BOOK REVIEWS

Vic Baker, Book Reviews Editor

MEASURING MOTHER EARTH: HOW JOE THE KID BECAME TYRRELL OF THE NORTH. *Heather Robertson. 2007. McClelland and Stewart, Toronto, Ontario. 348 pp. ISBN 978-0-7710-7539-1. Hardcover, $34.99 (Can).*

Fifty years after his death, we are presented with a new biography of geologist Joe Tyrrell. It is the third book-length biography, and is complemented by a PhD thesis and numerous other relevant publications. No other Canadian geologist has received this degree of biographical attention, but Tyrrell, while always in touch with the Earth through his ninety-eight years, is remembered not just as a geologist, but as an explorer, entrepreneur, and historian of science.

Joseph Burr Tyrrell (1858–1957) joined the Geological Survey of Canada in 1881—among the last to be hired without a degree in geology. He trained by helping to arrange the collections recently transported from Montreal to Ottawa, then in 1883 in the field with Chief Geologist George Mercer Dawson (1849–1901) to what is now Alberta. Tyrrell soon began independent survey, threading the Red Deer River, where he found commercial coal deposits and Canada's first dinosaur skull. He carried out further surveys in what are now the provinces of Saskatchewan and Manitoba, and then in 1893 and 1894 led two extensive explorations into the barren lands (now in the Northwest Territories and Nunavut). Tyrell's observations led him to recognize the former presence of what he named the Keewatin Glacier, an important feature of Ice Age Canada. In 1898 he left the Survey to become a mining engineer in the Klondike Gold Rush, and later played a leading role in the development of the Kirkland Lake gold fields in Ontario, ending his professional career as a wealthy mine owner. He was also a scientific historian, securing and editing the journal of then-forgotten fur trader, cartographer, and naturalist David Thompson (1770–1857), establishing his position as one of North America's leading explorers and mapmakers.

Tyrrell offers more than achievements to the biographer. He was a singularly colorful character—Robertson sums him up as "egocentric, obsessive and hot tempered". He got his foothold in the Survey through his father's political influence (not uncommon in the nineteenth century), quarreled with his colleagues, and sought the support of ministers and Canada's Governor-General over the heads of his civil servant supervisors. He took unpopular (though forward-looking) positions in geological controversies, and was involved in lawsuits in the Klondike, while his later career in the Ontario gold mines has not been free of criticism. His name was subsequently given to what is now Alberta's Royal Tyrrell Museum of Paleontology, as it was constructed near his only significant dinosaur find.

Tyrrell's first 'biography' is Loudon's *A Canadian Geologist* (1930), which, Robertson tells us, was funded (and partly written) by its subject, whose awareness of the importance of image is remarkably modern. After Tyrrell's death, Inglis in *A Northern Vagabond* (1978) tells a more detailed story, making some use of Tyrrell's papers in the University of Toronto and the Public Archives of Canada to tell his story, while seeking for—and finding—'the magnificence of his achievements'.

The new biography of this interesting and important figure comes from Heather Robertson, a well-known Canadian writer with more than a dozen books of fiction and nonfiction to her credit. She has a particular interest in social history, and this is her first

biography of a scientist. What (the reviewer must ask) does a new biography bring to this much trodden field that has not been done before? Robertson's work has some sixty pages of text more than Inglis, but gives much more historical context, so does not actually devote much more space to the central character of the story. However, Robertson has made more use of Tyrrell's journals and correspondence, tapped some other valuable sources, and presents sixteen pages of source notes to Inglis's two. She also has twice as many maps and photos, though many of these are poorly reproduced.

After a brief introduction, Robertson opens with the young Tyrrell in the west for the first time. Quoting extensively from his journals, and filling out the story in her own words, she presents a vivid picture of a young geologist coming to grips with his subject. She then backtracks to his early life and follows his career chronologically. Like Inglis, she devotes more than half her book to the seventeen Geological Survey years, moving relatively rapidly through the remaining decades.

Robertson ranges widely to present the scientific and exploration background to Tyrrell's story. Thus we start with Frobisher collecting rocks in Baffin Land in 1576, and further depart from Tyrrell's life to discuss explorers such as Franklin, Hearne, and Thompson, and geologists Louis Agassiz, the Dawsons, and Warren Upham who labored in the moraines of glacial research. Although some of these leaps in time and space may be a little dizzying for some readers (and her view of J. W. Dawson is very one-sided), there is a real context for Tyrrell's work and life, particularly valuable for readers unfamiliar with Canadian history. She illuminates Tyrrell by exploring the politics of the Survey (as it tried to produce fundamental research for a government that just wanted profitable minerals) and gives splendid accounts of his first appointment to the Survey, and his complex manipulations to get approval and funding for his Arctic trips.

At one point Robertson quotes her predecessor Loudon as he found geology 'too technical' to be included. While Robertson does much better in this respect, she too is at her weakest in geological matters, with some factual inaccuracies and misleading language. For example, there has been much confusion over the nature and significance of Tyrrell's dinosaur find, which alas continues here; Robertson credits Tyrrell with unearthing "the first fossil of a meat-eating dinosaur found in Canada", but Weston found bones and teeth of carnivorous dinosaurs in 1883 (the year before Tyrrell's find) at several localities. Tyrrell's claim to paleontological fame (as he himself clearly understood) was finding and collecting the first dinosaur skull found in Canada.

Robertson has many vivid turns of phrase, encapsulating people and situations in a few words, but unfortunately it is not always clear whether she is writing in Tyrrell's voice or her own. Thus, it would be easy for the reader to assume that Tyrrell thought the bed of Lake Winnipeg had been the bed of a tropical sea "500 to 200 million years earlier", long before such dates were serious considered. The historian may also be frustrated by such bold—and undocumented—statements that Tyrrell found "fossils unbearably boring" or speculations that he was being "punished for messing up his dinosaur" by inadequate excavation techniques, though Barnum Brown did not bring the plastering technique to Canada for another quarter of a century.

