ESSAY REVIEW

REVIEW OF VOLUME III, FIRST EDITION, OF LYELL'S *PRINCIPLES* FACSIMILE EDITION FROM UNIVERSITY OF CHICAGO PRESS

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The University of Chicago Press has published a relatively inexpensive, quality paperback facsimile of the three volumes that make up the first edition of Charles Lyell's *Principles of Geology*. This review concerns Volume III, reprinted in late 1991 from the original published in 1833 by John Murray. In preparing this review, I have reread Wilson's (1972) biography and examined such editions of Lyell's works as are available to me. There are four topics here: the content of Volume III, which is mainly the Tertiary geology of western Europe; Lyell's activities in preparing Volume III; the later history of Volume III, which became Lyell's *The Elements of Geology*; and the significance of Volume III in the history of geology.

Content. Volume III deals with what Lyell himself called "geology proper", the rock record of those inorganic and organic processes described in Volumes I and II of *Principles*. Classified by geologic age, more than 80% of Volume III deals directly with Tertiary rocks of Europe, and much of the remainder is indirectly connected with the Tertiary.

Considered as a document, Volume III consists of extended front matter, 26 chapters of text (385 pages), and voluminous end matter. The front matter includes a dedication to Murchison, a 12-page Preface, 4 plates of characteristic Tertiary fossils, a geological map of southeast England, and a frontispiece showing a volcanic landscape in Catalonia. The map and the frontispiece were hand-colored in the original.

The text begins with 4 chapters that establish Lyell's objectives for Volume III, his uniformitarian principles, and the significance of the European Tertiary, especially the Paris Basin. The next 16 chapters deal in detail with the Tertiary of western Europe, having separate discussions of the marine, non-marine, and volcanic rocks for each of Lyell's four divisions of the Tertiary. As was Lyell's unique, life-long custom, his descriptions go from youngest to oldest rocks, because, he says, it is necessary to start from what we know and work back toward the unknown past.

It requires 20 chapters of Volume III to get to the bottom of the Tertiary, which leaves only 6 chapters for everything else. The next two chapters emphasize erosion of the Mesozoic rocks of the Weald, a Tertiary event, so it is not until Chapter 23 that the Secondary (Mesozoic and late Paleozoic in present terms) rocks are described, and then by emphasizing the differences from the Tertiary.

Chapter 24 criticizes Elie de Beaumont's theory of mountain building. As with many of the topics in Volume III, this critique led to additional work. Over the next 25 years, Lyell hammered away at de Beaumont with field observations and analyses, establishing facts that modern geologists assume to be self-evident. It was characteristic of Lyell that during this period he visited many of the field examples used by de Beaumont. The final two chapters deal with primary rocks (which Lyell shows are not primary in time) and the differences between plutonic, volcanic, and metamorphic rocks in general. The text is illustrated by 90 consecutively-numbered woodcuts, most of them idealized geologic sections, and some of them not specifically mentioned in the text.

The end matter which follows Chapter 26 includes: stratigraphic tables, a diagram defining possible temporal relations between sedimentary and igneous rocks, Instructions for Using Deshayes' Tables of Shells, the Tables themselves (46 pages of Tertiary fossil shells), analyses of shell occurrences, a glossary, and a useful index. The end matter also contains woodcuts 91, 92, and 93, continuing the numbering from the text.

There are three sets of page numbers in Volume III. The front matter includes 31 numbered pages and the unnumbered plates. The text begins with page 1 and continues to page 398 at the end of the Instructions for Using Deshayes' Tables, after which the numbering begins again with page 1, running to page 109 at the end of the index. The facsimile edition continues this numbering through page 160 with a Bibliography by Martin Rudwick, discussing and identifying in modern

fashion the sources referred to informally by Lyell in all three first-edition volumes.

Lyell's Activities. Before beginning on *Principles,* Lyell had already been three times to the Continent. In addition to the working knowledge of French expected from a man of his background, he probably was fluent in Italian and competent in Spanish and German. Rudwick's Bibliography shows Lyell's sources to include works ranging from Homer's time to his own, including titles in Latin, French, Italian, German, Spanish, and Dutch.

Lyell was the oldest son of a man of property, and while preparing Volume III (1828–1833), he had additional income from his writing and teaching. This income allowed him the time and expense that field work required, and subsidized Deshayes' work on shells that became his criterion for subdivision of the Tertiary.

Some European Tertiary deposits are lake beds, and freshwater deposits get unusual prominence in Volume III. Lyell observed the deposits of recent bogs and lakes in Scotland when his father and other landowners drained their land for agriculture, and reported his observations in his first geologic paper (1826). This experience gave him considerable insight into the environment of deposition of the Tertiary lakebeds he found in France.

Lyell's Preface in Volume III gives a detailed account of his field work, and acknowledges the Italian and French naturalists who helped him with fossil shell identification. His field work on the Continent included a nine-month excursion to France and Italy beginning in May 1828; the summer of 1830 in France and Spain, followed by 6 weeks in the museum of Deshayes studying Tertiary and Recent shells; the summer of 1831 in the Eifel region of Germany; and the summer of 1832 along the Rhine. The Preface does not say, but the trips to Germany included visits to the Horner family near Bonn. He became engaged to Mary Horner in July 1831, and their wedding, exactly one year later, was followed by his 1832 summer field season.

Volume III was the outcome of a decision in December 1831 to end Volume II with the chapter on coral reefs, because Lyell had already arranged for Whewell to review Volume II, and the anticipated delay in completing the Tertiary chapters threatened the impact of the review. Furthermore, Volume I was selling out, and Lyell wanted to prepare a second edition. While preparing Volume III, Lyell also presented his results in a series of lectures at King's College that became a fashionable event of the time. (He later resigned his professorship because it took too much time from geology.) He then prepared a second edition of Volume II, and was involved in an extensive correspondence with Mary, and even in an investigation of the legality in England of the forth-coming marriage in Germany. Despite his best efforts, he did not finish Volume III before his marriage.

Murray had printed the first 112 pages of Volume III in the spring of 1832, and he printed pages as Lyell wrote during the following year. The published book gives evidence of this hurry. In addition to the overemphasis on the Tertiary and the unusual pagination, there is a footnote on page 316 of Volume III which corrects a statement on page 182 of the same volume. Footnotes on pages 19 and 41 imply that there is only one edition of Volumes I and II, but later footnotes either explicitly reference the two editions or refer to chapter numbers only. The preface is dated April 1833, but the adjacent plates of Tertiary fossils have dates of December 1831 (Plates I and IV) and 1832 (Plates II and III).

Publication History. Although Volume III was the third and final volume of the first edition of *Principles,* it was the fifth volume of *Principles* to appear, because the second editions of Volumes I and II preceded it. There never was a second edition of Volume III. Volume III of the first edition became Volume IV in the third, fourth, and fifth editions of *Principles.* Then, the main subject matter from Volume III of the first edition was transferred to *The Elements of Geology,* which first appeared in July 1838. In its third, fourth, and fifth editions (1851, 1852, 1855), the title of *The Elements* became *A Manual of Elementary Geology,* more explicitly directed to students, and in the sixth edition (1865), simply *Elements of Geology.* There then appeared *The Student's Elements of Geology* which went through two editions (1871, 1874), shortly before Lyell died.

Lyell took pains to distinguish between *Principles,* which he thought to be the more interesting work, and *The Elements.* The first was intended for the educated non-specialist, the second for the specialist and student. *The Elements* evolved into something like what is now called historical geology, written in Lyell's remarkable style. In a typical observation intended to show that shelled animals make superior index fossils (Volume III, p. 48), Lyell describes hermit crabs scuttling about the Mediterranean shore in shells of animals that had lived in the Alps, an observation typical also in that it was pointed out to him by the local naturalist.

The paperback under review is from the second facsimile first edition of *Principles.* The earlier facsimile was a hardcover edition published in Germany by J. Cramer (1970). Both editions have introductory essays by Martin Rudwick preceding Volume I, the more recent essay extending and deepening the earlier with new insights into how Lyell's intentions affected the organization and exposition of *Principles.* Comparing Volumes III of both editions suggests that the German publisher copied an earlier printing because both facsimile editions list the same errata, but most have been corrected in the paperback facsimile, including two misspellings on the frontispiece, and none were corrected in the hardcover facsimile.

Geologic Importance of Volume III. Lyell, of course, did not invent geology by writing his *Principles.* He was the product of his time, and he built upon, extended, and synthesized the very considerable work

already done. But with the perspective of today, Volume III has achievements whose number and generality have rarely been put new between the covers of one geology book. Lyell did the following in Volume III:

(1) Correlated Tertiary rocks from isolated basins throughout Europe by means of characteristic index fossils and a rational criterion: the percent of fossil molluscs in the rocks that are found living today; and at the same time showed by field examples and with theory why correlation of separate basins using physical characteristics of rocks is unreliable.
(2) Named the Recent, and with Whewell's help, three Tertiary subdivisions (Pliocene, Miocene, Eocene), expected that gaps would be found between and within the type sections of these rocks, and showed how they were to be defined outside of Europe.
(3) Made the European Tertiary the type example for explaining former changes of the earth's surface by causes now in operation; thus showing most catastrophes to be arbitrary and unnecessary assumptions that usually breed further catastrophes for their operation.
(4) By showing (as others already had) that some "primary" rocks are younger than secondary rocks, helped replace that temporal term with the names of rock types, 'hypogene' (his term), subdivided into plutonic (already widely used) and 'metamorphic' (his term).
(5) Was among the first to introduce the essential mapping terms, 'strike' and 'outcrop', the later in the verbal form, 'crop out'; among the first to complain about "the obscure and vague appellation 'graywacke' ", and the "vaguely employed" term 'molasse'.

