their work on some of the questions that have emerged from the coevolutionary scenario.

Not long ago, "coevolution" was often invoked to describe almost any feature of an insect or plant that affected their interaction. Several authors, including D. Janzen, M. Slatkin, and myself, cautioned that evidence for coevolution demands evidence for reciprocal evolutionary responses among interacting species, which is not easily obtained. To judge from this book, caution and skepticism now reign: the authors of at least 8 of the 16 research-based essays doubt that their systems have coevolved, and several others do not address the question at all. Many of the essays focus instead on the nature and processes of adaptation of one species (or set of species) to another, rather than on reciprocal selective effects. It would be premature, I believe, to conclude that such effects do not exist, but it is unquestionably difficult to tease out the evolutionary responses of two species to each other from the multispecific nexus in which they are typically embedded. As F. Gould points out, moreover, a complex of herbivores may intensify the selective impact of a single species on a plant, and we should not "assume that the only scientifically noteworthy outcomes of coevolution are coevolved species associations" (p. 17). In an outstanding review of the theory of coevolution from a genetic perspective, Gould demonstrates the importance of determining how diverse the impact of a plant secondary compound may be on different herbivores and how diverse the responses of an herbivore may be to different plant compounds.

Skepticism about coevolution is expressed by, among others, Brower *et al.*, who attribute to "exaptation" (preadaptation, retrospectively viewed) both the defensive sequestration of host plant toxins by monarch butterflies and the ability of orioles to circumvent this defense; by Price *et al.*, Lindroth, and Scriber, who doubt that the herbivores they study substantially affect plant fitness; and by Bryant *et al.*, who advocate an economic theory of plant allocation to defensive chemicals. Their hypothesis is appealing and finds considerable support, but I believe it is not, as they suggest, an alternative to a coevolutionary model of plant defenses. Nutrients and other environmental influences on the plant's economy may only circumscribe the arena within which coevolution might occur. Other noteworthy chapters on plant ecological chemistry include a skeptical essay by Myers on the influence of induced defenses on insect population dynamics, a summary by Chew of interactions among crucifers and associated insects, and a description by Cates and Redak of the probable impact of variation in terpenes on spruce budworm populations. In another vein, Faeth presents interesting data on the likelihood of competition and coevolution among species of herbivorous insects.

Perhaps the closest match to the Ehrlich and Raven scenario is Bowers's description of adaptations to toxic iridoid glycosides by specialized insects that in some instances use these host compounds as feeding and oviposition stimulants. This observation is not unprecedented, but rather few examples are known. Genetic processes of adaptation, which have received rather little attention in this field, are plumbed most deeply by Gould's study of cross-resistance of a noctuid moth to diverse plant compounds and by Berenbaum and Zangerl's examination, in wild parsnip, of genetic variation in and correlations among biosynthetically related furanocoumarins, their toxicity, and their costs and benefits. I do not know what to make of Spencer's chapter on interactions among *Heliconius* butterflies and Passifloraceae. This system is noteworthy because it is the subject of some classic coevolutionary stories, which Spencer attempts to extend by examining the diverse cyanogenic glycosides of many species of Passifloraceae. He advances plausible, if untested, hypotheses about why the toxicity of different cyanogenic glycosides might vary and how *Heliconius* species might differ in averting toxicity at the enzymological level. Relating the host records of butterfly species to the plants' chemistry, he concludes that host use is "correlated" with chemistry, that more "advanced" *Heliconius* species are more specialized with respect to host chemistry, and that the butterflies and plants have coevolved in a rather strict sense. If true, these conclusions would be most interesting, but I cannot understand Spencer's correlations, and his conclusions depend strongly on the phylogeny of both taxa, which has not been determined in either case by rigorous phylogenetic methods.

This volume does not exhaustively survey the subject; it is weaker on phylogenetic and genetic than on ecological approaches, it represents American work almost exclusively, and the chemical aspects, despite the title, are generally not explored deeply. It includes, however, some of the better work that is going on at present and will be a useful reference. If unity among the essays is not clearly apparent, that is a fair reflection of the subject, the threads of which have not yet been knitted into a theoretical fabric.