Inglis had some light and shade, but Robertson justly presents Tyrrell as a complex character. In her pages we find a lover of geology who made significant contributions to glacial geology yet who left science for the mining world; a capable leader of Arctic travel who was anxious to appear as a hero; a man impatient of direction and routine, who worked patiently for years on Thompson's journals; and an entrepreneur who through a combination of insight, luck, (and perhaps lack of scruple) ended up in control of the right mine and acquired the wealth he wanted.

Robertson's biography presents a credible portrait of this complex and inconsistent

man, and provides a lot of previously unavailable data. Despite some imperfections, it is by far the best biography of Tyrrell, and should be of interest to anyone interested in the history of the Earth sciences both inside and outside Canada.

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A CENTURY OF AUSTRALIAN DINOSAURS. *Thomas H. Rich and Patricia Vickers-Rich. 2003. The Queen Victoria Museum & Art Gallery, Tasmania, and Monash Science Centre, Victoria, Australia, 124 pp. ISBN 0 9586203 6 9. Softcover $19.95 (AUS) (plus postage). May be ordered from* shop@qvmag.tas.gov.au.

"It is difficult to be certain about *Agrosaurus* even being an Australian dinosaur", says an earlier text (Long's 1998 *Dinosaurs of Australia and New Zealand*) about a supposed 1844 find. Described by Seeley, and restudied by von Huene, one would have expected *Agrosaurus* to be unassailable, but the authors of this recent volume have no hesitation in throwing Oz's reputed first dinosaur out of Australia's scientific history. Chapter one, then, documents a detailed investigation into historical records, museum collections, and the reputed find site of *Agrosaurus* (where, in Crocodile Dundee fashion, a team member had to watch for crocodiles, sharks, and feral water buffalo). The evidence gathered provides abundant reason for suspicion about the provenance of this early specimen. Quite appropriately, this opening story sets the tone for a fascinating volume in which Australia's dinosaurs and paleontologists combine to present a multitude of quirky surprises.

A Century of Australian Dinosaurs celebrates a hundred years of work on this elusive—in Australia—group. The first real discovery was the 'Cape Paterson Claw' found in 1903 in Victoria. Collected by a survey geologist, it ended up (in the fashion characteristic of colonial science) in the hands of Arthur Smith Woodward at the British Museum, who ascribed it to *Megalosaurus*.

It was seventy-five years before another dinosaur was recorded from Australia, and subsequent chapters explain why. Although dinosaurs are now known from most of the States and Territories of Australia, vertebrate paleontologists have had to contend with a variety of unusual circumstances. For instance, the dinosaur skeletons of Queensland are isolated finds found almost exclusively in lag deposits in marine sediments, so that one discovery rarely leads to another. In three states, many bones are opalized, and thus at risk of destruction by opal miners. The sea coast of Victoria produces bones that are not 'bone-shaped', and can only be found by recognizing the texture of bone in cross sections; the most productive sites here have come from excavating tunnels to find the dinosaur bones. Dinosaur tracks are found at remote locations (such as the amazing Lark Quarry), or in the roofs of passages in coal and gold mines. The remarkable record of Australian dinosaurs has largely been found by under-funded collectors zealously searching for the sort of material that paleontologists in more fossil-rich areas discard as 'road kill'. The meagre record shows some polar-adaptations, and specimens and sites have been studied by innovative techniques, such as computer imaging from cameras mounted in a radio-controlled helicopter. Once found, other challenges have faced the researchers, as comparisons had to be sought elsewhere in a fragmented Gondwanaland, while reference collections are largely in the northern continents.

Six chapters focus on different finds, categories or regions, and the last surveys what is known and draws attention to outstanding questions being addressed by current research.

A four-page bibliography and a few notes complete the text.

Among the many attractions of this small book are the abundant illustrations (though a few could with advantage have been larger). These include maps, charts, and photos of locations, people and fossils, many in colour, often supported by long explanatory captions. The diversity of inputs—there are long quotations from various collectors and museum researchers—makes this a valuable research document, yet the style is light and readily accessible to a non-specialized audience. Although the subject matter is primarily dinosaurian and Australian, there are many excursions to other types of fossils; the players include numerous paleontologists from America, China, England and other countries; and the writers keep us aware of the wider context of dinosaurian research in Gondwanaland and elsewhere. There are many entertaining details—the bone that was used as a doorstop in a restaurant, and the five couples that married after meeting as volunteers in the dinosaur mine.

There are few things to criticise. The most serious deficiency is the absence of an index, an essential for such an informative book that will surely be used by many researchers. Since a number of important fossils are noted as disappearing into private hands it would also be helpful to have some understanding of what steps have been made or proposed for the legal protection of paleontological resources 'down under'. This reader would also like more personal glimpses of the paleontologists like the one of Tony Thulborn who "swore he would never study fossil footprints again" and then went on to write the definitive book on the subject. While we are given the backgrounds of many of the delightful names of Australian dinosaurs—for instance *Fulgurotherium* ('lightning beast' from the Lightning Ridge locality), *Kakuru* (for an opalised specimen from the Aboriginal name for 'rainbow serpent'), the authors—perhaps out of modesty—do not explain their own splendid names *Atlascopcosaurus* and *Leaellynasaura* (which other sources indicate are named after a company which supplied equipment, and their own daughter who discovered some of the bones. And it is only since Adrienne Mayor's 2005 book *Fossil Legends of the First Americans* that the extent and significance of records by native peoples have been widely understood, so it would be unfair to criticise the lack of detail in the intriguing references to Aboriginal religious interest in fossils and trackways; at any rate it seems here is an interesting opportunity for future research.

A Century of Australian Dinosaurs is a story of patience rewarded in a generally unfavourable environment. It will be of interest well beyond the limits of Australia, to anyone interested in dinosaurs, in the evolution of science (particularly in a colonial context), and in the many interconnections of scientists working together on scientific discoveries around the world.

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GRAVE SECRETS OF THE DINOSAURS: SOFT TISSUES AND HARD SCIENCE.
Phillip Manning. 2008. National Geographic, Washington, D.C. 317 pp. Hard cover, $28.00.

