BOOK REVIEWS

Gretchen Luepke Bynum, Book Review Editor

FERDINAND V. HAYDEN: ENTREPRENEUR OF SCIENCE. *James G. Cassidy. 2000. University of Nebraska Press, Lincoln. 389 p. Hardcover, $65.00.*

Cassidy's work is the second recent monograph on F. V. Hayden, and nicely complements the biography by Mike Foster (*Strange Genius: The Life of Ferdinand Vandeveer Hayden,* 1994; reviewed in ESH, v. 14, no. 1, 1995—Ed.). Together these mark the third wave in defining the historical role of Hayden in the Great Surveys of the American West and their consolidation (or elimination) in 1879 to create the U.S. Geological Survey. G. P. Merrill, in *The first one hundred years of American Geology* (1924), reflected the view of contemporary geologists. R. A. Bartlett (*Great surveys of the American West,* 1962) and W. H. Goetzmann (*Exploration and Empire,* 1966) looked at the four surveys as the history of great adventure in the final taming of the West. And Mary Rabbitt wrote volume 1 of the thorough, "official," centennial history of the USGS in 1979. John Wesley Powell and Clarence King have attracted their share of biographies, but until recently the "losers," Hayden and George M. Wheeler, have been largely neglected.

Cassidy focuses on the role of Hayden in creating a professional, permanently funded, federal geological survey. The 1870s saw the attempt by geologists to get the U.S. Congress to accept and fund science, with the realization that science must have practical benefits to warrant this funding. Lieutenant Wheeler's survey marked the Army Corps of Engineers' attempt to preserve the status quo interrupted by the Civil War; in military surveys the scientists were subordinates with a secondary mission. The Powell and King surveys, despite their leaders' "winning" roles in the consolidation aftermath, did not present serious alternatives to the military model. Powell's survey was always the smallest of the four, and he appeared genuinely content to retreat to ethnography, but ironically was the only one of the four survey heads to have a long-term significant role in science after 1879. With a purely civilian survey under the War Department, King's 40th Parallel Survey was an anomaly, and when he was appointed to lead USGS, for only two years as it turned out, it was a civilian agency in the Interior Department—what Hayden had built over a 10-year period.

How then did Hayden lose the leadership of an organization that looked exactly like what he had built up? Of the four survey heads, Hayden was by far the oldest, and the only one with a pre-Civil War record. He had chafed as a civilian scientist on military surveys under Warren and Raynolds, as a general-purpose naturalist collecting everything—fossils, rocks, animals, and plants. Hayden's survey retained his generalist approach after the Civil War. In the meantime, scientists were fast specializing; the young Clarence King had a Yale science degree, in contrast to Hayden's Oberlin College and general M.D. training. Hayden personally published few important scientific papers after the Civil War, and Merrill's history rated the geologists in the King and Powell surveys more highly—certainly none of the Hayden survey geologists had the stature of Dutton, Emmons, Gilbert, or Hague. Hayden and Wheeler surveyed large regions, but King and Powell published highly rated volumes that extended the theoretical basis of geology. The fight over the first director of the USGS was a personal battle, and geologists wanted a dedicated professional. Thus they largely kept Hayden's organization, but stripped to a geological core; it would take Powell several years to get back a topographical emphasis as a requirement for geologic mapping.

Cassidy views Hayden as primarily an entrepreneur. Given an opportunity to lead a limited survey of Nebraska, he created an organization that succeeded in getting $690,000 appropriated between 1867 and 1879. Hayden relied on a system of patronage, both scientific and political, and he played the game astutely for a dozen years. He used the press and his survey artists to spread the wonders of the West, established a system of publications that served a variety of functions, and cultivated an international reputation. By 1879 he was more bureaucrat and popularizer than naturalist, and the scientific community wanted a geologist. Kept on as a geologist at the new USGS but assigned few duties, Hayden's health was declining. He resigned in 1886 and died in 1887.

Cassidy's book tells how one man molded the culture of science in Washington and the West during the decade of the 1870s. For the first time since the Coast Survey, Hayden got the federal government to fund a continuous survey. The book is well researched, well put together, and I can quibble with only one fact—Wheeler graduated from West Point in 1866, and not 1868 as stated on page 30. This book is required reading for anyone interested in the Great Surveys of the American West, or the development of science as a career and profession. The tale of the first career in federal geology makes interesting reading following the aborted "Contract with America" that sought to abolish the USGS in the 1990s and lead to a massive reduction in force of its geologic division. I only hope that someone will write an historical analysis of that chapter in USGS's history with the care and thoroughness that Cassidy put into the role of Hayden in creating the precursor organization.

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THE DATING GAME: ONE MAN'S SEARCH FOR THE AGE OF THE EARTH. *Cherry Lewis. 2000. Cambridge University Press. ix + 253 p. Hardcover, $24.95.*

When I was a student in England in the 1950s, a fundamental reference was Arthur Holmes's *Principles of Physical Geology*. It was logically set forth, highly readable—much more so than our other prescribed geological texts—and excellently illustrated. I was well launched into my professional career when the second edition appeared in 1965 and delighted to be sent a review copy. That second edition was three times the length of the first, but quite as readable and even better illustrated. It disappointed me that Holmes died within a few months of its publication, too soon to see my own, and the numerous other, favorable reviews of this splendid achievement.

Holmes's textbook remains in vigorous use. A third edition was edited by Holmes's widow, Doris (1978), and a fourth by Holmes's former student Donald Duff (1993). Beyond doubt, it has contributed massively, not just to the education but also to the inspiration of successive generations of geologists.

It is curious that we students of the 1950s were so entirely unaware of Arthur Holmes's other, and arguably much greater, contribution to the earth sciences—his determined, and ultimately successful, quest to discover the absolute age of the Earth. By our academic era, the antiquity of the Earth had been demonstrated.

Geologists had long since thrown away the straitjacket of the biblical chronology and even discarded forever the somewhat easier one fashioned for them by Lord Kelvin. We were thinking already in hundreds of millions of Phanerozoic years, and pushing the date of the Earth's creation back by billions. However, Holmes was gaining no explicit credit for this immense achievement.

This book sets the record straight. It shows how, almost from the beginning and nearly to the end of his geological career, Arthur Holmes was striving to provide a firm framework of absolute dates. To these, the relative chronology of eons, epochs, and ages—a chronology based firmly upon fossils and of limited value for Precambrian rocks—could be anchored.

Though a continuing preoccupation, his quest could not be a focus for continuing research by Holmes. The major interruptions included his period of striving, in Burma, to inject new resources into the ossifying veins of a petroleum company in deep decline. In a subsequent period, in absence of geological work, he sought to make a living by selling oriental craftwork. There were also the increasing demands of administrative work and the stresses of the time when, having mentally outstripped the intellectual capacities of a rather ordinary first wife, his affections were becoming engaged by the more exhilarating companionship of a fellow geologist named Doris Reynolds. (Though Maggie Holmes's early death was to resolve that problem, the repercussions of their affair were to trouble Arthur and Doris even after their marriage). Arthur Holmes's last years were ones of deteriorating health and energy, with recurrent attacks of auricular fibrillation that put him out of action for days on end. Yet his interest in the age of the Earth never flagged and, when reaping the honors that his researches had earned, he was able to comment amusedly (p. 234):

> Looking back, it is a slight consolation for the disabilities of growing old to notice that the Earth has grown older much more rapidly than I have—from about six thousand years when I was ten, to four or five billion years by the time I reached sixty.

It is always a pleasure—and alas, not a common pleasure—to read a really well-written geological biography. Cherry Lewis is to be congratulated not only in producing one such biography, but also in setting forth with commendable lucidity the evolving scientific concepts by which the Earth's dating was achieved. We follow Arthur Holmes from the good fortune, in school days, of having an inspiring science teacher (pp. 7, 9–10, 28), through effortful and under-financed student days, during which his interest in geology crystallized (pp. 28, 30, 50–52) to his first big adventure, an exciting but perilous "holiday" in Mozambique (p. 67ff).

