ence" and the shroud of Turin notwithstanding. Although the authors in this collection devote most of their attention to the problems inherent in science reporting, occasionally they do remark that at its best it is better than anyone has a right to expect. I could not agree more.

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Important Fossils

The Burgess Shale. HARRY B. WHITTINGTON. Published in association with the Geological Survey of Canada by Yale University Press, New Haven, CT, 1985. xvi, 151 pp., illus. $25.

The Burgess Shale is a geologic formation in the Rocky Mountains of Canada that has yielded a diverse assemblage of exquisitely preserved marine plants and animals, providing a unique record of the marine organisms that lived during the middle Cambrian Period, about 530 million years ago. This book summarizes the anatomy and natural history of the Burgess biota and the history of its study from its discovery to the designation of the field area as a World Heritage Site in 1981.

The Burgess Shale crops out in a small area on the side of a high ridge in Yoho National Park near Field, British Columbia. The deposit preserves a biota that lived on the seaward edge of a shallow-water, tropical marine algal bank and on the steep bank face and muddy slope below the bank. The fossil assemblage was transported by turbidity currents and other sediment-gravity processes, which rapidly buried the organic remains in deeper-water anoxic sediments on the slope below the bank, thereby protecting them from destruction by scavengers and bacterial action. Few if any of the organisms are considered to be indigenous to the hostile environment in which they were preserved.

The biota of the Burgess Shale was discovered in 1909 by Charles D. Walcott, then secretary of the Smithsonian Institution. Walcott devoted a major part of his research time for the next 18 years to the collection, description, and classification of the Burgess fossils. His results were published from 1911 to 1931 by the Smithsonian Institution in a series of systematic monographs. Recently, several other outcrops have been discovered on nearby ridges by Desmond Collins, of the Royal Ontario Museum, and his associates, but these have far less prolific faunas than the original outcrops.

Harry B. Whittington, now professor emeritus of geology at Cambridge University, began a restudy of the Burgess fossils in 1966, while on the faculty of Harvard University, with the support and collaboration of the Geological Survey of Canada and the National Parks of Canada. New collections were made from Walcott's original quarry and were comprehensively studied by both paleobiologists and sedimentologists. The new collections and Walcott's original collections, over 60,000 specimens housed in the U.S. National Museum of Natural History, became the focus of a nearly 20-year-long research project.

Most of the laboratory studies were conducted at the Sedgwick Museum after Whittington moved to Cambridge. Major studies were made by Derek E. G. Briggs, David L. Bruton, Christopher P. Hughes, and Simon Conway Morris under Whittington's supervision. The result of this collaboration is a series of major monographs that document the anatomy, systematic relations, and paleoecology of many of the soft-bodied marine organisms that make up the Burgess biota. *The Burgess Shale* is an excellent overview and summary of results from these highly detailed studies.

Originally Walcott classified the Burgess fossils into existing phyla and the catch-all group Vermes, which obscured the anatomical and taxonomic uniqueness of the biota. Restudy of the fossils show that the biota contains numerous invertebrate body plans that do not fit within living phyla. Many extant phyla are also represented in the biota, but in proportions different from those encountered in living faunas.

A major part of the book summarizes the anatomy and problems of systematic relations of the fossils. The taxonomic groups recognized to date from the Burgess, and number of species in each, include: Algae, 20 (8 Cyanophyta, 1 Chlorophyta, 7 Rhodophyta, and 4 others); Porifera, 31; Brachiopoda, 7; Lophophorata, 1; Cnidaria, 2; Mollusca, 2; Priapulida, 7; Polychaeta, 6; Trilobita, 22; Crustacea, 21; unassigned Arthropoda, 22; Echinodermata, 6; Hemichordata, 2; Chordata, 1; and other unassigned animals, 17—for a total of 167 species.

Representatives of the biota are illustrated by high-quality photographs and line drawings. Other photographs show the general setting of the field area and the quarry operations. Well-constructed diagrams help explain the geological context of the Burgess Shale and the paleoenvironmental setting of the fossil assemblages. A bibliography of primary literature on the Burgess fossils published through about 1984 is a useful addition. Two important publications that appeared after *The Burgess Shale* went to press are a monograph on the Burgess sponges by J. Keith Rigby (*Palaeontographica Canadiana no. 2*, Canadian Society of Petroleum Geologists and Geological Association of Canada, 1986) and a well-illustrated pamphlet for a general audience by Conway Morris and Whittington ("Fossils of the Burgess shale," *Geol. Surv. Can. Misc. Rep. 43*, 1985).

