Book Reviews

Milk Proteins: From Expression to Food. Edited by Abby Thompson, Mike Boland, and Harjinder Singh. xvi + 535 pp. Boston, MA: Academic Press (Elsevier). 2009. $64.99 (cloth).

The contributors to this volume have truly done a superb job in describing at length every aspect of milk. The order of chapters is organized in a very logical sequence to provide an uninterrupted flow of knowledge describing milk protein's compositional differences. Such differences include: species, factors affecting milk proteins, use of milk proteins in industry, biological and physiological effects of milk proteins, and the future of milk proteins in industrial use. A brief review of these chapters is given below.

Chapter 1 serves as introduction to this book and provides an excellent overview about milk, its components, and its physical, chemical, biological, and physiological properties. The author details the history of milk used for about 8,000 years. It is a very flexible raw material, from which a range of different products are produced, including about 1,400 varieties of cheese. Microconstituents (minerals, vitamins, etc) are mostly derived from blood, whereas the macroconstituents (lipids, sugars, proteins) are synthesized in the mammary gland and are milk-specific. He further discusses differences that exist in milk secretion and composition among different species, thus setting the stage for the rest of the book.

Chapter 2 describes the comparative biology of milk using genomics, proteomics, and bioinformatics data in species with extreme lactation adaptations. The two animal models discussed in this chapter are tammar wallaby (*Macropus eugenii*) and the Cape fur seal (A*rctocephalus pisillus*). The tammar wallaby has a short gestation and a long lactation that is asynchronous. The Cape fur seal has a repeated cycle of lactation. The authors rightly point out that milk components with unique functions resulting from adaptations to extreme selective pressures are likely to have commercial potential either as nutraceuticals in functional foods or pharmaceuticals.

The dairy industry focuses on milk proteins which are rich in bioactive properties and are particularly valuable to dairy processors and suppliers. Chapters 3–5 discuss milk protein composition. Chapter 3 is mostly focused on bovine milk protein and the authors compare the composition, structure, and function of bovine milk proteins to milk proteins from other species. There may be as many as 300 different proteins in milk. Important milk proteins include caseins and its isoforms, β-lactoglobulin (β-LG), α-lactalbumin (α-LA), immunoglobulins (Ig), glycomacropeptide, lactoferrin (LF), lactoperoxidase, lysozyme, and bovine serum albumin (BSA). In Chapter 4, the authors explain how caseins exhibit a high degree of heterogeneity as a result of post-translational modifications. Phosphorylation of α- and β-caseins and glycosylation of κ-casein are the best-known modification which are critical for the formation and stability of casein micelles. Absence of κ-casein causes a failure of lactation, which results from aggregated caseins clogging the lumina of the mammary gland. Micellar structure of milk proteins is most important factor in regulating its properties, which is elegantly described within Chapter 5. Casein makes milk supersaturated with calcium phosphate, which transports calcium phosphate safely through the mammary gland for the development of bones and teeth in the suckling infant. Three models for casein–calcium interaction are described: the submicelle model, the nanocluster model, and the dual-binding model. Kappa-casein is the most important of the caseins in the dual-binding model of micellar assembly and structure.

The other important set of milk proteins are whey proteins and include β-LG, α-LA, Ig, glycomacropeptide, lactoferrin, lactoperoxidase, lysozyme, and serum albumin. The secondary and quaternary structure of the whey proteins under stable and destabilizing conditions (change in pH, temperature, pressure, etc) are described in Chapter 6. Whey proteins are widely used as nutritional and functional ingredients by the food industry. Processing treatments such as heat and high pressure are applied to kill microbes and to extend the shelf-life of products. Chapter 7 describes the effects of high-pressure processing (HPP) on whey protein and their interactions with other proteins. High pressures cause proteins to lose their native three-dimensional structures leading to denaturation and aggregation and/or their interactions with each other. Sensitivities of each of the whey proteins to heat treatment (Ig>LF>BSA>β-LG B>β-LG A>α-LA) and pressure treatment (β-LG B>β-LG A>IgG>LF>BSA> α-LA) are considerably different because the heat treatment also affects both covalent bonds and noncovalent bonds.

Milk can be subjected to high temperatures and pressures, high shear, and variation in concentration without causing appreciable damage to the casein micelle system but denaturation of whey proteins can modify the functional behavior of dairy products. Chapter 8 describes whey protein denaturation in detail. The interactions of denatured whey proteins with other proteins (including those of the casein micelles) and casein micelle dissociation reactions are discussed at length. Studies on these interactions may provide insights into the functional properties of heated-milk products.

Most milk proteins are used in a dehydrated form, the focus of Chapter 9. Dairy products are usually dehydrated by spray drying. Whole milk powder (WMP), skim milk powder (SMP), whey products, casein, and other dairy ingredients are discussed. The native properties of milk components are substantially unaffected by moderate drying conditions. The industrial requirement for protein powders with specific properties is expanding. Powder is the easiest way to carry and store milk derivatives and increasing in importance is the need to understand rehydration behavior of dairy powders. The next issue for the dairy industry is the storage of the dried milk components. Chapter 10 describes the chemical changes that milk proteins undergo even as dried powders. The dried proteins not only undergo microbiological degradation but also chemical change occurs during long-term storage. A range of reactions can occur in the dry powders, which can affect powder functionality and nutritional value.

