ESSAY REVIEWS

Vic Baker, Book Review Editor

THE BONE SHARP: THE LIFE OF EDWARD DRINKER COPE. *Jane Pierce Davidson. 1997. The Academy of Natural Sciences of Philadelphia. 237 p. Softcover, $25.00.*

THE BONEHUNTERS' REVENGE: DINOSAURS, GREED, AND THE GREATEST SCIENTIFIC FEUD OF THE GILDED AGE. *David Rains Wallace. 1999. Houghton Mifflin Company. 366 p. Hardcover, $25.00.*

THE GILDED DINOSAUR: THE FOSSIL WAR BETWEEN E. D. COPE AND O. C. MARSH AND THE RISE OF AMERICAN SCIENCE. *Mark Jaffe. 2000. Crown Publishers. 424 p. Hardcover, $25.00.*

The second half of the nineteenth century was a golden half-century for vertebrate paleontology in America. Government surveys and the expanding railroads provided access to fabulously fossil-rich strata in the western half of the continent, and the Darwinian revolution provided a new and compelling scientific context for the fossils that lay imbedded there. For several decades following the Civil War—as enormous fossil dinosaurs, tiny fossil horses, and fossil birds with teeth rolled eastward on the Kansas Pacific, the Union Pacific, and the Atchison, Topeka, & Sante Fe railroads toward New Haven and Philadelphia—paleontology was the premier American science.

This set of circumstances produced two extraordinarily talented and productive scientists—Othniel C. Marsh (1831–1899) and Edward Drinker Cope (1840–1897). Marsh was the well-connected, Yale-educated nephew of millionaire banker George Peabody, whose donations to Yale funded construction of the Yale Peabody Museum and helped secure for Marsh a professorship at Yale, the first professorship in paleontology in America. Cope came from a wealthy Philadelphia Quaker family. Although he had virtually no college-level education, Cope's family connections helped him obtain a professorship at Haverford College, a Quaker college near Philadelphia which his grandfather had helped found. Joseph Leidy, the founder of vertebrate paleontology in America (and "the last man who knew everything"), was Cope's very capable mentor at the Philadelphia Academy of Natural Sciences, helping Cope become something of a wunderkind of American science.

Cope and Marsh first met one another in Berlin in 1863, where both were waiting out the resolution of the Civil War. At first, their relationship was apparently amiable. In 1867 Cope named a fossil amphibian *Ptyonius marshii,* in Marsh's honor, and the following year Marsh named a mosasaur *Mosasaurus copeanus.* Their falling out apparently began in 1869. During that year Cope completed his biggest paleontological project to date, the description and reconstruction of a 35-foot-long Cretaceous plesiosaur from Kansas that he named *Elasmosaurus platyurus.* He published a major paper about it, illustrated with lithographic plates, in the *Transactions of the American Philosophical Society.* Marsh came to Philadelphia to examine Cope's spectacular fossil, and, as Marsh later told the story, "I noticed that the articulations of the vertebrae were reversed." Cope, who was only twenty-nine years old and still establishing his reputation, had mounted the head on the wrong end of the skeleton. Rather than

reconstructing the animal with a long, flexible neck and a short tail, he had done it the other way around. Cope was mortified at his mistake, and he attempted to buy up all of the published copies of the *Transactions* which contained his article. He paid to have the issue republished with the correct reconstruction of *Elasmosaurus,* but without any acknowledgment that a mistake had been made. The relationship between Cope and Marsh went downhill from there, culminating twenty years later in a no-holds-barred, public airing of their low opinions of one another in the *New York Herald* in January of 1890.

The basic story of the fossil war between Cope and Marsh is well known, but book-length, scholarly treatments of these men and their science have been surprisingly few. Henry Fairfield Osborn, who was a Cope protégé, in 1931 published *Cope: Master Naturalist,* which was largely financed by Cope's daughter. Osborn's sympathetic portrayal of his mentor prompted a Marsh student, Charles Schuchert, to write *O. C. Marsh* (co-authored by Clara M. Le Vene), published in 1940—a correspondingly sympathetic biography of Marsh. So, the Cope-Marsh feud lingered well into the twentieth century in the form of sanitized biographies. As far as I am aware, prior to the publication of the three books under review here, only one other book was published in which the main focus was Cope and/or Marsh. That was *The Fossil Feud Between E. D. Cope and O. C. Marsh,* by Elizabeth N. Shor, published in 1974 by Exposition Press, a book that I have not read.

So, after a long drought, three new books appeared between 1997 and 2000 that examine the lives, works, and motivations of these fascinating men. Apparently through a convergence of coincidence and centennial commemorative forces, these three books were published over a time span that was almost exactly one hundred years after the interval in which Cope and Marsh died. Cope died in 1897, and Marsh died in 1899.

The Bone Sharp, by Jane Pierce Davidson, is the most overtly scholarly of the three books. Davidson is an art historian who became interested in Cope while researching Flemish paintings that depict stuffed specimens of iguanas. Davidson's attempts to identify the species of iguanas in the Flemish paintings led her to works by Cope, who described many species of extant reptiles. Cope himself ultimately became more interesting to Davidson than were the iguanas. Finding that the only biography of Cope was the one by Osborn—which is largely an annotated collection of Cope's personal letters—she resolved to write a more balanced account of Cope's life and work.

Because Davidson's book is only the second biography of Cope, she felt obliged to point out how Osborn had gotten the story wrong. As Davidson states in her introduction, "My study . . . is also of necessity a book about Henry Osborn and how Osborn treated his friend's memory." Both Osborn and Davidson were handicapped by the fact that nearly all of the surviving personal letters are those written by Cope himself, with almost none written *to* Cope. This is especially frustrating with regard to correspondence between Cope and the members of his family. He apparently received many letters from his wife and daughter during his many long field campaigns in the west, for example, but only his responses have survived. Davidson suggests that Cope's widow and/or daughter destroyed many letters, to protect family privacy and Cope's reputation, before donating the remaining Cope documents to the American Museum of Natural History. Osborn's *Cope: Master Naturalist* was based on the AMNH collection of letters, along with Osborn's own personal notes and recollections. Davidson was able to locate many additional Cope family documents which she used to flesh out Cope's life.