The Burgess biota is of great importance to studies of the early evolutionary history of complex animal groups. Such analyses are still being made by paleobiologists. However, the success of the Burgess studies is in the meticulous preparation, observation, and description of the fossils by Whittington and his colleagues. The resulting data will serve as reference points for theoretical discussions of the early evolution of life for many years to come. The summary Whittington has provided has broad appeal for teachers, scientists, and general readers interested in the latest information on the Burgess biota and, more generally, the variety of early life on the earth.

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Californians at Risk

Waiting for Disaster. Earthquake Watch in California. RALPH H. TURNER, JOANNE M. NIGG, and DENISE HELLER PAZ. University of California Press, Berkeley, 1986. x, 446 pp., illus. $35.

Early in 1977 geologists discovered a bulge or uplift at Palmdale in the desert near Los Angeles. It suggested plate movement that could lead in months or a few years to an earthquake, which was already "overdue" in the general area. A year later a team of sociologists interviewed a large sample of Los Angeles residents and conducted five smaller telephone surveys over the next two years. They also carefully monitored the media and interviewed leaders of all the relevant organizations they could find.

The purpose of the study was to see how people reacted to "the severe threat of earthquake disaster represented by the uplift," and to "refine our understanding" of what people will do when "true earthquake predictions" are released in the future (p. 9). The data, exhaustively analyzed, show that people had little understanding of or reaction to, or even awareness of, the news of the uplift and are doing little to prepare themselves for the receipt of "true earthquake predictions."

The authors seem shocked by what they

find, but should they be? Respondents agreed that an earthquake was probably coming, but no doubt correctly reasoned that if it was small or moderate the chances were high that it would miss them and if it was truly catastrophic not much could be done about it. (The latter response is labeled "fatalism" and criticized because it leads to inaction, but it also could be labeled "realistic." Even draining all the dams in the area and condemning 14,000 risky structures would not do much in the case of a truly catastrophic earthquake, and the measures advocated for individual citizens by the authors, such as storing food and water and putting heavy catches on cabinets, would truly be insignificant.)

Rather than probe the logic the public uses regarding an event that has uncertain probability and extremely uncertain location, timing, magnitude, and consequences, the authors are concerned with what impact age, class, race and ethnicity, media recall, and other such variables have upon preparedness. Rather little, it turns out, again, I would think, for good reason. The authors note that people were probably preoccupied with more mundane matters, and I think it is fair to say that the objects of their preoccupations were more comprehensible and pressing matters such as taxes (this was Proposition 13 time), inflation, employment, discrimination, and crime.

Attitude studies that deal with knowledge of and response to low-salience, uncertain, and rare events are subject to low reliability and credibility. People have to give answers to questions that are not very meaningful. In this case few if any respondents had suffered damage in previous earthquakes, and few knew much about earthquakes, talked about them, or took the minimal (but quite inconsequential) steps recommended to them.

Respondents who lived in "inundation zones" (below dams, where some 2 to 2½ million live) "seem blithely unaware" of the danger. But the dams are many valleys and miles from most inhabitants of the zones, and the zone maps had not been published or even drawn at the time of the interviews. The questions that were intended to assess fatalism failed to specify either the size or the proximity of the earthquake, so we can't agree with the authors' interpretation that in agreeing that earthquakes "would cause widespread loss of life and property whether we prepare for them or not" 61% of the respondents were only "justifying hopelessness and inaction" (p. 191). "Household preparedness is dismal," the authors conclude, because of this fatalism (p. 191). They missed a chance to explore something more important than awareness and preparation through a survey; for low-probability events that might have catastrophic consequences we should explore cognitive issues, seeking to find out how people judge and compare probabilities, teasing out the latent rationality of their perceptions rather than attributing "fatalism" or decrying "ethereal" forebodings.