There followed another financially stressful spell as demonstrator at Imperial College, London (pp. 110, 118), spanning the First World War—a conflict from which his physical problems precluded his participation. His first marriage, and the birth of his and Maggie's son, forced him out from that congenial appointment into the jungle of Burma—a jungle economic as well as actual, in which financial predators prowled who were quite as dangerous as tigers (pp. 118ff). The painful finale to that episode, with the death of their handsome little son in infancy (pp. 135–136) and an ensuing period of further financial stresses (pp. 137–139) were Arthur's saddest time. After that came the task of creating a new Geology Department in the old University of Durham (pp. 140–144) and the eventual transfer to the University of Edinburgh, at a time when the Second World War was imposing fresh stresses upon academic life (pp. 179, 184–8). Only after the war had ended could the researches of Arthur and Doris really develop—his on geochronology, hers on granitization, both subjects being areas of intense controversy in which innovations in thought generated intense hostility. (Perhaps Ms. Lewis might some day write an account of that other controversy?)

Then, as the story draws to its close, we encounter that frequent phenomenon in scientific history—the almost simultaneous publication of near-identical results by wholly independent researchers. The work of E. K. Gerling in Russia (1945), and of Fiesel Houtermans in Germany and Holmes in Scotland only slightly later, furnished a date for the Earth's origin that exceeded 3000 million years—a date quite at odds with the much more modest estimates of contemporary astronomers. Then came 1953, when Houtermans' revised estimate of around 4,500 million years almost coincided with Claire Patterson's similar date. Coincidence, or a mere product of the inexorable progress of scientific research?

This, then, is a fascinating and well-told story. The only factual error I noted was the all-too-often-repeated one that James Usher, Archbishop of Armagh, used biblical sources to set not only the year, but also the month and day, of creation. Not so: Usher (very commonly misspelled "Ussher," as here) set only the year; it was John Lightfoot of Cambridge who attained those greater scholastic precisions. It happens that I don't believe in an end-of-Cretaceous "major extinction" (pp. 22, 24), but that remains a matter for dispute. Misprints are commendably few: I noted only "draw" for "drawer" (p. 41) and "continentals" for "continental" (p. 155).

Now that we are moving into another millennium, we can begin to assess the attainments of twentieth-century geologists with growing detachment and increasing percipience. There can be no question that, during a hundred years of exploding understanding, Arthur Holmes stands high in the roster of major contributors to knowledge of the Earth. Cherry Lewis's biographical study of his attainments is surely destined to become the fundamental reference thereon. If, as its author suggests (p. 242), its title causes it to be misplaced into the "Romances" shelves of bookstores—well, it will be worth searching for!

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ROBERT E. WALLACE. *Stanley Scott, interviewer. 1999. Connections—The EERI Oral History Series, Earthquake Engineering Research Institute, Oakland, California. 186 p. Softcover, $15.00 plus $5.00 shipping. (Order from EERI, 499 14th Street, Suite 320, Oakland, Calif. 94612-1934; California residents add 8% tax.)*

In this oral history, Bob Wallace gives an insider's view of why the US Geological Survey (USGS) has remained the preeminent earth science organization within the US Government. The book also provides an inspiring account of Bob's dedication to developing an earthquake program that included geology as an integral part of the research agenda.

In his formative years his parents, both of whom were teachers, nurtured Bob. As he tells it, his early "obsessions" began in the woods of northern New Jersey, where he became fascinated with birds and their habitat. Wanting to capture bird scenes that were significant to him, he learned the art of photography and with the help of his father built a darkroom. Little did he realize that his photography skills learned at an early age were to become a significant part of his later scientific contributions. Photographs produced by Bob can be found in many of his publications and have been used to emphasize important points in USGS committee hearings.

At the age of fifteen Bob passed all the requirements to be a licensed ham radio operator. This led him to consider majoring in electronics and physics at university, but after his sophomore year at Northwestern he chose geology. In his senior year, Bob was offered a fellowship to Caltech that led to both a Masters and Ph.D. degrees. He gives interesting vignettes of his interactions with the Caltech faculty and students. At Caltech, he began his life-long study of the San Andreas as his Ph.D. subject, a structural analysis of the fault near Palmdale. Using geomorphology, his study was one of the first to suggest 75 miles of strike-slip displacement! Bob was uncertain about the scientific value of his thesis at that time because he felt that he was not able to do all that he wanted to accomplish to substantiate his claim of such a large displacement. Indeed at that time it was a new and audacious idea, but in later years others confirmed such large displacements. Just before graduating from Caltech, Bob passed the USGS Civil Service Exam in 1941 and at the age of twenty-five was offered a position on an Alaskan project, starting his USGS career of more than fifty years!

The project he joined was part of a USGS strategic minerals program and was directly related to developing the potential for quicksilver in the Kuskokwim region as part of the war effort. Thus Bob spent the next four years carrying out fieldwork in Alaska and this experience honed his skills as a field geologist. As a licensed ham operator he developed the first field radio communication setup for USGS field camps. During the end of his Alaskan work Bob was involved with early permafrost studies to analyze its effect on military airfields.

Bob thrived in the USGS environment but wanted to try teaching. He accepted an appointment to the Geology Department at Washington State University, where he taught structural geology as well as mineralogy and paleontology. Some of his students were later to become his colleagues at the USGS Spokane, Washington office. During his teaching years Bob worked in the summer with the USGS in the Coeur d'Alene mining district, concentrating on the Osborne fault and its relationship to the ore deposits. By 1951 Bob felt the strong pull to return full-time to the USGS as he found teaching burdensome and longed for full-time field studies research.

During his Alaskan and Coeur d'Alene studies Bob became well known and admired by his geologic colleagues for his intellect and strong work ethic. No sooner had he returned to the Survey in the Spokane Office than he was assigned a "tour of duty" in Washington, D.C., in the Geologic Division Program Office under Harold Brannerman. This rotation system was one of the significant methods of getting scientists into management; it helped to insure that people who understood earth science and how to carry out research tempered important decisions in Washington. Furthermore, it was much easier to convince a promising young scientist that this was only a temporary assignment and that it was possible to return to doing research after his tour. During his Washington tour, Bob became popular because of his skills in dealing with people and his passion for bird watching. Tom Nolan, the Director of the USGS at this time, was also an avid bird watcher and invited Bob to participate in the annual bird count. This association led to a long-term friendship with Nolan and other high-level scientists in the Survey that was later useful when Bob needed help from Washington. The "tour of duty" gave Bob other important insights about how things did or did not get accomplished in the higher circles of the Survey.

Bob returned to the Spokane office, then moved in 1956 to the newly organized USGS "field center" in Menlo Park, assigned to the Nevada geologic mapping project. Bob recalls his delight in the climate of this new setting: "After the group came together in Menlo Park about 1956, for some reason the creative sparks started to fly, and things began to happen in a way that I have never experienced elsewhere." The field center concept, developed by Director Tom Nolan, led to the development of three main centers: Washington, D.C., Denver, and Menlo Park each with nearly equivalent library and support laboratories. The smaller size of the Menlo Park field center, where scientists were able to interact on a daily basis with each other, brought about a special synergy. The next two decades brought about the "Golden Years" of basic research at the Menlo Park field center. An incredible explosion of innovative new programs started, such as marine geology, astrogeology, paleomagnetic studies, and geothermal energy. The earthquake studies were the most visible, developing into a national program, with strong ties to the engineering community and local governments. The plate-tectonic revolution had profound effects on geologic research during this period and contributed to the innovative thinking.

Bob Wallace was soon to be a key figure in this surge of new research and to the fomentation of new ideas. His synthesis of the geologic mapping in Nevada led him to follow his structural skills in understanding fault systems of the Basin and Range structures. His early studies of fault scarps from historic earthquakes led to the important field of paleoseismology; using remarkably simple concepts, Bob developed a semiquantitative method to estimate the age of fault scarps by use of their erosional profiles. In the early 1960s, Bob was branch chief of the Southwestern Branch of Regional Geology and collaborated with Parke Snavely, Jr., Branch Chief of Marine Geology, to propose a $2 million program for a complete study of the San Andreas Fault system. This program, not initially given a high priority, languished until the Great Alaskan Earthquake in 1964 marked a major turning point and catalyst for new earthquake programs. Wallace comments on this: "To my way of thinking and most people's thinking, I believe the Alaska Earthquake was the beginning of, and stimulus for, our whole modern earthquake program."