Davidson's approach is thematic, rather than being completely chronological. Following some opening chapters about Cope's boyhood and his early formative years as a paleontologist, she devotes a chapter to the Cope-Marsh conflict, an-

other chapter to Cope's relationship with his wife and daughter, another chapter to the views of his contemporaries, another to "what happened at the end," and a final chapter is devoted to Cope's views on human evolution, society, and religion. In order to grapple with the life of a person as complex as Edward Drinker Cope, this is an appropriate approach, and it makes Davidson's book a useful reference book. One can, for example, go straight to the chapter on the Cope-Marsh war, or the chapter on Cope's views on human evolution, society, and religion, for a readable summary of that aspect of Cope's life. Three appendices add to the book's reference value; these are (1) a Cope family genealogy, (2) a list of correspondence between Cope and Ferdinand Hayden, housed at the University of Wyoming, and (3) a glossary of some important people in Cope's life.

The negative side of the thematic approach, is that all of the parts of Cope's life are not fully integrated. We don't get any sense, for example, of how Cope's neo-Lamarckian views on evolution may have been influenced by his paleontological research, and vice versa. I found some themes to be overdeveloped, while others are underdeveloped. For example, Davidson obviously took a very keen interest in Cope's life with his wife and daughter, and in Cope's reputation for womanizing while away from home. She painstakingly analyzes any and all references to women in Cope's letters, seeking clues to possible romantic relationships. Letters from Cope mentioning a "Miss Collins" of South Dakota are quoted, dissected, and psychoanalyzed, with the conclusion that "I strongly suspect her of having been a lover." At the other extreme, there is no mention at all in this book (or in the other two books under review, for that matter) of the phenomenon known as "Cope's rule," which says that average body size in any lineage of organisms gets bigger over time. I would much have preferred to have gained insight into the formulation of Cope's rule than into Cope's possible dalliance with Miss Collins of South Dakota.

However, Davidson does make an important contribution to clarifying the cause of Cope's death. There has been a widely circulated rumor that Cope had contracted syphilis which he had tried to treat by injecting his genitals with formalin, thereby killing himself. It is apparently true that he injected himself with formalin, as supported by a letter from Osborn to Cope, advising Cope to "find some less hardening medium of remedy and relief." But he apparently did not have syphilis. Davidson was able to arrange for a forensic and radiological examination of Cope's skeleton. Cope had directed that his skeleton, along with his brain, be preserved and available for scientific study. The skeleton showed "no evidence of bony syphilis," which would have been present if Cope had died of this disease.

Davidson's book is certainly an important and welcome contribution to the scholarship on Edward Drinker Cope. Unfortunately the book was not carefully proofread, and there are many typographical errors and sentences that needed an editor's pencil. These are a minor annoyance. Much more serious is the absence of an index, which is completely inexcusable and renders the book much less useful as a reference book than it otherwise could have been. The book does contain numerous, detailed endnotes which will be useful to the serious scholar.

Both *The Bonehunters' Revenge* and *The Gilded Dinosaur* are parallel scientific biographies of Cope and Marsh. Both are well-researched, well-written, essentially popular accounts of the lives and work of Cope and Marsh. David Rains Wallace, the author of *The Bonehunters' Revenge,* is a writer-historian. Although he had no prior experience with paleontology or the history of geology, he visited many of the field sites where Cope, Marsh, and their hired collectors worked, and he tells their story well.

Wallace's most significant contribution to the literature on the Cope-Marsh feud, and on the history of nineteenth-century paleontology generally, is his in-

sightful exploration of the role of the press. Wallace's story has three protagonists—Cope, Marsh, and James Gordon Bennett, Jr., owner and publisher of the *New York Herald* in the late nineteenth and early twentieth centuries. It was Bennett's newspaper that published the 1890 exposé that attacked Marsh and John Wesley Powell. Powell was the director of the U.S. Geological Survey at the time, and Marsh was the survey's chief vertebrate paleontologist and president of the National Academy of Sciences. The initial article, which was written by an ally of Cope, was followed by multiple rounds of published responses and countercharges, ultimately involving many prominent paleontologists. The political backdrop for this tragi-comedic scene was a Congress that was questioning the size of the USGS's budget and specifically the appropriateness of publicly funded paleontological research. The *Herald* exposé transformed the antagonistic relationship between Cope and Marsh from a private feud into a public spectacle, and it was bad press for geology and paleontology. Congress ultimately cut the USGS's budget, including Marsh's funding. Wallace portrays James Gordon Bennett, Jr. as the cynical businessman who manipulated the naïve scientists into airing their dirty laundry in public so that he could sell newspapers.

Mark Jaffe, author of *The Gilded Dinosaur,* is a science writer for the *Philadelphia Inquirer,* but newspapers are not a big part of his story as they are in *The Bonehunters' Revenge.* As suggested by his subtitle—the fossil feud between E. D. Cope and O. C. Marsh and the rise of American science—Jaffe pays more attention to how the Cope-Marsh saga fits into the evolution of American science in the late nineteenth century. For example, he examines Cope's neo-Lamarckian views on evolution in more detail than do either Wallace or Davidson. His book is the longest of the three, and his accounts and descriptions generally have more detail and texture.

