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BOOK REVIEWS

The Dinosaur Project[1]

By Wayne Grady
Ex Terra Foundation
Edmonton, Alberta
Toronto: Macfarlane Walter and Ross
1993, [8] + 261 p., $34.95

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In common with many thousand other Canadians — and, surely, virtually every Canadian paleontologist — I have seen "Jurassic Park" and paid my statutory visit to "the greatest dinosaur show on earth." The former I enjoyed; despite its minor plot glitches, it gave an awesome impression of those great reptiles as living entities. The latter I did not enjoy, despite the impressive display of splendid skeletons; the extreme congestion of its Toronto quarter, with the small circulation spaces so tightly crowded, and the batteries of video devices combined to drive me to a hasty and head-throbbing exit.

On my way out, in compensation for this haste and because I admire greatly the scientific initiatives of the Ex Terra Foundation, I purchased the volume here reviewed. It is the work of a Canadian journalist who, as the dustjacket flyleaf assures us, is a distinguished winner of awards for his exercisings of his craft. He himself tells us, in his Acknowledgements, of the aid he received from the Canadian and Chinese paleontologists who were participants in the five-year Project, both during the time he spent travelling with the team and afterward.

The result should have been an informative and exhilarating work. Quite possibly, indeed, many readers will find it so. For this particular reader, alas! It fell amply short of expectations.

A part of the trouble, for me, was the chronological disorder. Grady seems to assume that none of his readers has an attention span much greater than that of an eight-year-old, so it is needful to change theme within each three pages and then, a little later, to change back. In consequence, his text hops back and forth in a journalistic frenzy. The Introduction epitomizes this. First we find ourselves confronting a lady on a ping-pong table, at an exercise class somewhere in the Gobi Desert; then we are learning about Phil Currie's background; then, in a sentence of especial thematic confusion, viewing

> ...a huge chunk of land — what will eventually be mainland China — drifting away from a larger landmass known as Laurasia to become the isolated breeding ground for dinosaurs that might or might not have been the ancestors of the centrosaurs. (p. 3)

Next, the genesis of the Canada-Dinosaur Project is being discussed. After that, back we go to Phil Currie's childhood, then once more to the Project, for quite a long time by Mr. Grady's standards (almost five pages). Finally, back to the lady on the ping-pong table, ending with a bit of philosophizing. Perhaps these rapid transitions will prove exhilarating for some readers; I found them both confusing and already — by page 12, before Chapter 1 had even begun — wearisome.

A section of that first chapter is called Paper Chase; it might have been a fitting title for the whole book. Chapter 1 moves from Alberta to the Canadian Arctic, with massive asides concerning the personalities of the two Chinese participants in the Project who found a dinosaur brain-case in the Alberta badlands, and with rapid changes back and forth between present and past tenses. Next we're into China; then going to the Canadian Arctic; then returning to Alberta and the brain-case; and after that, bingo! we're back into the early 19th century, being given an abbreviated and inaccurate) look at the doctrines of Lamarck and Darwin and enduring a discursus on the origin of birds. The textual style is well portrayed by this example:

> The problem was that for creatures like giant reptiles to evolve into tiny hummingbirds would require millions and millions of generations. (p. 41)

and, as a further profundity:

> To say that dinosaurs and birds were descended from a common ancestors, concluded Heilmann, is like saying that human beings are related to ants because they both have their origins in the Precambrian soup. (p. 43)

Did Gerhard Heilmann really say that, back in 1925? Somehow, I doubt it; but I do not have his book to hand and cannot check. As for "Precambrian soup," it is not on my geological menu!

In so hasty a geographic and chronologic dash to and fro, Mr. Grady gives himself no time for scientific — or historic — precision. As an example, we are told that, when Roy Chapman Andrews led his expeditions to China,

> ...it was the time of the warlords, when the country was divided into a quiltwork of feifdoms [sic], each controlled by a powerful local bandit. For Andrews, it was a vestige of the American Wild West; he walked about carrying side-arms, he chased and was chased by gangs of marauders, he risked his life regularly in the name of science. (p. 67)

Desperate types indeed, these paleon-

[1]This review was submitted some time ago, but apparently was misplaced in the transition to new editorship. We are pleased to publish it now. R.W. Macqueen, editor.

tologists! Yet was there a time when the American Wild West was so wholly under bandit control? Surely not, and surely Andrews doings were not quite so incessantly dramatic!