Bob Wallace was from then on a major force in formulating a National Earthquake Program. He fought valiantly for strong multidiscipline groups, where geology and engineering should have the same importance as seismology and geophysics. Bob recounts the turf battle between the earth scientists and engineers in the period when a national earthquake program was being developed. This struggle highlighted the sharp division between a theoretical approach preferred by the National Academy of Science, whereas the National Academy of Engineering emphasized practical engineering in their earthquake advisory reports. In 1973, the move of the Crustal Studies Group from Denver to Menlo Park marked the formation of the Office of Earthquake Studies. This was now a powerful group consisting mostly of geophysical and seismological personnel. The emphasis in the early formative stages was centered on earthquakes, and geologic studies took a back seat. At this time Bob was the Regional Geologist in charge of the Western Branch of the Geologic Division in Menlo Park and involved in developing the San Francisco Bay Region Environmental and Resources Planning study, a co-operative effort with the Federal Department of Housing and Urban Development (USGS-HUD). The Menlo Park geologists and geophysicists in this group were concerned with urban community earthquake safety issues, concentrating on defining active faults and landslides. These studies, under the leadership of geologists in the USGS-HUD project, led later to the passage of the California Seismic Hazards Mapping Act in 1994.

In 1974, the earthquake program of the National Oceanic and Atmospheric Administration (NOAA) was consolidated into the USGS Office of Earthquake Studies in Menlo Park. Under the leadership of Bob Hamilton, Bob Wallace was appointed as the chief scientist of Earthquake Studies. Eventually in 1977, Congress passed the National Earthquake Hazards Reduction Act, and the difficult task of implementation began. As chief scientist, Bob provided an important geological counterbalance to the seismological and geophysical programs by his patient and astute salesmanship. Bob was chief scientist until his retirement in 1987, and it is clear that his guidance and influence were important to the success of earthquake studies. Bob recounts in some detail about the evolution of this program as well as the major players, including his evaluation of eight directors of the USGS.

Bob remained active after his formal retirement as a geologist emeritus, acting as editor in the production of a successful and popular USGS Professional Paper 1515 on the "San Andreas Fault system, California," published in 1990. Bob Wallace exemplifies the spirit of a dedicated and loyal scientist trying to produce honest and useful programs of scientific value. His leadership in developing "outreach" programs such as the USGS-HUD project was important to actual implementation of earthquake hazard reduction for the citizens living in the San Francisco Bay area. His accomplishments were honored in 2000 by a special seminar at the Menlo Park USGS field center and dedication of the Robert Wallace Building for the Office of Earthquake Studies.

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NEW YORK STATE NATURAL HISTORY SURVEY, 1836-1842. A CHAPTER IN THE HISTORY OF AMERICAN SCIENCE. *Michele L. Aldrich. 2000. Special Publication 22, Paleontological Research Institution, Ithaca, New York. 288 p. Softcover, $20.00; plus $5 shipping for first book, $2 per additional book. (Order from Paleontological Research Institution, 1259 Trumansburg Road, Ithaca, NY 14850.)*

Amos Eaton (1776–1842), first professor of geology at Rensselaer Polytechnic Institute (then known as the Rensselaer School) in Troy, New York, convinced the New York State Legislature to set up a state geological survey in Albany, New York. His aim was in part to place his students at its helm. Eaton had become the most influential American geologist; the period between 1818 and 1836 is known as the "Eatonian" era. This term pays tribute to the astonishingly effective public promotion of geology by Eaton.

The New York State geological survey became the training ground for geologists of New York and other states; the Survey's geologists were thrust into national and international prominence. They became the founders of the Geological Society of America, American Association for the Advancement of Science, and the International Geological Congress. Rensselaer faculty and students who were involved with the geological survey included such geologic pioneers as James Hall (1811–1898), Ebenezer Emmons, Sr. (1800–1863), Joseph Henry (1798–1878), Lewis Caleb Beck (1798–1853), Ezra S. Carr (1819–1894), and George W. Boyed (?–1840).

This book is Michele Aldrich's Ph.D. thesis and presents a comprehensive discussion of the formative years (1836–1842) of the geological survey. By 1836, when the geological survey was founded, eight other state geological surveys had already been formed, but the New York State Survey was the only early State survey that survived, while all the other state surveys folded. Thus today the New York State Geological Survey/State Museum is the oldest continuously operating State geological survey in the United States. 1842 was a critical year; not only was a distinctive stage reached in founding of the Survey, but also that year Sir Charles Lyell (1798–1875) came from England to visit Troy and Albany. Shortly after Lyell's visit, Amos Eaton died.

The author presents almost three hundred pages of details about six years of survey development. Chapter 1 is an introduction and explains that New York's natural history survey tells us much about the civilization of which it was part.

Chapter 2 is concerned with the time-interval between ~1800 and 1836 and relates where geologic science stood before the New York State Natural History Survey was founded. The names cited include Joseph Henry, James Eights (1798–1882), Samuel L. Mitchill (1764–1831), William Maclure (1763–1840), George Featherstonehaugh (1780–1866), William Williams Mather (1804–1859), and Samuel G. Morton (1799–1851), among others.

Chapter 3 is titled "Beginning the Survey." Factors that influenced the Survey's early operation were the legislation that created it and the scientists who staffed it. Great Britain set up a survey one year after New York State, but it was a modest effort compared to what New York was to sponsor. In Chapter 4 the book examines selection of the survey's scientists. Those selected for discussion include L. C. Beck, James Hall, W. W. Mather, Ebenezer Emmons, Sr., John Torrey (1796–1873), Lardner Vanuxem (1792–1848), Timothy A. Conrad (1803–1877), and Edward Hitchcock (1798–1873).

According to the author, the most fascinating applicant, and the one who would have made a drastic difference in the published results of the New York Survey, was Constantine S. Rafinesque (1783–1840). He had "an exotic style, a romantic personal history, and an eccentric view of natural science." Numerous fossils and some mountain summits in New York State carry Rafinesque's name. Rafinesque lived in poverty in Philadelphia until his death in 1840. His body was then transferred to a pauper's grâve. Some years ago the site of his grave was discovered and his body transferred for burial in a vault on the bottom floor of the administration building of Transylvania University in Lexington, Kentucky. [When I visited his grave with State geologists Donald C. Chaney and James C. Cobb of the Kentucky Geological Survey, we expressed our hope that the Transylvania administrative people had dug up the right body].

Chapter 5 is titled "Field Work, (1836–1838)." Much of the 1836 field season had passed by the time Governor Marcy appointed the scientists. The first year the geologists achieved less than could be expected in a normal work year; they ran rapid reconnaissances through their districts. The first year's work resulted in three achievements: "it showed (Governor) Marcy and the scientific corps where modifications in the work load were required; it resulted in interesting scientific discoveries; and it introduced the survey to the public through the scientists in the field and annual reports to the legislature." During the first year, Ebenezer Emmons, Sr. used "Adirondacks" for the first time for the Precambrian mountain range of northern New York and named the highest peak Mount Marcy, in honor of the state governor.

"Field Work, 1839–1842" is the title of chapter 6. This work included the publication of several papers and the development of New York's stratigraphy, which has been extended across the United States. L. C. Beck paid special attention to the quarrying of hydraulic cement and its use in canal construction. On a part-time basis, James Hall collected and sold fossils as a business. In fact, one of his fossil collections started the American Museum of Natural History, and another the museum of Rensselaer Polytechnic Institute. [The latter collection was returned recently to the state museum, which then sold the fossils to amateurs. I attended part of the sale. The amateurs were most excited: "Wow! How can you acquire fossils collected by James Hall more than a hundred years ago for just a few dollars!" Business was booming.]

"The Final Reports, from 1842 to an indeterminate time beyond," is the title of Chapter 7. Much of the time during 1839–1842 was spent working on these final reports. The black-bound, quarto volumes, with gold-embossed cover and spine were, indeed, distributed throughout the world and to this day remain a landmark in the history of natural history. Their importance is discussed in the final chapter. (Chapter 8: "Distribution and influence of the final reports"). The results of the survey provided a model for other geologists to extend and imitate. New York formation names of the same age were applied in western states. Western geologists followed the New York model.