Dinosaur mummies (whose bodies have dried out early in the fossilization process) are extremely rare, but immensely valuable to science, often preserving extensive skin impressions, gut contents, and other rarely preserved materials. Considering their importance, mummies have a remarkably small literature—even major encyclopedias of

paleontology and dinosaurs only give them passing mention in articles on fossil preservation and taphonomy. Apart from one volume written for children, this seems to be the first book to focus on the subject.

In 1999 a teenage boy, Tyler Lyon, found the tip of the tail of a dinosaur in the Hell Creek Formation of the North Dakota badlands. Five years later, he led a small team of volunteers, which began excavation and found a hadrosaur skeleton surrounded by an iron-rich crust containing skin impressions. Here was a mummy, but one offering unusual promise, for "the skin envelope looked like it had had been somehow preserved in its three dimensional form".

An American dinosaur would usually be first studied by scientists from the United States, but Manchester (UK) paleontologist Phillip Manning tells how he became involved, and assembled a remarkably diverse international team to study this fossil, nicknamed 'Dakota'. These researchers seem to be pursuing studies of greater depth and complexity than any other dinosaur has yet received. *Grave Secrets* presents a progress report, and thus a snapshot of many new directions currently pursued by dinosaur researchers.

Manning opens with an imaginative recreation of the death scene. A long diversion of three chapters discusses dinosaurs and their discovery, special fossil finds such as *lagerstatten* and frozen mammoths, the range of natural and artificial human mummies known to archaeology, and previously discovered dinosaur mummies. It is not until Chapter 5 that we learn of the author's background and connection with Dakota. Preparation for the dig and the actual excavation occupy two more chapters, and the remaining five discuss new research methods being brought into the service of dinosaurian paleontology. There are fifteen pages of black and white photographs, but the book has no glossary, references, or index.

Grave Secrets is obviously designed to appeal to a popular audience, though the content will be of interest to many Earth scientists and historians of Earth sciences. There is much vivid detail; we come to know the personalities of the discoverers and researchers (and even of one of the field vehicles); distractions to the researchers include rattlesnakes, scorpions, prairie fires, and even nightmares. Dinosaurs attract a pretty sophisticated readership these days, but the many brief discussions of technical matters will challenge some.

There is a lively account of the excavation and lifting of Dakota. A brief autobiography tells us how the author got to the point where he could take on such a complex project on another continent. Particularly fascinating are the generally lucid explanations of complex processes, as GPS, LIDAR, cat scans, geochemistry, bio-mechanics, SEM, EDX and other esoteric methods which are being applied to Dakota's remains. Some of the writing is good, with vivid images, use of a wide variety of language, and lively emails from preparator Stephen Begin. There are some entertaining examples of the sort of in-jokes with which geologists amuse themselves. I enjoyed the 'Mofaotyof' principle (translated as 'My oldest fossils are older than your oldest fossils'), and the Pythonesque 'Nobody expects the Cambrian explosion'.

Unfortunately, the egg is only good in parts. Names of some institutions (Senckenberg) and scientific names of genera (*Hylaeosaurus*, *Sphagnum*) are spelled inconsistently. Grammar is sometimes garbled, so that the author does not always say what he obviously intends—clearly it is *Iguanodon* that was thought to resemble 'some giant reptilian rhinoceros' not its 'thumb'.

Facts are sometimes treated with the same carelessness, as a few examples show. *Edmontosaurus* is a genus, not a species, and its type specimen was not found near Edmonton but in the Edmonton Formation near Drumheller. C. H. Sternberg (whose name is associated with the first mummy discoveries), was not, as stated, living in Kansas in 1876

with his young family, as he did not marry until 1880, and his first child was born in 1881. And dinosaur eggs were first found in France as early as 1859, well before the better publicized finds of the Roy Chapman Andrews expeditions more than half a century later.

While much of the technology is up to the minute, Manning's view of dinosaurs seems to be strangely old fashioned—usually only including what 'dinosaurologists' now refer to as 'non-avian dinosaurs'. He quotes approvingly Huxley's insightful view of birds as 'dinosaurs in disguise', yet in his text birds are treated as a different order, dinosaurs are extinct, and cladistics and feathered dinosaurs are not mentioned until near the end of the book.

Nor do we learn much about the results of the new research. There is evidence of the intercentra normally lost when only bones are preserved, hooves have been found on the toes, and some possibly original organic molecules have been recognized in the skin remains. At the time of writing, the dinosaur was still mainly in its plaster jackets, and clearly much research remains to be done before Dakota's story can be told, and science gets the full benefit of this remarkable specimen.

Are glossaries and bibliographies no longer needed now that a few keystrokes give us access to the worldwide web? I tested this thesis, and was certainly able to find more about 'Larry Witmer's Extant Phylogenetic Bracket', which appears in the text without explanation. However, I also sought clarification of 'taphonomy', which seems to be used by the author with two different meanings (either describing the processes of decay of an organism as it becomes fossilized, or as the study of such processes). The web quickly assured me that both meanings are in use, but a glossary would have told me what the author meant by the term. I also looked for the source of Manning's oversimplified statement that 'Pliny the Elder had called [*Protoceratops*] the griffin". Without my own prior knowledge I would have found it difficult to make the connection to Adrienne Mayor's book *The First Fossil Hunters*, so a reference would have been both courteous to the original researcher and helpful to the reader. Clearly glossaries and references are not yet redundant, while the value of an index for a work of value for ongoing reference is self-evident.

On balance then, Manning gives the best account yet of dinosaur mummies, and the fullest overview of new technical research directions applied to dinosaurs. The Earth science historian will find a sketchy (and not entirely accurate) background, a first-hand account of the people, the location, the science and some results by one of its leading players. Less fully discussed, but surfacing here and there in the text, is the message that the organization and funding of major paleontological endeavors is no longer the primary responsibility of a single institution, but (as in C. H. Sternberg's day) once again relies on collaboration by a variety of organisations, funders, and scientific entrepreneurs.

There is an inherent conflict in the work of a scientist who wishes to thoroughly research his subject, while also trying as a writer to satisfy a publisher that wants its product at the best market opportunity. Manning refers to his writing process as "a sprint to the finish line", and the haste was clearly because the publisher is National Geographic, who have already featured Dakota in a television program, *Dinosaur Autopsy*. National Geographic is also a funder of the research, so the preliminary nature of this book is not just part of the organizational story of the Dakota excavation, but also part of the publicity efforts that allows the Society to support such research.