Being the product of his time, Lyell did not entirely escape a catastrophic interpretation of geologic history. The geologist acquainted with Lyell through textbook references to uniformitarianism will be startled at the relict catastrophism in Volume III. If mountain ranges could not be thrown up overnight, as de Beaumont proposed but Lyell showed could not happen, Lyell still expected them to be ratcheted up by a series of 'earthquakes' and 'convulsions'. To explain phenomena like loess, parallel roads, softrock deformation, and karst topography, Lyell (circa 1833) required earthquakes to demolish barriers confining large lakes, or floods of unusually large discharge, or as a last resort, vaguely described 'violence' or 'subterranean convulsions'. He entirely underrated the relative efficacy of fluvial erosion, giving waves far too much credit, and he gives no evidence (in Volume III) that he recognized chemical weathering.

In Volume III (p. 328), Lyell made two estimates, based on fossils, of the relative durations of specific geologic time intervals. When checked against modern radiometric dates, one of these estimates was very poor and the other rather good. He thought that the duration of the Tertiary as he knew it was equal to (1) the time represented within the contact between the uppermost chalk and the bottom of his Tertiary, and (2) the time between the top of the chalk down through the English lower greensand inclusive. If we allow the K-T gap as he knew it to equal the duration of the Paleocene, and allow the lower greensand to go through the Aptian, then the first estimate is off by a factor of 6, but the second is accurate to within 10%, according to modern radiometric dating.

Charles Darwin received Volume III early in 1834 while the *Beagle* was on the Argentine coast, and immediately after reading it, he classified rocks found during the expedition up the Santa Cruz River as "somewhere about the Meiocene". A few months later, he classified as 'Meiocene' and Eocene, rocks found on his first expedition in Chile. Darwin's 'ei' spelling reflects the Greek root, which Lyell did not use on the advice of Whewell. It is a remarkable example of their shared Victorian culture that Darwin, isolated in Argentina, thought the 'ei' should be there, and that other geologists used 'ei' in spelling Miocene and Pliocene for decades after Lyell introduced the terms with simpler spelling.

In chapter XI of Volume III, Lyell says, when discussing de Beaumont's hypothesis of instant mountain building, "Now, if we were sufficiently acquainted with the Andes", he might address de Beaumont more specifically. Darwin probably read this both as an opportunity and a challenge, for he crossed the Andes in both directions during the following southern summer and made observations on their age and structure that excited considerable interest when reported in England.

In all three volumes, and especially in Volume III, Lyell suggests, consistent with his steady-state theory of the earth, that the rise of the earth's surface over large regions is somehow compensated by subsidence elsewhere: "subsidence of certain parts of the chalk, which sank while the adjoining tracts were rising" (last sentence of Chapter XX). Darwin's observation of uplift in Chile suggested to him the possibility of subsidence under the Pacific, which led to his coral reef theory, developed shortly after receiving Volume III. Much later, Darwin probably relied too much on Volume III in using the denudation of the Weald in the first edition of *The Origin of Species* as a measure of geologic time. He deleted this example from subsequent editions of *The Origin* after ridicule from William Thomson.

In his Preface to Volume III, Lyell remarks on how different the history of geology would have been if the science had started in Sicily rather than further north in Europe. Continuing that reasoning, it is probable that Lyell, along with his contemporaries and immediate predecessors in Paris and London, has bestowed upon us the present interest in the Cretaceous-Tertiary boundary. The most profound, widespread, and easily seen sedimentary rock boundary accessible to the French and English investigators who started the mod-

ern era of geology was the top of the chalk in the Paris and London basins. This rock surface evolved into the K-T boundary of present usage. Other boundaries of subdivisions within the Cenozoic and Mesozoic eras developed out of unconformities and changes in rock type studied in western Europe by those early workers. (It is reasonably clear that the original subdivisions had been based on rock type rather than fossils.) These rock boundaries have objective reality in Europe, but usually not elsewhere. The three Tertiary subdivisions determined by Deshayes from shells in his museum have boundaries that are congruent with the boundaries of the four Tertiary subdivisions determined independently from field work by Lyell.

The gap between the Cretaceous and the Eocene in the Paris basin and in southeast England suggests at least a hiatus at the K-T boundary in surrounding areas with more continuous sections. It is these surrounding areas (Denmark, Italy, Spain) that have produced the largest iridium anomalies at the K-T boundary. There would have been little reason for the recent intense investigation at the intervals containing these anomalies had Lyell and his contemporaries begun work in a region where sedimentation was continuous across what is now the K-T boundary. For examples, if London and Paris were situated, say, adjacent to Tel Aviv or west of Buenos Aires, the notable lithologic and unconformable boundaries would have occurred, respectively, slightly above the top of Turonian age sediments (top of Judeah) or within Campanian age sediments at the bottom of the Riograndico. The K-T changes so obvious in the Paris and London basins would not be there.

REFERENCE

LYELL, CHARLES, 1833, *Principles of Geology,* Volume III, First Edition John Murray, London, various pagination. Facsimile Edition published by University of Chicago Press, 1991, with Cumulative Bibliography for all three volumes compiled by Martin Rudwick.

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BOOK REVIEWS

Gretchen Luepke, Book Review Editor

THE ROCKS SPEAK (ESSAYS IN GEOLOGY—SOME PERSONAL RESPONSES OF A WILLING LISTENER). *Haddon F. King. 1989. Monograph 15, Australian Institute of Mining and Metallurgy, 191 Royal Parade, Parkville, Victoria 3052 Australia. 308 p. U.S. $30.00.*

I have just spent an enjoyable and rewarding few hours rereading "The Rocks Speak." I say "rereading" because I had already read the book before I was asked to review it, but I found myself easily drawn into it again as I approached the task of sitting down to write these paragraphs. The author is a hero of mine, and a hero to many of my ore-deposit-geologist friends, so writing the review should have been easy. But the book, basically a philosophical geological autobiography, is a complicated, deeply satisfying yet deeply troubling one, and it is NOT easy to review.

Who was the late Haddon Forrester King? Why is his book historically significant? He was more than the cliché "legend in his own time". He was a consummate field geologist and an intellectual maverick, a free but intensely disciplined thinker, a sculptor of ideas, concepts, and truths from the clay of what most people see but cannot shape. For those who know nothing of him, he was an Australian economic geologist. He worked for the biggest, most successful Aussie companies for almost 50 pivotal years, from 1930 to 1980—the formative years of mineral-deposit and mining geology. He traveled the world, must have had a total-recall memory, and was a gentle but forceful scholar of the Earth. His passion was to understand processes of ore-formation, a passion that led him to question, assess, and rethink not only all that was told him in one way or another, but also to seek data and to generate knowledge that would let his mind soar into new realms of geologic thought and let him forge whole new concepts of ore, rock, and crustal genetic relationships. He was one of a handful of scientists whose insights were so clear that he had no need to adhere to then-current dogma, and so he was largely responsible for our collective breakaway, or turn-around, from some of the entrenched mistakes of earlier ore-deposit genetic models. If you think that that's poetic excess, you HAVE to read the book. It's NOT!

The book is his Life's Statement. He called it "The Rocks Speak" to draw attention to his desperate hope that we who survive him will *really commune* with the lithosphere again. But more importantly, the book is an amazing insight into a brain, a look at the thought processes and rationales of a phenomenally clear and gifted geologic thinker. It's not a long book, only a little over 300 pages, but it is not an "easy read." Intensely rewarding, yes; easy, no.

It is set up in two main parts, after a short introduction. The first part (half of book) is a series of lucid essays that King wrote during his field days, presented with a lot of temporal and geographic flipping around that all makes perfect sense. Many of the essays are based on company reports, lecture notes, and workshop-type memos thoughtfully prepared as his life and ideas unfolded. They deal with the rocks and ores that influenced him—and that he influenced—at Broken Hill, Mount Isa, Kalgoorlie, the Hamersley Ranges, Norseman, and a score of other places on six continents. This part is the factual basis of his philosophy.

In the second part, he deals with concepts derived from his having listened to the rocks, in reflection and introspection, with 15 sections on geology in mining, on innovation in geological thinking, on assumption in geology, on discovery in geology, and on education for the practice of geology, to name but a few. It is a nice touch that the name of the book carries onto the section headings, so you can read "The Rocks Speak . . . on stratigraphy," for example. The book thus becomes an historical statement: a study of the fact-idea relationship and of the growth of geologic acumen in exploration and crustal studies in King's lifetime, a philosophical statement of his strong belief in field geology and mapping as geologic tools (among many concepts too sophisticated and complex to be discussed in a review), and his personal record. Interestingly, he says nothing about his own education or background influences before he was 21, so the question of WHY he was so gifted and capable is not forthcoming.