The authors attempt to apply a theory that was popular some decades ago in opinion research: news from the media affects people indirectly, through "opinion leaders" who process and interpret it. But the criterion by which opinion leaders are identified is problematic: they are persons who said that there was someone in their circle who was "most knowledgeable" about earthquakes and when asked to name that person named themselves. Two and one-half percent of the sample so identify themselves, and without any further evidence the authors dub these few as experts who provide "expert counsel on earthquakes" (p. 77), fitting "a classical model" wherein the "experts provide a rare and valued service to others" (p. 83), are accorded prestige because they read books about earthquakes, and have "special knowledge or wisdom on earthquake matters" (p. 86). Those who merely say that in their circle there is someone (other than themselves) who is more knowledgeable than others, are dubbed "associates." They too are given characteristics without any supporting evidence; for example, it is postulated that associates "may constitute the crucial link between the book-reading local experts and the general public" (p. 85) and, along with the (self-designated) experts, "may constitute a *social circle* within which opinions are sifted, issues defined, and some consensus reached" (pp. 85, 421). The provision "may" is then dropped, and much of the book discusses the implications of these assertions. For example, experts and associates are battered by 26 variables, and the small differences between them and the rest of the sample are analyzed (for example, experts are somewhat more likely to be not working, unmarried and male, and more educated and to watch more television specials on earthquakes). But then the authors are "shocked" that even 42% of the experts did not know of, or understand the significance of, the bulge in the Mohave desert, so widely reported in the media. The researchers are shocked only because they came to believe the myths they themselves created about the characteristics of these "experts."

The technical design of the survey is very good. Not only are there repeat surveys, including one immediately after a moderate earthquake on 1 January 1979 (which the respondents took in stride, most being far from it and there being only minor damage and few injuries), the authors compare responses of those in the higher-risk areas of the county with those outside them (no difference was found). There are many useful and interesting findings, perceptively discussed. For example, 21% believed that mystics and the like can sometimes forecast an earthquake, but, more important, secular mystics were more in evidence than religious ones, and science and nonscience not only coexisted in over a third of the respondents' minds but were integrated by them into a coherent viewpoint (p. 275). There is a fascinating but brief discussion of the politics of drastic measures such as closing down dams that provide irrigation for farms.

Since this is the only study of citizens' perceptions of earthquakes and its first survey came within a year of a significant and widely reported precursor of an earthquake, it is certainly useful. But its major error is to believe in its title: *Waiting for Disaster: Earthquake Watch in California.* People

Prices of Books

Average per-volume prices of books reviewed in *Science* 1981–1986. Data are for hard-cover books except where books were available only in paperback; books priced only in foreign currencies were excluded from the calculations. The average prices per page for the technical books in the natural sciences for the years covered were 11.3¢, 11.1¢, 11.1¢. 12.0¢, 12.7¢, and 12.2¢. For data from *Science* for years prior to 1981 see *Science* **211**, 933 [1981]. Other data, broken down by field, on the prices of academic science books are now being made available in the form of two price indexes, "U.S. College Books" and "North American Book Price Index," published in *The Bowker Annual of Library and Book Trade Information* (30th edition, 1985). The North American Book Price Index (1979/80 to 1984/85) has also been published, with discussion by its compiler, Dora Biblarz, in *Book Research Quarterly* **2** (no. 2), 83 [1986].

Category	Price (dollars)					
	1981	1982	1983	1984	1985	1986
All books	42.22	44.05	41.93	45.38	47.02	47.02
Technical books in natural sciences	52.76	51.70	51.18	55.29	49.66	53.57

were busy with their lives rather than waiting for a disaster, and, fortunately, only the relevant scientists were conducting earthquake watches. When the big one comes, watching for it and waiting for it, or even storing water bottles in doorways where they will be safe, are likely to have been irrelevant acts for these millions.

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Progenitor Cells

Megakaryocyte Development and Function. RICHARD F. LEVINE, NEIL WILLIAMS, JACK LEVIN, and BRUCE L. EVATT, Eds. Liss, New York, 1986. xviii, 435 pp., illus. $68. Progress in Clinical and Biological Research, vol. 215. From a conference, Woods Hole, MA, Sept. 1985.

In the past two years the availability of cloned recombinant hematopoietic growth factors and considerably better definition of in vitro assays have provided greater insight into the regulation of hematopoiesis. Understanding of megakaryocytopoiesis has lagged far behind. This is not at all surprising considering the rarity of megakaryocyte progenitors, the relative difficulty encountered in the enumeration of megakaryocyte colonies, and, above all, the extraordinary cell biology of platelet production, a complicated process that is simply not modeled in culture conditions in vitro.

Megakaryocytes are normally found plastered against the walls of the endothelial lining of the fronds of marrow tissue that extend into the marrow sinusoids. By a process that is totally obscure, they extend all or part of their cytoplasms through fenestrations in the endothelial lining structure and then shatter into platelets that are swept by the sinusoidal blood into the periphery. The regulation of megakaryocyte production from progenitors, the endoreduplication of the megakaryocyte nucleus, the path of the cell toward the endothelial lining, and the shattering process are all matters that are not understood.