Milk proteins are widely used as ingredients in many manufactured foods, e.g., dairy desserts, spreads, confectionery, and baked goods, and the authors provide coverage of how components in milk interact with other ingredients in Chapters 11, 12, and 13. Chapter 11 deals mainly with the properties and functionalities of food emulsions formed with milk protein products, and how

they are influenced by different environmental and processing conditions. The authors conclude that emulsions stabilized by milk proteins are generally very stable, whereas coalesced over prolonged storage as long as sufficient protein is present during homogenization to cover the oil droplets. Chapter 12 reviews the interactions that can occur between protein and polysaccharide molecules in aqueous solutions. Protein–polysaccharide complexes can serve as texturizing agents, encapsulating agents, fat replacers, and stabilizers of emulsions and other dispersed systems. The authors suggest modulation of macromolecular interactions can be used to control the release of nutrients and bioactive components during digestion and to target where and how such components are released. Interaction of individual milk proteins as well as mixtures of milk proteins with a range of micronutrients including vitamins, fatty acids, sugars, and minerals are described in Chapter 13. Liposoluble substances such as retinol bind to casein. Vitamin D2 binds to β-LG about 10-fold greater than vitamin A. Vitamin C does not interact with milk proteins. Milk also contains an array of vitamin-binding proteins, including vitamin-B12-binding protein, folate-binding protein, vitamin-D-binding protein, and riboflavin-binding protein. Most of the fatty acids present in milk are found as triglycerides and free fatty acids including myristic, palmitic, and oleate also bind to β-LG. The authors suggest that the interaction of milk proteins with various micronutrients is primarily governed by the physico-chemical properties of the protein.

Chapter 14 describes model food systems based on the formulation and processing of real foods, using laboratory and pilot plant facilities. These systems are comprised of lipids, proteins, simple and complex carbohydrates, emulsifiers and salts, which are capable of interacting with each other and modifying the final characteristics of the food. Proteins from different sources (e.g., soy, wheat, rice, corn, wheat, milk, egg, and fish) exhibit different functional properties that can be applied to different types of food products for influencing solubility, emulsification, gelation and foaming, water binding, and heat stability.

Reading Chapters 15 and 16 will make you hungry for a meal or for a dessert. The authors describe the crucial role of milk proteins in maintaining the flavor of all dairy foods in Chapter 15. Proteins provide a mouthful, viscosity, and structure to dairy foods. Amino acids and peptides can elicit basic tastes but can also serve as the starting substrates for numerous volatile aroma-active compounds. Proteolysis and the subsequently released amino acids and peptides are the sources as well as the substrates for many desirable and undesirable flavors in cheeses and other fermented-dairy products. The authors point out that the flavor of dairy proteins and their flavor performance in ingredient applications will ultimately influence their widespread usage and competitiveness with other protein sources.

Food components are known to have a role in directly influencing physiological processes in the body. They argue in Chapter 17 for the central place of dairy proteins in the development of functional and specialized foods. Milk can be used for designing the functional food to prevent and treat various physiological conditions. The bioactive peptides that are released during digestion may act as physiological modulators locally in the gut and remotely via their systemic effects. Amino acids (e.g., leucine, tryptophan) released during further digestion have regulatory functions or act as precursors for the synthesis of key nonprotein metabolites. Leucine has a unique role in the regulation of muscle protein synthesis. Glutamine, glutamate, and aspartate are preferred oxidative fuels for the gut. Arginine has been widely used in supplemental nutrition for surgical patients and patients with burns, to modify the inflammatory response, to enhance organ perfusion, and stimulate wound healing.

Future trends are contemplated in Chapter 18 and their likely impact on the production and use of milk proteins. The authors discussed global issues and new technologies that may or may not influence the future development and use of dairy protein products. Other issues such as rising energy costs, scarcity of water, and effect of greenhouse gases are discussed as contributory factor that may have an effect on the cost of milk production.

This book is necessary reading to anyone working in or with the dairy industry. Some chapters have redundant information but the repetition is not irritating. The strengths of the book include the comprehensive bibliography of recent articles in each chapter. In summary, this book is an excellent resource on milk proteins.

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Truth Machine: The Contentious History of DNA Fingerprinting. By Michael Lynch, Simon A. Cole, Ruth McNally, Kathleen Jordan. xxii + 391 pp. Chicago, IL: University of Chicago Press. 2008. $37.50 (cloth).

As with many important events in life it seems that it was only a short time ago that the term "DNA fingerprinting" became entrenched in the common vernacular of Western societies, but it has been over 20 years since the successful implementation of this powerful technique. The authors of this appropriately named monograph provide an in-depth description of its contentious introduction into Western legal systems and question its perception as the ultimate forensic "truth machine." Since its inception and implementation in the 1980s, the scientific methods utilized for forensic DNA analysis have evolved through a series of technological stages that have been legally challenged at every step. These are well documented in this work with particular focus on specific controversies in American and British courts and associated articles in scientific literature (as, for example, confrontational editorials and letters published in *Science* and *Nature*). A very powerful notion well-espoused in this work is that, like all other forms of forensic evidence and analysis, the probative value of DNA evidence rests on specific practices,

circumstantial knowledge, and administrative assurances that are not different from those that support the other, less glamorous, forms of forensic evidence.