We are further informed that Andrews "was well enough known in New York to be able to raise the private capital for the expedition" (p. 67). However, this was no single-handed endeavour. Had Andrews and the expedition not gained the support and vigorous advocacy of Henry Fairfield Osborn (see Rainger, 1991, p. 101-104), that capital would never have been raised.

Such errors and superficialities abound. Pierre Teilhard de Chardin, we are told, was "chief paleontologist with the Institut Catholique in Paris" (p. 70). There was no such appointment: Teilhard was Associate Professor of Geology at that institute. Nor had Teilhard "arrived in China to look for hominid fossils" or to help Père Licent "to find actual hominid fossils" (*idem*). Their aims were not nearly so limited as Grady implies; instead, the two Frenchmen were concerned with obtaining, for Licent's museum in Tsientsin, the remains of fossil mammals of all kinds and also collecting archeological artefacts (see Speaight, 1967, p. 113, 121-124). The surname of University of Saskatchewan paleobotanist James Basinger is misspelled (p. 36, 37). In an illustration caption (p. 52), we are told that Joseph Tyrrell found the first Albertan dinosaur bones "while looking for coal." Not so; Tyrrell, being an officer of the Geological Survey of Canada, was not on a mere mineral search, but was examining and mapping all aspects of Alberta geology.

We are informed, in an explanation of the origin of the term Cretaceous, that the periold was "first associated with the white cliffs of Dover" (p. 60). The term "Terrain crétacé" was first applied to the Chalk of the Paris basin, by J.J. d'Omalius d'Halloy (1822).

We are further told that,

> Ophiomorpha are fossilized shrimp holes; known as trace fossils, they look like petrified snakes or tree roots running down through the section, but are actually the filled-in holes left by shrimps or worms as they burrowed down into the mud... the kind of paleoenvironment that supported shrimp [was] shallow, still, brackish swamp beds. (p. 36)

Well, first of all, *Ophiomorpha* is an ichnogeneric name and should, like the generic names of dinosaurs, be italicized. Second, *Ophiomorpha* comprises, to quote Häntzschel (1962, p. W206) "tunnel trails with tubercle-like or wart-like ornamentation of [the] outer wall but smooth inside." They are obliquely, rather than vertically, directed; they are not much like tree-roots and not at all like petrified snakes. Third, these burrows are known to be made by decapod crustaceans, not by shrimps; and fourth, these animals live characteristically in unclean, shifting sands" (Bromley, 1990, p. 73, 217) in a fully marine, high-energy environment, not a "shallow, still, brackish swamp"!

By the end of Chapter 3 of this book, I am afraid I had lost patience with Mr. Grady's thematic and chronological leapings to and fro and with his plethora of inaccuracies and superficialities; so I gave up reading it. No doubt persons with a greater tolerance for Mr. Brady's particular journalistic style, and a smaller awareness of his text's inadequacies, will find pleasure in this book. For my part, I will hope some day for a more balanced account of this major scientific endeavour, presented in a more logical fashion by a sounder scientist and historian.

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Coal and Coal-bearing Strata as Oil-prone Source Rocks?

Edited by A.C. Scott and A.J. Fleet
Geological Society
Special Publication 77
1994, 213 p., £22/US$37 (member)
£45/US$75 (non-member)

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Many studies over the past two decades have shown that coal-bearing strata are the source for some commercial accumulations of liquid hydrocarbons. Although the significance of oil-prone terrigenous source rocks is minor on a global scale, reserves in excess of 2 billion barrels in fields in Australia and Indonesia indicate that these types of source rocks can be prolific oil generators. The aim of *Coal and Coal-bearing Strata as Oil-prone Source Rocks?* is to review the status of our understanding of the formation of oils from coals and coal-bearing strata, with the ultimate goal to derive a set of criteria that may be used to predict the occurrence and distribution of oil-prone, coal-bearing sequences for oil exploration.