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THE REMARKABLE LIFE OF WILLIAM BEEBE: EXPLORER AND NATURALIST. *Carol Grant Gould, 2004. Island Press/Shearwater Books, Washington, D.C., 447 pp. Hardcover, $30.00.*

"At three o'clock Eastern Standard Time on 22 September, 1932, a fair part of the world sat breathless beside the radio, straining to hear the voice of William Beebe speaking from a cramped position in his tiny bathysphere nearly half a mile beneath the surface of the ocean". So begins the Prologue to Carol Grant Gould's fascinating biography of a man whose daring and dangerous trip attempted a to obtain a view of deep-ocean life for the first time. The back cover photo of Beebe sitting atop the bathysphere offers a perfect visual impression of the claustrophobic environment endured by him and Otis Barton, the sphere's designer. The expedition's danger and ultimate success could be easily compared to the 1969 *Apollo 11* mission to the Moon; both Beebe and Barton are thereby guaranteed a place in the history of science.

But the first deep-ocean 'dive' was only one of many in Beebe's truly remarkable life. His writings appeared in scientific journals, best-selling books, and popular magazines. His first job was at the newly constructed Bronx Zoo. His association with the American Museum of Natural History made him a colleague of Henry Fairfield Osborn and William Temple Hornaday (who chronicled his own adventures in the wilderness of the American Southwest in *Camp-fires on Lava* in 1908). In addition to being a confidant of President Theodore Roosevelt, Beebe was also part of New York's literary and artistic circles, hosting legendary parties with attendees such as Noel Coward and Katharine Hepburn (incorrectly spelled 'Katherine' in this book). Everyone seemed to know William Beebe's name in the first half of the twentieth century.

Beebe's name is little known today, which illustrates how fleeting fame can be. Author Grant appears to be just the person to resurrect his story. In the book's preface, she describes her great luck in being the first person to be based on Beebe's newly released letters and journals, many of which he kept since childhood. She also makes a compelling case that his secretive personality has kept successive generations from knowing about him. Her attention to detail is breathtaking; she has used her sources to make this history of science read like a first-rate novel.

The book is divided into four parts, each describing Beebe's multifaceted career of as Naturalist, Ornithologist, Marine Biologist and Tropical Ecologist. He could have claimed fame in any one of these individual fields; he eventually won world renown in all four. The four parts are further divided into thirty-seven chapters; excerpts from Beebe's many writings head all but four chapters. The book also has endnotes, an index, and a selected bibliography of both Beebe's writings and references by other authors.

Part 1 (Chapters 1–8) describes Beebe's childhood, all of which clearly foreshadows his further career. He was simply interested in all living things, and appeared to want to collect a sample of every one of them. Part 2 (Chapters 9–21) focuses on Beebe's bird studies; among other achievements, he was first scientist to suggest the idea of sexual dimorphism in birds. But even when concentrating on birds, he could not shake the habit of carefully examining other creatures as well. At least eighty-eight living creatures bear the Latinate version of his name: *beebei*. The first two critters were an earwig (p. 160) and a Himalayan slug (p. 152).

Part 3 (Chapters 22–31) finds Beebe turning to marine biology. This section will probably be of most interest to Earth science historians, because this is where his descent in the bathysphere is detailed. This pioneering effort marked the beginning of all manner of undersea exploration that continues to this day. One detail that appears to be missing, however, is the inner diameter of the bathysphere; of the two men who occupied it, Beebe was the taller at six feet. The otherwise vivid descriptions of the cramped quarters illustrate the incredible courage it took to accomplish this feat.

Part 4 (Chapters 32–37) covers his contributions to tropical ecology. This last part of his life could be said to have brought him full circle, because he had never given up looking at all living creatures. Now he considered their interrelationships as well, making him one of the founders of the science of ecology.

For science historians this book will be invaluable for understanding how science is conducted. On his first trip to the Far East in 1910, for example, Beebe had a chance to meet with some Japanese scientists, who discussed the problems they had with their bureaucracy getting in the way of research progress. Problems of doing science obviously have a very long history, and most of these problems remain a century later. Personality clashes crop up constantly, of course; suffice it to say that human behavior hasn't changed much over time either.

The photo of William Beebe on the dust jacket front and in the frontispiece of this book must have been the very model of the Great White Hunter caricature seen even today in cartoons. In this case, Beebe more than lived up to the stereotype. (His six-foot height, considered practically gigantic in those days, probably helped his out-sized reputation.) Photos enhance the text throughout this book. I liked the one of Will and his first wife Blair in the Himalayas, looking toward of Mount Everest (p. 153).

Like so many scientists, Beebe passionately loved his work, but he suffered from depression off and on throughout his adult life, in addition to other physical ailments. He never got a PhD, so he was sensitive to conflicting pulls between his scientific and popular writings. In his world travels he had to deal with the problems between cultures that confronted him, when he clearly would rather have been paying attention to his work. His personal life is too complicated to be summarized in this review, but it will keep the reader turning the pages.

In short, Grant has written an outstanding biography that for me was like reading an adventure novel; I couldn't wait to find out what happened next. The word 'remarkable' in the title is frankly an understatement. Could this excellent, reasonably priced biography bring renewed interests in his life and writings? I recommend this book without reservation.