The book is divided into 10 chapters with five interspersed "interludes" that present brief accounts of some of the legal and scientific issues featured at various points in the text. Chapter 1 brings into question whether DNA fingerprinting constitutes a "scientific revolution" in forensic science with the authors concluding that indeed it does and the banner of the revolution is "DNA" (in the context of forensic evidence, "DNA" is now shorthand for the family of techniques and statistical analyses associated with DNA fingerprinting). They nicely describe how in public discourse of DNA evidence, laboratory science is equated with truth and thus it follows that "DNA" has become emblematic of a level of objectivity and certainty unmatched by any other mode of criminal evidence. To fully explore the organizational practices through which lawyers, experts, and nonexperts build up and break down the credibility of DNA evidence, the authors employed an "ethnomethodological" approach. This method examines the ways in which people interpret their world, convey these understandings to others, and construct the mutually shared social orders in which they live. This ultimately provides a broad view in which not only science and law issues are described but also many of the sociological aspects of the contentious introduction of DNA analysis into modern legal systems.

Of particular noteworthiness and interest are the detailed descriptions of actual case studies and the role that advanced statistical analyses played in obtaining a conviction, or proving innocence, by way of DNA fingerprinting. The presentation of the often complicated statistical analysis associated with DNA typing (in the context of population genetics) was novel to judicial systems and caused considerable consternation for prosecutors, defense attorneys, and judges (all the way up to the Supreme Court). The means by which these issues were argued, exploited, attacked, and defended are well chronicled using case studies such as the *Regina v. Deen* case and associated appeals. This case, which took place in England in 1994, consisted of the appeal of a conviction for three counts of rape in which a DNA profile match was the most important item of prosecution evidence. It proved to be the first case in which DNA evidence was successfully appealed in the United Kingdom. This and other notable cases are nicely employed to illustrate many facets of the DNA "Wars" that took place in courtrooms and numerous editorial pages in scientific journals.

Since its initial use in legal systems in the late 1980s, DNA fingerprinting (and statistical analysis) have undergone numerous and often contentious technical iterations. The universally accepted method used today is the short tandem repeat (STR) technology that amplifies and resolves 13 specific regions of an individual's genomic DNA. Its acceptance derives, in part, from the fact that it can statistically discriminate an individual from not only all living humans but from all humans who have ever lived (with the exception of identical twins). Interestingly, the strong reliance on appropriate statistical analysis and the increased reliability has caused an "inversion of credibility" for DNA fingerprinting's original namesake—namely, true dermal-ridge fingerprinting. It was interesting to read that traditional fingerprinting, which previously was considered the gold standard of forensic science and also a popular icon of unique personal identity, became suspect in light of the new standards of "scientific" certainty associated with the new paradigm in forensic science heralded by "DNA." This phenomenon is well chronicled in the final chapters of the monograph.

Although generally well written and appropriately chronicled, there are sections of this monograph the overall editing is somewhat wanting. A particular example of this is found on page 31 where the authors attempt to describe the polymerase chain reaction (a reaction that is a critical element of the STR method)—"In each round, the precise DNA sequence replicated is defined by two 'primers' (special probes) that bind to either end, one to initiate the replication reaction and the other to terminate it." One aspect of the described roles of the primers is absolutely incorrect. Both primers do function as initiators for the polymerase that synthesizes the new strands of DNA, but neither function as a terminator for any one cycle or the total reaction. In addition, some sections of the text are so dense and convoluted that many points are rendered obtuse and thus lost to the reader. Therefore this monograph is not recommended for the general public, yet it could potentially serve as a useful text for students studying the fields of Science and Technology Studies or for those interested in pursuing careers in forensic law.

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Reticulate Evolution and Humans: Origins and Ecology. By Michael L. Arnold. xii + 233 pp. New York, NY: Oxford University Press. 2009. $120.00 (cloth).

Michael Arnold's newest book, *Reticulate Evolution and Human: Origins and Ecology*, is an interesting new contribution to the literature on human evolution. The book reflects Arnold's career-long exploration of genetic interactions between species and the significance of these processes in challenging the traditional notion of species as genetically isolated biological units (previous books—*Natural Hybridization and Evolution*, 1997, Oxford University Press; *Evolution through Genetic Exchange*, 2006, Oxford University Press). In this book, Arnold places his argument for the replacement of traditional "tree-like" thinking in evolutionary studies with "web-like" thinking in the context of humans and what humans do. The book is structured around the significance of reticulate evolution, Arnold's preferred term for the genetic interaction between lineages, for understanding humans. The book explores not just the potential significance of reticulate evolution in humans and human origins directly, but also the importance of such processes in a host of species that are essential for human society.

Arnold's book succeeds more as a clearinghouse of information and references on the complexity of interspecific

evolutionary processes than a compelling revision to the fundamentals of how we think about evolution. This latter shortfall, however, is in many ways a product of the success of the former. Arnold highlights so many different examples of reticulate processes, or possible evidence for reticulation, that there is often little room for lengthy discussions of the details. Even if it is a smaller target than intended, Arnold's book is successful because of its persistence.

In the opening chapter, Arnold lays out his thesis—the genetic interactions between lineages are vital to the structuring of broad evolutionary patterns and our understanding of those patterns. Arnold intentionally uses the more ambiguous word "lineage" to reference the evolutionary units he discusses. At times, this can be confusing as Arnold, in his examples, bounces between researches discussing what are traditionally thought of as different populations, subspecies, or species. That is the point, as Arnold is attempting to blur the lines between traditionally constructed hierarchical evolutionary categories by highlighting the important processes of genetic change and exchange between them.