The New York geologists did not invent the systems approach; Lyell had used it for the Tertiary rocks, and Murchison had applied it to Silurian formations. But the line of descent seemed to be from the New York Survey, rather than the original British models. "The New York survey not only accelerated the economic development of the state, it also enriched American intellectual life by its contributions to science."

Photographs of the Survey's founders and early colored maps of the state's geology embellish this volume. Figure 1 is Maclure's geological map of the United States of 1818 (reprinted from a 1964 copy) and figure 2 is Eaton's geological map of 1830. This map was photographed from the original copy belonging to Northeastern Science Foundation in Troy, New York. The author acknowledges the loan of the Foundation's copy, but in the Notes section (Note 42, p. 214) states that I used the copy of this map at the Beinecke Library, Yale University. This statement is incorrect. Presumably the Yale University copy was poor or not available, hence she requested to copy the Northeastern Science Foundation's map.

More than two decades have passed since Michele Aldrich completed this book. New publications have appeared, some of which she has cited in a section titled "Bibliography Supplement." Collectively this book is an excellent source of information and reference. I must congratulate Michele on an outstanding contribution. My only additional remark is that she should have published this book several decades earlier. I myself came to New York and Rensselaer Polytechnic Institute from faraway Oklahoma to immerse myself in the treasure which she has discussed. Thank you, Michele, for your immense contribution.

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ADVENTURES IN THE BONE TRADE: THE RACE TO DISCOVER HUMAN ANCESTORS IN ETHIOPIA'S AFAR DEPRESSION. *Jon Kalb. 2000. Copernicus Books, Springer-Verlag, New York. 389 p. Hardcover, $29.00.*

Jon Kalb has produced a wonderfully engaging account of his seven years in Ethiopia, when he was both witness to and participated in the 1970's gold rush to discover human ancestors in Ethiopia's Afar Depression. Kalb is a geologist by training, so his account has a distinctly geological flavor, but the story Kalb tells is much broader than that, educating the reader on the culture, geography, and recent history of this exotic region. Moreover, Kalb's writing delivery is uncomplicated and humorous, making this story easy to digest, a "page-turner" as one colleague called it. This combination should make Kalb's book a great read for scientists and layman alike.

The book is structured around a chronological account of Kalb's geological and paleontological studies in Ethiopia, but in the process Kalb interweaves several other themes into his book. One of these is the recent political history of Ethiopia. The period largely covered by the book, 1971 to 1978, was a time of major political upheaval and change in Ethiopia. It started with the fall of Haile Selassie in 1974, followed by the unstable period under the ruling junta, or Derg, and culminated in the consolidation of power in the hands of Marxist strongman Major Mengistu. The other focus of the book is the chronicle of events surrounding the discovery and ensuing territorial battles over of what is probably the richest region for the fossil remains of early man in the world, the Afar Depression.

Today, most paleoanthropological research in Africa is done by academics and students from universities and research institutes who invest a few months of each year in fieldwork and then head home. For Kalb, this endeavor was a passion, not an occupation. He moved his wife and infant daughters to Ethiopia, invested life and limb in his pursuit, starting with his entry into the country with high hopes and a few thousand dollars in his pocket, and ending in abrupt expulsion from Ethiopia seven years later. While reading I could not help comparing to stories of nineteenth-century exploration. Sir Richard Burton's famous account of his pilgrimage to Mecca is one example, an adventure that was motivated, according to Burton, by the desire, to "remove a white blot in the map." Kalb's many references to Richard Burton, John Speke, and particularly Henry Morton Stanley—the greatest names in East African exploration of the last century—belie the role models for his undertaking in Ethiopia. Kalb chose the Awash Depression for his blot, one of the last regions on the continent to be traversed by Europeans. Certainly it was *terra incognita* geologically before 1970, and it was Kalb, along with a Frenchman, Maurice Taieb, who deserve the credit for breaking the new geological ground there.

Kalb clearly had something to get off his chest in writing this book. He never comes out and says it, but Kalb's extreme disappointment—the collapse of a childhood dream—is nonetheless palpable in the final pages of the book. The man allegedly behind his demise was, according to Kalb, Dr. Donald Johanson, discoverer of Lucy and head of paleoanthropologic studies at Hadar, along with lesser players in various Ethiopian ministries and in our own National Science Foundation. In the book, Johanson comes across as manipulative, backstabbing, and brazenly self-promoting, a veritable of J. R. Ewing of the Awash. While some of this is hard to swallow and impossible to judge for sure, other recent accounts also take a hard view of Johanson's personality [e.g., the book by G. H. Curtis, R. Lewin, and C. C. Swisher: *Java Man: How two geologists changed the history of human evolution* (2000)]. At a minimum, reading about Johanson's alleged naughtiness has great entertainment value, in the same way I used to enjoy watching (guiltily) the TV show "Dallas."

A point that resounds in Kalb's book is the competitive, at times vicious character of the race to find fossils. The temporary alliances and predictable divorces, glory-grabbing, and petty sniping give parts of the story a ridiculous, circus-like quality. Like a good historian, Kalb usually doesn't openly pass judgement on all this misbehavior. From my perspective as scientist, many of the players described in the book (but fortunately not all) either never learned or forgot how to act as normal scientists and simply let themselves be consumed by the gold rush.

The book is fairly long and Kalb provides a great deal of geological and geographical detail on the Afar Depression, a necessity I agree if he is to tell the history completely and accurately. I am also a geologist with experience in the Afar Depression, so it is hard for me to judge how this will play with non-geologists. Fortunately, the book comes with seven maps to ease the reader through the welter of wadis, fossil sites, and Afar villages. Certainly, through all the detail, the reader comes away with an appreciation of what the day-to-day challenge of being a scientist in the Afar Depression is. We have all seen the *Nova* programs or *National Geographic* Specials about the fossil hunting expeditions in East Africa, but these depictions can be glamorized. Kalb really manages to convey life as it is out there: blasting hot days, downpours, pit vipers, armed Afar tribesmen, and the often tedious but ultimately rewarding process of fitting all the bits of the geological and fossil puzzle together, day-by-day.

My feeling is this book will stand as a key historical account of the scientific opening of the region, written by a person who shaped much of that history and witnessed firsthand most of the rest. But I doubt Kalb's account will be the last word, as the field of paleoanthropology seems to spawn many histories and counter-histories. I do look forward to one day reading the personal accounts of other players in the region, to get their perspective. And who knows, I may write one myself, as the Afar Depression remains as untamed as ever, and the geologic and fossil record there, as Kalb points out, will take many more decades to decipher.

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THE CULTURE OF ENGLISH GEOLOGY, 1815–1851: A SCIENCE REVEALED THROUGH ITS COLLECTING. *Simon J. Knell. 2000. Ashgate Publishing, Burlington, Vermont. 377 p. Hardcover, $104.95; £ 59.50.*

What was William Smith's true importance in the development of British geology? Although the pioneering stratigrapher received the Geological Society of London's first Wollaston Medal in 1831, and bears the sobriquet "father of English geology," Smith has nevertheless come under fire from modern historians who point out that his publications were scanty and of little contemporary influence. In 1987, Rachel Laudan confidently concluded that, "it is hard to imagine that the development of geology would have been much different if he had never published" (*From Mineralogy to Geology,* p. 168).

This assertion has not gone unchallenged, however: the well-known researches of Hugh Torrens and Jack Morrell over the last twenty-five years have gone a long way toward rediscovering the social context of Smith's work, and indeed of British geology generally in his era. It is firmly in this social history tradition that Simon Knell undertakes his assessment of *The Culture of English Geology*. Indeed, Torrens supervised the dissertation upon which this book is based, and Morrell's work on John Phillips (William Smith's nephew and right-hand man) underlies one of Knell's central arguments. To this history of science scholarship, Knell brings some two decades of museum experience as a geological curator and as a faculty member in Museum Studies at the University of Leicester. His chapters on collectors, collections, and curators will be of great interest to historians of geology who want to understand the "meaning of fossils," not just for the emergence of stratigraphy, but in the wider social and economic world of provincial scientific institutions.