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THE EXPLORER KING: ADVENTURE, SCIENCE, AND THE GREAT DIAMOND HOAX—CLARENCE KING IN THE OLD WEST. *Robert Wilson, 2006. Scribner, New York, 303 pp. Hardcover, $26.00.*

John Hay is quoted as saying that Clarence King was the "best and brightest man of his generation". Henry Adams said of King that "men worshipped [him] not so much [as] their friend, [but] as the ideal American they all wanted to be". King was a regular in a small group of these friends who met daily in 1881 for "witty, often scathing conversation". King was admired for his intelligence, charm, spontaneous wit, and ability to tell fascinating

stories. At age twenty-five, he was appointed by Congress and granted funds to determine the geology and mineral resources of the Fortieth Parallel from California to Colorado, a remarkable feat by itself in an era when military men had done most of the exploration in the western United States. He assembled a team of leading scientists to study the geography, geology, paleontology biology, and meteorology, and they produced reports that set benchmarks in science for decades to come. King's report "attempted to give a complete history of the geology of the West that would explain the laws of geology itself". In 1879 at age thirty-seven, King was appointed the first Director of the newly established US Geological Survey. He lasted only two years. Wilson explores the reasons for many failures in the latter part of King's life until 1901 when he died heavily in debt, far from home, and virtually alone, but the fact remains that King is virtually forgotten when a contemporary, such as John Wesley Powell, is remembered as a great explorer.

What makes a great and popular man so easily forgotten? Wilson believes that his marriage to a black woman using an assumed name was bad enough in the Brahmin society he frequented, but failure to provide adequately for his five children when he died was inexcusable. He may not have had any options. He failed most business ventures he tried after leaving the Geological Survey, making money only infrequently as a consultant in mining disputes. He borrowed large sums of money from John Jay, but Wilson points out that the volume of tributes after King's death provides better clues than debt to explain why he has been forgotten. The second half of King's life embarrassed his friends in relation to expectations from the first half. He could not live up to his myth.

The most exciting part of Wilson's book describes King's heart-stopping adventures in exploring the unmapped granite summits of the Sierra Nevada south of Yosemite Valley. He and a friend were equipped only with rancher's boots, a light blanket, a rope, various instruments to measure elevation and to triangulate to known peaks, and enough food to last a week. As they climbed higher in July 1862, the temperature dropped to two degrees above zero. When they encountered a vertical face of ice, they had to use a Bowie knife to cut steps to ascend. As they inched along a two-foot wide-shelf in a vertical face of granite with a 1,000-foot drop to certain death below, King managed to turn around, grasp two small protuberances, and with feet dangling in air slide down until he grasped a small gooseberry bush. He had told his partner, who was not secured, to let him go if he fell. Page after page of similar exploits make this a fascinating book.

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WHATEVER IS UNDER THE EARTH: THE GEOLOGICAL SOCIETY OF LONDON 1807 TO 2007. *Gordon L. Herries Davies. The Geological Society of London Publishing House, Bath, U.K., 356 pp. Hardcover,* £50.00.

The story of the two hundred year history of the Geological Society of London is well told in Gordon Herries Davies' inimical prose, including notes about the broader occurrences in history that influenced the Society. Although chronologically organized, there are major themes followed throughout the book. Besides remembrances of the geologists of the society, there are the Society's initiation and growth as well as changing standards for membership; the locations where it has met and their conditions; operating finances; changes over the years for its museum and library; the history and challenges of GSL publication; attitudes toward the membership of women over time; and, of course, changing

ideas of what a professional society should be with respect to changes in the science of geology and the world. Herries Davies spent nearly ten years writing this account, with the immense resources of GSL, as well as access to Wallace Pitcher's notes from the latter's initial intention of writing the history. At a meeting in Edinburgh in 1997, the standard was passed to Herries Davies by Pitcher, who before his death had recognized what a long endeavour it would be. Many of us still cherish our bright red brief cases from that meeting, inscribed with the name of an excellent single malt Highland whiskey with which we toasted the outcrop at Glen Tilt, and during which meeting we also went to the classic site of Siccar Point.

In the late eighteenth and early nineteenth centuries, the science that would become geology enjoyed unprecedented popularity. Educated men convened to hear and read mineralogical and field descriptions, and the United Kingdom was no exception. Theories abounded, among them the Neptunist, Plutonist, and Vulcanist ideas about rock origin. And early in the nineteenth century, thirteen men formed the core of a group calling themselves the 'Geophilists' (p. 13) who stated their aim as the formation of a Geological Society for the communication of ideas. Most were interested in mineralogy, and most had been associated with the short-lived British Mineralogical Society. As has so often been a feature with geologists ever since, the discussions were fueled with good food and good wine. The Society was formed in the late Fall of 1807, although not without dissention. Herries Davies covers the same ground here as did H. B. Woodward's in his account of the first hundred years of the Society, commissioned for the Centennial: *The History of the Geological Society of London*, published in 1907 by the GSL. But as would be expected, the later work has the advantage not only of longer hindsight, but also of one hundred more years of geology and scholarship about it.

Membership grew steadily from the initial few to 1,268 Fellows in 1875 (p. 152). Criteria for membership were not yet settled, some members having only a passing interest in the science, but who enjoyed the social cachet of FGS after their names (and had the ability to pay the dues). Foreign members were added regularly. There had been a few papers given by women, and in 1895 the President suggested that perhaps women might be admitted to hear papers read. Early in the twentieth century women were accepted in attendance, and in 1919 Margaret Crossfield was the first to become a Fellow. As geology became less of an investigation of the Earth's properties by men of leisure and the academic world, and more engaged in the real worlds of mining, transport, etc., the character of the membership changed as well. Admission of 'practical' geologists, as in the time of William Smith, was not without controversy, although when the roles are scrutinized, mining and related technologies were, in fact, always represented. Later, radiometric measurements and other laboratory specialties added another layer to the sort of expertise represented in the Society, while throughout the twentieth century, demands for professional competency increased. Membership fell between the two world wars, but revived as geology itself did after the excitement of plate tectonics. Since 1990, Fellowship has been limited to "experienced graduates in geology and to those non-graduates possessed of long practical association with the science" (p. 310). From its beginning as a rather homogeneous society concerned mainly with mineralogy, paleontology, and stratigraphy, Specialty Groups have proliferated and today meetings are held throughout the United Kingdom and sometimes outside. At present there are about 10,000 Fellows (p. 268).