The book is organized into two main sections, and also includes overview and summary papers by the editors. The first section contains five papers devoted to general studies, and the second section includes four papers describing case histories.

The first paper in the General Studies section is by T.G. Powell and C.J. Boreham. They discuss the interpretation of geochemical, microscopic and pyrolysis data to characterize the oil and gas potential of coaly sequences. They point out that there is no simple relationship between the petrographic composition and pyrolysis yield with petroleum potential. They suggest that a combination of a mass balance approach with pyrolysis studies is essential to quantify the amount and types of petroleum generated and expelled from coaly source rocks. They also describe biomarker and isotopic characteristics, which are characteristic of oils derived from terrigenous sources. The second

paper, by M.E. Collinson *et al.*, provides a review of the oil-generating potential of plants contributing to coal and coal-bearing strata through time. A large part of the paper is devoted to a discussion of the oil-prone nature of Carboniferous coals. They conclude that the lack of Carboniferous terrestrially derived oils must be due to "geological or exploration factors, not in the absence of oil potential in the coals themselves." P.R. Philp describes the geochemical characteristics that are common to crude oils derived from higher plant source materials (*e.g.*, waxy n-alkane distributions, low S-content, pristane/phytane>4.0, steranes dominated by C_{29} derivatives, various sesqui-, di-, tri-, tetra- and pentacyclic terpanes). S.A. Stout used a combination of organic petrographic and laser extraction-micropyrolysis gas chromatography-mass spectrometry (GC-MS) methods to investigate the chemical heterogeneity among adjacent coal microlithotypes. He concludes that whereas the type of macerals is an important factor in oil generation, it is the physical association among macerals (*i.e.*, the microtexture) that influences the primary migration of oil within, and expulsion from, coal seams. The final paper in the General Studies section is by D.S. MacGregor, and provides a compilation of the global occurrences of coal-bearing source rocks. He notes that significant oil-prone coal sequences are restricted to two paleoclimatic and paleobotanical "fairways"; Tertiary angiosperm assemblages within 20° of the equator and Late Jurassic-Tertiary gymnosperm assemblages formed on the Australian and associated plates.

The Case Histories section includes papers describing most of the major oil provinces tied to coal-bearing source rocks. Contributions dealing with the North Sea, Niger delta, and Beaufort-Mackenzie delta terrestrial source rocks, unfortunately, are not included. S. Thompson *et al.* describe examples of coaly source rocks from Oligocene-Miocene strata of Indonesia, Jurassic strata from Egypt, and Namurian sequences from northern England. These authors stress the importance of integrating oil and source rock geochemistry with an understanding of sedimentary processes in order to predict the occurrence of oil-prone facies in coal-bearing rocks. C.J. Matchette-Downes *et al.* analysed a suite of oils and condensates from Indonesia, and based on GC-MS and isotope data postulated the existence of a mature to extremely mature terrestrial source for the hydrocarbons. D.J. Curry *et al.* examined oil-generative coals from the Cooper Basin (Permian, Australia) and the Taranaki Basin (Eocene, New Zealand), and determined that long-chain aliphatic groups in terrestrially-derived oils may originate from primary plant consituents and/or from microbially derived organic matter. The final Case History by M.A. Bagge and M.L. Keeley concerns the oil potential of Jurassic coals from Egypt, and these authors note that a combination of Rock-Eval hydrogen indices and pyrolysis-gc P2 fingerprints is the best method for determing the oil- or gas-prone nature of the coals.

In the final paper in the book, A.C. Scott and A.J. Fleet summarize the problems associated with determining the oil-prone nature of coals and coaly sequences, and these include the nature of the organic matter, the factors governing expulsion of oil from coals, and the effect of lithologic patterns and basin architecture on hydrocarbon migration. They provide some of the possible approaches that may be taken in order to resolve these problems. One of the key issues which they mention, and which is apparent from reading through the preceding papers in the book, is the need for the development of a standard nomenclature to describe coals and related kerogens. Clearly, there is a continuum of sediment types from shale to coal, but some sort of classification scheme would aid global comparisons of the nature of oil-prone coaly sequences.