Each of these three books is a welcome addition to the literature on the history of paleontology in nineteenth-century America. *The Bone Sharp* breaks the most new ground, but it is the least engaging for the non-specialist. *The Bonehunters' Revenge,* because of its emphasis on the role of the press, is the one to read for the person who is especially interested in the relationship between science and popular culture. And, for the earth scientist or general reader who wants to enjoy a good story as well as acquire a better understanding of science and politics in America in the late nineteenth century, I recommend *The Gilded Dinosaur.*

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THE OXFORD COMPANION TO THE HISTORY OF MODERN SCIENCE. *J. L. Heilbron, et al., eds. 2003. Oxford University Press, Oxford, U.K. 941 p. $110.00.*

THE OXFORD COMPANION TO THE EARTH. *Paul L. Hancock and Brian J. Skinner, eds. 2000. Oxford University Press, Oxford, U.K. 1174 p. $75.00.*

An encyclopedia is a gargantuan task, but not a thankless one. Having produced one—*Sciences of the Earth: An Encyclopedia of Events, People, and Phenomena* (New York: Garland Publishing, 1998), 901 p.—I identify with the editors of the two volumes here reviewed. Indeed, their volumes and mine comprise a natural grouping. Mine focuses directly on the history of geoscience. *The Oxford Companion to the History of Modern Science,* written from the general viewpoint

of the development of science since the Renaissance, places the history of the earth sciences among those of biology, physics, and so on. *The Oxford Companion to the Earth,* primarily intended to bring together the state of the art in many geosciences, shows the results thus far of that development and includes a serious focus on historical questions. I wish to address in this essay the utility and importance of these two volumes for anyone interested in the history of modern geoscience. Of course, I will also say a few things about the limitations of both volumes for scholars whose interests are indicated by this journal. My reading of these books, however, is tempered by an important principle. One should always take into account in a review the purpose the author or editor had in producing a work. Hence, both volumes also deserve reviews in other journals that evaluate them based on their own primary concerns, to which history of the geosciences is secondary.

The *Oxford Companion to the History of Modern Science* ranges broadly over "Major" and "Minor" subject divisions from alchemy to zoology. (The "Thematic Listing of Entries" is at the front of the volume, on pp. xxiii–xxviii.) Alongside the disciplines of physics and biology, we find essays on cartography, earth science, geography, geology, meteorology, mineralogy and petrology, natural history, and oceanography. Michael Dettelbach, a superb choice for the article "Geography" (pp. 335–338), makes clear the importance of a science which is sometimes given short shrift in history of geoscience. Rachel Laudan, well known to historians of geology, acted as one of five editors on this project and also wrote many of the geo-articles. In particular, she wrote "Earth Science" (pp. 226–227), "Geology" (pp. 338–340), and "Geophysics" (pp. 340–341), as well as biographical and conceptual articles. Her focus in these three articles is mainly on study of the solid Earth and in the later twentieth century on plate tectonics, although she briefly mentions oceanography and the International Geophysical Year. To learn about other aspects of these sciences related to the atmosphere, oceans and hydrology, or near-space, one has to seek out other articles. Within the boundary that Laudan defined, however, these articles offer accurate and competent overviews and a few challenges to future scholars. As she notes at the end of "Earth Science": ". . . as yet we have no comprehensive history of the disciplinary change to earth science" (p. 227). It's time for someone to write it.

The article "Oceanography" (pp. 598–600) by Fritz F. Rehbock and Gary Weir and Theodore S. Feldman's article "Meteorology" (pp. 518–519) are notable because they treat the non-solid Earth, that is Earth's fluid envelopes. The articles "Space Science" (pp. 767–769) by David DeVorkin and "Ionosphere" (pp. 423–424) by this reviewer also broaden the perspective from the solid Earth. All of the disciplinary articles provide well-executed overviews of the histories of these areas. In all cases, Laudan and the other editors have recruited appropriate authors, well known for their scholarly work in the areas of their assignments.

Beyond the articles focused on particular disciplines are others that concern particular theories, instrumentation, institutions, application, and other topics of interest to historians of the geosciences. Among the "Theoretical Constructs" that merit articles are "Climate Change and Global Warming" (pp. 157–158) by Feldman, "Earth, Age of" (p. 224) by Joe D. Burchfield, and "Mohole Project and Mohorovičić Discontinuity" (pp. 541–542) by Joanne Bourgeois. There are two dozen articles dealing with geo-theories. Among the articles on "Apparatus and Instruments" are a number that at least have application in geoscience: "Barometer" (pp. 80–81) by Feldman, "Exploration and Field Work" (pp. 288–290) by Simon Naylor, and "Instruments, Surveying" (pp. 415–417) by Jim Bennett. Perhaps a few instruments specifically from the earth sciences would have been appropriate: seismometers, gravimeters, and goniometers, for example. But of

course, these instruments might be discussed in related articles and it is unfair to suggest that such a large volume should have been made even larger!

The "Uses" category is perhaps the weakest in its consideration of the geosciences, perhaps an unexpected situation given the importance to twentieth-century society of, for example, mapping, mining, and meteorology. Nevertheless, there are articles on "Metallurgy" (pp. 514–515) by Susan T. I. Mossman, "Navigation" (pp. 567–568) by Bennett, and "Radio and Television" (pp. 699–701) by W. D. Hackman. The perspective of the first and last articles, however, was not mainly on the connections of these applications to the geosciences.

This volume does somewhat better in its consideration of both "Institutions" and "Biographies." Although not even Lamont Earth Observatory or Woods Hole Oceanographic Institution have their own articles, there are general articles on "Cabinets and Collections" (pp. 117–119) by A. J. Lustig, "Meteorological Station" (pp. 516–518) by Feldman, "Mining Academy" (p. 534) by Laudan, and "Oceanographic Institutions" (pp. 596–598) by Margaret B. Deacon. Likewise, while Vilhelm Bjerknes, H. U. Sverdrup, A. G. Werner, and Alfred Wegener did not have targeted biographies, they are discussed in appropriate topical articles. Among the geoscientists who do gain the spotlight are Cuvier and Lamarck (together, pp. 193–194) by Pietro Corsi, Alexander von Humboldt (pp. 383–384) by Kathryn Olesko, and James Hutton (pp. 387–388) and John Wesley Powell (pp. 671–672) by Laudan.