Chapters 2 and 3 look at evidence for reticulate evolution in nonhuman primates. Chapter 2 draws attention to a host of recent work looking at introgressive hybridization in New World and Old World monkeys, as well as gibbons and orangutans. Much of the evidence for reticulation centers on the presence of detectable hybrid zones in these organisms today, as well as the identification of complicated "mosaic genomes" which suggest occurrences of ancient reticulation. In Chapter 3, evidence for such genetic mosaics is examined in great detail for the *Homo-Gorilla-Pan* evolutionary trio. Moving past the issue of the proper resolution of the trichotomy, the focus is instead placed on the significance of the short phylogenetic branch lengths separating the originators of these three lineages, and the possible genetic interactions between them.

Chapter 4 is one of the shortest sections of the book, but presents a clear and much needed summary of recent work examining genetic reticulation in the evolution of *Homo*. Arnold begins with a concise comparison of the predominant models currently in circulation for recent human evolution; replacement, multiregionalism, and hybridization/introgression. Noting the large degree of overlap between multiregional and hybridization/introgression models with respect to their evolutionary predictions, Arnold focuses on contemporary evidence for replacement versus nonreplacement models. Section 4.3.3 reviews the molecular evidence relating to the differing models of recent human evolution and is perhaps Arnold's most direct effort to highlight the significance of his subject for humans. He can only address a few of the recent developments in the burgeoning field of comparative human genomics, but Arnold effectively discusses some of the most significant findings, including the Neandertal genome and the diversity of patterns observed in different genetic systems. Arnold concludes this chapter by gesturing in the direction that much of the recent work in this area points to; "When the data are examined critically, even from studies concluding otherwise, signatures of some level of genetic exchange between *H. sapiens* and archaic species such as *H. erectus* and *H. neanderthalensis* are apparent" (p. 80).

The remainder of the book focuses on a long litany of stories about organisms important for humans and evidence for reticulate evolution within their lineages: reticulate evolution in human pets (chapter 5.2), beasts of burden (5.3), clothing products (5.4), and an assemblage of other assorted useful materials (5.5). Section 5.6 is perhaps the most amusing illustration of Arnold's stubborn adherence to his topic, presenting a potpourri of "vices" for the reader to peruse, including chocolate, tobacco, alcohol, coffee, and cannabis. Chapter 6 goes into the animal proteins on which many of us enjoy dining. Chapter 7 provides an accompanying vegetarian fare, focusing on honey, root, seed, and fruit crops. Chapter 8 ventures into some of the more traditional models for interspecific genetic exchange, vectors associated with disease, and various assorted human pathogens.

Matthew Arnold's book is certainly a useful reference for one interested in the complex ecology of human genetics. Or is it the complex genetics of human ecology? Aside from a course dedicated solely to the topic of reticulate evolution in humans, it is unclear exactly what type of course, if any, this book is aimed toward. Nevertheless, its coverage and synopsis of current research (the extensive list of references is populated almost entirely by works published in the past 5–10 years) makes it a worthwhile addition to the bookshelf.

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Endocrinology of Social Relationships. Edited by Peter T. Ellison and Peter B. Gray. vii + 499 pp. Cambridge, MA: Harvard University Press. 2009. $49.95 (cloth).

Endocrinology of Social Relationships is a timely and informative work. Intimate and sustained personal interactions may be the most powerful driving force behind our actions. Our social relationships, with family, in the work place, friendships, love, marriage, and raising children has been the focus of literature, philosophy, and is in large part the reason for the field of psychology. Despite the fact that our social lives are, at least in part, biological manifestations and as such the product of natural selection and physiological responses, we have only recently begun to seriously address the biological nature of our daily and lifetime relationships.

The increased interest is exemplified by the burgeoning field of Social Neuroscience, which is dedicated to understanding the mechanisms that regulate the underpinnings of social interactions and whose foundation is the interplay between hormones, brain, and our social environment. In *Endocrinology of Social Relationships*, leading researchers discuss the role of critical hormones from the neuropeptides, oxytocin, and vasopressin, to steroids including testosterone, estrogen, and cortisol to the monoamines serotonin and dopamine, going beyond their regulation of individual actions to their involvement in the

complexity of social relationships including social status within society, mating, long-term relationships, and parenting.

There is something for readers at all levels; many of the chapters are presented so that they provide insight for both the layman and the professional. I appreciated the fact that most of the authors not only pointed out gaps in our knowledge but they also posed questions that need to be addressed, giving inspiration to new researchers and leaving the desire to learn more. The book is divided into three parts. Part one explores how ecological and selective forces have molded social relationships through their effects on hormones. Part two discusses what has been learned from studying selected nonhuman animal models, while part three delves into what we know about human relationships and their challenges. The goal is to produce a smooth transition and understanding from the broad concepts, including evolutionary and ecological implications of hormones to human social relationships. Unfortunately the presentation falls short, because there is so much information in each section that it will challenge even the most knowledgeable reader to tie it all together. It would have been helpful to have a brief summary/transition from one section to the next.