The Society's meeting rooms have migrated to several places in London, and the twin demands for more space and the financial ability to support it have changed over the years. Perhaps sadly, the collection in the Museum was dispersed in 1911. Despite the interest of some items in the collection it had received fewer and fewer visitors, and space was at a premium. However, the Library was growing rapidly. In 1909 alone donations

consisted of 493 books and volumes of periodicals, 316 pamphlets, and 153 sheets of geological maps (pp. 202–203), and the Library soon expanded into the Museum space. Because of bombing in World War II, thousands of books and documents were dispersed outside of London and were safely returned after the war. Twenty years after World War II membership and the library were again growing rapidly, while the other Societies with which the Geological Society had shared Burlington House were also growing. After an unprecedented period of fund-raising, expansion and renovation to achieve more modern and functional quarters, including replacement of the hallowed old Meeting Room, was completed. The new space was put into use starting in 1972, at the current address of Burlington House, Piccadilly, London.

As would be expected, governance of the Society has evolved over the two hundred years of its existence. Many great names in British geology have held the office of President. To name a few: George Bellas Greenough, Charles Lyell, Roderick Impey Murchison, Thomas Henry Huxley, Henry Clifton Sorby, Archibald Geikie, Herbert Harold Read; Wallace Spencer Pitcher, to the present Richard Alan Fortey. From that first group of thirteen members, recent administrators and office bearers need to contend with a group of thousands, including students and foreign members in a bewildering array of specialties who attend an array of meetings. There is still sometimes an apparent separation between the interests of academic as opposed to industry geologists.

The current publications of the Geological Society of London are illustrative of the broad reach of the Earth sciences. The story of the evolution of those publications alone is nearly a history of the science, at least in Britain. Initial publications in the early nineteenth century were concerned mainly with mineralogy, stratigraphy and field studies, and paleontology. Even the modest expenses were sometimes a problem for the Society to cover. The venues of publication changed several times until 1989 when the Society began in-house publication from premises located in Bath (p. 293), where it is now located. The publishing house is now one of the major publishers of Earth science literature in the world and has reciprocal agreements with other societies, so that their publications website is most useful.

Herries Davies has written a book that is both the history of one nation's growth in the Earth sciences, as well as documenting how geology has responded to the growth of knowledge and the number of its practitioners. Along the way he has given us priceless vignettes of the characters, some noble, some not, some difficult, some conciliators, who have woven the fabric of Earth science.

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THE CHRONOLOGERS' QUEST: THE SEARCH FOR THE AGE OF THE EARTH. *Patrick Wyse Jackson. 2006. Cambridge University Press. 291 pp. Hardcover, $30.00.*

Philosophy, of which natural science is arguably a part, has been defined as the providing of lawyerlike answers to childlike questions. Motivation to write *The Chronologers' Quest* arose in part from a question posed by Patrick Wyse Jackson's five-year-old daughter during a family vacation on the Dingle Peninsula in southwest Ireland: how long ago did the world begin? Subsequently, the author, who is a lecturer in geology and curator of the

Geological Museum, Trinity College, Dublin, discovered something that made his book seem to be predestined: he is a distant relation by marriage to James Ussher (1580–1656), Archbishop of Armagh. One of the many charms of this book is its clarification of the misquotations and errors associated with the mythology that surrounds Ussher's biblical calculations that trace Earth's origin to divine creation about 6,000 years ago. (For example, Ussher never claimed that it took place at nine o'clock in the morning.)

John McPhee in his 1981 book *Basin and Range* coined the wonderful term 'deep time' to refer to the immensity of geological time. More recently Martin J. S. Rudwick has shown in two magisterial volumes, *Bursting the Limits of Time* (2005) and *Worlds Before Adam* (2008), that the emergence of modern geology in the late eighteenth and early nineteenth centuries provided one of the most important revolutions in human thought by its combining of causal and historical understanding of humankind's place in the world. A history requires a beginning, and early ideas on directional time and its beginning are very much associated with western religious thinking. Thus, by focusing his book on the search for the age of the Earth, Wyse Jackson is able to cover much of the history of geology as a whole, extending it from the early biblical calculations of Ussher, through its recognition of 'deep time' in the revolution noted by Rudwick, and forward to the ultimate, very modern quantification of that time scale by Clair Patterson (1922–1995) in the 1950s.

In telling this story Wyse Jackson embellishes the history with very entertaining sidelights. It is interesting to learn, for example, given our modern obsession with peer review to justify funding, promotion, etc., that funding was rejected for Patterson's research proposal to do the work that ultimately resolved the quest! Only when the proposal was resubmitted under the name of his better scientifically known postdoctoral supervisor did the research get funded. The result, of course, was Patterson's calculation of the age at 4.5 billion years. Nevertheless, one wonders how many potential breakthroughs are rejected because their proposers lack a 'big name' surrogate for their ideas.

Jackson also conveys the colorful character of his historical subjects. On Roderick Murchison: "He was organized and meticulous, and embarked on his work with the zeal of a general attempting to get to Moscow before winter". Regarding Georges-Louis-Marie Buffon, who succeeded to the estate where his father George-Louis Leclerc, Comte de Buffon (1707–1788), conducted experiments on the cooling of the Earth from its original molten state: "Catherine the Great remarked after meeting him that it was ironic that the sons of geniuses often turned out to be imbeciles". Wyse Jackson affords special attention to the Irish actors in the drama, who, in addition to Ussher, included Edward Lhwyd (1660–1709), who used the inferred rate of boulder accumulation in Llanberis Pass, North Wales, to estimate an age for the Earth older than the biblical 6000 years; Richard Kirwan (1733–1812), who defended the Neptunian theory against Hutton and the Plutonists; and John Joly (1857–1933), who estimated the age of the Earth via the gradual rate of salt accumulation in the world ocean. Joly later worked with Ernst Rutherford (1871–1937) on 'pleochroic halos', an early, somewhat abortive attempt to apply knowledge of radioactive decay processes to the dating question. Of course, radioactivity proved ultimately to resolve the quest, largely championed through the efforts of Arthur Holmes (1890–1965), whose work is described in more detail by Cherry Lewis's *The Dating Game* (2000).