Overall, I think that the editors of *Coal and Coal-bearing Strata as Oil-prone Source Rocks?* are to be congratulated on producing an informative and well-balanced overview of the topic, and I would recommend it to anyone interested in the potential of coals and coal-bearing rocks as source rocks for liquid hydrocarbons. This book provides a wide range of information on this subject, and I believe it is a useful reference for academics, as well as for those involved in hydrocarbon exploration.

Vertebrate Fossils and the Evolution of Scientific Concepts

Edited by W.A.S. Sarjeant
Gordon and Breach Publishers
The Netherlands
1995, 622 p., £78/US$120, hardcover

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L. Beverly (Bev) Halstead, one of the most colourful and most frequently published figures in the recent history of vertebrate paleontology, met a tragic death in a traffic accident in 1991. Although I was familiar with his contributions to the paleontology of primitive vertebrates and to debates about the merits and demerits of cladistic classification, and with the fact that he confused students by publishing under several different surnames, I met him only once. That was during a North American visit in 1987, when Halstead, accompanied by Helen Haste, made presentations at several western Canadian universities and museums. Some of those presentations were by all accounts straightforward, but at least two, the one in Regina and the one I witnessed in Edmonton, were extraordinary for their lightweight content and their risqué illustrations of both himself and his companion.

Accordingly, I was intrigued by the opportunity to review this volume of historical and descriptive papers assembled in Halstead's memory by his close friend, W.A.S. Sarjeant of the University of Saskatchewan. Originally published in the journal *Modern Geology*, which Halstead had edited, the papers are grouped into a biographical section and six sections presenting historical and descriptive accounts of subjects to which Halstead had devoted his academic energies.

The biographical section includes a biographical tribute written by Sarjeant, a bibliography of Halstead's publications, a brief recollection of his travels in Poland in the 1950s written by a Polish colleague, and a collection of natural history art by Jenny Halstead (née Middleton) resulting from her many col-

laborations with her husband. Sarjeant's biography is most successful, painting as it does a picture of Halstead's many adventures (*e.g.*, visits behind the Iron Curtain when they were difficult and unpopular, work in Nigeria, South Africa, and India) and of the many causes that he championed, both politically correct and politically incorrect by today's norms. Supported also by the description of his Polish visit, I came away with more admiration for Halstead as a fellow human being than I expected to have.

The four chapters in the section on paleontology of early vertebrates were also of considerable interest to me, as I currently work in this research area. French colleagues Janvier and Blieck review Halstead's influence on ideas about heterostracans (armoured early vertebrates) and his advocacy of the importance of histological data for early vertebrate studies generally. Estonian Mark-Kurik provides a useful summary of scale cover in the heterostracan family Psammosteidae, and Russian colleague Novitskaya gives her views on the relationships of various living and extinct jaw-less vertebrates. The section concludes with a brief review by Turner and van der Brugghen of the Thelodonti, a problematic group of early vertebrates whose study is currently undergoing a resurgence.

A section on the history of the study of fossil reptiles, mainly dinosaurs, spans 140 pages and provides some interesting comparisons. For example, according to Buffetaut *et al.*, early research on French dinosaurs was fragmented and retarded in comparison to contemporaneous research in Britain. Chapters by Cooper, Dean and Norman review the British history of dinosaur studies, but from the point of view of different (and often competing) pioneer workers such as Gideon Mantell and Richard Owen. A chapter by Torrens discusses the popularization of dinosaurs and changing views of their morphology and physiology over the past century and a half. The section concludes with a chapter by Padian concerning competing early ideas about pterosaurs.

The fourth section has a longer title but would more aptly be called "dinosaur miscellanea," concerning as it does such diverse topics as dinosaur extinction theories (Charig), world paleobiogeography (Ager), bone histology (Chinsamy, Reid), English Portlandian reptiles (Delair *et al.*), and dinosaurs as metaphor (Haste). The most useful chapter in this section is probably that by Lucas on biochronology of dinosaur-bearing formations of North America across the Jurassic-Cretaceous boundary.

