Scenarios of Paleontology

Wonderful Life. The Burgess Shale and the Nature of History. STEPHEN JAY GOULD. Norton, New York, 1989. 347 pp., illus. $19.95.

Wonderful Life deals basically with the central significance of contingency in history and the historical sciences. Its title pays abbreviated, but appropriate, homage to Frank Capra's 1946 film *It's a Wonderful Life*, in which Jimmy Stewart's guardian angel, Clarence Odbody, averts Stewart's suicide and then, to pep him up, shows him how different life in Bedford Falls might have been without him. In so doing, Odbody demonstrates that the course of history can be mightily and unpredictably influenced by small and seemingly insignificant changes.

Gould, whose goal in *Wonderful Life* is to become an "insider's McPhee," makes the case for contingency in an admittedly roundabout way. First, he considers the history of discovery of the Middle Cambrian Burgess Shale biota; then, in a chapter that makes up nearly half the book, he contrasts the weird and wonderful animals that Walcott visualized from his studies of the Burgess Shale fossils with those reconstructed by Whittington, Briggs, Bruton, Conway Morris, Collins, and several others (including Hutchinson, Størmer, and Simonetta) from the same or similar materials. Whittington and his colleagues, of course, gradually concluded in a series of remarkable papers that many of the Burgess Shale fossils represent animals for which there is no place in a taxonomic framework based on the modern biota. In short, their work (and that of several others) suggests that a much larger number of basic body plans than now exists may have characterized the Cambrian radiation and that this early disparity, rather than having been maintained from Cambrian to present times, may have been reduced by subsequent decimation.

The long third chapter of *Wonderful Life* is followed by one in which Charles Doolittle Walcott (in Gould's view "America's greatest paleontologist and scientific administrator") is carefully dissected to expose his reasons for assigning so many of the enigmatic Burgess Shale species to otherwise familiar animal classes and phyla. In this analysis, Walcott, as a taxonomist, is seen as an advocate of the "shoehorn" and, in his role of evolutionary historian, as a devotee of the "cone of diversity." Gould suggests several reasons for Walcott's views. On the one hand, Walcott may have been too busy as a scientific administrator to have grasped the messages of the Burgess Shale biota seen by Whittington and his colleagues. On the other, he might not have been prepared socially or philosophically to accept that message, even had he perceived it. That is, Walcott was a conservative, politically and socially, and a devout Presbyterian, to whom (Gould asserts) a belief in a complete progression of life forms, from simple to highly complex, would have come quite naturally. That Walcott shared such a belief with most of his scientific contemporaries is amply documented by what he wrote. Thus the Burgess Shale biota, in Walcott's view, was composed of the simple ancestors of a few primary divisions, all represented in much greater diversity and complexity of form in the modern biota. From this, of course, the shoehorn and the cone of diversity came quite naturally.

The principal message of *Wonderful Life*, however, is embedded in a 14-page section at the end of the "Walcott" chapter entitled "the Burgess Shale and the nature of history." In that section Gould re-emphasizes the central significance of contingency in the historical sciences and identifies it as both the watchword and the lesson of the new interpretation of the Burgess Shale biota, which is succinctly summarized as "a fantastic explosion of early disparity followed by decimation, perhaps by lottery."

After summarizing in his final chapter the general patterns that illustrate contingency, Gould proceeds to examine a number of "what if's" in a fascinating attempt to see what might have happened at various stages in the history of life if the scenario had been only slightly modified.

Wonderful Life is Gould at his best. To be sure, the book is peppered with long, discursive footnotes, jammed with hyperbole, and characterized by a writing style that might be described as "elephantine levity." However, it is also suffused with hope and a contagious, uncontained excitement, which is maintained from the first sentence of the preface to the last one of the final chapter. The message, that the historical sciences differ profoundly from the others, is not new, but it cannot be emphasized too often in a world dominated by physicists and chemists, whose views of the world need not allow for historical contingency and whose generalizations may thus be based on a sampling program that is highly concentrated in space and time. The message of history is superbly conveyed in *Wonderful Life*, which is recommended reading for scientists and nonscientists of all persuasions.