One sidelight that Wyse Jackson could have explored more relates to the attitude difference that progressively developed between those who quantified the geological time scale via principles of physics and chemistry versus those who relied upon the specific and unique signs of past events. This underlies the famous debate with Lord Kelvin (1824–1907), which is covered in more detail by Joe Burchfield's *Lord Kelvin and the Age of the Earth* (1990). Though it was Rutherford who showed Kelvin's calculations to be based on the false secondary premise of ignoring the role of radioactivity, it was also Rutherford who

placed historical geology in the following context: "Science is divided into two categories, physics and stamp-collection". Rutherford's assertion (and the attitude that underlies it) continues to invoke controversy, as when Luis Alvarez applied it to paleontologists who objected to many details in his asteroid impact hypothesis for the extinction of the dinosaurs.

Patrick Wyse Jackson gives us with a very readable account of one of the great triumphs in geology and also provides a useful annotated bibliography of important works in the history of geology as a whole. It is a story that will engage both a popular and a professional readership. In the end, he concludes, "[f]or centuries humankind has been attempting to discover the age of the Earth, and in 1953 Clair Patterson gave us the answer". Nevertheless, this brings us back to a problem with the definition of philosophy and science with which I started this review. How can we continue to have any science if we finally get to know the answer? The fifty years since the precise determination of Earth's age shows us why this is not a concern. Knowing the age of the Earth merely opened up a whole new array of questions about the what, where, and when of things before and after that date—but that will be have to be a subject for future historical scholarship.

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PROTOGAEA. *Gottfried Wilhelm Leibniz. Translated and edited by Claudine Cohen and Andre Wakefield, 2008. University of Chicago Press, Chicago, 173 pp. Hardcover, $55.00.*

Any credible list of greatest scientists will be likely to place the name Isaac Newton (1643–1727) at the top. Newton certainly merits this distinction for his physics, but not for his alchemy or his biblical numerology—dedicated passions that have been revealed by modern scholarship. Similarly, Newton's geology was as mediocre as his physics was brilliant. He is known to have greatly admired Thomas Burnet's *Sacred Theory of the Earth*, which sought to reconcile various scientific theories of the day with biblical texts. One way to discover the great geologists among Newton's contemporaries is to find those scientists with whom he had bitter disputes. Foremost among the latter was Robert Hooke (1635–1703), whose geological contributions have been wonderfully documented by Ellen Tan Drake's book *Restless Genius* (1996). Newton reserved his special antipathy for those who seem to have made discoveries at about the same time he did. With Hooke, this was the inverse square law. With Gottfried Wilhelm Leibniz (1646–1716), it was the calculus. It is an irony of history that the calculus that we all learn today (with the familiar integral and differential signs) is the type initiated by Leibniz, while Newton's variety (using fluxions), though equally valid mathematically, is not in common use and is mainly of historical interest.

Although one is not likely to find geologists' names on those lists of greatest scientists (unless that of Charles Lyell slips in near the end), this is not the case for lists of greatest philosophers. A surprising number of them have had some significant association with geology (broadly defined). In this regard, on the list of top philosophers one will likely find the names of Thales, Aristotle, Lucretius, Ibn Sina (Avicenna), Albertus Magnus, René Descartes, Gottfried Leibniz, Immanuel Kant, Johann Wolfgang von Goethe, Charles Peirce, and perhaps William Whewell—all of who wrote rather intelligently on geological

topics. The book under review concerns an important work by one of these philosopher–geologists; it is an English translation of Leibniz's *Protogaea*, which was written between 1691 and 1693.

Protogaea emerged out of a commission to Leibniz by Ernst August, Duke of Brunswick and hereditary Elector of the Holy Roman Empire. The Elector and his successors had in mind a popular book on the history of the House of Brunswick that would advance their dynastic agendas. Instead, Leibniz, showing the usual disdain with which dedicated scientists hold the petty power games of politicians, worked on a scholarly project that expanded to multiple volumes that were not published until long after his death. Despite this, however, the ideas in *Protogaea* were quite influential, particularly on continental geological thinkers, many of whom received circulated extracts and shorter papers that were published by Leibniz. For example, this influence can be seen in the very important work of George Louis Leclerc, Comte de Buffon (1707–1788), particularly his *Theorie de la terre* (1749).

Leibniz was unusual for his time in being able to merge both the grand theoretical visions of his contemporary philosophers with more common everyday knowledge of the particular region, Lower Saxony, which was the focus of his natural history. Though Leibniz clearly respected the speculations of René Descartes (1596–1650), expressed in *Principia philosophiae* (1644), and Thomas Burnet (1635–1715), expressed in his *Telluris theoria sacra*, he paid most attention to the details of local phenomena, including the Harz silver mines, in which he had both practical and scientific interests. He wished to ground his more abstract theories in the quirky particulars of local circumstances to generate what he called a 'natural geography'. Despite the seeming fragmentary text in *Protogaea*, partly reflecting the state of knowledge at the time, it is clear that Leibnitz had a grander vision. By focusing on the details of a very limited region he hoped to provide a model for something that might be extended to the entire world. This vision likely derived from his optimistic philosophical views that postulated a 'monadology' in which the key aspects of wholes and universals were contained in particular fragments, such that each mirrored the more general character of the universe.

The understanding of fossils expressed in *Protogaea* was clearly informed by the ideas of Nicolaus Steno (1638–1686), with whom Leibniz had long-standing communication. The book also expresses a sense of continuity between natural and human history. Leibniz, who like Charles Peirce (1839–1914), believed that human thought was organized by signs and symbols, clearly appreciated the analogy between the documents of human history and the strata, bones, and fossils of natural history. Thus, his historical project was at odds with a major strand of modern historiography, argued most cogently by Robin Collingwood (1889–1943) in his book *The Idea of History* (1946). Collingwood claims that there can be no natural history because historical knowledge is confined to that which can be re-enacted in the historians mind. Collingwood even used geology as an example of why such natural history is not possible. However, Collingwood's version of idealism (and geology) is not that same as that presumed by Leibniz (and later by Peirce), which raises some interesting questions for current Earth science historians.

It is absolutely fantastic to have this handsomely presented translation of Leibniz's classic work, with the original Latin and the modern English on facing pages. The book also includes copies of the accompanying illustrations, plus an excellent introduction by the editors. The latter places *Protogaea* in its wider historical and philosophical context. What a joy to have one of the greatest of philosophers writing seriously and deeply on geological themes!