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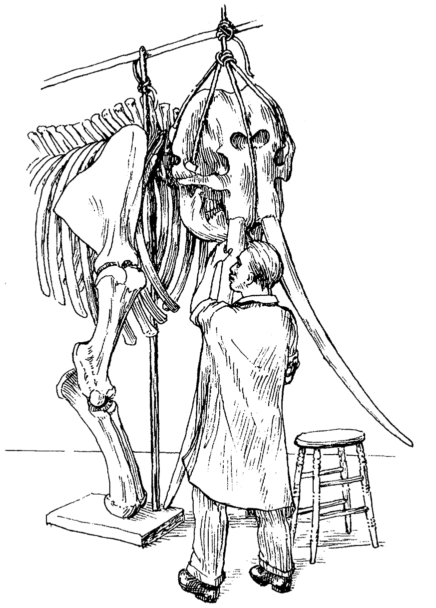
Working with Fossils

Digging into the Past. An Autobiography. EDWIN H. COLBERT. Dembner, New York, 1989 (distributor, Norton, New York). viii, 456 pp., illus., + plates. $25.

Edwin Colbert's second autobiography offers the reader more details of his personal life, interests, and motivations than the earlier *A Fossil Hunter's Notebook: My Life with Dinosaurs and Other Friends* (Dutton, 1980). His teachers, fellow fossil collectors, museum associates, and prominent acquaintances around the world are portrayed in vignettes and anecdotes. In particular, colleagues at the American Museum of Natural History, where Colbert spent most of his career, are delineated in a fashion that clearly recalls them to anyone acquainted with that institution. Some of the escapades of paleontologists, especially in the course of collecting fossils, make hilarious reading.

Colbert traces the circumstances, both serendipitous and planned, that shaped his career. A visit to the Field Columbian Museum in Chicago in 1922 introduced him to vertebrate fossils, and after a few years studying forestry and working in national forests he entered the University of Nebraska with the intention of becoming a paleontologist. Here he acquired the basics of fossil preparation, exhibition, collecting, and curation under the guidance of E. H. Barbour. After graduate study at Columbia University under William K. Gregory and service as assistant to H. F. Osborn, he spent more than a decade in "armchair" study of Asiatic fossil mammals collected by Roy Chapman Andrews's Central Asiatic Expeditions and by Barnum Brown in India and Burma. (Collecting had been severely restricted during the depression of the 1930s.) In 1942 upon Brown's retirement Colbert was appointed curator of fossil reptiles at the American Museum. He selected Triassic fossil vertebrates as a subject for research, and the discovery of the little dinosaurs on the Ghost Ranch in New Mexico in 1947 provided the springboard for a long series of studies of the reptiles and amphibians of the beginning of the Age of Reptiles, including collection of fossils on every continent, including Antarctica. His popular book on dinosaurs and the museum's public exhibition of these spectacular fossil reptiles further contributed to Colbert's growing reputation as an authority on dinosaurs.

His investigations of Triassic reptiles involved Colbert in problems of biogeography and the question of continental drift. He describes the steps by which he was converted from a staunch defender of continental stability to an even more enthusiastic advo-



"Mounting the fossil skeletons [at the University of Nebraska museum] was invaluable training for me since it gave me the opportunity to learn one phase of paleontological museum work that is not often available to students of the science." [From *Digging into the Past*]

cate of continental drift.

The museologist will be interested in Colbert's ideas on museum administration, based on problems at the American Museum. He provides an account of the establishment of the professional museum journal *Curator* and the problems of designing and installing the exhibits in two large halls devoted to dinosaurs.

Colbert stresses the importance of publishing the results of scientific collecting. Only on publication of the identification and description of a fossil "does it become a truly significant object." Colbert's own scientific work abundantly illustrates this precept.

Throughout his career his wife, Margaret Matthew Colbert, daughter of a distinguished predecessor at the American Museum and illustrator of many of his books, shared in his scientific endeavors. She accompanied him on most of his foreign excursions.