Vertebrate footprints concern the fifth and shortest section. A survey of Triassic trackways in Cheshire and a translation by Sarjeant of Demathieu's works on dinosaur walking and leaping speeds are less interesting to the non-specialist than Currie's brief review of dinosaur trackways in the Peace River Canyon.

Marine reptiles are the subject of the sixth section, which contains more original data (as opposed to historical review) than any of the preceding sections. Deeming *et al.* discuss a putative ichthyosaur embryo and its implications for the biology of those reptiles. Lingham-Soliar reviews the taxonomy and possible feeding mode of the mosasaur Leiodon. Thulborn and Turner illustrate an elasmosaur skull apparently bitten by a pliosaur, Tokaryk illustrates mosasaur fragments from Saskatchewan, and Nichols and Brinkman describe an important, primitive ichthyosaur from the Triassic of British Columbia.

Four chapters conclude the volume. Two by Storer concern Cretaceous and Cenozoic fossil mammals from Saskatchewan. Moody and Sutcliffe give a useful review of vertebrate-bearing formations of central West Africa, while Walkden and Fraser describe vertebrates in Triassic fissure sediments in Britain.

In many ways, both positive and negative, this book is an accurate reflection of Halstead's contributions and interests. On the positive side, it spans a remarkable variety of subjects and includes both original data and interesting historical content. Sarjeant has done an admirable job of gathering diverse contributions from Halstead's many friends and thereby paying Halstead an appropriate tribute. On the negative side, the scientifically and historically light content of some chapters corresponds in significance with a considerable number of Halstead's own published works. I was also disappointed that none of the contributions really captured the adventurous, bold and controversial side of Halstead's life; I could not find any bold new ideas contained in the volume. Overall, I read about half of it with considerable interest, and ploughed through the other half out of duty. If you work in one of the areas in which Halstead made a contribution, I recommend that you acquire a copy as much for its sentimental value as for its content. Beyond that, it is difficult to recommend it as an essential part of a professional library.

Cartographies of Danger – Mapping Hazards in America

By Mark Monmonier
University of Chicago Press
1997, 384 p., US$25

Regions of Risk – A Geographic Introduction to Disasters

By K. Hewitt
Addison Wesley Longman Ltd.
1997, 389 p., C$32

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With burgeoning urban areas increasingly susceptible to environmental hazards and the rapidly rising cost to insurers of underwriting the resulting disasters, environmental hazards have aroused the wider interest of such people as economists, accountants and others, including, as we approach the millenium, the doom sayers. Most universities now offer an introductory or service course in environmental disasters. The hazards literature is full of specific case studies often requiring specialist knowledge by the reader. Enter two recent books aimed at the generalist "hazards" market and being touted office-to-office by book salesmen.

M. Monmonier's *Mapping Hazards in America* is a pragmatic attempt to further the study of hazards by asking the question where and why? The book

aims, according to its dust jacket, to provide "plain language advice on hazards and how to avoid them." The book's focus is on American hazards, the author leaving it to foreign readers to make their own compilations. Each chapter briefly reviews what is known of an individual hazard (from the usual list of suspects such as floods, earthquakes, volcanic eruptions, nuclear disaster, radon, meteorite impacts, eroding shorelines, and air and groundwater pollution) and includes several small-scale black and white maps of the United States or any one state to show the incidence or risk. The short reviews are well-written and are good summaries of specialist sub-fields, thereby fulfilling the book's mandate of using plain language. The maps, though, largely because of the scale and lack of cross-referencing of other data sets, don't really further the aim of explaining why by an understanding of where. For example, a map of potential radon hazard omits any geological data so the reader is left guessing as to cause. As to advice on how to avoid hazards, the dust jacket errs somewhat. These deficiencies aside, Monmonier's book is a good easy read, thought-provoking, and one that could be safely placed on an undergraduate reading list.