The Oxford Companion to the History of Modern Science will prove valuable to several different audiences in different ways. First, since it will be found primarily in university libraries, it will serve students with introductions to the history of many modern sciences. I will certainly send my students to its pages. Second, historians of other modern sciences may use it as a basic indicator of how the earth sciences relate to sciences they write about. And lastly, historians of earth sciences will be wise to peruse the non-geo-articles. This is especially important for geoscientists who are just beginning a historical project and who might not be so familiar with the methods and standards of history of science. About one hundred articles concern topics in historiography. Just as one would not expect a geologist to conduct research without a grounding in field or lab techniques, one should not expect historical investigators to "do history" without an understanding of historiography. (A mirror image comment applies to historians with regard to *The Oxford Companion to the Earth,* below!) The articles "Scientific Revolution" (pp. 741–743) by H. Floris Cohen and "Humboldtian Science" (pp. 385–387) by Olesko clearly can provide perspective, but many others can, too.

In sum, *The Oxford Companion to the History of Modern Science* is an excellent reference work that every research library and many scholars should have on their shelves. The editors and the 217 authors who "historicised" the science of the last five hundred years deserve deep appreciation. Any criticisms are minor and by no means negate the overall value of the volume.

Turning to the second volume under review, I must note that this volume was reviewed by Gretchen Luepke Bynum in **Earth Sciences History,** 2002, 21: 88–89 and that my comments below are intended to examine this volume in contrast with *The Oxford Companion to the History of Modern Science. The Oxford Companion to the Earth* presents a wide array of articles on the Earth, its physics, chemistry, biology, and its history. Articles in it from a physical perspective include "General Circulation of the Atmosphere" (pp. 384–386) by Charles N. Duncan and "Earth Tides" (pp. 280–281) by Frank D. Stacey. Geochemical articles range from the obvious and useful "Geochemical Analysis" to articles on "Oceanic Salinity" (pp. 742–743) by Ian R. Hall, "Redox Equilibria" (pp. 882–886) by M. Sato, and "Methanogenesis" (p. 679) by R. John Parkes.

No geoscience, it seems, is omitted: geology, geophysics, geodynamics, planetary science, space science, stratigraphy, palaeontology, palaeogeography, geomorphology, climatology, oceanography, and on. Did I forget anything? I don't think the editors did. Altogether there are more than nine hundred entries by about three hundred authors. There is no better place to look first than this volume if you need to get an introduction to an aspect of geoscience beyond your own. The longer articles include suggestions for further reading.

Moreover, the utility of this volume goes beyond its summation of contemporary geoscience. It is remarkable to find a science compendium like the *Oxford Companion to the Earth* with so significant an awareness of history. Among the "Thematic Lists" (at the back of the volume, on pp. 1129–1134), the section "Earth sciences: general" includes thirty-one topics placing the science in broader contexts. The articles in this group with a historical perspective include "Classical times and the Earth sciences" (pp. 114–115) by D. L. Dineley (the volume's associate editor), "Geological Controversies" (pp. 404–406) by Anthony Hallam, and "Museums and Geology" (pp. 716–717) by Simon J. Knell. Meanwhile the section "Earth sciences: historical" includes dozens of biographies of famous geoscientists and about a dozen thematic essays. David L. Dineley wrote many articles in both of these categories, including: Agricola (p. 11), Cuvier (p. 203), and Hooke (p. 515), as well as "Beginnings of Geological Thought" (p. 68), "Medieval Mineralogy and Figured Stones" (p. 665), and "Specialization in the Earth Sciences after the Second World War" (pp. 995–996). Indeed, only a few of the biographies were *not* written by Dineley!

More biographies are listed in other categories in the "Thematic Lists." These include Croll, Lamb, Milankovich, Urey, Dutton, Bullard, and Blackett. Most of these are a column or less, so they lack the room to explore open questions or provide deeper context. Still, they provide some basic information about these important individuals. Given that hundreds or perhaps thousands of individual geoscientists might merit inclusion, it would be unfair and unrealistic to criticize the editors for their selection. The list slants a bit toward geologists and somewhat slights oceanographers, meteorologists, and a few other groups. This emphasis is moderated slightly in the articles related to particular problem areas or disciplines, which frequently interject biographical asides. One shortcoming is that the biographical articles make no suggestions for further reading, but a better source for this might be the other *Oxford Companion* (above) or my own *Sciences of the Earth* (1998).

Readers will also want to know what to expect in the historical essays. These vary in length and quality. Andrew S. Scott's "Art and the Earth Sciences" (pp. 38–42) is rather longer, quite stimulating, and up-to-date. Likewise, Dineley's "Catastrophism and Uniformitarianism" (pp. 101–104), is valuable, especially for placing the recently renewed debate in historical context. Some historians and a number of scientists known for their sustained interest in history of science are counted among the volume's authors: Victor R. Baker, Allan Chapman, David Gubbins, Rom Harré, Jill S. Schneidermann, and C. R. Twidale, and those mentioned earlier. Nevertheless, one must read all historical comments and evaluations with the same critical care taken with scientific interpretation.

Of course, this isn't a historical encyclopedia. Its greatest value is in providing entrée to so many topics in contemporary geoscience. While the articles could guide readers to more critical sources, they nevertheless provide historians and other scholars with good technical explanations of observation programs, theories, and more, concerning a broad range of earth sciences, with a good degree of historical awareness. Just as it is crucial for scientists entering historical writing to become adept at and informed about the methods and standards of history, it is essential that historians inform themselves about science, its methods, and its

results. While it might not be critical that every scientist understand the details of every historiographic issue, they need to know about those that do impinge on the history they are writing. Likewise, while historians won't need to understand every aspect of contemporary geoscience (and who could anyway?), they do need to understand areas of science related to what they write about. It may be that they need to understand geology ca. 1850 and not 2003, but it still won't hurt to know what is going on today. *The Oxford Companion to the Earth* provides ready access to a broad range of these contemporary geosciences. This volume treats not just geology, but the atmosphere, meteorology, climate, economic geology, environmental science, geochemistry, hydrology, oceanography, planetary science, and much more.

