1.8 Ma) brought *H. erectus* out of Africa (Figure 14.10). Additional waves of migrants brought other hominins out of Africa, such as *H. neanderthalensis* (Figure 14.12) some 300,000 years ago (Ka) and *H. sapiens* in Africa some 100-200Ka (Figure 14.14) as separate lineages (Figure 14.16), except for some interbreeding between the former two circa 60Ka out of Africa (Figure 14.18). Possibly sociality (Figure 14.21) and traits related to language make us different from other human-like creatures. As humans moved to every corner of Earth, they continued experiencing natural selection (e.g. ability to acclimate to higher elevations, Figure 14.23). Evolution may have modeled some of our behaviors, such as aversion to loss, mate choices, and parental investments (Figure 14.25).

Why are all of these evolutionary ideas important to us? We know loved ones who suffer or have died from diseases. We will gain new perspectives on our own behaviors (see examples in Chapter 9) and insights on the workings of the forces of evolution through a closer look at evolutionary medicine (Chapter 15). For instance, by comparing the DNA sequences of different species, scientists can begin understanding the origin of diseases, such as Human Immunodeficiency Virus (HIV), human cytomegalovirus (Figure 15.2), and Severe Acute Respiratory Syndrome (SARS) (Figure 15.4), as well as how can some viruses change hosts relatively rapidly in evolutionary time (Figure 15.7). The war-like interactions between hosts and pathogens can be best understood from an evolutionary perspective as cases of selection (e.g. resistance of humans to the malaria *Plasmodium*, Figure 15.9; resistance to antibiotics by *Staphylococcus aureus* pathogenic bacteria, Figures 15.12-15.13). All organisms, including humans, have variation in resistance to disease. In isolated areas, or "islands", the effects of small founder populations (genetic drift), exacerbated by marriages between relatively genetically close individuals (assortative mating), can increase the frequency of diseases (Figure 15.14). In other cases, genetic variation has been associated with response to drugs, such as the anticoagulant (and rodenticide) Warfarin. Evolutionary selection is related to the development of varieties of cancerous cells that are increasingly more resistant to drugs (Figure 15.15). Perhaps, the precipitous changes in our modern life, such as the ultracleanness of many city dwellers, has occurred too fast for evolution to get caught up (see page 249, *The Story of the Human Body. Evolution, Health & Disease* by Daniel Lieberman). Evolutionary medicine takes advantage of common genetic networks and diseases in organisms, even distantly related ones such as yeast and humans. With this knowledge, one can rationally test drugs to combat diseases, such as cancer, by, for instance, blocking the development of the circulatory system, which is the pathway that these nutrient-hungry cells fuel their uncontrolled division (Figure 15.19).

Students motivated to learn about the vastness of functional morphology of organisms may find it easier through the doors of evolution. *The Tangled Bank* is written in a language that is serious and scholarly yet easy to understand. Most illustrations are gorgeous. An expanded glossary would help students with a weaker background in biology. Also, I would suggest deleting the repeated citations in the references (*Further Reading* and *Cited Literature*) and using an asterisk to highlight references deemed deserving further reading. Together with companion resources (about to become available), I look forward to using *The Tangled Bank* in this non-science majors course.

The Story of the Human Body. Evolution, Health and Disease

by Daniel E. Lieberman. 2013. Allen Lane an Imprint of Penguin Books. London, England, UK. 460 pp. ISBN-978-1-846-14392-2 (softbound)

Evolution is descent with hereditary modification; its main mechanism is natural selection, colloquially known as survival of the fitter. The main thesis of *The Story of the Human Body* is that many modern human ailments result from our lifestyle changes, which are going at a much faster rate than our biological evolution. In evolutionary medicine, this idea is known as the "mismatch hypothesis". Some of our prolonged, or chronic, non-infectious diseases include overweightness, cardiovascular problems, cancer, type 2 diabetes, osteoporosis, and many others. Lieberman cautions that "[s]ome simplistic applications of the mismatch hypothesis propose that since humans evolved to be hunter-gatherers, we are therefore optimally adapted to a hunter-gatherer way of life. This kind of thinking can lead to naïve prescriptions..." (p. 17).

For example, obesity is a rapidly-spreading causal factor for some diseases. Excess true chemical sugars, such as glucose and fructose, are mostly converted into fats and stored in visceral fat cells and in our bloodstream. This excesses cause a complex suite of medical conditions, including high blood pressure, high blood levels of fatty acids, such as triglycerides, glucose, too much bad cholesterol, etc. The whole suite is collectively known as metabolic syndrome. Unlike what our ancestors experienced eons ago, today our relatively sedentary life, decrease of fibers intake, and "super-sized" meals, make many of us are get fatter. In addition to what we eat, other important factors related to obesity are genetics (e.g. *FTO* gene), stress, and the mismatched intestinal microbes we carry, which normally help us digest and perform other bodily functions.

What practical solutions are offered to mitigate these mismatches? The focus, according to Lieberman, should be in preventing disease by empowering people, through education and measured, rational, government intervention. The ultimate goal should be enjoying life with better-fitting nutrition and exercise. "In short, if cultural evolution got us into this mess, then shouldn't cultural evolution be able to get us out?" (p. 364). Echoing Voltaire's end to *Candide*, the book concludes with the familiar "[w]e must cultivate our bodies" (p. 367).