K. Hewitt's *Regions of Risk – A Geographic Introduction to Disasters* attempts to take a deeper, scholarly approach to natural hazards, boldly rejecting the dominant treatment of hazards as damaging natural events and instead emphasizing social disasters such as aids, poverty, genocide and war. Most readers will find this view a real stretch and anything but the promised "new paradigm" and "profound challenge to hazards researchers and policy makers." The approach, moreover, is simplistic: Hewitt actually suggests that the European railway system is to be regarded as a hazard because it was used to transport Jews to concentration camps. Hmmmm. Despite the superficiality of approach, Hewitt's writing style is tortuous and excessively wordy — why use one brief sentence when three long ones will do — and also prone to jargon. War is regarded as "place annihilation" and "urban Armageddon." The book contains few illustrations to break the text and is replete with long, dull tables and histograms listing, among other things, civilian casualties in various conflicts, What's the point being made here and what new insights are being revealed? None, it would appear. Instead, it all seems a rather pretentious exercise in deep academic thinking entirely divorced from the very real and very dangerous world of natural hazards and the science of hazard reduction. This book definitely doesn't make my undergraduate reading list.

Lyell: the Past is the Key to the Present

Edited by Derek J. Blundell and Andrew C. Scott
Geological Society of London
1998, 376p, US$65/£39 (member)
US$132/£79 (non-member)

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With a neat twist on the aphorism usually used to tag the principle of uniformity as applied to the geological sciences, this volume celebrates and records a symposium held in 1997 at the Geological Society with which Lyell was deeply involved for all of his life, the bicentennial year of the birth of Charles Lyell, and incidentally the same one in which James Hutton died.

The book is divided into three parts: the first on the life and influence of Lyell, the second on Lyell and the development of geological science, and the third, more distant in its lyellian echoes, is on the legacy of Lyell. Those whose prime interest is in the history of geology will find the first section most useful, with some overdue perspectives on Lyell in relation to his *Principles* (Rudwick), his life and times (Wilson), the Geological Society (Thackray), his reception to Europe (Vaccari), debt to North American travels (Dott), presence in New York State (Friedman), and his involvement in the antiquity of man later in his career (Cohen).

Of these essays, that on New York is the most parochial and least useful, with little new content other than substantial local background, and simple description of his route, and copious quotations from his 1845 *Travels in North America*. Claudine Cohen's chapter The Antiquity of Man forms an interesting chapter to read in parallel with Dott's chapter North America, for in both places Lyell's authority, albeit at different stages of his career, had a substantial impact on the general acceptance and subsequent propagation of this "foreign" geological information by those in London. Cohen shows, too, the substantial investment that Lyell made in this new line of material that had to be integrated into both standard geology, and the new evolutionary perspective of Darwin. Equally, Dott's conclusion that both North America and Lyell himself benefited enormously from his travels there, is a just one. Whatever Lyell's defects as a lecturer and as a geologist, there is little doubt that many of his perspectives were substantially influenced by the evidence he saw and gathered for himself in North America.

The other three chapters in the first section are first-class guides to the *Principles*, the man, and his European influence, the latter an area that has been surprisingly neglected until recently. Rudwick shows convincingly that Lyell used the many editions of *Principles* and its various offshoots — his primary financial support — as a fluid medium and running commentary on the the state of the art of geology. Rudwick shows, as do other chapters, that Lyell was not entirely set in his ways, even if on some topics he was very slow to shift his ground. The same sense of the man is gathered from Wilson's chapter, which provides an comprehensive overview of his career and activities, and usefully complements and augments the more detailed material available in Wilson's books on Lyell.

Many of the chapters in the second section put Lyell into a broader 19th century perspective and will be read with interest by those with particular disciplinary interests: on stratigraphic nomenclature (Berggren), the Quaternary (Boylan), hydrogeology (Mather), time (Burchfield), speciation (Hallam), climatic change (Fleming) uniformity and catastrophism (Baker), and sedimentology (Leeder). Most of these chapters include new material and often extracts from Lyell's notebooks: his field sketches on glacial terrains are especially noteworthy.

Several chapters of the final section of the book generally lie beyond my competence, and while their references

back to Lyell are not without interest, they are frequently tangential to the topics they address. They wave gracefully to Lyell in the first paragraphs, then leave him far behind! Nevertheless, the two chapters on coal-bearing strata (Scott), and the Carboniferous of Nova Scotia (Calder) are particularly helpful in casting a public light on the unusual evidence that Lyell so widely publicized 150 years ago.