In the editorial in *Earth Sciences History* (2003) vol. 22, no. 1 (p. 1) the reviewer noted the favorable comment by Rachel Laudan in *The Oxford Companion to the History of Modern Science* that this journal is "now the major journal for the history of geology and earth science." (p. 227). It is perhaps apt to quote, as well, the comment in *The Oxford Companion to the Earth* (p. 412), namely, that the "final word" on the history of geology and geological societies "will perhaps one day be pronounced by the History of Earth Sciences Society . . ."! While we express our appreciation for this compliment by Bruce Wilcock, we should humbly remember that there are many more people writing history of geoscience who have yet to publish within our covers! The fact that both of these *Oxford Companions* have commented on HESS and *Earth Sciences History,* however, indicates that we are coming of age.

These two volumes are hefty, as their grand subjects require. Both are termed "Companions." The "Earth" volume starts by saying "A true companion should be a person with whom or an object with which one feels comfortable, and to whom, or to which, one can turn for advice and counsel." These volumes certainly will provide advice and counsel, but how any work one thousand pages long on heavy paper can feel comfortable, I'll never know. Let's just say I won't be reading these companions while lying in the hammock! When I'm working at my desk, however, they will be constantly at my side.

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BOOK REVIEWS

Vic Baker, Book Review Editor

THE RHINE: AN ECO-BIOGRAPHY, 1815–2000. *Mark Cioc. 2002. University of Washington Press. 272 p. Cloth, $29.95.*

Shortages of potable fresh water have been identified as one of the major environmental crises of the twenty-first century. Freshwater species are vanishing at rates similar to those of tropical rainforest species, and loss of riparian habitat is widespread and severe in urbanized, industrialized nations. Within this context, the importance of rivers as ecosystems, and the importance of river conservation and rehabilitation, are increasingly emphasized by industrialized countries. However, as Mark Cioc discusses in his eco-biography of the Rhine River, it is proving very difficult to restore and rehabilitate rivers that have been impacted by centuries of human land use.

The Rhine is one of the major rivers of western Europe in terms of economic importance, resource supply, and regional identity. Although not large by world standards, the Rhine has been vital to the economic development of France, Germany, Switzerland, and the Netherlands. Unfortunately, the modern Rhine reflects this history of economic development, and has been called "Europe's romantic sewer." Cioc traces this history of regional economic development and human impacts to the river ecosystem in detail. He attributes many of the nineteenth- and twentieth-century alterations in the river to the 1815 Congress of Vienna, at which European diplomats "created an overarching blueprint for improving the Rhine as a navigational and commercial artery, but no corresponding one to protect it as a biological habitat." This partly reflected contemporary attitudes that rivers were, at best, imperfect or defective systems capable of improvement, and at worst potential "enemies" of humans in need of being "domesticated," "tamed," or "harnessed."

A few brave voices spoke out against this attitude. Fishermen and farmers protested the fouling of the river and its floodplain, as well as the loss of fish stocks. Biologists and appreciators of natural landscapes protested the deliberate "sacrifice" of valuable river ecosystems that were often undertaken with flimsy economic pretexts. But commercial and governmental attitudes largely favored active river engineering at the expense of any protection of the river's natural functions until conditions became so bad in the late twentieth century that even laissez faire economists and politicians began to take notice.

After tracing the history of negative impacts to the river, Cioc devotes the final chapters of the book to assessing rehabilitation attempts that have had limited, but heartening, success. He uses the legend of the sorcerer's apprentice as a metaphor to describe how "humans are easily seduced by solutions that promise a quick fix but end up delivering results laden with unforeseen peril," then ends the book on a note of limited optimism.

The book is nicely produced, with clear and useful illustrations, extensive end notes and bibliography, and few typographic errors. It is also well written and provides an interesting and important case study for anyone concerned with how humans can best interact with rivers in the coming decades. Although specific to the Rhine River, the history described here has many similarities and insights to rivers elsewhere in the world, and I expect to see more such eco-biographies

of rivers in years to come. I was disappointed in the lack of photographs of the Rhine landscape. I also missed a strong scientific background on the river. Cioc includes some details of geomorphology, hydrology, and aquatic ecology as the book proceeds, but the reader has to pick up this information piece-meal. Many biographies of human subjects begin with some background on the subject's ancestry, and an analogous section describing the physical, chemical, and biological characteristics of the natural Rhine prior to industrialization would have provided a clearer perspective on the characteristics and downstream variety of the river. Despite this lack, Cioc's eco-biography of the Rhine is a timely, informative, and readable book.

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WALTER GRANGER, 1872–1941, PALEONTOLOGIST. *Vincent L. Morgan and Spencer G. Lucas. 2002. Bull. 19, New Mexico Museum of Natural History and Science, 58 pp.*

NOTES FROM DIARY—FAYUM TRIP, 1907. *Vincent L. Morgan and Spencer G. Lucas. 2002. Bull. 22, New Mexico Museum of Natural History and Science, 148 pp.*

Quick! Who was the key collector and paleontologist during the American Museum of Natural History's famous Central Asiatic Expeditions (CAE) to the Gobi Desert, in the 1920s? And who found those amazing dinosaur eggs, along with rich hordes of dinosaur and mammalian fossils? If you said Roy Chapman Andrews, it would be understandable. But the correct answer is Walter Willis Granger (1872–1941). Granger was as quiet and modest as Andrews was attuned to attention, and his name has submerged from view in the decades since his death. Morgan and Lucas present a valuable overview of Walter Granger's life and times, as they attempt to unearth his many important contributions to vertebrate paleontology and expose the reasons that his name is now known to very few people. The authors do not cross over into the realm of blatant hagiography, but they do present a powerful case for historians and geoscientists taking more notice of the quiet New Englander who spent so much time in the field, from Wyoming to the Fayum Desert of Egypt to Central Asia.