Now it can be seen that Haddon King not only walked with the kings of his profession, he was one of them himself. He truly revolutionized Australian thinking on the origin of Broken Hill ores, and from that springboard he was one of the global movers and shakers of 20th-century thought in sediment-hosted ore deposit geologic progress. The book could have been an ego trip for him, but (without apparent effort!) there exists not a shred of discernible self-adulation. What persists and shines from the pages is a mind, a force, an intellectual engine at work, imploring us all to use thought, mapping, ground truth, logic, and white-hot honesty in dealing with the Earth and her scrutable problems.

The book is a MUST for explorationists as well as for science historians. If I were an exploration manager anywhere in the world, I would provide a copy for each

of my staff and arrange time for them to read it. I used the words "deeply troubling" early in this review, because King wants us all to buck the trend of dependence upon lab data collected in the absence of adequate field control—a juggernaut that I see rolling in the opposite direction and gaining momentum. A lot of the detail King presents is ore-deposit-related, but anyone engaged in field work, anyone interested in the larger questions of solving geologic problems or the processes of cognition and deduction, anyone involved in the history of ideas and scientific revolutions should spend some time listening to "The Rocks Speak."

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AN AGENDA FOR ANTIQUITY: HENRY FAIRFIELD OSBORN AND VERTEBRATE PALEONTOLOGY AT THE AMERICAN MUSEUM OF NATURAL HISTORY, 1890-1935. *Ronald Rainger. 1991. University of Alabama Press. 376 p. Hardcover, $37.95.*

In the library of The Cosmos Club in Washington is a shelf labeled "new books" and another labeled "new books by members." Our group may never reach quite that level, but it is always a pleasure to note a book by a member of the History of Earth Sciences Society. It is particularly nice to note one by a member who has been an active contributor to the journal. Finally, it is a joy to be able to give virtually unstinting praise to a book.

The subtitle is the key to the ten chapters that make up this work. It is about Osborne, but it is not a birth to death biography. One gets just enough of Osborne outside the museum environment to grasp the forces which influenced him. The first two chapters review the status of vertebrate paleontology before Osborne arrived at the American Museum and how he set out to wreck the last years of the life of O. C. Marsh. Marsh was certainly no shining white knight, and he had made life exceptionally difficult for E. D. Cope, but one sees a very nasty streak in the early Osborne. In contrast, his classmate at Princeton University, and later his fellow faculty member at that institution, William Berryman Scott was a gentle soul and a far better scientist. It is a pity more was not written of Scott, and one hopes the author has saved him for another book.

Osborne moved from Princeton to Columbia University, started a new academic department and developed a joint program with the American Museum of Natural History (AMNH). Within a very few years he moved to the museum and also made the transition from being a biologist to being a vertebrate paleontologist, thereafter scorning experimental biology. Osborne built a well-staffed department in vertebrate paleontology which filled a void left by the death of both Cope and Marsh. From there he went on to become President of the Museum and a scientific power in the country.

There is no question of Osborne's importance in building that institution to prominence in public exhibits; he knew the large and spectacular would draw the crowds and bring in major contributions from the rich. Once Osborne was in charge, the chic activity in some circles was to support that ever growing organization. The exhibits and the artistic restorations of extinct animals properly form an entire chapter of this work. What was particularly new to me was Osborne's interests in living animals and his influence in the New York Zoological Society.

Osborne's notions of evolution were those he learned at the knee of Edward Drinker Cope and in spite of all he wrote, they are dismissed today. Meanwhile, he developed an interest in early man and from that went on to write about education, modern civilization and the huddled masses. The philosophy of the Galton Society, which he helped to found, is as "scientifically" racist as any group which has come along in this century; [and] it was Osborne who helped influence Congress toward restrictive immigration laws to save the purity of real Americans, that is, the WASP's.

At the same time, Osborne had the knack of finding outstanding assistants. William Diller Matthew is the subject of a chapter appropriately titled "Organisms in Space and Time." William King Gregory merits "Fossils and Function," again a felicitous heading, as indeed are all the chapter titles. In the same vein, I did not find an unclear or awkward sentence throughout the entire volume.

As might be expected from Rainger, the work is carefully documented with 65 pages of notes, a substantial bibliography, and a good index. If it is my duty as a reviewer to find something to complain about, the illustrations should have been consolidated and printed on higher quality paper. Notwithstanding that, once again the University of Alabama Press has done itself proud.

In a final short chapter Rainger provides an excellent short retrospective: "Osborne's legacy is ambiguous." His influence and monied connections enabled a great deal of collecting and research to be conducted that might not otherwise have been possible. He had a major impact on museum displays. In the journalist G. Hellman's history of AMNH, "Beetles, Bankers, and Bones," the pomposity of Osborne was sketched out; [and] here it is treated in some detail. I could go on, but it is far, far better to read the book. Vertebrate paleontology may be the main theme, but the background melody is about personalities, the use of power and money, and empire building. This is just a grand book.

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CHARLES DARWIN. A NEW LIFE. *John Bowlby. 1991. (1st American Ed). W.W. Norton. 511 p. $24.95*

Charles Darwin (1809–1882) entered science as a geologist, contributed significantly to the Lyellian revolution during the middle of the 19th century, and continues to influence geology. He is now remembered (as geologist) for his subsidence theory of coral reefs, which he got right before ever seeing one; for his documentation of gradual tectonic uplift, which led him to the coral reef theory; and for his emphasis on the incompleteness of the geologic record, a fact which some still dispute and which each generation of geologists apparently learns anew.

He is also remembered for two geologic blunders which embarrassed him in his own lifetime: his explanations of the parallel roads of Glenn Roy and the origin of erratic boulders, the first based on an unwarranted extension of his uplift observations, and the second on his overestimate of the time needed to denude the Weald.

The author, Edward John Mostyn Bowlby (1907–1990), was a London psychoanalyst, internationally known for his studies of the child's attachment to his mother. He departed from the prevailing Freudian view to suggest that such instincts exist because they have Darwinian survival value for the species. Bowlby appears to have few prior credentials as a Darwin scholar and none as a geologist, but he has written, at an age Darwin did not reach, a factual, full-length biography benefitting from the recent publication of the *Beagle Diary* and the *Complete Correspondence* (through volume 4 when this book was finished). I had been persuaded by prior reviews that the book would not be of interest, but came across a copy by accident, after which it was difficult to leave off reading.

The 28 chapters divide approximately as follows: family background and youth (4); university (2); voyage of the Beagle (6); post-Beagle activities, marriage, and move to Down (4); life at Down and barnacles (4); *The Origin of Species* (1859) and immediate consequences (3); further books on the species question and botany (3); and final decade (2).

The Beagle voyage (1831–1836) is the narrative high point of the book, and it occupies more than twice the space devoted to any other 5-year interval in Darwin's life. The barnacle classification (1846–1854) was his most concentrated effort on a limited subject, and it served as a necessary apprenticeship to the species question. Publication of *The Origin* (1859) is the professional high point of his life, but it takes less prominence when considered here as one in a long train of Darwin's works.

Darwin's family and friends provide two threads that continue through the book. His somewhat calculated marriage to his first cousin, Emma Wedgewood, was unusually successful and produced 7 adult sons and daughters, including three who were FRS. He attracted Henslow, Lyell, Hooker, Gray, Huxley, and Wallace as friends on his way to *The Origin,* and all were significant in the battle to get acceptance for evolution of species by natural selection.

Although professionally concerned with the effect of separation on the emotions, Bowlby says relatively little about Fanny Mostyn Owen, Darwin's good friend and the probable romantic interest of his youth and university days. Her letters to Charles (*Complete Correspondence* v. 1) are engaging and witty reports on social life of the landed gentry, appropriate for a supplement to Jane Austen. When Darwin sailed from Devonport at the end of December 1831 on the start of his 5-year voyage, Fanny was an unattached woman of about 23. By the end of May 1832 (within 6 months, not 18 months as in Bowlby), she had married a Member of Parliament, complete with castle, and the marriage would have been two months earlier had Parliament not been tied up with the Reform Bill.

In Bowlby's book, Darwin's achievements are overlain by descriptions, often in Darwin's own words, of his continuing struggle with illness. This illness was especially prominent for a 30-year interval ending about 1870, and its pervading character justifies, in part, the judgment by prior reviewers that this is a gloomy book. It is now well accepted by medical practitioners who have examined the evidence that Darwin's symptoms were mainly, if not entirely, psychogenic, and Bowlby concurs in earlier suggestions that they were the result of hyperventilation due to stress. Bowlby supposes that the stress causing the hyperventilation originated from Darwin's repressed emotions arising from family events, particularly the unmourned death of his mother when he was 8, an hypothesis that seems less compelling. (This hypothesis is largely confined to the Prologue, Chapters 3 and 4, and an Appendix.)

Darwin's family had a history of emotional sensitivity, and his own sensitivity was well known before the voyage. When he was a student at Edinburgh (age 16), one of his sisters wrote carefully to him that his favorite dog had been sent to the home of his brother-in-law, evidently expecting him to be ill at the news of this separation (Colp, 1977, brings this out). In later years, Darwin was reportedly too unwell, or too afraid of becoming ill, or too committed to convalescence to attend the funerals of his father (d. 1848), his beloved daughter Annie (d. 1851), and the three sisters who died (1858, 1865, 1866) during his lifetime. His most famous work hinges on his recognition of the selective effect of death on the origin of species. By birth, Darwin was a Shropshire lad in the geographic sense, and it appears, by introspection, he was, as well, in Housman's poetic sense.