I welcome this book as a substantial contribution to knowledge about Lyell and his times; it is well presented and makes a handsome and intellectual contribution to any library shelf.

Dinosaur Impressions. Postcards from a Paleontologist

By Philippe Taquet
Translated by Kevin Padian
from L'Empreinte des Dinosaurs: Carnets de piste d'un chercheur d'os
Cambridge University Press, New York 1998, 244 p., US$24.95, hardcover

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As a person whose only research affinity with the mystical world of dinosaurs is in examining the microscopic reproductive structure of what they ate, I am very grateful for the efforts of Kevin Padian in making Philippe Taquet's book available to the anglophone reader. For me, this style of book stimulates a desire to read more such personal accounts of the lives of contemporaries engaged in stimulating careers. For persons looking forward to their own life focus, it demonstrates that there are still personally fulfilling life trails to follow.

From the parochial perspective of dinosaur research presented in the North American popular press, it is refreshing to view this discipline through the mind of a scientist from the other side of the ocean. We must admire the accomplishments of Phillip Currie and Dale Russell in enhancing the public's consciousness of Canada's rich dinosaur resources, and the accomplishments of Horner and Bakker in the United States, in stimulating an understanding of dinosaur group behaviour and biology. However, Philippe Taquet's book brings home the realization that even in this time of worldwide rapid communication systems, there are still solitudes in a discipline with universal fascination.

Dinosaur Impressions follows the career of Taquet from his introduction, in 1964, to the richness of northern African vertebrate localities to the final decade of the 20th century. The first seven chapters take the reader on a fascinating voyage of discovery as Taquet explores for vertebrates in North Africa, Central Asia, and Laos. One gains an appreciation of the breadth of anatomical knowledge necessary to correctly interpret imperfectly preserved skeletal material. Anecdotes involving the interaction between the world's community of dinosaur researchers and extended dialogues on the methodology of exposing, collecting, interpreting and displaying dinosaurs and associated vertebrates add an informative depth to the travelogue aspects of these chapters. Additionally, one can appreciate the sensitive account of the people whose land yields the fossils so valued by our museums and their visitors.

The focus of Chapter 8 shifts to an account of the dinosaur record from Europe. One senses in this chapter a frustration by the author with the North American "we have it all" approach to dinosaur research, and this leads to a subtly defensive historical account of dinosaur and other large vertebrate discoveries in Europe. Taquet's accomplishment is to bring forward the significance of European finds, the historical and geographical context of their discovery, and their importance in having provided the foundation for the ever-expanding world knowledge of large vertebrates.

Most popularized accounts of the proposition of a catastrophe at the end of the Cretaceous cannot resist using dinosaurs to broaden the public's attention to what are otherwise accounts of geochemical anomalies, extinctions within invertebrates or plants, or the hypothesized physical effects of extraterrestrial impacts. Likewise, Taquet was compelled to end his original book with a chapter on factors involved in the extinction of nonavian dinosaurs. This chapter is not the place to find a substantive characterization of the Cretaceous-Tertiary boundary event, but has two aspects that are enlightening. It provides a perspective on the extinction of the dinosaurs, gained by one whose career was devoted to these grand animals, and it offers an opinion that the Chicxulub extraterrestrial impact event, as the primary causal trigger for extinctions, has yet to be universally accepted. An account of dinosaur diversification and contractions in diversity since the origin of the dinosaurs in the Triassic provides an effective background for a discussion of end-Cretaceous extinctions. Taquet divides his abbreviated discussion of current thought on the causes of extinctions into external and biological. The focus of external causes is placed on asteroid impact and large-scale volcanism as exemplified by the Deccan Traps, which by their nature are relatively short-term and potentially catastrophic. More gradual changes, but with the potential of having affected long term survival, are discussed under the topics "marine regression" and globally lower temperatures" and "competition among species". Even from this balanced approach, it is apparent that Taquet's bent is toward more gradual propositions for dinosaur extinctions. As the overwhelming value of this book is in bringing to the reader the breadth of knowledge and drive of the successful bone hunter, this may be forgiven.