Granger, like Charles Schuchert of Yale, rose to the pinnacle of his profession without college or graduate-school experience. Recognized early on as an exceptional naturalist and taxidermist, the Vermont-born youth of seventeen was invited to become an assistant taxidermist at the American Museum of Natural History (AMNH). (Yes, family contacts did play a role in this unlikely scenario.) It was then a case of quality rising, as Granger learned from a series of masters; Barnum Brown, William D. Matthew, and Henry Fairfield Osborn are but three of his early co-workers and mentors. Granger became an associate curator (1911) and then Curator of Fossil Mammals (1927) at the museum. But it was not in New York City that he made his real contributions to the discipline of vertebrate paleontology. Morgan and Lucas present a well-narrated and well-illustrated account of Granger's field seasons in the American West (1890s and early twentieth century), the Fayum Desert of Egypt (1907), and the Gobi Desert and Central Asia (1921–1930).

Dinosaur remains, including egg fragments, the giant flightless bird *Diatryma,* and numerous Eocene mammals, were among the American materials Grang-

er collected and curated for the museum. The Fayum Expedition yielded Cenozoic treasures, ranging from proboscideans to primates. And, as is widely known, thanks in part to Michael Novacek's contemporary accounts, the Gobi and Central Asia continue to provide exceptional insights into Upper Mesozoic dinosaurian paleontology. Granger and his team found *Velociraptor, Oviraptor,* and *Protoceratops,* along with those famous eggs and nests. Tertiary finds included *Baluchitherium grangeri,* the world's largest terrestrial mammal. And Granger worked at the Zhoukoudian (Chou-Kou-Tien) site, celebrated by Pierre Teilhard de Chardin and others as the home of "Peking Man" (an example of *Homo erectus*). The authors do a good job of introducing Granger's co-workers, specifics of the paleontology and stratigraphy, and interesting background on the regions and the eras. For example, we learn just how dangerous field work was in Southern China during the time of banditry and warlord reign, and it is revealed that Roy Chapman Andrews really *was* on contract with the U. S. Navy's Office of Naval Intelligence as an "information gatherer" in China. (Andrews as the real-life model for Indiana Jones takes on new dimensions!)

The first volume (Bulletin 19) serves as an excellent introduction to Walter Granger, as a person and as a paleontologist. Many of the 141 notes provide valuable supplements to the chronologically arranged, but not dry, text. A strong reference section is included, as are Appendix A, a bibliography of Granger's works, and Appendix B, a concise listing of the American Museum of Natural History expeditions undertaken by Granger. Bulletin 19 should appeal to professional paleontologists interested in knowing about the foundations of their discipline, as well as historians wishing to know more about the person of Walter Granger, an institution (AMNH), and a bygone era. In fact, anyone open to adventure and seeing evocative illustrations of past times and places will enjoy the book.

The second volume (Bulletin 22) is of historical interest by its very nature. Although nicely supplemented with information provided by the authors, the bulk of the text is Granger's own day-by-day diary of the productive AMNH trip (1907) to the Fayum Desert of Egypt. This was well before Elwyn Simons brought the region to popular attention with his *Scientific American* articles in the 1960s, recounting the significance of the Fayum in illuminating hominid evolution. Morgan and Lucas do a good job explaining why Henry Fairfield Osborn, the powerful administrator of the AMNH's section on vertebrate paleontology, wanted to go to the Fayum, and also why the Museum's staff did not go back. They also explain why contemporary readers should understand more fully the trials and triumphs of the important but little-known expedition.

The narrative does an excellent job of generating a sense of time (1907), place (Egypt), and era (including colonial activities of the British, French, and Germans). The 226 notes provide insights into a rich cast of characters and an impressive amount of contextual information. Every person who interacted with the expedition, whether scientifically or politically, receives biographic treatment, including dates, institutions, and contribution to the goals of the trip. Readers also learn about the American Museum of Natural History and vertebrate paleontology at the turn of the twentieth century. The illustrations themselves offer evocative visions of field work in "exotic" and trying conditions almost a century ago. Appendix A (pp. 69–141) allows the interested reader to interact with Granger's own handwritten notes; Appendix B is Granger's brief "Report on the Expedition"; and Appendix C is a nicely illustrated article on "Hunting the Two Million Year Old Elephant," as reproduced from the *Illustrated London News* of 7 March 1908.

It is evident that the authors worked hard to incorporate relevant details about personages and the significance of the biota found on the expedition. The editors

did an excellent job minimizing typographic errors, ensuring strong narrative flow, and selecting text-supporting illustrations. The two bulletins can be read as "stand alone" books, but that means that there is some overlap in illustrations and general points made. The Fayum tome should appeal to a wide spectrum of geologists, paleontologists, historians, and inquisitive members of the general public.

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LATITUDE: HOW AMERICAN ASTRONOMERS SOLVED THE MYSTERY OF VARIATION. *Bill Carter and Merri Sue Carter. 2002. Naval Institute Press, Annapolis, MD. 252 p. $1871 (Naval Institute member) or $24.95 (non-member).*

At the end of the prologue, the authors of *Latitude* term the book "the story of one of the first great contributions to astronomy by American scientists," (p. 21), but I see it also as a story of geophysical research. The "variation" in the title is the variation of latitude of a point on Earth over time due to Earth's rotation. (More on this later.) Bill and Merri Sue Carter explain how a phenomenon that was at first a perplexing annoyance became recognized as a real phenomenon, an astronomical, geophysical spin-off, so to speak. Many now call this phenomenon Chandler's wobble.