Part one is strong, with an integrated set of chapters examining the theoretical and empirical context of endocrinology and social relationships. Phyllis Lee does an excellent job of laying the foundation in Chapter 1 discussing the evolution of mating strategies and parenting systems. In Chapter 2, Wallen and Hasset use a variety of species to demonstrate how steroids, peptides, and hypothalamic-pituitary-adrenal axis represent the major mechanisms that both regulate and are regulated by social behavior. Chapters 3 and 4 take an ecological perspective. Ellison examines social relationships in the context of reproductive ecology, where energy resources are a key factor in determining reproductive effort. His discourse on the interplay of the central nervous system and endocrine system in making energy/resource based decisions is compelling. Wingfield follows with an eloquent chapter on how environmental conditions can challenge reproductive and social status. Lancaster and Kaplan close with a sweeping chapter on the endocrinology of human social adaptation, within the time frame of evolution, the influences of division of labor, and female mate choice, touching upon many of the concepts presented in the previous chapters.

Part two selectively examines human relevant animal models. However, limiting the species also impacted continuity. As should be, my bias is showing, this section starts with the socially monogamous prairie vole, one of the primary rodent model systems for studying social behavior, and here, Carter and colleagues recap the role of oxytocin and vasopressin in establishing the basis of the bonds at the center of family ties. The next three chapters examine hormones and social behavior in primates. Ziegler and Snowdon explore family relationships in biparental monkeys, with a fascinating discussion of "communication" about pregnancy and ovulation between the pair. Fairbanks provides an interesting and detailed picture of the interplay of dominance and testosterone, serotonin, and dopamine, revealing the fluid and dynamic interaction of hormones and behavior in regulating aggression in monkeys. Thompson closes comparing the endocrinology of sexual relationships in apes, providing a transition to the human animal.

Part three although less empirical is worth the read, getting to the main focus of the book, human social relationships, but perhaps that is one of the lessons. There is still a lot to learn about the neuroendocrinology of human social behavior. What is immediately evident is the emphasis on steroids. In nonhuman mammals, females are typically perceived as more social because of the need to care for offspring, with heterosexual social relationships associated with changes in male behavior, thus generating a focus on testosterone. There is no discernible logic to the order of presentation in part three and I found myself referring back to different chapters to draw connections between the topics. It would have been easier if the chapters had been presented by type of hormones being highlighted. So I present my review by grouping the chapters by class of hormone. McIntyre and Hooven in Chapter 10 examine how androgens influence the organization of the brain and activate sex differences in the perception of social relationships, van Anders in Chapter 15 discuss how androgens in males and females may lead to our choice of partner(s), while Gray and Campbell reveal the relationship between testosterone male pair bonding and being a father. Their findings of significant differences between North American males and males from other cultures emphasizes that while hormones affect behavior, culture also affects hormones. In Chapter 11, Roney brings the perspective of evolutionary psychology to address sex hormones and mating in humans. Chapter 16 by Nepomnaschy and Flinn provides an overview of how early life experiences can influence the development of later responses to stress and the value of long-term longitudinal human studies. Sanchez and colleagues in Chapter 14 discuss the importance of oxytocin and vasopressin revealing the translational potential of nonhuman animal studies for humans. The interplay of the different hormones in regulating social relationships is highlighted by Fleming and Gonzalez in Chapter 13 through a presentation of human maternal care.

Endocrinology of Social Relationships, even if not tied together in a neat package, provides significant insight into the biology of social relationships.

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The Rise of Homo sapiens: The Evolution of Modern Thinking. Edited by Frederick L. Coolidge and Thomas Wynn. viii + 308 pp. New York, NY: Wiley-Blackwell. 2009. $89.95 (cloth), $29.95 (paper).

With the exciting advances that have been made recently in our understanding of the human brain, it seems surprising that very little attention has been paid in other disciplines to archeological evidence. As those behaviors claimed to be uniquely human—the manufac-

ture of tools, cooperative hunting, self-awareness, innovation, even (perhaps) some aspects of language—have one by one been demonstrated in other animal species, it has become more essential than ever that archeology—the only discipline with the evidence for the evolution of the uniquely human style of cognition—elbow its way firmly into the centre of debates on the subject.

It is timely, then, to welcome a book co-written by a psychologist and an archeologist. *The Rise of Homo sapiens* is a slim volume with an ambitious remit: An explication of the origins and evolution of modern thinking. The book itself falls into two halves; the first covers the brain, working memory, brain evolution, and primates (Chapters 2 through 5), whereas the second half takes the reader through the anthropological and archeological evidence for human evolution. Also in this second half, Chapters 8 and 11 outline what the authors believe to be two major 'leaps' in cognitive evolution. In a nutshell, they argue that *Homo sapiens*' unique cognitive style derives from an enhancement of 'working memory' enabling them to hold more concepts in mind simultaneously, and thus allowing cross-modal thought, comparison, reflection, etc. I am still not entirely convinced by the argument but I found much to enjoy here.

In the first half, chapters on the brain and its evolution place a welcome emphasis on development and experience. Chapter 3 on working memory is thorough, and the authors are upfront about the major problem I have with the concept. It often seems little more than an heuristic device, so abstracted from actual cognitive processes as to be all but useless as an explanatory concept. Chapter 5 on primates eases us into the more contextualized and concrete examples provided by the second half of the book. Here at last is a brief discussion of environmental (both physical and social) influence.