There are two main strands interwoven throughout Knell's analysis. One charts the life of provincial philosophical societies, particularly in Yorkshire, from their explosion in the early 1820s (in no small part due to excitement generated by William Buckland's dramatic reconstruction of the Kirkdale Cave megafauna) to their near-total collapse under the weight of their own poorly-curated collections in the 1840s. Knell emphasizes that these societies arose for different, local reasons in each town, and that their relationships were marked more by ruthless competition than by adherence to a common scientific cause. A comparison between the philosophical societies at York, Whitby, and Scarborough is instructive. York had the gentlemen of science (including William Vernon Harcourt of BAAS fame) but poor local fossils. Whitby had unrivalled fossil deposits but little social status; and Scarborough, though lacking other resources, was the home of William Smith and his paradigmatic circular stratigraphical museum.

One of Knell's most important points is that fossils circulated as different kinds of commodities in each social stratum. They had commercial value to the working-class collectors who actually gathered them from storm-wracked coastal cliffs. They had cultural and aesthetic value to the leisured elite who purchased them from dealers simply for donation to needy local institutions in exchange for social recognition. And they had scientific value to a small number of museum keepers (most notably John Phillips) who saw in them a rare opportunity to build a professional career. Conflicts between these agendas could have serious consequences for provincial institutions, as in 1841, when Whitby lost a magnificent local plesiosaur to Adam Sedgwick's man from Cambridge after a carefully managed bidding war between several regional philosophical societies.

The second major trajectory tracked by Knell is the unique career of John Phillips, a story that turns out to provide a decisive link between local Yorkshire endeavors and the core of British geological practice. Phillips got his start in geology at the tender age of sixteen, when he was called upon to arrange the fossil collection of his uncle (William Smith) for its sale to the British Museum. Following his impecunious uncle to Yorkshire on the public lecturing circuit, Phillips continued to exemplify in his work the Smithian principle of identifying strata on the basis of their fossil contents, clarifying and improving such ideas as he went. His curatorial duties for the York Philosophical Society from the mid-1820s, and later his well-received monographs on Yorkshire geology, were both, in Knell's view, contributions to the Smithian project.

Professor of geology from 1834 at King's College, London, Phillips quickly became involved with H. T. De la Beche in the newly established Geological Survey. They initially tried to make use of existing collectors, gathering specimens just as provincial institutions had in the previous decade. It soon became apparent, however, that such methods were unsuited to the much higher standards of accuracy that De la Beche sought and the new kinds of paleoenvironmental questions he asked. Where collectors sought single, intact, beautiful fossils, geologists needed to investigate in their own fieldwork the total faunal assemblage of a bed, and its taphonomic condition, to assess its identity and meaning. Although William Smith himself was nowhere near such an idea, it is hard to deny his influence on his nephew and protégé Phillips, who in turn was instrumental in improving British stratigraphy and reforming paleontological nomenclature. Phillips also played a key role in establishing the Museum of Practical Geology in 1851, thus ending the scientific relevance of the provincial institutions that had nurtured him.

In a way, Laudan may have been justified in saying that Smith's publications *per se* were unimportant. For, as Torrens has consistently and persuasively argued, there is a lot more to history than what is published, and many more people matter than only those who wrote for print. No one exemplifies this "alternative élite" of surveyors, engineers, and other practical men and women better than William Smith, but Knell manages to bring a whole host of previously overlooked figures into the light. Artisan collectors employed in the jet trade, enterprising fossil dealers, and tragically exploited curators all have a part to play in the debt that provincial geology in England owed to wider social, economic, and cultural phenomena in the 1820s and 30s.

In *The Culture of English Geology,* Simon Knell succeeds in synthesizing the extensive literature on British geology in the first half of the nineteenth century. He adds to this a close study of important primary sources, such as the John Phillips manuscripts at the Oxford University Museum of Natural History and the archives of Yorkshire philosophical societies. As a synthesis, this book generally does a good job of negotiating the differences of emphasis in recent studies. But what is perhaps troubling for the field as a whole, it also reflects a widely held consensus. The old "received view" of the history of geology now seems to have so few professional proponents that it is possible to write an entire book on the "culture" of geology while making surprisingly little reference to Lyell, and virtually none at all to uniformitarianism and deep time. Surely such a feat would have been inconceivable in the not very distant past. Only more time will tell if the pendulum has swung too far.

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CATALOGUE OF METEORITES, 5TH EDITION. *Monica M. Grady. 2000. Cambridge University Press, Cambridge, U.K. 689 p. Hardcover, $150.00. (Includes CD-ROM.)*

In 1849 Henry Clifton Sorby became the first geologist to make thin sections of rocks in order to study them with a microscope. He quickly realized that the petrographic techniques he was developing for terrestrial rocks could be applied to meteorites to answer questions about their evolution in space. One of his most valuable contributions was a description of chondrules, which are millimeter spherules in meteorites that were produced in the solar nebula prior to the accumulation of planets. In a lecture at the Museum of South Kensington (1877) he compared the textures of chondrules with those in erupting volcanic rocks, concluding they were igneous rocks that had formed as molten droplets in a gas or, in his words, "like drops of fiery rain." Chondrule-bearing meteorites, or chondrites, are the largest group of meteorites known today and continue to fascinate meteoriticists for the wealth of information they contain about the origin of our solar system.

Given this venerable history of meteorite studies in what is now the United Kingdom, it is fitting that the world's *Catalogue of Meteorites* is maintained by the Natural History Museum in London. The fifth edition of the *Catalogue of Meteorites* is dramatically larger than the 1985 fourth edition. The new edition contains information about 22,507 meteorites, including 15,190 chondrites like Sorby described, while the fourth edition only listed 2,611 samples. A large portion of this increase is a consequence of government-sponsored research programs in Antarctica, which have recovered 17,808 meteorites. It also illustrates an increasing interest in cosmic debris by scientists and the public and their increasing ability to access arid regions of the world. For example, nearly 1,200 samples have been recovered from the Sahara.

Most of the information in the catalogue is gleaned from *The Meteoritical Bulletin,* which is the internationally recognized record, now published annually, of authenticated meteorites. When a new meteorite is discovered, specific sets of analyses are needed to determine the classification. Per an internationally recognized protocol, the results of these analyses, along with the circumstances of the find, are forwarded to the Committee for Meteorite Nomenclature of the Meteoritical Society, which assigns a classification and name to each meteorite. Each listing in the *Catalogue of Meteorites* begins with the name of one of these authenticated meteorites. The listing then continues with the location of the meteorite fall or find, the circumstances of the meteorite's recovery, its classification, any synonyms the specimen may have, its recovered mass, information used to classify the sample (e.g., mineral compositions, any unique petrologic features), a list of publications describing the meteorite, the distribution of material among museums and other institutions, and a list of specimens in the collection of the Natural History Museum, London.

The *Catalogue of Meteorites* continues to be a historical resource as well as a scientific resource. The descriptions of meteorite falls and the circumstances of meteorite finds are wonderful vignettes of human history:

Gerzeh (Egypt): "Iron beads found in 1911 in predynastic graves at Gerzeh, 50 miles south of Cairo."

Navajo (Arizona): "A mass of 3306 lb (1499kg) was found in 1921 buried in talus, with Indian beads."

Cape York (Greenland): "Knives of iron with bone handles were given to Capt. John Ross in 1818 by the Inuit of Prince Regent's Bay, J. Ross (1819). Three large masses, purported to weigh respectively about 59 tonnes, 3 tonnes, and 896 lb (406.3kg) and named 'The Tent' or Ahnighito, 'The Woman,' and 'The Dog,' were shown to Lieut. R. E. Peary, by whom they were later transported to New York, R. E. Peary (1898)."

Macau (Brazil): In 1836 "after the appearance of a brilliant meteor, followed by detonations, a shower of stones, some said to weigh from 1 lb (450g) to 80 lb (36.3kg), but most the size of doves' eggs, fell near the mouth of the river Assu, killing several cattle . . ."

Portales Valley (New Mexico): In 1998, "after detonations were heard and smoky trails seen in the sky, a shower of meteorites landed near Portales, New Mexico. 45 objects have been recovered, with a total mass of 67 kg. The largest pieces weighed 16.5 kg (witnessed to fall by Nelda Wallace and Fred Stafford), 17.0 kg (found by Elton Brown), and at least nine others over 1 kg. A 530 g fragment went through the roof of Gayle Newberry's barn and embedded itself in a wall, indicating a trajectory west to east."

