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William A. S. Sarjeant

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Aller au sommaire du numéro

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and the vicissitudes of a great scientific institution. If their conclusions, like mine, differ from the author's, well, we should be grateful for the data so carefully organized and presented to us, for they have surely been stimulating to our thinking.

Science in the Subarctic. Trappers, Traders and the Smithsonian Institution

By Debra Lindsay
Foreword by William W. Fitzhugh
Smithsonian Institution Press
Washington, DC
1993, 176 p., US $34.00

Reviewed by William A.S. Sarjeant
Department of Geological Sciences
University of Saskatchewan
114 Science Place
Saskatoon, Saskatchewan S7N 0W0

To set the scene for this review, it is appropriate to quote from William Fitzhugh's foreword (p. x, xi):

> Baird's field collecting method emphasized the collection of large numbers of carefully documented "voucher" specimens from a given region; such specimens, with later description and analysis, established a firm empirical basis for scientific classification. With analysis of field documentation and careful comparison of specimens, the method supported classification studies that, at higher levels of abstraction, revealed geographic, evolutionary, and historical relationships. The method applied equally to species of animals and plants, to languages, and to ethnographic studies. As the study region was gradually expanded, larger patterns developed that provided solutions to major problems of biological and cultural classification. Baird was particularly aware of the pristine conditions for collecting in northwestern Canada, the Northwest Coast, the Russian America. The prospects of expanding such analyses toward the Northwest, into Alaska, and eventually across Bering Strait into Asia were the larger vision that inspired Baird's labors as a research organizer in northwestern North America. [Robert] Kennicott's later Alaskan work as leader of the Western Union Telegraphy survey became the Smithsonian's entrée into Russian America, influenced the purchase of Alaska, and resulted in the training of the first generation of America's Alaskan scientists, including William Healey Dall, Henry Wood Elliott, and others...
>
> One of the most important innovations of Kennicott's Mackenzie program was the involvement of native collectors. Roderick MacFarlane, a Hudson's Bay Company agent, used native people extensively and to great advantage, making important collections of animals, birds, and ethnographic objects during the winter season when post managers and most naturalists were not out and about. The use of native collectors also provided other advantages, including the acquisition of native names, terminology, and observations on animal behaviour, on biological phase changes, and on ethnographic data.

The theme of this book, then, is potentially a very interesting one and it is clear, from the sources she quotes, that Ms. Lindsay undertook very extensive researches before writing it. There are three troubles with it. First, the title is misleading, suggesting a much fuller survey of the Smithsonian's connections with the subarctic than is actually presented. Second, the text is too brief for any in-depth examination of her themes, a mere 130 pages, forcing too much to be epitomized or cited without sufficiently full quotation. Third, as I shall illustrate below, she is not a good writer. A fourth objection for readers of this journal is that she is a historian, with interest in biology but not in geology. Although Baird indirectly, and Kennicott directly, made appreciable contributions to our knowledge of the geology of subarctic Canada, rocks, fossils and geology gain only the most passing of mentions (on pages 30, 31, 101, 113 and 185).

Problems for the reader are numerous. There are irritating duplications: the oologist Thomas Brewer is introduced on page 25 and again on page 33; the comments on Kennicott on pages 46-48 are repetitious; and Kennicott's view of egg-collecting as "glorious sport" (p. 70) unnecessarily prefaces a long quotation — one of very few — which included that phrase. There are phraseological awkwardnesses: "Fort Anderson did not drain into the Mackenzie River System" (p. 61) and "Their activities were similarly precipitated by scientific visitors" (p. 43). There are unexplained contradictions, as when page 105 informs us that Kennicott "had always intended on going to Russian America" whereas page 106 tells us how very hard it was for Western Union to persuade him to do so!

Kennicott is called "the mysterious 'Bugs' Kennicott" on page 49, but we are told neither why he was considered mysterious nor how he gained that nickname. On the whole, the author shows a surprising hostility to Kennicott (p. 113 and earlier), yet her eventual comments on his childishness and physical frailty (p. 116) were not presaged in her earlier text, and his death, probably by suicide, comes to the reader as a shock of unreality.

Do the virtues of this book compensate for these problems? I do not think so, yet it has its importance in stressing how much the attainments of early field naturalists rested upon the work — sometimes voluntary, more often paid — of their assistants (native Americans in particular). For that reason alone, perhaps it deserves to be read until a better study, with fuller documentation by direct quotation from the original sources, is available.

From Stone to Star. A View of Modern Geology

By Claude Allègre
Translated from French by
Deborah Kurmes Van Dam
Harvard University Press
US $16.95, paper

Reviewed by William A.S. Sarjeant
Department of Geological Sciences
University of Saskatchewan
114 Science Place
Saskatoon, Saskatchewan S7N 5E2

A first requirement of a scientific text, surely, is that it should be accurately titled. In that regard, this title begins well, but ends ill. It is a history of how the investigations of scientists extended from the consideration of the rocks of this earth to the spectrum of stars and the constitution of the Universe: thus, *From Stone to Star* is accurate enough. However, it is *not* a view of modern geology. On the one hand, the account ranges far beyond geology into physics and astronomy, so that the subtitle is not broad enough. On the other hand, only

certain aspects of our wide-ranging discipline — principally, geochemistry (the author's particular research concern) and geophysics — are considered. The subtitle at once claims too little and too much.