The Story of the Human Body assumes a fair knowledge of biology. The book would benefit from additional illustrations. This is a valuable resource for faculty members as well as anyone seriously interested in learning about an evolutionary explanation to our modern ailments that integrates paleobiology and the actual story of the human body with modern diseases so that readers can understand what adaptations we have and why. An extensive references section, which includes online resources, gives added-value to this tome. Certainly, I plan to use *The Story of the Human Body* to supplement "The Body", the affectionate name I give to my anatomy and physiology course for non-science majors.

Bugs Rule! An Introduction to the World of Insects

by Whitney Cranshaw and Richard Redak. 2013. Princeton University Press. Princeton, New Jersey, USA. 480 pp. ISBN-978-0-691-12495-7 (hardbound)

Bugs Rule! is a gloriously illustrated book on insects and their allies intended for non-science majors and also written as a general guide to arthropods for anybody that may be interested in these crawly creatures. I think it is a great book for non-science college majors. What is it that students want to know in non-science majors course? In my experience, they want to learn the basics of a subject matter and how it affects them. In addition to fulfilling those learning desires, dedicated faculty members want to reach students' hearts so that at least a few will remain passionate about entomology even if they choose not to pursue the subject matter "professionally". *Bugs Rule!* strikes a good balance for all of these teaching and learning goals.

In addition to the typical material included in introductory entomology books for science (or entomology) majors (Chapters 1-4) and addressing the creatures that typically have more than six true legs, *Bugs Rule!* contains numerous chapters on diverse groups of insects. The chapters devoted to arachnids and non-insect arthropods, such as crustaceans, centipedes, and millipedes, are a very-well crafted introductions with emphasis on the tremendous importance of many of them (e.g. mites and ticks) in humans affairs. Those two chapters set *Bugs Rule!* apart from most introductory entomology books. Additionally, instead of using formal names, like Lepidoptera, common names and appealing chapter titles, such as "Scale-Winged Beauties", are used often. Cranshaw and Redak give us interesting, pertinent, and readable stories about each group of arthropods. For instance, in the case of butterflies and moths (Chapter 16), the stories about the "Scale-Winged Beauties" include migration, economic importance, navigation, biological control, historical and cultural remarks, among others, in an enjoyable and readable style. Appendixes, including US state insects, largest bugs, and a summary of hexapodan orders features, as well as lengthy Glossary concludes the book.

Each of us has favorite bugs and themes. *Bugs Rule!* gives something to everyone. My only complaint is the absence of a references section. Although each one of us have had different experiences with students, in my experience, there are always those who want to learn more and quietly quench their desire for more information. Additionally, *Bugs Rule!* lacks a key to the identification of arthropods, say to the order and family levels. However, numerous books and online resources can easily supplement *Bugs Rule!* if the situation so demands. For instructors, Princeton Publishing does provide supplementary teaching materials. I am sure *Bugs Rule!* will generate many new bug enthusiasts. If a reader has bug-o-phobia, this book will either cure it or make the student forever hate insects and their allies.

Guía de Árboles de Puerto Rico. Guía ilustrada para la identificación rápida de árboles

by Félix Rivera Montalvo. 2013. Hortus+Culturae Publishing Co. Arecibo, Puerto Rico. 250 pp. ISBN-978-0-9857482-1-0 (softbound, in Spanish)

Nothing mortifies me more in a taxonomic work than minimal or no illustrations. Well, finally, here is a book, *en español*, that I can recommend to anyone wishing to learn trees of Puerto Rico: *Guía de Árboles de Puerto Rico. Guía ilustrada para la identificación rápida de árboles*.

The book, the first of a contemplated lengthy series, includes 41 out of the over 800 species of plants (~ 5%) known to grow as trees (plants with an elongated stem, called trunk, generally woody and/or exceeding 3 meters in height), shrubs, palms, and other arborescent woody species in Puerto Rico. The book follows an alphabetical order and, within each family, some of the most common species of trees are discussed. If a reader is curious, say about the *pajuil* (or cashew), *Anacardium occidentale* L. (Anacardiaceae), s/he just have to browse over pp. 8-11 to learn about its botanical family, number of described genera and species worldwide, a diagnosis of the family, species present in Puerto Rico, an abbreviated synonymy, etymology of the name and numerous other fascinating factoids, and, yes, color images everywhere.

Although likely not the purpose of the book, I would have followed a phylogenetic order and tried to include all trees within a family. However, as any experienced writer will attest, it is often difficult to compile all the images needed for all intended species. Certainly, the most obvious omission is the lack of aids for the systematic identification of the trees. For instance, say that one finds a plant with botanical cones, a conifer. With this volume, one would call it *Araucaria heterophylla* (Salisb.) Franco (Araucariaceae) when there are actually other conifer trees growing in Puerto Rico, including an endemic member of the family Podocarpaceae. Because traditional taxonomic keys tend to be lengthy and specialized, a multi-access, profusely illustrated key, available on line, like those for a number of organisms (e.g. http://www.discoverlife.org/nh/) would have been welcomed. Portions of the subject matter can be supplemented with the *Flora of Puerto Rico and the Virgin Islands*, available online in English and Spanish, http://botany.si.edu/antilles/PRFlora/index.html . Introductory botanical and nomenclatural chapters would have helped readers those less skilled in the science of plants and their allies.

All in all, however, the full value of this series will be realized when the treatment of all species is completed. This *Guía* is a monumental initial step into making science available to more.