As expected, the rate of recorded meteorite falls has increased with population and the fraction of the world occupied by people. In addition, the circumstances of meteorite finds and falls have evolved over time. Whereas meteorites were recorded as falling near rivers (early routes of transportation) and killing domestic animals in past centuries, more recently they have been found by hikers in the interiors of continents and reported hitting automobiles. Contrary to Hollywood's depiction, none of the reports of meteorites hitting automobiles indicate they caused ear-splitting and eye-searing explosions.

The *Catalogue of Meteorites* is also a valuable resource for scientists. It allows them, for example, to determine which meteorite specimens are appropriate for a particular study. If one wants to study impact-cratering processes on chondritic asteroid surfaces, one can use the catalogue to find meteorite samples that are classified as shock-metamorphosed specimens. If one is interested in nebular chemistry, one can use the catalogue to identify samples that were collected soon after they fell and, thus, have the least amount of terrestrial contamination. The catalogue's listings also allow statistical analyses of different types of meteorites, including newly recognized ones like the CH, CK, and CR carbonaceous chondrites, acapulcoites, brachinites, rumurutiites, and winonaites. Useful tables summarizing the number of meteorites in different classified groups and the names of individual meteorites in each of these classified groups are included at the front of the volume. Additional tables follow these tables with the number of meteorites recovered from different geographic regions of the world and a list of individual meteorites found in each geographic region of the world.

The *Catalogue of Meteorites* has traditionally been very useful because it allows a meteoriticist to quickly find references to previous published scientific results about a meteorite. The fifth edition, however, is not as useful as past editions because it does not give any bibliographic information other than the authors of past work and the year of publication. Complete bibliographic information is relegated to a CD-ROM, which is the principal shortcoming of the volume. Even the editor lamented: "The editor appreciates that the reference format (author and year only) will be irritating—it irritates her—but space constraints preclude full citation within the body of the text or a reference list at the end of the volume." Unfortunately, the CD-ROM is unsatisfactory because it cannot be read by some current computer systems. Furthermore, CD-ROM technology will soon be obsolete so the information will not be retrievable from any computer system.

Despite the loss of data to a CD-ROM, the *Catalogue of Meteorites* is still a critical resource volume for geologists and historians studying meteorites. It should be in every academic library. I also recommend it for individual investigators who often study the history and/or science associated with meteorites.

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MAPPING THE DEEP: THE EXTRAORDINARY STORY OF OCEAN SCIENCE. *Robert Kunzig. 2000. W.W. Norton & Company, New York and London. 345 p. Softcover, $15.95.*

The deep ocean and the parts of the ocean all the way to the surface that lie far from land are the focus of this book. About a third of the book deals with the history of exploration and mapping of the abyssal depths. Another third focuses on deep-sea and far-offshore marine life, and the last third is concerned with diverse topics such as the cause of deep-ocean currents, climate change as related to deep-sea sediment, and the birth and future death of the ocean.

The author is a science writer—an editor of *Discover* magazine—and he has done exhaustive research for this book. His particular talents are readability and a skill at explaining complex processes understandably. From a historical point of view, the book covers the discoveries of about 175 people. Of the thirteen scientists to whom the greatest number of pages are devoted, only one, Victor Hensen, a nineteenth-century student of plankton, worked before World War II. This illustrates a major theme of the book—the deep was virtually unknown until recently.

A main hero is Bruce Heezen, mapper of the deep ocean, discoverer of the seafloor-spreading ridges, and co-discoverer of turbidity currents. He gets about twice as many pages as his nearest rival. Others that follow him in order are Wallace Broecker (currents and climate change), Laurence Madin (free-swimming tunicates), Marie Tharp (Heezen's collaborator), Ken Macdonald (ridge processes), and Lloyd Keigwin (sediment and climate).

The book, perhaps because its coverage is so broad, is selective. Magnetic lineations, which map the geologic age of every point on the ocean floor, are not mentioned. Tuzo Wilson, who published the first plate-tectonic map of the world, gets a single laudatory note, "a flash of insight," but a reader without pre-knowledge would think that someone else put together spreading axes, subduction zones, and transform faults to create the theory of plate tectonics. Also, hotspots, discussed in three parts of the book, are never linked to Wilson, their discoverer.

Kunzig makes a strong effort to include the most up-to-date understanding about each phenomenon that he covers. The book seems quite accurate for those topics about which I am knowledgeable. A few lapses are that most midocean earthquakes are not precisely along the middle of a spreading axis, "at the very centre of the Ridge," but are slightly offset on short transform faults, where the rock is colder and more brittle. Also, more important to subbottom acoustic profiling than that the signal has "power" or is "loud" is that it has a low frequency, which matches that of the imaged rocks.

This book will not be the place to start further historical research. The chapters average only 7 references each. The references are equally divided between highly selected discovery papers, reviews like this book, and random citations to specific items discussed in the text.

The main value of this book is the interesting style of its writing and the splendid stories of exploration and research that have been selected for inclusion. When you have read it, you will be up to the minute on a broad range of topics about the ocean.

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ESSAY REVIEW

VICTORIAN SENSATION: THE EXTRAORDINARY PUBLICATION, RECEPTION, AND SECRET AUTHORSHIP OF "VESTIGES OF THE NATURAL HISTORY OF CREATION." *James A. Secord. 2000. University of Chicago Press. 624 p. Hardcover, $35.00.*

In April 1845 Edward Quillinan wrote to Henry Crabb Robinson complaining about a book and the review of it that had just appeared in the first issue of a new Unitarian journal. "As to Article 3 in the *Prospective Review* on *Vestiges of the Natural History of Creation,*" he assured his correspondent,

> it is about as bad as the wretched book itself. I wish wicked people (like you) were not so clever, or clever people (like you) were not so wicked. That volume of "Thoughts on the Vestiges of Creation" is a book of hypotheses grounded mainly on the modern discoveries in geology; a grand and solid foundation, on which free-thinkers build nebulous towers that reach the skies, and from those airy observatories pry into the Holy of Holies, peruse the inner mind of the Almighty, and look down with pity on the ignorant multitudes who have nothing to help them in their heavenward aspirations but blind faith in the truths of revealed religion.[1]

On 24 March 1845 Robinson himself had thought *Vestiges* "an edifice very skilfully constructed . . . though the materials are mere rubbish."[2]

The author of this daringly unorthodox anonymous book was a Scottish journalist named Robert Chambers, but his identity was not officially revealed until 1884. In its earliest, numerically small but much noticed editions, *Vestiges* proposed an evolutionary history of life on Earth. Though several earlier thinkers (including Erasmus Darwin and Lamarck) had similarly proposed the transmutation of species, their hypotheses had been vigorously rejected by naturalists and clergymen alike. In putting forth his own evolutionary scenario, Chambers was therefore obliged to outface both the authority of Scripture and prevalent scientific opinion.

The book began with a description of the solar system and the nebular hypothesis of its origin. It discussed the composition of Earth and Moon, then reviewed the eras of terrestrial history in ascending order, beginning with the earliest rocks and fossil organisms then known and proceeding through the Cretaceous to the Tertiary and its mammals. Chambers next speculated on the origins of species and their subsequent evolution, the early history of mankind, the mental constitution of animals, and their relationship with ourselves.[3] Mercy and Grace, we are assured, underlie the seeming ruthlessness of nature (1844, p. 384).

In his concluding chapter, Chambers focused on his own anonymity as an author (his being a name that, "in all probability, will never be generally known"). He called his book "The first attempt to connect the natural sciences into a history of creation" (p. 388), though Buffon and others had obviously preceded him, and presented himself as a truth-seeker undeterred by prevalent philosophical or religious opinions. He hoped that a reconciliation of his thinking with the tenets of liberalized religious belief would someday be possible, much as had already happened in the case of geology and its rejection of a literal Genesis (the biblical Creation week and Flood being now passé).