Very well, then; this is an essentially historical account of the progressive growth of knowledge of the materials of the Universe, from our Earth to the other planets and beyond the solar system to the distant stars, showing how this has led to the development of theories concerning the origin of life and of the Universe itself. It is well written and recurrently uses effective imagery to facilitate the reader's comprehension: employing the analogy of face-slapping heating the victim's cheek to show why impact of a meteorite on a planetary surface should likewise release heat (p. 89), and comparing the flow of traffic in Paris's Place de la Concorde with the motion of the stars in our galaxy (p. 173).

The framework for this account was well and logically planned, the translation is, in general, good, and proofreading has been so careful that the text is virtually error free. Figures are well designed to facilitate comprehension and are clearly reproduced. Photographic illustration is not extensive and much less well reproduced, suffering from print bleed through (*e.g.*, the portrait on p. 110), but that was the fault of printer and publisher, not of author and translator.

The problem for the geological historian reading this text is its plethora of minor inaccuracies, omissions and superficialities. Some of these are simply the consequence of a reliance upon secondary sources. For example, the old error that Bishop James Usher used biblical sources to set not only the year, but also the month, day and time of the Creation is repeated on page 38: in fact, he determined only the year, John Lightfoot of Cambridge being the one who refined Usher's calculations. Further errors include the implication that William Smith's work was done in 1817 (p. 40), whereas his conclusions were available to geologists more than a decade earlier. The geological concepts "Primary," "Secondary" and "Tertiary" are implicitly attributed to other geologists (p. 3, 40). The name of their true originator, Giovanni Arduino, is nowhere mentioned.

It is simply not true that, from 1912 to 1930, geologists at large were preoccupied with the concept of continental drift. Wegener's theory was swiftly discarded (too swiftly, as hindsight shows, since the idea was viewed with as much incredulity as Velikovsky's moony imaginings). Wegener's theory was not even in most geologists' thoughts until its virtual reincarnation in the 1950s. Allègre is also incorrect in his statement (p. 18) that the concept of a central fire within the Earth was abandoned at the end of the 18th century; it was still to be found in "educational" texts, and still being given consideration by geological scholars, up to the 1950s, when our growing comprehension of plate tectonics lent new credulity to Wegener's simplistic theory, to the same degree that the concepts of evolution in *The Origin of Species* had for those in Robert Chambers' *Vestiges*.

Allègre attacks "the myopia of classical geology" (p. 37-38) as causing 75% of research attention to be focussed on "the last 200 million years" and only 5% to the 2.5 billion years of the Archean. Yet, is that so surprising when, as he admits, so much of the Earth's continental surface and margins is formed or covered by those more recent rocks, when they are of so much greater economic and practical importance, and when their study is so much easier? His own interest in the birth of the Universe and the planets has, I feel, distorted his viewpoint: the development of life during the Phanerozoic, and its effects in shaping the world we know, have surely an interest as great, or greater? The processes of insemination and of the growth of the embryo form only a small part of the study of living beings; the origin and early growth of the Earth form only a prelude to its maturing since the beginning of the Cambrian.

Allègre is wrong in stating (p. 253) that trilobites are the earliest evidence of multicellular life: the so-called "small shelly fossils" and the varied, albeit shell-less Ediacaran faunas, now found so widely, carry the history of multicellular organisms back much further. Is he really unaware (p. 216) of Brazil's great richness in minerals? Surely not. His statement that 7 billion years is hardly more than 4-5 billion years (p. 164) caused my eyebrows to rise: surely 2.5 billion years is a substantial difference! Does he really believe in "the fixed distribution of erosion" (p. 229) — regardless, presumably, of climatic and geographic control — or that "the formation of relief has a random distribution" (*idem*)? Does he really consider that television screens and spacecraft are "essential to modern society" (p. 190)? I would regard both as luxuries, at best!

Other statements are made without adequate explanation or citation of sources. We are told: "It has been shown that at least five objects — five proto-planets — would be necessary to account for" the diversity of meteorites (p. 121). If this was justified in the earlier text, I missed it. How have we learned of the *internal* structure of stars other than the sun (p. 159)? Does a white dwarf implode or does it explode? Surely it cannot do both, as page 160 states. How was it calculated that, on average, a water molecule stays for 40,000 years in the ocean (p. 228)? How was the "average age" of the Earth's core calculated (p. 252): by inference from meteorites? Why is there no mention of the contribution of microorganisms to the processes of erosion and sedimentation?

Some amusing minor slips must result either from clumsy phraseology or from rare errors in a generally meticulous translation. Only one mammoth, not several, is on display in the St. Petersburg Museum and it is *not* still frozen (p. 10)! Chamberlain did not really hypothesize "the Earth's origin at the beginning of the twentieth century" (p. 14). He knew that it happened much earlier!

I was sorry to see once again repeated (p. 118) that old chestnut, the extraterrestrial cause of that great geological non-event, the cataclysmic extinction of the dinosaurs. Let us remember that this was an extinction not affecting any other terrestrial creatures and only known to have happened (well *below* that iridium layer) in those small areas of western North America and eastern Asia where suitable continental sediments crop out. Alas, I fear geochemists will long continue to discount all those evidences from paleontology and stratigraphy that happen *not* to fit this theory of theirs!

In summation, though, this book has real value, for it does expound very clearly the shaping of the theories of the origin of Earth and Universe from information drawn from a whole variety of scientific sources. That there are flaws in the recounting of the early part of this story and some (probably inadvertent) passings-over of evidence for particular conclusions is perhaps inevitable when this book's theme is so broad. Perhaps it should be read with care, but, yes, Allègre's work eminently deserves to be read.