Darwin was an excellent scientist because he was an acute observer, a naive but ultimately critical compiler of results obtained by others, and a dogged analyzer of the facts. He was gifted to a high degree to do such work. When combined with (probable) genetic sensitivity, a retiring lifestyle, and especially the medical knowledge of his day that made it impossible to rule

out serious organic disease, his qualities were well-calibrated to produce severe psychosomatic illness. That illness itself may have had its own survival value for a man so given to hard work.

The book contains considerable apparatus to clarify and illuminate personal, temporal, and spatial relations. Over 80 illustrations, including 9 of Darwin, picture all major and many peripheral persons and places. In addition, there are 6 maps, including 4 with dated tracks of the voyage, and 6 genealogical charts relating family members from Darwin's grandparents through his grandchildren. The book closes with 38 pages of notes, Who's Who, bibliography, and index.

The subtitle, "A New Life", is accurate. Continuing studies of Darwin will revise and extend our knowledge of him, but in the meantime, this clear, well-documented book provides an excellent synoptic view of Darwin's life.

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THE INDIVIDUAL IN DARWIN'S WORLD: THE SECOND EDINBURGH MEDAL ADDRESS. *Stephen Jay Gould. 1990. Edinburgh University Press, Edinburgh. 42 p. Softcover, £3.95.*

This little book, elegantly printed, contains a transcript of the address delivered by Stephen Gould in 1990—more precise date unspecified—on the occasion of receiving the second Edinburgh Medal at that city's International Science Festival. The organizers of the festival intended for the speaker to address the general theme of science and society. Their choice of speakers was apposite, for few have demonstrated Gould's depth or humanity in reflecting on this theme. In his talk Gould canvassed the literal meaning of his title by acknowledging Darwin's debt to Scottish laissez faire economic theory in constructing the theory of evolution through natural selection. Gould also reminded his audience of the chance or contingent nature of the process that led to the existence of the human species, and, by extension, of individual human beings. Here he was revisiting the theme of his book *Wonderful Life: The Burgess Shale and the Nature of History* (1989). In his talk he summarized his book as follows: ". . . the decimation of the Burgess Shale fauna is a grand scale lottery, meaning it would not happen the same way again if you replayed the tape and decimated it a second time in different ways." But clearly the subject of most interest to Gould himself in his talk was his last point: what he claimed as a non-Darwinian reading of selection. After suggesting that biology has often shown the notion of what constitutes an individual organism to be ambiguous (as with aphids and corals), Gould asked,

> Was Darwin right that natural selection works only on bodies[?] I would like to suggest that this is not right and that probably the most interesting revision now occurring within evolutionary theory is the attempt by many to construct a hierarchical theory of natural selection in which natural selection is still the agency of change, but it does not only work on bodies, as in Darwin's theory, but works on a whole hierarchy of increasing levels in genealogy.

From this, Gould drew out the provocative notion that "that universal brotherhood and sisterhood to which we aspire is perfectly good biology." In sum, though the word individual appeared in Gould's title, in working out his subject he focused primarily on individuals as members of groups.

Sandra Herbert, Department of History, University of Maryland Baltimore County Campus, Baltimore, Maryland 21228

VIEWING THE EARTH: THE SOCIAL CONSTRUCTION OF THE LANDSAT SATELLITE SYSTEM. *P. E. Mack. 1990. MIT Press, Cambridge, Mass. 270 p. Hardcover, $27.50.*

This important account is not only history of science in its traditional sense, but also an invaluable exposition and analysis of official (and some backstage) program office politics and negotiations. An important conclusion of this study is that the detours and delays in the technological evolution of earth resource satellites was due to changing programmatic players and an apparent unwillingness of some sponsors to relinquish project control of this promising technology.

The initial three chapters address the contexts of military, space, and earth resources agencies as driving interests shaping the initial program funding for ERTS (Earth Resources Technology Satellite), later renamed LANDSAT. As detailed in Chapter 2, there was little idea of the variety of users and user requirements, for NASA LANDSAT proved a more complicated case of technology development than either weather or communications satellite programmes. Around 1963–1964, NASA had planetary flyby satellite results and a community of meteorologists and geoscientists each having serious and often conflicting use requirements. The LANDSAT satellites, launched between 1972 and 1984, carried vidicon and multispectral scanners, the specific band locations and spatial resolution of which long remained an object of heated controversy among different user groups and competing agencies (Defense Mapping Agency, U.S. Geological Survey, NOAA, and NASA). Organizing, processing, archiving, and extracting the virtual flood of new information proved to be the project's most technically challenging problem. At least on a prototype scale, LANDSAT data were soon successfully used to detect linear geomorphological features associated with petroleum deposits, crop and harvest statistics, snow and water cover, and

land use maps. However, even with sophisticated technology-transfer efforts, wider federal and commercial use of LANDSAT data was slow in coming, because of its public aura of overly-high technology and widespread doubts in the future evolution and maintenance of the program.

Another perennial controversy, between NASA and the scientific community at large, was whether it was better to employ spacecraft with or without a human crew for earth resources assessment. Even within the scientific community and subcommunities at different governmental agencies, there were many competing perceptions and proposals (large/small, multi/single sensors, etc.) as to the ideal orbital earth resources satellite. Mack argues that NASA's "big $ science" style was detrimental to the more rapid development and usage of the eventual LANDSAT satellite. Likewise, the 1966 announcement of the Department of the Interior's own Earth Resources Observation System (EROS) programme caused NASA to notably accelerate its LANDSAT program, although problems of competing interests in transitioning this technology from theory to operational stages continued unabated.

Thus, for example, the process of selecting LANDSAT's eventual sensor package demonstrated the degree to which technical decisions were inevitably also negotiations and compromises about different agency and user goals. Even more problematic was the selection of the data processing system. NASA apparently had not made any detailed commitments to the rapid data distribution required by resource managers monitoring critical short-lived phenomena such as runoff, ice in shipping lanes, forest fires etc. Other electronic data processing (EDP) problems arose not only from equipment breakdowns but also from lack of output standardization. Once again, many of these and other problems arose because the EDP system was designed to produce a variety of novel prototypical products themselves not commensurate with the full range of processed data used in most operational applications.

The development and evolution of the EDP system illustrates a number of concurrent scientific, engineering, sociological, and personal/bureaucratic factors heavily influencing an emerging technology, which later is also closely tied to the more general emergence of advanced image processing and pattern recognition technologies. Further coverage includes synopses of some of the several hundred successful and unsuccessful tests of users for LANDSAT data in geohydrology, glaciology, geomorphology and thematic mapping, coastal engineering, and soil physics, in addition to many agricultural applications (Chapter 12). Unfortunately missing from this account is the story of the technically compelling transitioning of Jet Propulsion Laboratory digital image processing software as suitable for large-volume LANDSAT EDP.

This book can be profitably compared with John McLucas' recent *Space Commerce*. It will be a valuable acquisition for most university libraries and for all those interested in the history, sociology, and policy history of the natural sciences.

Gerardo G. Tango, C.P.G., P.O. Box 23, Covington, Louisiana 70434

GEOLOGICAL SOCIETY OF AMERICA CENTENNIAL ARTICLES (REPRINTED FROM VOLUME 100 OF THE GEOLOGICAL SOCIETY OF AMERICA BULLETIN). *R. D. Hatcher, Jr. and W. A. Thomas, eds. 1991. Geological Society of America Special Paper 253. 463 p. Softcover, $18.00 (plus $3.00 shipping. Order from the GSA Publication Sales, P.O. Box 9140, Boulder, Colorado 80301)*

The year 1988 was the Centennial of the Geological Society of America (GSA). In commemoration of this event, a series of volumes and maps providing a modern view of the geology of North America were undertaken, most of which have now been published. These volumes interpret the geology of the continent and its adjacent waters in terms of modern plate tectonic models and will serve as the foundation upon which future studies will be built.

In addition to the above, a series of 28 invited articles were published in all 12 issues of Volume 100 of the *Bulletin of the Geological Society of America*, a series that has been assembled into this volume. The papers were designed to cover the spectrum of the geological sciences and are authored by a distinguished collection of earth scientists. The advisory committee for this publication recommended to the authors that they place some emphasis on the scientific achievements of GSA publications, but they were otherwise given their heads with regard how they treated their subjects.

When the Geological Society of America began publishing in 1890, it, as well as its few competitors, dealt with the science of geology *in toto*. The science was not as complex at that time, geologists were more generalists than specialists, and many—perhaps most—of the modern subdisciplines did not even exist. Through time, as new fields opened up and the demands of these required more specialization, new publications arose that responded to the needs of these specialists. Since one writes papers for one's peers, many of the papers describing new ideas within individual subdisciplines tended to be published in these more specialized journals. At first glance this would appear to limit the impact of GSA publications, but this has not been the case. While the initial report of a new idea or technique might be in a specialized journal, application of the idea to the real world found a broader audience in the *Bulletin*. Thus the *Bulletin* has continued to have an impact on the science through time.