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INTERESTING PUBLICATIONS

compiled by Gerald M. Friedman

Gerald M. Friedman, the Founding Editor of *Earth Sciences History*, has prepared this column since the journal's inception. Readers' help has been, is, and will be greatly appreciated in providing contributions to this column. Persons wishing to list recent books and papers of interest to HESS's membership are therefore requested to send them to Professor Friedman, Northeastern Science Foundation, P.O. Box 746, Troy, NY 12181-0746, USA; FAX: 518-273-3249; gmfriedman@thesciencefoundation.com.

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Torben Wolff was formerly Chief Curator at the Zoological Museum, Copenhagen and Deputy Leader of the *Galathea* Deep Sea Expedition (1950–1952). His main occupations have related to the taxonomy and biology of crustaceans, particularly *Isopoda*, and deep-sea ecology. In later years he has also worked on the history of marine expeditions, general zoology, and biographies of Danish zoologists.

Davis Young is a Professor of Geology, Emeritus, Calvin College, Grand Rapids, MI, USA. His most recent books are *Mind over Magma: The Story of Igneous Petrology*, and *John Calvin and the Natural World*. A forthcoming book co-authored with paleontologist Ralph Stearley, *The Bible, Rocks and Time*, is addressed primarily to Christian readers. This work presents much of the geological evidence for Earth's antiquity and includes chapters that summarize the history of ideas about geologic time.

Enric Aragonès (b. 1948) studied geology at the University of Barcelona, Spain, and Environmental Engineering at the Polytechnical University of the same city. He does work as a technical officer for the regional Government. He has published on the history of geological mapping and early geological knowledge of his country.

R. Lee Hadden has been a physical sciences librarian for over thirty years, and is currently a map librarian with the US Army Corps of Engineers at the Topographic Engineering Center at Fort Belvoir, Virginia. For almost fifteen years, he worked as a reference librarian with the US Geological Survey Library in Reston, Virginia, where he was a curator of the USGS Library's rare book and rare map collection and worked closely with the Heringen Collection and the George F. Kunz Collection on precious stones and gems. He has written several bibliographies on the geology of Middle Eastern and African countries, and has also published on speleology, military history, and the Civil War. Most recently he worked as part of an Army team to write a number of commemorative plaques for notable American topographers and cartographers.

Rowl Twidale is a graduate of the University of Bristol and of McGill University, Montreal. He was awarded an honorary doctorate in the Universidad Complutense, Madrid, in 1991. After service with CSIRO's Land Research and Regional Survey, he joined the University of Adelaide in the late 1950s. In research he has been mainly concerned with Australian landscapes but has lectured and studied in many overseas universities. Granite landforms, weathering, desert landscapes, planation surfaces and palaeoforms, and the history of ideas have been of particular interest. In retirement he holds a professorial appointment in the University of Coruña, Spain, and an Honorary Visiting Research Fellowship in the University of Adelaide.

Barbara Mohr received her university education at Bonn, completing her PhD in 1982 on Tertiary pollen floras from the Cologne area, Germany. As a post-doc she worked in West Berlin as a palynologist (1982–1985) in close cooperation with vertebrate palaeontologists.

She spent ten years as assistant professor at the ETH of Zurich, Switzerland, mostly studying Mesozoic and Tertiary pollen floras from Antarctica in order to understand southern high-latitude past vegetation and climate change. Since 1996 she has held a position as curator of the Mesophytic plant collections of the Museum of Natural History, Berlin. Her primary research area is now the early evolution of angiosperms and she is especially interested in the history of geosciences and palaeontological collections.

Evelyn Kustatscher received her university education at Ferrara where she completed her PhD in 2004 on fossil plants and pollens from the Middle Triassic of the Dolomites/Alps. After a post-doc year she moved to the Museum of Nature of South Tyrol in Bolzano, where she is responsible for the museum's palaeontological collections and is scientific coordinator of the temporary palaeontological exhibitions. Her research focuses on fossil plants and palynomorphs from the Permian and Triassic of the Southern Alps and their use for palaeoenvironmental and palaeoclimatic reconstructions. She is especially interested in comparing the flora of the Alps with coeval European floras.

Cornelia Hiller is trained as a preparator and worked for eight years in the Department of Anthropology at the Museum of Natural History, Berlin (MfN). Since 1990 she has been responsible for the technical aspects of the curation of the museum's palaeobotanical collections. Experimental archaeology of Europe is another of her main areas of interests.

Gottfried Böhme trained as museologist and palaeontologist. He received his university education at Jena and Berlin, where he completed his PhD in 1979. From 1959 to 1969 he worked at the Museum in Meiningen in Thuringia. From 1975 he was curator at the MfN with responsiblility for the geological collections. His main area of research has been concerned with reconstructions of Quaternary lake ecologies, based on the remains of lower vertebrates. He retired in 1999 but is still active. His special interests are related to the history of central Germany and natural history collections.

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Good, Gregory A. (ed.). 1998. S*ciences of the Earth: An Encyclopedia of Events, People, and Phenomena*. 2 vols. New York and London: Garland Publishing Inc.

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Jago, J. B., Pharaoh, M. D. and Wilson-Roberts, C. L. 2005. Douglas Mawson's first major geological expedition: the New Hebrides, 1903. *Earth Sciences History* 24: 93–111.

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Unpublished thesis or dissertation

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Erratum

Some words were inadvertently omitted during the process of formatting the article by Everett and Smith in *Earth Sciences History*, 2008, No. 1 (p. 8). The text should have read as follows:

> Though fascinated by Hess's ideas, he was unconvinced of their *correctness, and also of* Carey's exposition of oroclines and sphenochasms—which Carey presented at a graduate seminar in Princeton. Smith was also heavily influenced by Jeffreys, who had presented the apparently irrefutable arguments outlined above, that the forces needed to move continents around were much larger than any that had so far been *proposed*. *While completing his PhD, Smith was fortunate to have been employed as a* research associate by Bill Bonini at Princeton, during which time he learned computer programming.

We apologise for this error (ed.).

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