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Fiberworks

Science and Civilisation in China. JOSEPH NEEDHAM. Vol. 5, part 9, Textile Technology: Spinning and Reeling. DIETER KUHN. Cambridge University Press, New York, 1988. xxxiv, 520 pp., illus. $110.

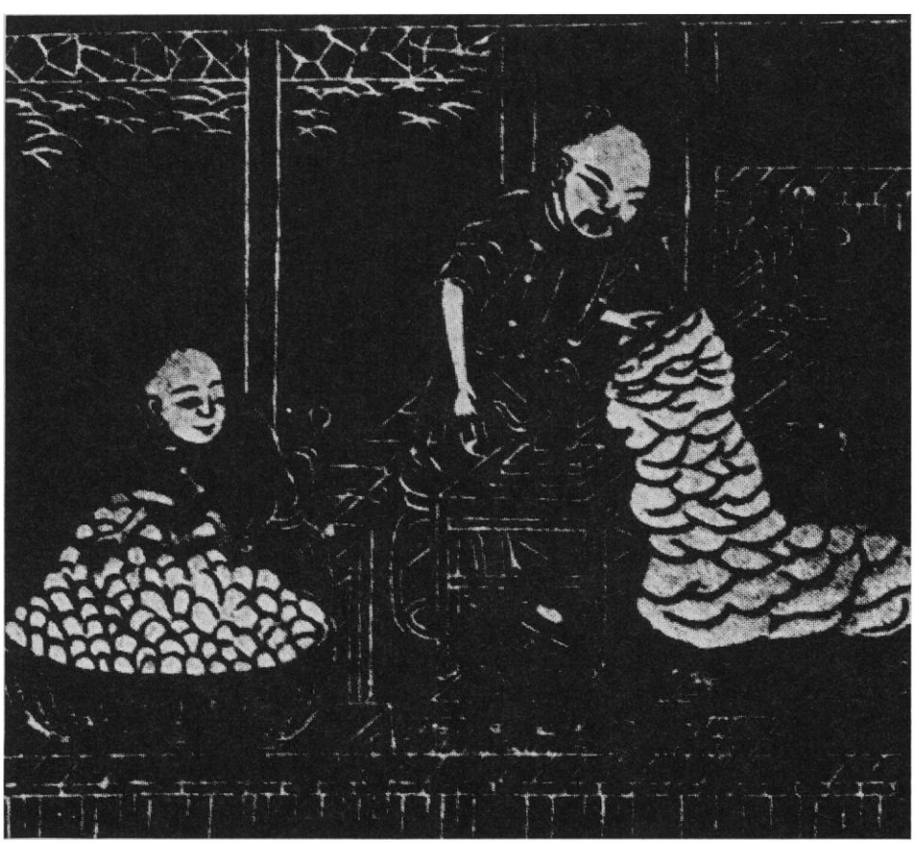
Dieter Kuhn has prepared an encyclopedic account of spinning and reeling in China as part of Joseph Needham's project to investigate science and civilization in that country. He presents the history of yarn preparation from Neolithic times to the 19th century. His account ranges from the nature of the fibers employed to the dimensions of the implements developed to the myths and customs associated with all of this. So thorough is his research, and so

Steaming of cocoons, A.D. 1313, as depicted in the treatise *Nung Shu* (Book on Agriculture), 1530 edition. In order to preserve cocoons for reeling out of season when labor and reeling apparatus were less in demand, silkworm breeders steamed them in baskets over a mixture of salt, oil, and water, shifting the baskets to control the process. If the cocoons were steamed too much the fibers softened, if too little the moths could perforate them. [From *Science and Civilisation in China*, vol. 5, part 9]