Some of the authors (for example, J. M. Guilbert on economic geology and J. Thomas Dutro on paleontology) review their topics and discourse on historical

developments since 1888. Others (Bruce Marsh on crystal capture in convecting magma and Hans Laubscher on material balance in Alpine orogeny) present new data and ideas, while still others (Arthur Sylvester on strike-slip faults and Warren Hamilton on plate tectonics and island arcs) follow a patch somewhere in between. This is not surprising, because the data and the techniques that characterize some of the topics have been available for only a part of the last century. Geomorphological studies (papers by Dale Ritter, Marie Morisawa, and Victor Baker) cover the entire century while sequence stratigraphy (paper by L. L. Sloss) dates back only to the late 1940's. The study of passive continental margins (paper by Gerard Bond and Michelle Kominz) spans the century, although little was known about the sea floor until the remarkable period following World War II and proper interpretations awaited plate tectonics. Paleoceanography (paper by William Hay) did not become a subject for serious study until the 1950's when oxygen isotopic studies suggested that deep water temperatures had been warmer in the past, and the 1960's when the plate tectonics model provided an historical framework in which to place the data. Seismic investigations of the continental crust (papers by M. E. Bickford and by Jill McCarthy and George Thompson) did not begin much earlier, and while radioactive dating techniques have been under development since early in the century, most of the modern techniques and data date from the post-war period. So it could be argued that a good part of the difference in approach reflects the timing of development of experimental methods and analytical techniques and of the availability of sufficient new data that informed speculations could make. In the more classical areas of geology a century of investigations is the norm, while in the newer areas the time constant is much shorter.

Thus, this collection of papers, although it contains some which are clearly historical, should not be viewed strictly as an outline of the history of the subdisciplines covered, but more as a statement of where we are now with, in most cases, some description of the development of the ideas that led us here. Perhaps this is just as well, since scientists are usually not very good historians. They tend to take a linear view of history, concentrating on the successes and ignoring the failures, while to the historian the failures may be equally important. Perhaps the biostratigraphers are the best historians, because the numerous failures of organisms to be found in the geological record are the heart of their data.

The most significant common historical thread running through the papers is the influence that plate tectonics has had on the interpretation of almost all geological data. One could nit-pick and point out that there are areas of the earth sciences with very meager coverage, but the purpose of the collection is to span the field as a bridge spans a river—not to cover it completely by putting it into a conduit—and to emphasize the contributions of GSA publications. As such it succeeds admirably.

Charles L. Drake, Department of Earth Sciences, Dartmouth College, Hanover, New Hampshire 03755

INTERESTING PUBLICATIONS

Since the start of this journal, 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 the editor.

Aked, Charles K., 1991, A short epistle to the longitudinarians: **Antiq. Horology**, v. 19, p. 292–300.

Anderson, A. T., Newton, R. C., and Sivertsen, B. J., 1992, Preface to the centennial volume (of the **Journal of Geology**): **Journal of Geology**, v. 100, p. 1.

Baughman, Timothy H., 1990, British contributions to Antarctic exploration, 1891–1900: **Diss. Abstr. Int.**, v. 51, p. 1356-A.

Bedini, Silvio A., 1991, The pulse of time: Galileo Galilei, the determination of longitude, and the pendulum clock. Olschki, Firenze, Italy, 132 p.

Bierman, Kurt-R., 1990, Miscellanea Humboldtiana. (Beiträge zur Alexander-von Humboldt Forschung, 15.) Akademie-Verlag, Berlin, 304 p.

Blaeu, Joan, 1990, Blaeu's the grand atlas of the 17th-century world. Rizzoli, in co-operation with Royal Geographical Society of London, New York, 224 p.

Buttrey, T. V., 1990, Natter on gem collecting: Thomas Hollis, and some problems in the Museum Britannicum: **Jour. Hist. Collect.**, v. 2, p. 219–226.

Carozzi, A. V., 1992, The history of petroleum geology and the Geneva naturalists (1790–1815): **Journal of Petroleum Geology**, v. 15(1), supplement III, p. V–VIII.

Carozzi, A. V., and Zenger, D. H., 1991, The original chemical analysis of dolomite by Nicolas-Théodore de Saussure (1792): A Laboratory Error and its Historical Consequences: **Archives des Sciences**, v. 44, p. 163–196.

Chancellor, G. R., editor, 1990, Charles Darwin's St. Helena model notebook: **Bull. Brit. Mus. (Natur. Hist.) Hist. Ser.**, v. 18, p. 203–228.

Chavigny, Richard, 1991, Antoine Redier and his tower barometers: **Bull. Sci. Instr. Soc.**, v. 28, p. 12–13.

Ciancio, Luca, 1990, Controversie scientifiche e storiografia: **Intersezioni**, v. 10, p. 589–600.

Cleevely, R. J., Tripp, R. P., and Howell, Y., 1989, Mrs. Elizabeth Grey (1831–1924): A passion for fossils: **Bull. Brit. Mus. (Natur. Hist.) Hist. Ser.**, v. 17(2), p. 167–258.

Collie, Michael, 1991, Huxley at work. With the scientific correspondence of T. H. Huxley and the Rev. Dr. George Gordon of Birnie. Macmillian, Houndmills, England, 158 p.

Cunningham, F. F., 1990, James David Forbes: Pioneer Scottish glaciologist. Edinburgh, Scottish Academic Press, 329 p.

Davids, Karel A., 1990, Finding longitude at sea by magnetic declination on Dutch East Indiamen, 1596–1795: **Amer. Neptune**, v. 50, p. 281–290.

Davies, Arthur, 1990, Forty years of progress and achievement: A historical review of WMO. Secretariat of the World Meteorological Organization, Geneva, 205 p.

Dawson, J. B., 1992, First thin sections of experimentally melted igneous rocks: Sorby's observations of magma crystallization: **Journal of Geology**, v. 100, p. 251–257.

Dean, Dennis R., 1991, Robert Mallet and the founding of seismology, **Ann. Sci.**, v. 48, p. 39–67.

Dean, Lewis S., 1991, Michael Toumey and the pursuit of a Geological Survey of Alabama, 1847–1857: **Alabama Rev.**, v. 44, p. 101–111.

Eisenstadt, Peter R., 1991, The weather and weather forecasting in colonial America: **Diss. Abstr. Int.**, v. 51, p. 2850-A.

Emery, K. O., and Ross, D. A., 1991, Past and future evolution of marine geology, p. 11–14 **in** Osborne, R. H., editor, From shoreline to abyss: Contributions in marine geology, in honor of Francis Parker Shepard: SEPM (Society for Sedimentary Geology) Special Publ. No. 46, 320 p.

Fierro, Alfred, 1991, Histoire de la météorologie. Denoel, Paris, 325 p.

Freeman, E. F., 1992, The origin of the Geologists' Association. Offprint from: **Archives of Natural History**, v. 19(1).

Harley, J. B., 1990, Maps and the Columbian encounter: An interpretive guide to travelling exhibition. Golda Meir Library, University of Wisconsin, Milwaukee, 149 p.

Harrell, J. A., and Brown, V. M., 1992, The world's oldest surviving geological map: The 1150B.C. Turin papyrus from Egypt: **Journal of Geology**, p. 3–18.

Jensen, J. V., 1991, Thomas Henry Huxley communicating for science. University of Delaware Press, Delaware, 256 p., $38.50.

Kiersch, G. A., editor, 1991, The heritage of engineering geology: The first hundred years. Geological Society of America, Centennial Special v. 3, 619 p., $62.50.

Mason, A. Stuart, 1990, Essex on the map: The 18th century land surveyors of Essex. Essex Record Office, Chelmsford, England, 138 p.

McConnell, Anita, 1991, Condamine's scientific journey down the river Amazon, 1743–1744: **Ann. Sci.**, v. 48, p. 1–19.

Muljačić, Žarko, 1990, Per un inventario del carteggio di Alberto Fortis: **Nuncius**, v. 5(1), p. 127–203.

Muller, D. W., McKenzie, J. A., and Weissert, H., editors, 1991, Controversies in modern geology: Evolution of geological theories in sedimentology, earth history and tectonics. Academic Press, London.

Painter-Burkhart, Deborah, 1992, Hugh Miller—Scotland's chronicler of the Paleozoic: **Earth**, v. 1, No. 2, p. 10–18.

Pearson, C. L., Zeek, W. C., and Peters, J. J., 1991, Mining the Past: The Columbia School of Mines Collection: **Matrix**, v. 2, p. 33–41.

Porter, Dennis, 1991, Haunted journeys: Desire and transgression in European travel writing. Princeton University Press, Princeton, N.J., 341 p.

Rusnak, G. Q. A., 1991, Afoot and afloat along the edge: Adventures of an ingenuous beachcomber—a tribute to Francis Parker Shepard (1897–1985), p. 1–7 **in** Osborne, R. H., editor, From shoreline to abyss: Contributions in marine geology in honor of Francis Parker Shepard: SEPM (Society for Sedimentary Geology) Special Publ. No. 46, 320 p.

Sato, Tadashi, 1991, Historical review of geological sciences in Japan: **Episodes**, v. 14, p. 187–189.

Secord, J. A., Herbert, S., and Rhodes, F. H. T., 1991, Darwin and geology: Brit. Jour. Hist. Sci., v. 24, p. 133–229.

Segala, Marco, 1990, La Favola Della Terre Mobile. Il Mulino, Bologna, Italy, 340 p.

Seibold, I., and Seibold, E., 1991, Neues aus dem Geologen-Archiv (1990). Mit Erinnerungen an Franz Kossmat (News from the geological archives with recollection of Franz Kossmat): **Geologische Rundschau**, v. 80, p. 801–804.