The historian of science should find many points of interest, not only in Colbert's own career but in his account of events leading up to a major shift in the ideas of geologists on the driving forces in geological history and on geographic patterns of past ages. His impressions of many leading scientists with whom he was acquainted are likewise of interest. General readers will find adventure, hardship, and the pleasures of discovery set forth in a highly readable account.

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Many-Body Theory

The Fractional Quantum Hall Effect. Properties of an Incompressible Quantum Fluid. T. CHAKRABORTY and P. PIETILÄINEN. Springer-Verlag, New York, 1988. xii, 175 pp., illus. $45. Springer Series in Solid-State Sciences, vol. 85.

The fractional quantum Hall effect was discovered experimentally in 1982. It was immediately recognized as a fundamentally new macroscopic manifestation of the quantum laws underlying electrical conduction in solid matter. Initially puzzling to theorists, it was explained in its essentials within a year by R. B. Laughlin with his proposal of a liquid wave function. This work spawned a number of novel concepts, most notably that of fractional charge—the idea that an interacting many-electron system could appear, for example, to consist of a two-dimensional gas of particles of charge equal to one-third of the charge of the electron. Because of this and other remarkable features, the theory of the fractional quantum Hall effect is often felt to be the most significant advance in many-body theory of this decade.

These initial breakthroughs have been followed by progress in experimental techniques; in particular, steady advances in semiconductor technology have improved the quality of the transport measurements that identify the quantum fractions. Theoretical progress has been made as well, especially in developing the hierarchy picture, which extends Laughlin's original work to most (though not all) of the currently observed quantum states. Much remains to be done, however. On the experimental side, the development of other measurements to complement the transport data, the extension to multilayer structures, and the clarification of the even-denominator fractions are most pressing. On the theoretical side, the issues associated with higher-order and even denominators, finite temperatures, and multilayers still need a great deal of work.

One virtue of Chakraborty and Pietiläinen's book is therefore its timeliness. The field has completed an initial phase in which the most fundamental issues have been identified and largely clarified. This means that there is plenty of material for a full-length monograph. There has now come a realization that there are a number of interesting and rather diverse research paths to be followed. Any theoretical physicist who wants to be involved in these efforts needs a thorough grounding in the basics. This new book offers that.

The three main computational methods of the field—exact diagonalization of small systems and Monte Carlo and diagrammatic methods—are each explained in detail. Particularly welcome is the exposition of the "hypernetted chain" approach, which has never received a unified and clear treatment in the context of the Hall effect. The book explains the well-established applications to various aspects of the problem—the ground state and its excitations, both quasiparticle and collective. The authors discuss spin-reversed states at considerable length, a welcome choice of topic because of the experimental discovery of these states since the book was written. In sum, all of the topics for which there are firm results are covered, and covered in detail sufficient to equip anyone who has digested the contents for beginning research.

This book invites comparison with the only other comprehensive survey of the field, the second half of *The Quantum Hall Effect*, edited by R. E. Prange and S. M. Girvin. Chakraborty and Pietiläinen's focus is narrower in that they discuss theoretical issues mainly on the level of internal consistency and technical detail and mostly ignore broader implications. This is perfectly appropriate in a very specialized treatise, but the air does get a bit thin at times. Still, one could contend that this makes a good contrast and complement to the earlier book, which offers a much broader perspective. Prange and Girvin is still the best place for a beginner to start.

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Immunogenetics

Immunoglobulin Genes. T. HONJO, F. W. ALT, and T. H. RABBITTS, Eds. Academic Press, San Diego, CA, 1989. xviii, 410 pp., illus. $79.50.

One could argue that immunoglobulin genes and proteins, their structure, function, and expression, are the most intensively studied gene-product system in biology. Of course, several other genes and proteins have also been studied in detail (for example, α- and β-globin), but none displays the specificity and diversity of immunoglobulins or the programmed DNA rearrangements of immunoglobulin genes. Simply, immunoglobulin (or antibody, the alternative term) genes have been investigated more because there is so much more to investigate. This wealth of experimental results is summarized in *Immunoglobulin Genes*.

There are several characteristics of immunoglobulin expression that make it interesting. An individual mammal can produce more than ten million different immuno-