A Legendary Debate

Controversy in Victorian Geology. The Cambrian-Silurian Dispute. JAMES A. SECORD. Princeton University Press, Princeton, NJ, 1986. xx, 363 pp., illus. $49.50.

During the 1830s researchers active in the Geological Society of London participated in one of the great conceptual breakthroughs of modern science, delineating the stratigraphic column on the basis of distinct fossil groups. The heroes of that era conducted legendary debates: the contest between Charles Lyell and his colleagues over uniformitarianism is especially well known, but historians have recently focused more attention on debates over stratigraphy. Martin Rudwick has described at length the conflicts that erupted over the Devonian, and now James Secord has published an account of the bitterest debate of them all, the prolonged contest between Roderick Murchison and Adam Sedgwick over the boundaries of the Silurian and the Cambrian.

Secord relates a dramatic story of temporary triumph undone by desperate resistance and the unexpected discovery of new evidence. Like so many disputes this one began as a friendly collaboration, when Sedgwick and Murchison set out in 1831 to survey the complex and poorly understood stratigraphy of Wales. On the basis of fossil evidence, Murchison established the existence of a new stratigraphic system, the Silurian, extending downward from the Old Red Sandstone. Sedgwick's rocks lacked good fossils, but on the basis of structure and lithology he confidently identified a Cambrian System below the Silurian. Unfortunately, Sedgwick was unable to produce a distinctive fossil fauna for the Cambrian, and fossils from a number of his formations proved essentially identical to those of Murchison's Silurian. Murchison moved to incorporate the whole of the older fossil-bearing rocks of Wales into his well-publicized Silurian System, and his colleagues in the Geological Society, impressed by the value of fossil-based classification, overwhelmingly supported his judgment in doing so.

The disappointed Sedgwick held out for the value of structure and lithology, at first quietly and then with increasing fervor. Despite his attempts to find a point of division in the Silurian, Murchison's view prevailed, confirmed anew by the more accurate mapping of Wales by the professional corps of the British Geological Survey. At most the surveyors were willing to grant Sedgwick an apparently non-fossiliferous formation just above the primary granite and gneiss. However, in 1852 Sedgwick's assistant Frederick McCoy uncovered an unconformity at May Hill that divided Murchison's Caradoc formation—and indeed his entire Silurian—into two distinctly identifiable fossil groups. Furthermore, Joachim Barrande was also discovering a new, distinctive fossil assemblage in the lower strata of the Bohemian Basin that could be correlated with Murchison's lowest divisions and even with the non-fossiliferous "Cambrian" of the Geological Survey. Murchison accepted no dimunition of his Silurian empire, but gradually other geologists began to accept Barrande's ancient fauna as the basis for an expanded Cambrian. To the end of his days, Sedgwick insisted on a Cambrian that would include all formations up to the May Hill unconformity. Only after his death was the Ordovician slowly accepted as a compromise designation for the disputed territory.

The description above in no way conveys the richness of Secord's narrative. He has entirely reinterpreted the story in the light of a painstaking review of published and unpublished evidence. As years passed both Sedgwick and Murchison proceeded to reinvent much of the history of the controversy, and these reinventions were passed on by their biographers and other followers. In the period before the May Hill discovery, Sedgwick was driven to great lengths to justify his claims, sometimes making statements clearly inconsistent even with his own previous publications. As a result of his vehemence, he found himself increasingly isolated, and he ended his career revered at a distance but cut off by his own self-imposed exile from activity in London. Ironically, the frequent polemics that so isolated him in life turned to his advantage after his death, making his side of the story better known. However, Secord's thorough research has not merely reestablished a balance between the two men, it has recovered the original complexity and difficulty of intellectual achievements smoothed out by passing time and the failing memory of the participants.

Secord does particularly well in analyzing the contrasting style and principles of the two men. Sedgwick gave up the possibility of marriage in order to keep his geological professorship at Cambridge. Since mathematics and the physical sciences had high prestige at Cambridge, he was encouraged to overestimate the significance of physical indicators in classifying strata. At the same time his role in teaching undergraduates mostly destined for the clergy gave him few opportunities to train professional followers who might have supported his doctrines and beliefs. Secord sees Sedgwick as a bluff dalesman, independent-minded, skeptical of authority, and with a fierce moral conviction of the rightness of his claim. At the same time he notes that Sedgwick's inability to complete a significant geological book left him frustrated, defensive, and more rigid in asserting his priority. By contrast Murchison, as a former soldier made independent by his wife's money, had very different attitudes. He decided early that fossils held the key to stratigraphic dating, and with his superb military sense of planning and organization he accomplished prodigies of geological surveying and mapping, which resulted in lush publications. Not only did he march with the professional consensus on dating, he knew the right people, entertained lavishly, and developed an expansive seigniorial attitude, both toward his profession and toward the formations he described. To top everything off he eventually assumed the directorship of the Geological Survey, which remained for long afterward a center of resistance to Sedgwick's viewpoint. Murchison fit the role of haughty establishmentarian quite as well as Sedgwick fit the role of angry rebel.