Smith, Catherine Delano, 1990, Maps as art and science: Maps in 16th century bibles: **Imago Mundi**, v. 42, p. 65–83.

Stempien, M. F., Jr., 1992, Striking oil: **American Heritage of Invention and Technology**, v. 7, p. 2.

Stoczkowski, Wiktor, 1990, La Préhistoire dans les manuels scolaires, ou Notre mythe des origines: **Homme**, v. 30(116), p. 111–135.

Teichert, Curt, 1991, Palaeontology in Australia 50 years ago: **Australian Assoc. of Palaeontologists**, no. 20, p. 2–5.

Vaccari, Ezio, 1990, Primo contributo all'inventario del carteggio di Giovanni Arduino: **Nuncius**, v. 5(1), p. 79–126.

Weir, Veta, 1992, Actor depicts geologist/explorer. "Powell" to talk of canyon trek: **Explorer**, v. 13, No. 2, p. 5.

Whitten, C. A., 1992, William Bowie: Engineer, administrator and diplomat: **EOS**, v. 73, No. 11, p. 113, 125.

Woodward, David, 1990, The maps and prints of Paolo Forlani: A descriptive bibliography. (The Hermon Dunlap Smith Center for the History of Cartography) Occasional Publication 4.) Chicago, The Newberry Library, 60 p.

OFFICER REPORTS

SECRETARY'S REPORT FOR 1992

Ten years after its founding, the Society continues to evolve in positive ways. In 1992, the History of the Earth Sciences Society held its first-ever Annual Meeting. As many of you know, from first-hand experience or secondary sources, Gerald M. Friedman, Editor of EARTH SCIENCES HISTORY, hosted the 29 July–1 August meeting at the Rensselaer Center of Applied Geology, in Troy, New York. Successful aspects of the meeting included formal papers on a variety of subjects, a full-day geologic and historic-site field trip, an enjoyable evening at Sue and Gerry Friedman's home, and a great deal of informal camaraderie and professional discussion. One focus of the technical sessions concerned the history of geology in Canada. The collected papers will be brought together in a Special Issue of EARTH SCIENCES HISTORY.

Participants judged the 1992 meeting sufficiently valuable that they advocated the Society's sponsoring a Second Annual Meeting in 1993. The sessions will be co-hosted by the Pacific Division of the American Association for the Advancement of Science. The A.A.A.S. meeting will take place in Missoula, Montana, on 20–24 June. If you wish to receive detailed information, contact Dr. Alan Leviton, California Academy of Science, Golden Gate Park, San Francisco, CA 94118.

Membership and institutional subscriptions continue at recent levels. No visible attrition occurred when a dues increase was suggested in my May 1992 letter, accompanying the Ballot and Dues Notice. In fact, the officers of the Society once again thank and commend the membership for an almost unanimous favorable vote on the increase. Special thanks to members outside of the United States, who seem to understand the realities of postal costs and who therefore voted for the increase and mail surcharge. Our dues are still extremely low, relative to other subscriptions, but we do regret any move toward higher rates. We also apologize for the slimmer volumes of EARTH SCIENCES HISTORY in the same year that we suggested a dues increase. Again, members seem to understand that professional production costs, combined with the very large Arctic Issue, drained our coffers to the point that publishing large issues in 1992 would have been irresponsible. All is now in order! Your patience is appreciated.

The May 1992 elections gave us another strong set of officers. Léo F. Laporte, Earth Sciences Board at the University of California, Santa Cruz, is President-Elect in 1993. He will pick up the President's reins from Rachel Laudan in 1994. Thomas E. Pickett, of the Delaware Geological Survey, was officially elected to a full term in 1992, after a year of fine service as interim Treasurer. David R. Oldroyd, School of Science and Technology Studies, University of New South Wales, Australia, is our new Councilor, for the years 1993 and 1994.

The year 1992 included two noteworthy Society endeavors, above and beyond hosting our first meeting and producing EARTH SCIENCES HISTORY. Rachel Laudan, Anne Millbrooke, and Ron Rainger distributed a questionnaire designed to gather information about members' research interests in the history of geoscience, and about their hopes for the evolution of the Society and its journal. A summary and analysis of the responses may be obtained by writing to Dr. Ronald Rainger, Dept. of History, Texas Tech University, Box 4529, Lubbock, Texas 79409-1013. Secondly, Keith Tinkler and his students at Brock University have produced an index of EARTH SCIENCES HISTORY. Work was complete at the time of writing this report, but particulars about format and cost had not been established. Those interested are welcome to contact Dr. Keith Tinkler, Dept. of Geography, Brock University, St. Catharines, Ontario L2S 3A1, CANADA.

Discussions took place in 1992 concerning the possibility of producing a new Membership Directory. Financial matters raise their hydra-like heads as we anticipate production of the Directory. It will be done in the summer of 1993, if we can avoid jeopardizing the Society's minimal balance. In order to make the Directory as current as possible, please send me any relevant change of address notices immediately. Also appreciated would be formal notification of resignations or deaths of members. I am sorry to report the 1992 death of Emanuel D. Rudolph, of the Ohio State University.

Now that I am finishing my second term as Secretary, a brief note of thanks and farewell is in order. Corresponding with all of you, via formal mailings, and with a goodly number of you on a personal basis, has been enjoyable. Our Society operates with a very small cadre of officers, and I acknowledge all of them for their cooperation and hard work during my six years in office. If any members have suggestions about ways in which the Secretary's office could serve you better, or if you need brochures explaining the Society's mission (to distribute to potential new members), feel free to drop me a note, through December 1993.

Respectfully submitted,
Kennard B. Bork
Secretary, H.E.S.S.

ANNUAL REPORT OF THE TREASURER

1992 was a tough year financially for the Society. But, with a lot of help and understanding from the membership, we appear to be cautiously optimistic about the future. The dues and subscription structures were not in line with realistic costs of producing our journal. Now they are, by a 10 to one vote.

The gratitude of the Society goes to the 150 members who made generous donations beyond the payment of dues. The Geological Survey of Canada made a generous donation of 2000 Canadian dollars for the journal. K. Mark, M. Weiss, J. Marche, and J. Coash made page contributions.

Total credits for 1992 were $20,851.45. Total debits were $20,590.76. Costs were paid to the Editor and Allen Press; plus a few hundred dollars postage and photocopy expenses by the Secretary and Treasurer. Officers donate time and effort and work "on a shoestring" to hold down costs!

A chronic problem is delinquency in dues payment. As of February 1993 87 members had not responded to two requests for dues. Twenty-eight of those are now two years delinquent! Please pay dues as billed (in late spring for the current year).

Respectfully submitted,
Thomas E. Pickett

ANNOUNCEMENTS

EARTHWATCH

H.E.S.S. members may be interested in the work of EARTHWATCH. The organization coordinates volunteers for an impressive range of research opportunities. Volunteers pay tax-deductible contributions (to cover food, lodging, and field expenses) as they take part in the expeditions. Examples of 1993–'94 programs are: geophysical investigations of ancient Minoa; Israeli desert floods; glaciation on Mt. Olympus, Greece; Big Bend volcanoes; the rise and fall of the Himalayas; Mexican mammoths; and human origins in Africa. Not everyone will have schedules which allow participation, but others may wish to contact EARTHWATCH (680 Mount Auburn Street, Box 403, Watertown, MA 02272) for particulars. If any members decide to take part, please inform the H.E.S.S. Secretary, because EARTHWATCH has a generous "Cooperating Institution Program" which could benefit our Society at the same time our members profit from involvement in the field-research options.

History of the Geosciences: An Encyclopedia

Work has begun on History of the Geosciences: An Encyclopedia, to be published by Garland Publishing. Scheduled to appear in 1994, the book is intended to provide an overview of current scholarship and new directions in its field, will encompass a broad cultural and chronological range, and will include entries on a wide range of subjects in the history of the geosciences, including but not restricted to geophysics, geology, oceanography, meteorology, and nearspace science. Inquiries should be addressed to the editor, Gregory A. Good, Department of History, West Virginia University, Morgantown, WV 26506.

Information is requested on North American Commission on Stratigraphic Nomenclature

Assistance is requested in documenting the early development of the North American Commission on Stratigraphic Nomenclature. The period of interest ranges from the 1930–32 "national committee" that resulted in the "1933 Stratigraphic Code" through the call to establish the American Commission on Stratigraphic Nomenclature in 1941 to its publication of the "1961 Code of Stratigraphic Nomenclature." The notes and minutes of the Commission provide basic facts, but the debate of fundamental principles by the great geologists of the time is less well documented. Pertinent correspondence, references, and recollections will be greatly appreciated. Please contact: Robert R. Jordan, Delaware Geological Survey, University of Delaware, Newark, DE 19716. Phone (302) 831-2833, Fax (302) 831-3579.

EARTH SCIENCES HISTORY CALENDAR

1993

Feb. 8-11—Geological Remote Sensing, Meeting, Pasadena, Calif. Nancy J. Wallman, Environmental Research Institute of Michigan, Box 134001, Ann Arbor, Mich. 48113-4001. Phone: (313) 994-1200, ext., 3234. Fax: (313) 994-5123.

Feb. 11-13—Earthquake Engineering Research Institute, Annual Meeting, Seattle. EERI, Suite 320, 499 14th St., Oakland, Calif. 94612-1902. Phone: (510) 451-0905. Fax: (510) 451-5411.