In the second half, sensibly, the authors do not get bogged down in taxonomic debate, discussing the evidence in terms of 'grades' of species sharing similar basic life ways. Thus, Chapter 6 on early hominins covers the poorly known early hominins *Sahelanthropus, Ardipithecus,* and *Orrorin*, the more familiar australopithecines (including Lucy) and Paranthropines (the robust australopithecines, aka 'Nutcracker Man') as well as the earliest fossils currently assigned to *Homo* (*Homo habilis*). Stone tools and the cognitive demands of their manufacture then are given prominence here, and discussed alongside primatologists' work on great ape tool use, to illuminating effect. Similarly, Chapter 7 covers the archeology of *Homo erectus* (the first hominin species to demonstrably use fire, the inventors of the handaxe and arguably the first hominin to flourish outside its African homeland), and Chapter 9 *Homo heidelbergensis* (the first true Europeans; the Africa form was probably also the immediate ancestor of *Homo sapiens*). Neanderthals follow in a similar vein in Chapter 10, covering everything from handedness to abstract and algorithmic devices.

In addition, Chapters 8 and 11, slotted in to this second half, detail the authors' own arguments for two 'major leaps' in cognition. The first, they argue, results from an increase in the proportion of sleep obtained on the ground rather than in trees, allowing hominins to extend the length of time spent asleep and thus the relative proportions of slow wave and REM (dreaming) forms of sleep, which enhance simulation and thus creativity and procedural memory. However, their argument is undermined somewhat by confused sections on dream themes and on creativity and dreaming, which detract from their otherwise very pertinent points about dreams as simulation and 'priming' for waking life and as making connections between disparate realms of thought. Nevertheless, the detail provided here on the evolutionary significance of sleep and dreaming is both new and fascinating.

Chapter 11 on the second major leap in hominin cognition goes on to argue that, after these developments, a genetic mutation or epigenetic change enhanced working memory in ways that added to our hominin ancestors' cognitive skills to produce a dramatic behavioral change. While I cannot agree with their assertion that there is little evidence for executive functions much earlier than 32,000 years ago and I am generally unsympathetic to *deus ex machina* 'mutation' explanations for modern cognitive capacities, the authors' assertions are at least more specific than most and they are at pains to demonstrate how it might be falsified. The evidence is dealt with fairly and the discussion, an excellent survey of the data—if rather brief.

And here lies the major problem. Taken individually, each section provides excellent summaries of most of the relevant evidence (although there are some blind spots; the Châtelperronian is dismissed in a single line (p. 204), while the absence of any mention of the admittedly controversial FOXP2 'language' gene nevertheless seems a strange omission). However, with such a lot of ground to cover, each topic is dealt with in highly summarized form. This will be fine for nonarcheologists, although the archeological data are surprisingly poorly referenced, but much of the material will probably be really quite familiar to anyone with any background knowledge. Meanwhile, Chapters 8 and 11 deal specifically with the authors' argument—by far the most interesting in the book—are poorly integrated with the data and crying out for more detail. Integrating the relevant sections of the first few chapters into the data-driven second half would have contextualized their rather dry and abstract background information, whereas structuring the book around the authors' central thesis would have given their arguments room to breathe, making for a much more engaging read.

Nevertheless, the book has many strengths notably in its lucid account of the archeological record in relation to what it can tell us about cognitive evolution. Crucially, the authors recognize that 'cognition' is not a single discrete thing but consists of a variety of subcomponents ('technical', 'social', 'spatial', etc.), and that our ancestors may have had cognitive styles that do not necessarily fit on a linear scale between primates and humans. The distinction between 'expert strategy' (chains of action learned by repetition) and innovation and creativity is significant; much of what even modern humans do is more akin to the former than the latter, making our derived cognitive style additive rather than completely unique. Perhaps most important of all, the book presents its archeological data with an appropriately bullish outlook. As the authors state, archeological data are simply 'the best [indeed, the only] evidence available for what our ancestors actually did, and how they thought' (p. 70). This highly readable and thought-provoking book will do much to highlight the significance of archeology in the study of cognition.

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Finding Our Tongues: Mothers, Infants, and the Origins of Language. By Dean Falk. xii + 240 pp. New York: Basic Books (Perseus Books Group). 2009. $26.95 (cloth).

The larger significance of Dean Falk's book, *Finding Our Tongues: Mothers, Infants, and the Origins of Language*, is that the author looks to early maternal care and socialization as a key environmental influence on infant survival, and, therefore, a crucial locus of natural selection. This perspective is a welcome corrective to the dominant evolutionary discourse which focuses on the hunting behavior of adult males or their differential mating success. To mate and reproduce, a human being, born very immature, must first survive the first 2 years of life. Konner (1977) long ago pointed out that, because of very high infant mortality rates (probably 50% or more) in the environment of evolutionary adaptation, the life stages of infancy and toddlerhood functioned as severe selective tunnels in which only the healthiest infants subjected to the most effective caregiving and socialization could survive. Lack of adaptive fit between human being and environment has more severe consequences in infancy than in adulthood; in infancy, it is much more frequently a matter of life and death. Survival is a prerequisite for reproduction, a fact often forgotten in evolutionary psychology's rush to problematize adult sexual and reproductive behavior. This argument implies that maternal care and socialization of infants and toddlers are crucial keys to human evolution. Yet, maternal care and socialization have been given relatively little attention in the field of evolutionary psychology and in evolutionary thought more generally. *Finding our Tongues* is important because it takes a big step in redressing this balance.