wide its range, that it will serve specialists in archeology, textile technology, economics, anthropology, linguistics, and sinology (all of which he draws upon and to each of which he contributes), yet the presentation is accessible to a reader knowledgeable in as little as one of them. For example, before approaching spinning, Kuhn provides a substantial account of the nature of the bast (ramie, hemp, and the like) and silk fibers, from culture through preliminary processing, including their places in the economy, daily life, and culture. (Shoes, often made of bean-creeper fiber, were "symbolical marriage presents because they always occurred in pairs" [p. 42].) Hand spinning with and without implements is described and compared with parallel developments in other cultures. Hand spindles and the whorls, or weights, that give them momentum are next presented and warn of the problem with the encyclopedic approach: many readers may not feel a need for some 65 pages of such description. The reader must pick his or her way through this book. Many may feel that a good deal of the information could better have been moved to footnotes or appendixes. Yet the linguist, I imagine, will welcome the interspersing of Chinese terminology and bibliography that impedes another reader. Who will welcome the overall level of detail (for example, measurements sufficient to a model-builder for innumerable implements) I'm not sure.

Yet even this complaint underlines the successes of the book. The development of the spinning wheel and its Chinese origin will not likely need retelling soon. Likewise for the multispindle treadle-powered reel dating from the 11th century, the entire complement of equipment for producing silk, from raising the worm (since the 4th millennium B.C.) to twisting the filament. Throughout, social development, custom, superstition, and economics maintain a parallel role in the tale. Though the style is a bit turgid, the illustrations (over 250) are illuminating and the explanations clear.

Kuhn has managed to maintain three levels of interpretation: the descriptive, which develops the processes and tools and their place in the life of their time and region; the intellectual, which involves the role of textile-processing in myth and symbol; and the theoretical, where he hypothesizes from available evidence and speculates about divergent paths of development in East and West. His accomplishment is immense.



Cotton gin at work, A.D. 1765, as depicted in a stone relief prepared for the *Mien Hua Thu* (Illustrations of Cotton Planting and Manufacture), one of the numerous agricultural works published in China in the 18th century. "The cotton seeds with the fibres adhering to them were fed into the narrow slit . . . between the rollers, where turning the handles caused the seeds . . . to fall to the ground or into a basket while the fibres appeared on the other side." [From *Science and Civilisation in China*, vol. 5, part 9]

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Cortical Function

The Prefrontal Cortex. Anatomy, Physiology, and Neuropsychology of the Frontal Lobe. JOAQUIN M. FUSTER. Second edition. Raven, New York, 1988. xiv, 255 pp., illus. $69.

If one of the goals of neuroscience is to understand the physics of the human mind, then a significant effort must go into learning about the prefrontal cortex, the expansion of which is a distinguishing mark of the human brain. The closest feasible model system is the prefrontal cortex of the Old World monkey, and this region is daunting in its complexity. The first edition of Joaquin Fuster's book was the place to begin any scholarly inquiry about the prefrontal cortex, and the new edition is a valiant attempt to force some coherence on this bewildering subject.

Separate chapters on anatomy, physiology, neurochemistry, neuropsychology, and human studies exhaustively survey the literature and provide capsule descriptions of much research. Some of this survey, however, is uncritical and not updated, probably because the diffuse nature of the field renders it intractable for a single author. For example, several times Fuster cites Jones and Powell's classic paper on prefrontal relationships to separate sensory streams, which emphasizes the somatosensory function of area 7 in the posterior parietal lobe. This view does not take into account subsequent work by Mountcastle and his group, who have emphasized the visual nature of much of this region, and although Fuster refers to Mountcastle, he never integrates the two views. Similarly, the book discusses the old paradox that although electrical stimulation evokes saccadic eye movements from the frontal eye field in the monkey, Bizzi's early studies failed to reveal neurons that discharged before saccades. Recent studies, however, have clearly established that there is a movement signal in the frontal eye field that precedes purposive saccades, even those made in total darkness, and have allowed the resurrection of theories suggesting that the frontal cortex does drive saccadic eye movements. These sorts of inaccuracies in the descriptions of literature that this reviewer knows intimately make one wonder about the fidelity of the capsule descriptions of research in other areas.