Feb. 11-16—American Association for the Advancement of Science, Annual Meeting, Boston. American Association for the Advancement of Science. 1333 H. St., N.W., Washington, D.C. 20005. Phone: (202) 326-6400.

Feb. 15-17—Society for Mining, Metallurgy, and Exploration, Annual Meeting, Reno, Nev. SME Meetings Department, Box 625002, Littleton, Colo. 80162-5002. Phone: (303) 973-9550. Fax: (303) 979-3461.

Feb. 25-27—Geologische Vereinigung, Annual Meeting, Berlin. P. Giese, Freie Universität Berlin, Fachbereich Geowissenschaften, Institut für Geophysikalische Wissenschaften Fachrichtung Geophysik, Rheinbabenallee 49, 100 Berlin, 33 Germany.

Feb. 28-March 4—Nuclear Waste, Annual Meeting, Tucson, Ariz. WM Symposia and others. WM Symposia, Suite 19, 245 S. Plumer, Tucson, Ariz. 85719. Phone: (602) 792-2561; (702) 624-8573. Fax: (602) 792-3993.

March 14-17—Venezuelan Society of Geologists/American Association of Petroleum Geologists, International Meeting, Caracas, Venezuela. AAPG Convention Department, Box 979, Tulsa, Okla. 74101-0979. Phone: (918) 584-2555. Fax: (918) 584-2274.

March 15-16—South Central Section, Geological Society of America, Meeting, Fort Worth, Texas. Vanessa George, GSA, Box 9140, 3300 Penrose Place, Boulder, Colo. 80301. Phone: (303) 447-2020.

March 15-19—Lunar and Planetary Sciences, Annual Meeting, Houston. Pamela Jones, Lunar and Planetary Institute, Program Series Department, 3600 Bay Area Blvd., Houston, Texas 77058-1113. Phone: (713) 486-2150.

March 21-23—Society of Petroleum Engineers, Meeting, Oklahoma City., Okla. Society of Petroleum Engineers, 222 Palisades Creek Drive, Richardson, Texas 75080. Phone: (214) 952-9393. Fax: (214) 952-9435.

March 22-24—Northeastern Section, Geological Society of America, Meeting, Burlington, Vermont. Vanessa George, GSA, Box 9140, 3300 Penrose Place, Boulder, Colo. 80301. Phone: (303): 447-2020.

March 29-30—North Central Section, Geological Society of America, Meeting, Rolla, Mo. Vanessa George, GSA, Box 9140, 3300 Penrose Place, Boulder, Colo. 80301. Phone: (303): 447-2020.

April 1-2—Southeastern Section, Geological Society of America, Meeting, Tallahassee, Fla. Vanessa George, GSA, Box 9140, 3300 Penrose Place, Boulder, Colo. 80301. Phone: (303): 447-2020.

April 1-3—Fractals and Dynamic Systems in Geosciences, International Meeting, Frankfurt/Main, Germany. Jörn H. Kruhl, Geology-Paleontology Institute, JW Goethe-University, Senckenberganlage, 32 D-6000, Frankfurt/Main, Germany. Phone: 0049-69-7982695. Fax: 0049-69-7988383.

April 1-4—National Science Teachers Association, Annual Meeting, Kansas City, Mo. NSTA, 1742 Connecticut Avenue, N.W., Washington, D.C. 20009-1171. Phone: (202) 328-5800. Fax (202) 328-0974.

April 4-8—Remote Sensing and Global Environmental Change, International Symposium, Graz, Austria. Environmental Institute of Michigan, Consortium for International Earth Science Information Network, and Joanneum Research. Dorothy M. Humphrey, ERIM, Box 134001, Ann Arbor, Mich. 48113-4001. Phone: (313) 994-1200, ext. 2290. Fax: (313) 994-5123.

April 5-8—Global Warming, International Meeting, Chicago, Ill. Sinyan Shen, Natural Resource Management Division, SUPCON International, One Heritage Plaza, Woodridge, Ill. 60517-0275. Phone: (708) 910-1551; (419) 372-8207. Fax: (708) 910-1561.

April 5-8—In Situ and On Site Bioreclamation, International Meeting, San Diego, Calif. Battelle and others. Phillip Wells, The Conference Group, Suite 5, 1989 W. Fifth Ave. Columbus, Ohio 43212-1912. Phone: (800) 783-6338; (614) 424-5461. Fax: (614) 488-5747.

April 12-16—Aerospace Science and Sensing, International Meeting, Orlando, Fla. The International Society for Optical Engineering, 1000 20th St., Bellingham, Wash. 98225. Phone: (206) 676-3290. Fax: (206) 647-1445.

April 14-16—Seismological Society of America, Annual Meeting, Ixtapa-Zihuatanejo, Mexico. SSA, 201 Plaza Professional Building, El Cerrito, Calif. 94530. Phone: (510) 525-5474. Fax (510) 525-7204.

April 15-16—Science and Technology Policy, Meeting, Washington, D.C. American Association for the Advancement of Science. 1333 H. St., N.W., Washington, D.C. 20005. Phone: (202) 326-6400.

April 17-20—Exploration and Discovery, Meeting, Denver, Society of Economic Geologists, Society of Exploration Geophysicists, and others. J. Alan Coope, SEG Conference '93, Box 571, Golden, Colo. 80402. Phone: (303) 837-5819. Fax (303) 837-5851.

April 19-23—Remote Sensing, International Meeting, Enschede, The Netherlands. International Institute for Aerospace Survey and Earth Sciences, and others. Myriam Fahner, Box 6, 7500 AA Enschede, The Netherlands. Phone: 31-53-874 255. Fax: 31-53-874-436.

April 21-25—Geoscience Education and Training, International Meeting, Southampton, England. University of Southampton and others. Dorrik A. V. Stow, GEOED, Dept. of Geology, University of Southampton, S09 5NH, England. Phone: (0703) 593049. Fax: (0703) 593052.

April 25-28—American Association of Petroleum Geologists, Annual Meeting, New Orleans. AAPG, Box 979, Tulsa, Okla. 74101-0979. Phone: (918) 584-2555. Fax (918) 584-0469.

May 5-8—Geotechnica '93, International Symposium, Cologne, Germany. Hans Teetz, Cologne International Trade Fairs Inc., 21st Floor, 666 Fifth Avenue, New York 10103-0165. Phone: (212) 974-8836. Fax: (212) 974-8838.

May 16-20—Environmental Hydrology and Hydrogeology, Meeting, Washington, D.C. Secretariat, American Institute of Hydrology, Second USA/USSR Conference, 3416 University Ave. S.E., Minneapolis, Minn. 55415-3328. Phone: (612) 379-1030. Fax: (612) 379-0169.

May 17-19—Geological Association of Canada and Mineralogical Association of Canada, Annual Meeting, Edmonton, Alberta. J. W. Kramers, Alberta Geological Survey, Box 8330, Station F, Edmonton, T5H 5X2, Canada. Phone: (403) 438-7644. Fax: (403) 438-3354.

May 19-21—Cordilleran/ Rocky Mountain Sections, Geological Society of America, Meeting, Reno, Nev. Vanessa George, GSA, Box 9140, 3300 Penrose Place, Boulder, Colo. 80301. Phone: (303) 447-2020.

May 31-June 2—Applied Mineralogy, International Meeting, Perth, Western Australia. Jim Graham, ICAM '93, Private Bag, P. O. Wembley, 6014, Australia. Phone: (619) 387-0371.

June 1-5—Geotechnical Engineering, International Meeting, St. Louis. Norma R. Fleming, 119 M E Annex, University of Missouri, Rolla, Mo. 65401-0249. Phone: (800) 752-5057; (314) 341-6061. Fax: (314) 341-4992.

June 14-16—Soil Dynamics and Earthquake Engineering, International Meeting, Bath, United Kingdom. Sue Owen, Computational Mechanics, Ashurst Lodge, Ashurst, Southampton, SO4 2AA, United Kingdom. Phone: 44 (0) 703-293223. Fax: 44 (0) 703-292853.

June 20-27—Zeolites, International Meeting, Boise, Idaho. International Committee on Natural Zeolites. F. A. Mumpton, Dept. of Earth Sciences, State University of New York, Brockport 14420. Phone: (716) 395-2635; (716) 637-2324. Fax: (716) 395-2416.

June 21-23—Water Pollution, International Meeting, Milan, Italy. Sue Owen, Computational Mechanics, Ashurst Lodge, Ashurst, Southampton, SO4 2AA, United Kingdom. Phone: 44 (0) 703-293223. Fax: 44 (0) 703-292853.

June 21-25—15th International Conference on the History of Cartography, Chicago, Ill. James R. Akerman, Newberry Library, 60 West Walton St., Chicago Ill. 60610-3380.

June 28-July 2—Congress of International Association of Hydrogeologists, Oslo, Norway. Geological Survey of Norway, Bax 3813-Ulleval Hageby, N-0805, Oslo, Phone: + 47-2-950930. Fax: + 47-2-950895

July 7-14—5th International Congress for the History of Oceanography (ICHO V), Scripps Institution of Oceanography, La Jolla, Calif. Deborah Day, Archivist, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, Calif. 92093-0175.

July 17-24—Geological and Landscape Conservation, International Meeting, Great Malvern, United Kingdom. Margaret Phillips, The Company, St. John's Innovation Centre, Cowley Road, Cambridge CB4 4WS. Phone: (0223) 421124. Fax: (0223) 421158.