Falk is of course treating the evolution of language in particular rather than human evolution in general. In the domain of language, Falk's approach is also an important corrective to dominant evolutionary theorizing. Language must be acquired by children before it can be used by adults. Therefore, the developmental processes of acquisition and learning must be central to its evolution. Yet, this crucial fact has been quite ignored in the dominant paradigms for understanding the evolution of human language. Falk focuses on evolutionary change in maternal communication adjustments adapted to infant capacities ("motherese") as the motor of language evolution. This is an original and valuable approach.

Where I would disagree with Falk is on her lack of attention to a large body of research on ape communication in human-ape cultural environments; this body of research provides important evidence for her thesis and has other implications for the evolution of human language. The long-term project of Sue Savage-Rumbaugh and collaborators in which humans and apes have been communicating and developing an interspecies culture for more than 30 years is a case in point. Scaffolding by human caregivers (a type of "baby talk" or developmentally adjusted interaction) of bonobo and chimpanzee communication is built into this situation and has led to vocabulary development (Savage-Rumbaugh et al., 1986), protogrammar (Greenfield and Savage-Rumbaugh, 1991, 1992; Lyn et al., in press), as well as to advances in symbolic play (Lyn et al., 2006). These cases of interspecies input or scaffolding demonstrate the ability of a human caregiver to stimulate the expression of protolinguistic and symbolic skills throughout the clade that includes bonobos and chimpanzees—not just in human children, as Falk implies. This conclusion suggests that the *capacity* for protolanguage, even if not realized in the ape environment, goes back five to seven million years, before the split between *Pan* and *Homo*—much farther than the mere two million years asserted by Falk.

Although her focus is speech, Falk rightly sees the roots of language in multimodal communication that includes gesture. However, when she cites and discusses some of the key human research in gestural and sign development, she does not mention that, like children, bonobos and chimpanzees living in a human-ape interspecies culture spontaneously combine gesture and symbol in order to communicate (Greenfield and Savage-Rumbaugh, 1991; Lyn et al., in press). Nor does she note that all three species use gesture-symbol combinations as a stepping stone to protogrammatical combinations of symbol with symbol (Greenfield et al., 2008). These comparative findings not only indicate an important role for multimodal communication in language development and evolution; they also suggest that, contrary to Falk's timetable, the capacity for protolanguage extends back five to seven million years, before the *Pan–Homo* split.

This limitation notwithstanding, the reader will find Falk's book to be a treasure trove of ideas, information, and evolutionary argumentation that puts mothers and infants back into the picture of human language evolution. *Finding our Tongues* constitutes an important advance in theory and scholarship that cannot help but impel the field toward a more accurate view of human evolution in general and language evolution in particular.

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Charles Darwin's Shorter Publications 1829–1883. Edited by John van Wyhe. xxvi + 529 pp. Cambridge, England: Cambridge University Press. 2009. $160.00 (cloth).

Darwin was a prolific writer with sixteen books, some of which are still in print, about 12,000 pieces of manuscript correspondence and a mere 100,000 words of *marginalia* alone, including also many short pieces written by the naturalist for *Gardeners' Chronicle*, the *Journal of Horticulture and Cottage Gardener*, the *Athenaeum*, or *Nature*, *Philosophical Transactions of the Royal Society*, and the transactions of other learned societies, now of limited accessibility. The first collection of these shorter pieces was first published by Paul Barrett (1977) but more have appeared since then, and this volume represents probably as definitive an edition as we are going to have. Darwin scholars will find here 251 such items penned by Charles Darwin covering his many areas of interest: the humble bee, the geological action of ice and icebergs, movement of plants, carnivorous plants, barnacles, the inheritance of instincts, fossils, ideas on the distribution of animals and plants, on the mechanism of the origin of species, as well as further evidence of his ever present courtesy in acknowledging honors bestowed on him, and other personal notes. Approximately 30 items are on geology, 100 on botany, 100 on zoology, and the rest are of a social or more personal nature.

Some of the selected items, although very short, I found of particular interest, for instance those referring to James Torbitt and his scheme to avoid further potato crop failures in Ireland. Torbitt's scheme required obtaining many seeds by out-breeding, growing new varieties (or cultivars) from the true seed so-obtained, rather than from the "set" (the tuber itself, as is the common practice of farmers), and selecting the resistant cultivars only. Torbitt was anxious to canvas Darwin's support for his scheme, and make use of his written statements in his advertising campaign for the distribution of his select resistant seeds among the farming community (DeArce, 2008). Having received some private encouragement from Darwin (in a letter dated April 4, 1876), and a telegram saying: *You may publish what i have said* (p 397), Torbitt proceeded to distribute printed adverts including Darwin's words but this annoyed Darwin who had meant a more restricted circulation, just by word of mouth, when canvassing growers or civil servants. The brief telegram goes some way to explain Torbitt's misunderstanding. Darwin disliked his name being used for advertising purposes, but in spite of this, it was used extensively without prior consultation.