Though *Vestiges* is often regarded as a work of popular science, the theoriz-

1. Thomas Sadler, ed. *Diary, Reminiscences, and Correspondence of Henry Crabb Robinson.* 3 vols., London: Macmillan, 1869. 3:241–242.
2. Secord, *Victorian Sensation,* 412. But Robinson was quoting (and endorsing) the opinion of another writer.
3. Tennyson was full of enthusiasm for Chambers' chapter on the "Mental Constitution of Animals" in 1848. See Hallam Tennyson, *Alfred Lord Tennyson: A Memoir* (London: Macmillan, 1899), 231–232 (1848).

ing that it included belonged in aggregate to no one other than its author and appeared within its pages for the first time. Though written for intelligent laymen, it was intended as a genuinely original contribution to natural history. Faced with certain opposition from both the religious and scientific establishments, Chambers followed his evolutionary predecessors by using a popular literary form (influenced in this case by his journalistic background and Scott's historical novels) to appeal directly to the public.

To an extent that even its author had not anticipated, the publication of *Vestiges* created a sensation. Unlike most supposedly scientific books, this one plainly contradicted normal religious belief and for that reason distressed the men of science who had been at pains to assure the literate public that their work and that of the churches were not at odds. Though some of the nation's most famous geologists had been clergymen (Buckland becoming Dean of Westminster), no such rapprochement in the case of *Vestiges* seemed possible. If *Vestiges* was science, it reflected a world view that appealed more to the disenfranchised and the unbelieving than to the politically empowered and the orthodoxly religious.

From the 1840s onward England was not lacking in either religious or political rebels. Whether one accepted the teachings of *Vestiges* wholeheartedly (as few did) or opposed them vehemently, debate regarding the book reinvigorated national churches that had hitherto been dwindling into irrelevance. Given the influence of Lyell, Victorian geology also had begun to lose momentum, as nearly all of the major figures within it (except a secretive Darwin) steadfastly opposed the transmutation of species.

Led by Sedgwick and Owen, the scientific opposition to *Vestiges* was formidable. In response to well-informed criticism pointing out his numerous errors, Chambers felt obliged to issue a candid volume of *Explanations* in 1845, as the factual deficiencies of his argument were mercilessly assailed in journals, newspapers, and pamphlets. Yet his book remained current through some twelve editions, several of which included significant revisions, most of them improvements.

In *Victorian Sensation* Secord never details either the arguments presented by Chambers or the supposed facts on which they are based. He is rarely concerned with the truth or falsity of Chambers' assertions and has little interest in the validity or lack thereof with which Chambers' positions were attacked. In short, Secord's book is not really about the history of science. It belongs instead to the interdisciplinary field of literary and cultural history known familiarly as Victorian studies. Within that broad and very productive discipline, Secord's topic is not so much science as reading and authorship. His interest is not in what *Vestiges* says but in how it was read at the time. On that basis, Secord's latest book is as outstanding a contribution to scholarship as one would expect from the author of *Controversy in Victorian Geology* (1986). But the utility of *Victorian Sensation* to those interested specifically in the development of nineteenth-century science remains disappointingly limited.

As of 1994, Secord's working title for what is now *Victorian Sensation* was *Evolution for the People: Popular Publishing and Scientific Practice in Victorian England.*[4] The later title, his present one in full, is livelier, better, and more to the point. Subsequent rewriting by Secord emphasized through quotations how frequently the word "sensation" was actually used by contemporaries to describe the public reception of *Vestiges*. Very ingeniously, Secord then went on to show what the word "sensation" itself was held to mean in terms of the phrenological

4. Robert Chambers, *Vestiges of the Natural History of Creation and Other Evolutionary Writings*, ed. James A. Secord (Chicago and London: The University of Chicago Press, 1994), xxviii, n. 39. Anyone endeavoring to profit from Secord's *Victorian Sensation* will want to have this edition available to him. "Evolution for the People" is now the title of *Victorian Sensation,* chapter 3.

psychology with which Chambers was all too closely associated. Such alertness to the possibilities of treasure within one's newly-found sea of information is not altogether common among deeply submerged scholarly authors. Secord is habitually alert, but his researcher's acumen is often of more interest in itself than for what he finds. Though assisted by several diligent predecessors, all of them acknowledged, Secord has dived deeply into the social and intellectual currents of Victorian Britain, almost to the point of drowning.

"A Great Sensation," appropriately, is the book's opening chapter, which ranges broadly to include the influence of steam on publishing (books became much cheaper) and on the importance of steam railways to literacy and reading habits. Overall, *Victorian Sensation* is divided into four parts, each of which contributes to our understanding of the *Vestiges* phenomenon from a separate perspective, in the manner of Lawrence Durrell's four-part novel *The Alexandria Quartet* or the Japanese film "Rashomon." The chief effect of this nonlinear arrangement is that the book progresses in the manner of an expanding helix, often returning to the same incident more than once but from a larger point of view.

Part One of *Victorian Sensation* is almost exclusively concerned with literary celebrity, discussing *Vestiges* as a product of authoring, printing, publishing, and reading. Though interesting in itself, this familiar material has relatively little to do with science. Part Two compares and contrasts the diverse readings given *Vestiges* in selected British locales, namely Edinburgh, Oxford, Cambridge, Liverpool, and aristocratic London. Many readers will find this the most interesting part of the book as it is replete with famous names. In Part Three, Secord is primarily concerned with the typology of individual readers not otherwise well known—an evangelical vs. an atheist, for example. Part Four then considers the impact of the *Vestiges* controversy as it affected serious practitioners of science, ultimately including Darwin. Throughout, Secord defines and illustrates the various ways in which *Vestiges* was being read. He discusses his overall methodology most explicitly in a concluding Epilogue.[5]

There is no question that Secord has assembled an encyclopedic body of information about the reception of *Vestiges* as a Victorian book, and much of it is new. His research and writing are outstanding in every respect. Though further scraps will undoubtedly turn up from time to time, they are unlikely to add much not already here. One comes away sharing the author's conviction that few if any Victorian books ever generated an equivalent record of such broadly based public interest. If another ever did, no present-day scholar has yet found and assembled such an array of evidence on its behalf. Though many of the opinions do not of themselves mean a great deal, they are collectively impressive and an irrefutable vindication of Secord's final title.

Few of us who publish scholarship today have been permitted such lavishness of illustration as appears in *Victorian Sensation*. Secord has taken full advantage of his opportunity to include a wealth of well-chosen contemporary and later documentation. The book is finely produced throughout, two unimportant typos short of being flawless. It is a most handsome edition, of which both author and publisher can be proud. Each regards *Victorian Sensation* as the most comprehensive account of the making and reception of a book (other than the Bible) ever attempted.

As part of his Epilogue, Secord graphs the sales of *Vestiges* and Darwin's *Origin* against each other to prove that "the *Origin* did not decisively overtake *Vestiges* until the twentieth century" (p. 526). There is no arguing with the facts

5. See esp. 518 ff.

of publication, but Darwin's *Origin* enjoyed immense cultural and literary influence well before natural selection returned to scientific favor in the 1930s. I'm sure Secord knows that as well as I, but I do take issue with him when he suggests that *Vestiges* may have been an important stimulus to the popularity of literary realism in late nineteenth-century England (p. 489).

Realism, as opposed to Romanticism, most obviously appeared in France during the mid 1840s and is particularly associated with the painter Courbet. The term became widespread during the 1850s and began to be applied to novelists like Flaubert (*Madame Bovary,* 1856). It has since been extended to earlier writers, like Stendhal (*The Red and the Black,* 1830) and Balzac. The chief British example, George Eliot's *Middlemarch* (1871), derived more from French novelists than from English science.[6] To some considerable extent, realism is inherent in the novel as a literary form.

As a recognized movement within the arts, realism was largely superseded in the late nineteenth century by naturalism, a more scientific perspective in which fragile humans are seen as being part of, and subject to, an indifferent natural world that can neither be controlled nor understood. Darwin, of course, influenced and validated naturalistic beliefs through his famous "struggle for existence." Like realism, naturalism recurs periodically in the history of literature and art. The major French example is Zola; and the British, Hardy. There are also many American examples (Crane, Dreisér, Steinbeck).