Aug. 15-19—Carboniferous to Jurassic Pangea, International Meeting, Calgary, Alberta. Canadian Society of Petroleum Geologists, and Global Sedimentary Geology Program. Benoit Beauchamp, Geological Survey

of Canada, 3303 33rd St. N.W., Calgary, Alberta T2L 2A7. Phone: (403) 292-7190. Fax: (403) 292-4961.

Aug. 23-29—Coastal Sedimentology Meeting, Hamilton, Ontario. William F. Tanner, Department of Geology, B-160, Florida State University, Tallahassee, Fla. 32306. Phone: (904) 644-3208.

Aug. 28-Sept. 15—Landslides, International Meeting and Workshop, Czech and Slovak Federal Republic. ICFL-C.S., Landslides '93, % NOVOSAD IG/EG, I. Sekaniny 1801, CS-70800 Ostrava-4, Czechslovakia. Phone: (42-69) 473028. Fax: (42-2) 381848.

Sept. 5-11—Nuclear Waste Management, International Meeting, Prague, Czech and Slovak Federal Republic. American Society of Mechanical Engineers, Czech and Slovak Mechanical Engineering Society, and the Czech and Slovak Nuclear Society. Radovan Kohout, Ontario Hydro (H11 A2), 700 University Ave., Toronto, Ontario M5G 1X6. Phone: (416) 592-5384. Fax: (416) 592-4485.

Sept. 12-15—Rocky Mountain Section, American Association of Petroleum Geologists, Meeting, Salt Lake City, Utah. American Association of Petroleum Geologists, Box 979, Tulsa, Okla. 74101. Phone: (918) 584-2555. Fax: (918) 584-0469.

Sept. 15-17—Mining Development, International Meeting, Philadelphia. Society for Mining, Metallurgy, and Exploration. SME, Meetings Department, Box 625002, Littleton, Colo. 80162. Phone: (303) 973-9550. Fax: (303) 979-3461.

Sept. 19-22—Eastern Section, American Association of Petroleum Geologists, Meeting, Williamsburg, Virginia. American Association of Petroleum Geologists, Box 979, Tulsa, Okla. 74101. Phone: (918) 584-2555. Fax: (918) 584-0469.

Sept. 19-24—International Symposium on Subsurface Microbiology, Bath, United Kingdom. Liz Hide, IBC Technical Services, Gilmoora House, 57-61 Mortimer St., London W1N 7TD. Phone: +44 71 637 4383. Fax: +44 71 631 3214.

Sept. 21-23—Andean Geodynamics, International Symposium, Oxford, England. University of Oxford and Institut Français de Recherche Scientifique pour le Développement en Coopération (Orstom). Pierre Soler, Orstom, CS1, 213 rue Lafayette, 75480 Paris Cédex 10, France. Fax: 33-1-48 03 08 29.

Sept. 25-Oct. 1—International Association of Volcanology and Chemistry of the Earth's Interior, Meeting, Canberra, Australia. (AVCE) ACTS, GPO Box 2200, Canberra ACT 2601, Australia. Phone: 61/6/ 257-3299. Fax: 61/6 257-3256.

Sept. 28-Oct. 1—Environmental Pollution, International Meeting, Barcelona, Spain. European Centre for Pollution Research and others. ICEP Conference Office, ICTR Secretariat, 11-12 Pall Mall, London SW1Y 5LU, England. Phone: 44 71 930 6825. Fax: 44 71 976 1587.

Oct. 17-20—American Association of Petroleum Geologists, International Meeting, The Hague, Netherlands. American Association of Petroleum Geologists, Box 979, Tulsa, Okla. 74101. Phone: (918) 584-2555. Fax: (918) 584-0469.

Oct. 18-20—National Ground Water Association, Meeting, Kansas City, Mo. National Ground Water Association, 6375 Riverside Drive, Dublin, Ohio. Phone: (614) 761-1171. Fax: (614) 761-3446.

Oct. 20-22—Gulf Coast Section, American Association of Petroleum Geologists, Meeting, Shreveport. American Association of Petroleum Geologists, Box 979, Tulsa, Okla. 74101. Phone: (918) 584-2555. Fax: (918) 584-0469.

Oct. 20-22—Conference on "Over thrusting into Foreland Basins: Sedimentologic Consequences", Troy, N.Y. Gerald M. Friedman, Northeastern Science Foundation Affiliated with Brooklyn College of the City University of New York, 15 Third St., P.O. Box 746, Troy, NY 12181-0746. Phone: (518) 273-3247, Fax: (518) 273-3249.

Oct. 25-28—Geological Society of America, and Affiliated Societies, Annual Meeting, Boston. Vanessa George, GSA, Box 9140, 3300 Penrose Place, Boulder, Colo. 80301. Phone: (303) 447-2020.

Nov. 11-14—History of Science Society, Annual Meeting, Santa Fe, New Mexico. Paul Farber, Department of History, Oregon State University, Corvallis, Ore. 97331. Phone: (503) 737-4151. Fax: (503) 737-2434.

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Feb. 18-23—American Association for the Advancement of Science, Annual Meeting, San Francisco, Calif. American Association for the Advancement of Science. 1333 H. St., N.W., Washington, D.C. 20005. Phone: (202) 326-6400.

June 19-24—American Nuclear Society, Annual Meeting. New Orleans. Meetings Department, American Nuclear Society, 555 N. Kensington Avenue, LaGrange Park, Ill. 60525. Phone: (312) 352-6611.

NOTES

NEWS FROM RUSSIA: V. I. VERNADSKY'S ARCHIVES, NOW LOCATED AT COLUMBIA UNIVERSITY

One of the most brilliant scientists and thinkers of Russia was Vladimir Ivanovich Vernadsky. His works are not merely fundamental in one particular field, Vernadsky was the founder of several geological specialties. There are at least three such specialties: radiogeology, biogeochemistry, and the study of biosphere as a global system. He "is increasingly regarded as a prophet for our time" (Science, 1990, v. 249, p. 1312). Vernadsky's fundamental book entitled "The Biosphere" was published in English in 1986 (Synergetic Press, Oracle, AZ) and the first monograph about him was published in English in 1990 (Science and Russian Culture in an Age of Revolution, V. I. Vernadsky and his Scientific School, 1863–1945 by K. E. Bailes, Indiana University Press, Bloomington).

Basic Idea

During his lifetime V. I. Vernadsky lived in Russia, Ukraine, and in several other European countries, but both of his children, a son George, who was a Professor of Russian History at Yale University, and a daughter, Nina made their home in the United States for several decades and both died there. V. I. Vernadsky corresponded with them on a regular basis. This correspondence and a large number of letters from various persons such as E. Dana, I. I. Petrunkewich, and F. I. Rodichev a.o. were included along with a vast iconography and various other Vernadsky papers. These papers, written in Russian, Ukrainian, Czech, German, French and English, were collected by his children for many years, and were later deposited in the Libraries of Columbia University. There are at least ten boxes of these papers that have yet to be scientifically inventoried, only a small part of them was recently published (Minuvsheje, Atheneum, Paris, 1989, v. 7, p. 424–494; Vestnik AN SSR, 1990, n. 12, p. 122–133). The basic idea of this program is to make first a scientific description of all Vernadsky's papers deposited in the Columbia University libraries and to prepare part of them for publication.

Supposed Results

Many events of Vernadsky's biography and ideas were not displayed or distorted under the former communist dictatorship. A description of Vernadsky's papers deposited in the Columbia University library could shed some new light on his previous ideas and may possibly provide some new scientific insight on Vernadsky's work. As a result of proposed work two separate publications will be prepared: 1. V. I. Vernadsky's Papers Deposited in the Columbia University, A First Scientific Description. 2. Selected Correspondence of V. I. Vernadsky and his Son G. V. Vernadsky. Both of them will be able to be published with the participation of Columbia University and the Russian Academy of Sciences Committee on the investigation of Vernadsky's scientific heritage.

Realization and Financial Side

A. V. Lapo will conduct this research in the U.S. at Columbia University in the city of New York. The research is planned for September through October of 1993. For this study Dr. Lapo would require financial support for 1½ months. Estimated buget: food, local transportation, xerox, etc. $50.00 × 45 days = $2250; hotel $70.00 × 45 days = $3150; and transportation by air from St. Petersburg to New York round trip $1300.00; Total $6700.00.

Leader of the Program

Dr. Andrei V. Lap is an expert in the geology and history of science, especially in the investigation of Vernadsky's heritage. He has acquainted himself with Vernadsky's papers in the libraries of Columbia University during his lecture trip in 1991. Lapo is the author of "Traces of the Bygone Biospheres" which is devoted to a development of Vernadsky's Biosphere concept and has been published several times in Russian and in English (Moscow, 1979, 1982, 1987; Moscow and Oracle, A.Z., 1987) and reviewed in the American scientific press (Geomicrobiol. Jour., 1989, v. 7, p. 193–194) and also in 120 other publications. He is the founding secretary of the Vernadsky International Fund and also a member of the Russian Academy of Sciences Committee on investigating Vernadsky's scientific heritage.

Please contact: Dr. Andrei V. Lapo at the VSEGEI, 74, Sredny pr., 199026, St. Petersburg, RUSSIA.