Another episode that takes a number of items in the book refers to an experiment that Darwin had carried out to assess the effect of exposure to sea water on the germination of seeds from a variety of plants (p 252–254 and 258–266). The idea behind the experiment was an attempt to explain the distribution of certain plants. Henry Hennessy (1826–1901), an Irish meteorologist, was the first to collect temperature data for the whole of the United Kingdom, and he had observed that certain isothermal overlapped quite exactly with the distribution of two species of *Saxifraga*, plants that are found exclusively in Asturias in Northern Spain and Kerry in Southern Ireland, but not in England or the Continent of Europe (Hennessy, 1870). Hennessy claimed that they had been carried by humans moving between the two regions shortly after the last ice age about 12,000 years ago, when sea levels were a lot lower. Darwin wanted to test whether the seeds could have been dragged by sea currents between the two locations, and still germinate on arrival.

Some of the items are of broader historical interest. The item titled *Vindication of Gartner—effect of crossing peas* (p 327–329) dated February 3, 1863 shows how very close Darwin and other hybridists had been to observing Mendel's 3:1 ratios after crossing monohybrid peas. Gartner, Kolreuter, and Goss, were some of the great plant hybridists that inspired Mendel's seminal work on peas, published in 1866. Perhaps Mendel's mind was more attuned to quantitative analysis of figures than Darwin's was. Another historical piece is the joint Darwin-Wallace paper presented by Charles Lyell and Joseph Dalton Hooker to the Linnaean Society of London, and read on June 30, 1858 (p 282–296). This is the famous paper where Darwin is given priority over Wallace as originator of the theory on the role of natural selection in producing new species.

Probably every entry in the book could evoke one or more stories like the ones aforementioned. Experts in the history of different sciences will find different contexts to situate each of the entries in this book, and it is to them that the book is primarily addressed. Continuous reading without such background will at least provide curious readers with an insight into Darwin as a person, into his mind and work habits and into the state of natural sciences during his lifetime. The only criteria for inclusion appear to have been just authorship (anything printed during his lifetime that was written or signed by Darwin, although some privately printed items are included), and length (shorter than a book). Careful notes help the reader to identify the different people mentioned by Darwin, or supply succinct background. John van Wyhe has rendered another great service to Darwin scholarship.

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Dietary Modulation of Cell Signaling Pathways. Edited by Young-Joon Surh, Zigang Dong, Enrique Cadenas, and Lester Packer. xxii + 477 pp. Boca Raton, FL: CRC Press (Taylor and Francis Group). 2009. $149.95 (cloth).

During the last decade, there has been a popular trend in the antioxidant research field to move from direct antioxidant activities to functional effects. In the post-genomic era, a new challenge in nutrition or diet and health is to understand the mechanism of action of dietary compounds, especially the role of phytochemicals and nutrients on the modulation signaling pathways and their interactions.

Dietary Modulation of Cell Signaling Pathways is one volume in a series entitled *Oxidative Stress and Disease*, edited by Lester Packer and Enrique Cadenas. The work reviews some of the latest research findings and focuses on nutrient–gene interactions with particular emphasis placed on the intracellular signaling network. The book addresses the dietary modulation of particular gene expression systems and highlights the underlying molecular and cellular mechanisms that involve upstream signaling molecules, such as, receptors, kinases, and transcription factors in the context of their therapeutic potential. It describes the action of nutrients on the activation of antioxidant and inflammatory transcription factors and the induction of their target gene expression.

In each chapter, the authors focus on their own research and, as a result, the format is diverse. Chapters 1, 7, 8, 11, and 13 are all well written—and represent the highlights of the book. Chapter 1 also serves as an introduction to the volume although only six major phytochemicals are covered. Chapter 3 provides a section on "future perspectives" although this is limited to the MAPK pathway. Chapter 6 reviewed the effects of polyphenols on regulation of inflammation, redox, and glucocorticoid signaling and also raised some adverse effects of polyphenols, including reduction of iron absorption from food, and inhibition of P-glycoproteins and interactions between polyphenols and some drugs.

Much of the remaining chapters address either specific phytochemicals (polyphenols, isothiocyanates, curcumin, and carotenoids) or focus on the whole foods/beverages, such as, tea, ginger, wine, ginkgo biloba leaf extract, fermented papaya preparation, and the "high fat" diet. However, acetyl-L-carnitine and homocystein are not "dietary compounds" and this chapter does not fit in the title of the book, although these compounds have a significant role to play in neurodegenerative diseases. The main diseases covered are CVD, diabetes, Alzheimer's, cancer, and inflammatory-related diseases. Important signaling pathways that are addressed include MAPK, PI3K/Akt, NF-κB, HIF-1α, VEGF, COX-2, Keap1-Nrf2-ARE, etc. and their involvement in gene expression, inflammation, cell cycle arrest, apoptosis, angiogenesis, and epigenome. It is especially important to note that all of these compounds have effects on multiple targets. There are two chapters on the essential trace element selenium: selenoprotein biosynthesis and regulation of signaling pathways in cancer, these fit in well together. More than one chapter covers the effects of resveratrol, curcumin, tea polyphenols/EGCG, sulforaphane, and ginger; as a consequence there is some overlap and duplication which could have been removed by judicious editing.

Overall, this book is both informative and timely, and its index is comprehensive. Tighter editing or better thematic grouping of themes (and compounds) would have provided more consistency. Moreover, the inclusion of a chapter describing future directions or new challenges would have been particularly stimulating. Given the cost ($149.95), its inclusion in most academic libraries is warranted, and it is also useful for researchers working in nutrition, phytochemicals, or the diet and health field to have a volume for personal reference.

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