The main characters in this story—Seth Carlo Chandler, Jr. (1846–1913), Benjamin Apthorp Gould (1824–1896), and Simon Newcomb (1835–1909)—may not be well known to historians of geology. Some of the background characters are better known: Leonhard Euler (1707–1783) and Pierre Simon Laplace (1749–1827), in particular. I find it remarkable that the story of the discovery of the variation of latitude has not been told before now, so I strongly appreciate the task that the authors have undertaken.

Seth Chandler stands at the center of this story. Son of a successful merchant—a practical, Yankee trader—Chandler was noticed in high school by Benjamin Peirce, a professor at Harvard, who hired him as a computer when he was fifteen years old. Soon thereafter, in the mid-1860s, Peirce recommended Chandler to Benjamin Gould, who directed the U.S. Coast Survey's telegraphic longitude program. Gould provided Chandler's entry point into the most active scientific bureau in the U.S. government at the time. The Coast Survey provided Chandler's technical education. Here he learned the latest in practical mathematics useful in reducing latitude and longitude data, as well as how to use instruments such as chronometers and zenith telescopes. Indeed, while still a very young man he began re-designing his instruments.

A clear geophysical lineage emerges in this story, although the authors do not especially stress this thread. Peirce was involved in the geomagnetic crusade and later directed the Coast Survey with its wide variety of geophysical research. When Gould was young he met and worked with George B. Airy, J. B. Biot, and François Arago. Gould even enlisted Alexander von Humboldt to convince Carl Gauss to accept him as a student. All of these investigators took active interests in geodesy, geomagnetism, and other geophysical investigations. Gauss, for example, invented many of the basic mathematical theories for these investigations, as well as the algorithms and procedures that allowed armies of computers to undertake the voluminous calculations on which geophysics rests. He developed spherical harmonics and the method of least squares. This is the tradition in which Chandler trained and worked.

Much of the book places Chandler's scientific work against the backdrop of his family life and his professional, actuarial activities. That's right, for a period in the middle of Chandler's life, he applied his mathematical abilities to insurance theory, if that's the right phrase. The authors portray a man in love with numbers, calculations, precision, and accountability. The business of variable stars or latitude variation paralleled the business of life expectancies and trusteeships, which Chandler discharged often and responsibly.

Chandler dedicated himself to astronomy off hours from business and on his long summer breaks. He edited the *Astronomical Journal* and observed at Harvard College Observatory and at his vacation home. He was especially interested in variable stars and cataloged and studied hundreds of them. He avidly calculated comet and asteroid orbits. He and a colleague invented a code that used a common dictionary to transmit information on comets and other objects without errors via the telegraph.

One chapter especially relevant to history of earth science in the book is chapter seven, "Inventing the Almucantar" (pp. 90–110). Questions of instrumentation are always crucial in the precise study of phenomena, especially important if the phenomena undergo minute variations. The traditional methods of determining latitude in the mid-nineteenth century involved transit instruments and visual zenith telescopes. Major observatories such as Greenwich had monumental instruments, but geodetic work required portability. Even permanently mounted observatory instruments experienced problems in craftsmanship, drifting variables, and observational methods. These problems were magnified with portable instruments. Chandler invented two main instrument types to replace those then available: a vertically mounted "pendulous" design called the chronodeik (in 1880) and a horizontally mounted instrument called the almucantar (in 1884). The problem, for those who have not considered how latitude was measured before GPS, is to assure that one can observe the altitudes of various stars accurately. An error of one second of arc in measurement translates approximately to one hundred feet or thirty meters, an unacceptable error for geodetic work by the late nineteenth century.

Chandler borrowed the word almucantar from Arabic, meaning a line of equal altitude. The instrument's most important feature was the mercury flotation bearing, which guaranteed that it could be directed at well-regulated altitudes above the horizon. As the instrument was rotated around its vertical axis, this altitude remained remarkably consistent. Its great advantage was to simplify and shorten the observational regimen. When Chandler tested his first instrument by measuring the latitude of Harvard Observatory, he found the accepted value differed from his by fifty feet or fifteen meters. That is, he measured stellar positions differing from expected values by half a second of arc, which was (perhaps surprisingly) a large value for methods at the time. Such a value could indeed be an instrumental error, and so Chandler proceeded to build larger almucantars. He installed one of these at Harvard, too, and spent months adjusting it, testing it, and developing the mathematical theory of its instrumental errors. He discovered errors due to temperature variation and modified the instrument accordingly. When he finally was satisfied that he produced a dependable instrument, his new determinations of Harvard Observatory's latitude agreed with his first value within a few hundredths of a second of arc. He was satisfied that he had the correct value. Were latitude values obtained decades earlier in error? Or was this evidence of an irregular rotation of the Earth? In a characteristically careful reconsideration of earlier observations, Chandler declined to draw a conclusion and called for a more thorough investigation, which he undertook.

The authors don't return to the question of variation of latitude again until chapters eleven through fifteen. These are the heart of the book. They review the

work of James Bradley, Nathaniel Bliss, and Nevil Maskelyne in the eighteenth century, and that of Airy, Friedrich Wilhelm Bessel, C. A. F. Peters, J. C. Maxwell, others in the nineteenth century. By the 1880s, when Chandler's work was just taking off, most other astronomers and geodesists had concluded that if latitude varied at all, it was by only a meter or so. But one European scientist, Karl Friedrich Küstner, had turned to this problem using a more conventional instrument of the finest construction, at the Berlin Observatory, one of the world's best. Küstner persevered through confusing results until he was satisfied in 1888 that he had demonstrated the reality of the variation of latitude. The results could not be explained away and soon the International Geodetic Association was advocating a concerted research program, with the establishment of an observatory in Hawaii, almost exactly 180° from Berlin.