Given the lack of understanding of the system, it is not at all surprising that the growth factor requirements that promote megakaryocytopoiesis are also vague. A variety of factors called thrombopoietin, megakaryocyte colony stimulating factor, megakaryocyte potentiating factor, and thrombopoiesis stimulating factor have operationally defined several different in vitro assay systems. The requirements for megakaryocytic progenitor cells to form recognizable colonies differ so widely that results of different assay systems become impossible to evaluate. As Richard F. Levine, senior editor of this proceedings volume, concludes, "We have become victims of reading and writing too many papers that present neat boxes of distinct cell populations that do not exist in nature."

Levine's opening paper focuses on the early history of the field, including identification of megakaryocytes and the regulation of megakaryocytopoiesis as a function of platelet demand. This overview is followed by some 40 contributions on the kinetics and control of megakaryocytopoiesis, the hormonal regulation of megakaryocytes, megakaryocyte biology, megakaryocytes in human disease, and platelet production from megakaryocytes. The book summarizes the state of the art as of 1985. It will probably be the last book of its kind in this field. In the next five years, as pure growth factors emerge from cloning laboratories and new monoclonal antibodies are developed that purify progenitors, the systems that encourage the development of megakaryocytes from progenitors will surely be defined. Whether we will actually fully understand the cell biology of platelet production from megakaryocytes is another matter.

I recommend this book to students of hematopoiesis as a compendium of what has been and a hope for what will be.

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Some Other Books of Interest

Embryogenesis in Angiosperms. A Developmental and Experimental Study. V. RAGHAVAN. Cambridge University Press, New York, 1986. xiv, 303 pp., illus. $39.50. Developmental and Cell Biology Series.

Raghavan's objective in *Embryogenesis in Angiosperms* is "to present an integrated version of the facts about the morphology, ontogeny, biochemistry and genetics of different modes of embryogenesis encountered in angiosperms in a book that would be suitable for a one-semester course on plant embryogenesis" and that would serve as "a review of the current perspectives in the field" for specialists. An opening chapter gives an account of "how the scene has changed" in the study of embryogenesis as new techniques have become available. The next two chapters treat the development of embryos, endosperm, and accessory embryos and cellular and biochemical aspects of embryogenesis. Results of "experimental embryogenesis" (experiments based on perturbation of normal embryogenesis) are then summarized. Further chapters deal with embryogenesis from somatic cells and from pollen grains and with the regulation of gene activity during embryogenesis, a subject about which the author notes relatively little information is available. A final chapter is devoted to applications of experimental embryogenesis, including embryo rescue in inviable hybrids as a way of transferring potentially useful genes. The book includes a bibliography of some 1000 items and author and subject indexes.—K.L.

NMR of Proteins and Nucleic Acids. KURT WÜTHRICH. Wiley-Interscience, New York, 1986. xviii, 292 pp., illus. $49.95. The George Fisher Baker Non-Resident Lectureship in Chemistry at Cornell University.

Noting that the "potentialities and practice" of nuclear magnetic resonance in the study of the structure and function of proteins and nucleic acids have been "decisively changed" in the past few years, Wüthrich in this volume sets out to provide "a comprehensive introduction to the underlying principles and experimental procedures" of such applications of NMR for the benefit of "practicing scientists and students of biochemistry, chemistry, biophysics, and molecular biology." The volume opens with an account of symbols and abbreviations used and an introductory survey of NMR generally. The first main section of the text, headed The Foundations: Structure and NMR of Biopolymers, contains chapters on NMR of amino acid residues and mononucleotides, NMR spectra of proteins and nucleic acids in solution, the NMR assignment problem in biopolymers, two-dimensional NMR with proteins and nucleic acids, and nuclear Overhauser enhancement in biopolymers. Parts 2 and 3, containing seven chapters in all, are devoted to resonance assignments and structure determination in proteins and nucleic acids respectively. The final section of the book, With NMR to Biopolymer Conformation and Beyond, consists of chapters on the conformation of noncrystalline proteins and nucleic acids and NMR studies of intermolecular interactions with biopolymers. A 15-page bibliography and an index conclude the volume.—K.L.

Drosophila. A Practical Approach. D. B. ROBERTS, Ed. IRL Press, McLean, VA, 1986. xx, 295 pp., illus. $47; paper, $30. The Practical Approach Series.

"The aim of this book is to provide the basic set of techniques necessary to exploit *Drosophila* as a research organism," writes