The biological determinism common to Victorian naturalistic literature may have derived in part from *Vestiges* (despite Chambers' emphasis on "improvement"). If so, a possible instance is Charles Kingsley's novel *Yeast* (1848), in which some rural workers appear so degenerate that his protagonist Lancelot Smith can only wonder if they are "even animals of the same species" as himself.[7] In *The Time Machine* (1895), H. G. Wells would suppose that they were not. It is worth remarking that the period of supposed literary influence by *Vestiges* (end of the nineteenth century) was also the time when anti-utopian fiction was at its height.

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6. A classic document in the history of Victorian literary realism is chapter 17 of George Eliot's *Adam Bede* (1859), published the same year as Darwin's *Origin*.
7. See also Secord, *Victorian Sensation*, 469, n. 100. *Vestiges* may very well have encouraged novelists to substitute scientific dilemmas and themes for religious ones, thus fostering the popularity of science fiction.

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 c/o Northeastern Science Foundation, Inc., Rensselaer Center of Applied Geology, P.O. Box 746, Troy, NY 12181-0746 U.S.A.; gmfriedman@juno.com

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TREASURER'S REPORT FOR 2001

Total funds transferred from previous Treasurer Dr. Dorothy Sack	$37,108.61
INCOME TO HESS Since Transfer of Funds	$ 7,853.35
Less payment to ALLEN PRESS for 19-1 ISSUE of ESH	−8,922.53
Less other Operating Expenses including new website	−935.66
BALANCE FORWARDED TO 2002	$35,103.47

Explanation:

One issue of *EARTH SCIENCES HISTORY* was published in the year 2001. However that issue was v. 19-1 for 2000. It should also be noted that the above income figure forwarded to 2002 includes $950 in institutional dues payments received in 2001 for 2002 subscriptions. Our balance of funds may appear to be unusually high but at the time this report was completed members had not received the second issue for 2000 (19-2) nor the two issues for 2001 (20-1 and 2). [Editor: Indeed, this report is being printed in 20-2!] Those three issues will be completed and payments sent to Allen Press by June of 2002. With the efforts of our editor, Greg Good, and the new associate editors our publication will be back on schedule by the end of 2002. We all owe Greg Good and his help a sincere thank you.

The above expenses include $256.85 for: registration of a new domain name for HESS, for our new website, one year's hosting of that website, and for our computer technician to help launch the site. The design, software, and photography expenses were donated by Ed and Mary Rogers. The site will cost HESS under $150 per year to host. The ownership by HESS of the domain name will insure that web search engines and crawlers find our new site. This new website will give HESS the exposure it needs on the worldwide web to attract new members.

Other expenses include the annual $300 payment to West Virginia University, a refund of Ball State's subscription, postage, and two framed certificates. These certificates were presented to Gerald M. Friedman and Dr. Ellis L. Yochelson at the GSA meeting in Boston in 2001 in recognition of their work in founding HESS and their continued support of HESS over the past twenty years. We all owe these two individuals a special debt of gratitude for having the vision to found HESS.

I am grateful to HESS assistant treasurers: Stuart A. Baldwin (U.K.), Rosa Domènech (Spain), Keith Tinkler (Canada), and Barry J. Cooper, (Australia) for their assistance with overseas members. Within a short time it is hoped that all members will be able to use a credit card to pay for HESS dues and back issues of *EARTH SCIENCES HISTORY* That announcement will appear in an upcoming issue.

On behalf of our society, a sincere thank you is given to all those members who provided donations to HESS and provided page charges to *EARTH SCIENCES HISTORY* in 2001. Thanks to all of our members for your continued support of HESS and *EARTH SCIENCES HISTORY.*

Lastly, I am especially thankful to the HESS membership for giving me the opportunity to serve as your treasurer. I am especially thankful to the previous treasurer Dorothy Sack for her time and help in learning the responsibilities of this position. A special thanks to the current and past officers of HESS for their help in overcoming some early unanticipated obstacles.

Respectfully submitted,

Edward Rogers, HESS Treasurer

NOTES ON CONTRIBUTORS

David Edgar Cartwright received his doctorate from the University of London, England. He has spent about thirty-five years as a researcher in Physical Oceanography, specializing in the physics of sea waves and tides, on which he has published over eighty papers in major journals. From 1974 to 1986 he was Assistant Director of the UK Institute of Oceanographic Sciences, as head of its laboratory at Bidston near Liverpool. Later, he continued his studies as a Senior Resident Associate at the NASA Goddard Space Flight Center at Greenbelt, Maryland, USA. Retired since 1994, he has directed his interests towards the history of his subject, especially tides. He is author of a book, *Tides—A Scientific History* (Cambridge University Press, 1999).

Dennis R. Dean, a retired academic, is the author of numerous articles and three books on the history of geology, including *Gideon Mantell and the Discovery of Dinosaurs* (Cambridge, 1999). Dean's interests include the cultural influence of geology and evolutionary biology. One of the courses he originated, called Darwin and His Cultural Influence, stressed naturalism in science, literature, and art.

Gerald M. Friedman, founding editor of **Earth Sciences History** and Distinguished Professor Geology at Brooklyn College and Graduate School of the City University of New York, received thé Sidney Powers Memorial Award, the highest honor of the American Association of Petroleum Geologists. He also was elected an Honorary Lifetime Member of **History of the Earth Sciences Society** in 2001, along with Ellis L. Yochelson. These are the first two individuals chosen for this distinction, based on their significant contributions to the history of the earth sciences and to the society.

Tadas Jankauskas is a Lithuanian palynologist and biostratigrapher. He was born in Siberia, U.S.S.R. and graduated from the University of Novosibirsk, subsequently working a while in Syria. After accepting an invitation to settle in his parent's country, Lithuania, he learned the Lithuanian language and was appointed professor at the University of Vilnius. He is currently engaged in studies of the Cambrian acritarchs and biostratigraphy of Lithuania.

Robert G. Quayle was employed in various positions in the National Climatic Data Center (NCDC) from 1965 until his retirement in 2000. His positions included head of Data Operations and later head of the Global Climate Lab.

Gary D. Rosenberg is a biomineralogist who is interested in spatial relationships. The latter arose when he developed an interest in art history as well as geology as an undergraduate at the University of Wisconsin, where Robert Dott introduced him to Leonardo da Vinci's role as a founder of modern geologic thought. He learned about geometry and biological evolution from Stephen Jay Gould's seminars on allometry during his first year as a graduate student at Columbia University, and he began to think about "compositional allometry" as a graduate student at UCLA under Clarence A. Hall. Later, he began to collect and study art, which ultimately led him, with the encouragement of Arthur Mirsky, to develop several courses at IUPUI combining geology and art. His paper with W. William Hughes, Donald L. Parker, and Bruce D. Ray, "The Geometry of Bivalve Shell Chemistry and Mantle Metabolism," in the *American Malacological Bulletin,* 2001, 16:251–261, is his most recent attempt to fuse his biomineralization, art history, and spatial interests.

William A. S. Sarjeant is a palynologist, palaeoichnologist, and historian and bibliogrpaher of geology. He has written on many aspects of the history of geology and especially of palynology, but is best known as the author of the ten-volume, international bibliography of *Geologists and the History of Geology.* He is a professor of geological sciences at the University of Saskatchewan, Canada and a Fellow of the Royal Society of Canada.

Brian C. Shipley is a Ph.D. candidate in the Department of History, Dalhousie University (Halifax, Nova Scotia, Canada), and an Assistant Editor with the Thomas A. Edison Papers at Rutgers, the State University of New Jersey. His dissertation-in-progress concerns William E. Logan and the practice of geological surveying and mapping in colonial Canada. His recently published article, Rough Science in the Bush, *The Beaver: Canada's History Magazine,* Feb/Mar 2002, 82(1):8–15, describes Logan's first field season on the Gaspé peninsula. He has also written about the relationship between John Perry and Lord Kelvin in their debate on the age of the Earth. Visit Brian online at http://www.rci.rutgers.edu/~bshipley

Haruyo Yoshida earned a Ph.D. in history of science at Hokkaido University. She is currently teaching history of science and technology at Sapporo University, Japan. She has been studying the history of modern Japanese science, and especially the research of Aikitu Tanakadate. She has published: Aikitu Tanakadate and the Beginning of the Physical Researches in Japan, *Historia Scientiarum,* 1997, 7(2). Recently she is also researching on the history of computing.

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