While a German investigator and the U.S. Coast and Geodetic Survey sent a team to Hawaii, Chandler set himself the task of a critical review of measurements starting with those of Bradley and continuing through his and Küstner's and other results from Washington, Pulkovo, and other observatories. Chandler's concern went beyond establishing the reality of latitude variation. He sought the period of the variation. In 1891 he published four articles, ultimately concluding that Earth's poles circulate from west to east around a circle thirty feet or nine meters in diameter, with a period of 427 days. This might have been a dry result, except that it differed significantly from the theoretical value predicted 150 years earlier by Leonhard Euler, based on Newtonian dynamics. A complicated interaction ensued between Chandler and Simon Newcomb, who was much more the theoretician. Newcomb refined Euler's analysis to include the movement of the oceans and the elasticity and viscosity of the Earth. While Newcomb's results were consistent with Chandler's first results, they parted company when Chandler announced in 1892 that the period of the variation of the latitude itself varied. Newcomb maintained that this was dynamically impossible, and Chandler argued that this was a time to set theory aside and base conclusions strictly on observations. Chandler maintained that Newcomb and earlier scientists were too committed to theoretical models.

In 1892 Chandler published still further refined conclusions. The variability of the variation of latitude, he wrote, was due to the superposition of two periods: his 427-day period and another annual variation, which necessarily sometimes reinforced the longer period variation and other times acted against it. He saw this as a reconciliation of theory and observation. But it was more than that. Chandler led the way in providing a model for the analysis of other variable geophysical phenomena produced by superposition of causes of different periods. The IGA also continued systematic observation of latitude variation into the twentieth century.

In sum, *Latitude: How American Astronomers Solved the Mystery of Variation* is a welcome contribution to the history of the earth sciences. While I think the book digresses onto the minutiae of various scientists' early lives and careers too much on occasion, the chapters that stick to the issue are models of well written accounts for a non-technical audience. And the book could have been strengthened by more complete documentation and some additional illustrations. Nevertheless, it is based on an extensive familiarity with primary sources, ranging from technical publications in several languages to manuscripts never before taken into account. I know of no other history of this topic that comes close to so complete an execution.

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INTERESTING PUBLICATIONS

Gerald M. Friedman, CONTRIBUTING EDITOR

Since the start of this journal, Founding Editor Gerald M. Friedman has prepared this column. Contributors wishing to list recent books and papers of interest to our membership are requested to send them to Professor Gerald M. Friedman, Brooklyn College and Graduate Center of the City University of New York % Northeastern Science Foundation, Rensselaer Center of Applied Geology, P.O. Box 746, Troy, NY 12181-0746 U.S.A.; FAX: 518-273-3249; *gmfriedman@juno.com*

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Stephen J. Pyne, Certain Allied Problems in Mechanics: Grove Karl Gilbert at the Henry Mountains, in *Two Hundred Years of Geology in America,* ed. Cecil J. Schneer (Hanover, NH: University Press of New England, 1979), 225–238.

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Fields of academic endeavor often memorialize the passing of their practitioners through the publishing of obituaries, memorials, or éloges. The History of the Earth Sciences Society has established a committee (composed of the Past President and three other HESS members) to arrange for the writing of such biographical notices. These éloges will be published in **EARTH SCIENCES HISTORY** at the first opportunity. The committee and the authors of éloges will follow these guidelines:

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(As of August 1, 2003)

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Less other operating expenses including website and postage	−$ 3,103.57
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EXPLANATION

Three issues of **Earth Sciences History** have been published in the year 2003 up to August 1. The final issue for 2003 will be published this winter. **Earth Sciences History** is back on schedule. This could not have happened without the efforts of our editor Greg Good and our associate editors. The cost for the final issue will be in line with previous issues and HESS will finish 2003 with a healthy budget surplus. It should be noted that no 2004 dues have been collected to date. The above surplus is a reflection of only 2003 dues payments and a prior surplus. This surplus is in spite of the weakened economy, numerous state and private institutional fiscal crises, and the bankruptcy of Divine/RoweCom/Faxon. That bankruptcy has had a major financial impact on many societies which had subscriptions handled by the firm. We have been far more fotunate and will suffer a minor loss at worst. Many of our institutional subscribers which were handled by Divine, et al., were picked up by another library service provider prior to the bankruptcy. We have seen a very small increase of under 3% in printing costs from Allen Press. This combined with other increases in financial costs has necessitated an increase of $2 in the membership cost and subscription for 2004. This will also enable HESS to remain a financially healthy and strong society.

Other expenses for 2003 to date include: $1356.20 for printing and mailing of a HESS informational brochure and membership form to members of the History of Science Society. This effort was handled by our Secretary, David Spanagel. We owe David a sincere thank you for undertaking this daunting task. HESS continues to see new memberships as a result of David's efforts and these new memberships will enable HESS to grow as a society. Our website and domain name were renewed. These renewals together with our web technician's services totalled $457.29. The website continues to generate significant web "traffic" and has resulted in new memberships. The booth cost for the Geological Society of America's Annual Meeting in Denver was $245.97. Other society expenses included $260.56 for Ed Rogers's participation at the GSA's Affiliated Society meeting in Boulder this past February and $783.55 for printing and mailing of dues notices, reminders and reimbursements to our associate editors.

Many current members and new members have taken advantage of our credit card services for paying dues and also for purchasing complete runs of **Earth Sciences History.** The purchase of complete runs has led to some early issues of **Earth Sciences History** becoming rather rare. If any member knows of someone who wishes to donate a run of **Earth Sciences History,** arrangements can be made to have the set shipped to our editor. We are currently in need of many of the early issues which are out of print. We received our first donated set of early issues this August.

On behalf of our society, a sincere thank you is given to all those members who provided donations to HESS and provided payment of page charges to **Earth Sciences History** in 2003.

I am especially thankful to the HESS membership for giving me the opportunity to serve as your treasurer.

Respectfully submitted,
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Barbara Marchioness of Hastings (1810–1858)—fossil collector and 'lady-geologist'

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Lyon Sprague de Camp (1907–2000): His Contributions to Science and Technology, Factual and Fictional

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