This book aims at serious goals and achieves all of them. It provides a fundamentally new interpretation of the Cambrian-Silurian dispute based on exacting research and thoughtful interpretation. It also relates the dispute both to the general social background of British geology and to the distinctive personal experiences of Sedgwick and Murchison. Secord writes clear, vigorous prose and provides plenty of helpful illustrations. One cannot ask for more.

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Non-Revolutions

Misunderstanding Media. BRIAN WINSTON. Harvard University Press, Cambridge, MA, 1986. xii, 419 pp., $22.50.

Brian Winston, who has worked in the worlds of broadcasting, journalism, and education, does not believe in the information revolution. He explains why in a book salted with provocative headlines: "Thomas Edison invents the telephone"; "The U.S. Navy invents television"; "Bing Crosby invents videotape." None of them did, of

course. This is just Winston's way of telling the reader that conventional stories of the evolution of information focus too narrowly on a single inventive moment. He corrects this with a study of the prehistory and posthistory of the inventions. The historical accounts are assembled from secondary sources, sometimes indiscriminately. For example, one's confidence in Winston as historian is shaken early on when he states incorrectly that electronics theory and technology changed little between 1907 and 1923, and later when he relies on a superficial treatment of industrial research to buttress his conclusion about innovation in industry. But in between the history is usually both accurate and enlightening. The book contains a good explanation of how electronics-based television overtook mechanical scanning disk systems; a good international perspective on the history of television, computers, and communications satellites; excellent discussions of the evolution of cable television and of videotape recording as compared to its rivals. It also includes numerous digressions. Sometimes the quantity of information does not illuminate but instead befogs.

But a message well worth receiving burns through the fog. Today's new information technologies (personal computers, cable television, communications satellites, fiber optics, videocassette recorders), like yesterday's (telegraphs, telephones, radio, television), do not appear overnight and then radically transform society. Instead they appear after plenty of advance warning, emerge when society is ready for them, and then accommodate themselves to existing institutions. From this general thesis, Winston derives 20 courageously specific predictions. For example: "Entertainment channels, whether delivered by cable or other means, will probably never exceed one dozen" (p. 2).

But why believe the general thesis? Because, Winston tells us, innovation always follows a sequence of predictable phases, driven by two laws. "The law of supervening necessity" states that social readiness, not technological readiness, determines the pace of innovation. One expects "the law of the suppression of radical potential" to tell of a capitalist plot to suppress technology-for-the-people but gets instead the unsurprising news that established interests try to envelop and control challenging new technologies. Sometimes they succeed. The radio networks dominated television; the electromechanical tabulating machine company IBM dominated computers. Sometimes they fail. Western Union did not dominate telephony; the vacuum tube giants RCA, GE, and Raytheon did not dominate solid-state electronics.

Winston fits the history of eight information-related technologies to his model. In the process he gathers into one place a broader account of the history of these technologies than will be found elsewhere. His purpose, however, is not history for its own sake but validation of his model.

It is hard to see how any invention would fail to fit the model. "Supervening necessity" appears to be no more than whatever preceded invention. "Radical potential" appears to be anything that did not follow invention. Thus radio broadcasting, by most standards a radical innovation, is implicitly dismissed by Winston as non-radical because it happened.

More defensible than Winston's exercise in model-based prediction are the more general conclusions he draws from recent history. The amount of information in the world is not growing exponentially; the pace of technological change is not speeding up dramatically; the independent inventor is not obsolete. Historians will both welcome these conclusions and recognize them as a confirmation of the ones reached by Jewkes, Sawers, and Stillerman in their classic *The Sources of Invention* 30 years ago. Since then, books about future shock, information revolutions, and wired societies have rolled steadily off the presses. Some people have apparently not gotten the word that most alleged discontinuities in society's use of technology are more hype than fact. Perhaps this energetically expressed formulation will get that word to them.

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Metamorphic Rocks

Blueschists and Eclogites. BERNARD W. EVANS and EDWIN H. BROWN, Eds. The Geological Society of America, Boulder, CO, 1986. viii, 423 pp., illus. $55. GSA Memoir 164. Based on a conference, Bellingham, WA, Sept. 1983.

This collection of 28 papers deals with the petrology of relatively high-pressure–low-temperature rocks generally thought to form in convergent plate junctions. In aggregate, it provides an overview of the origin and tectonic evolution of such lithologies worldwide. Up-to-date reports of research on mineral reactions, thermodynamic analyses of phase assemblages, and descriptions of particularly illuminating circum-Pacific and Alpine high-pressure occurrences are thoroughly documented. The first three papers detail experimentally determined and thermodynamically computed phase relations. The rest contribute data on natural occurrences from western North America (ten papers), Europe and the Mediterranean (nine papers), the U.S.S.R. (one paper), Japan (four papers), and New Caledonia (one paper).

Synthesis of sodic amphibole-bearing assemblages in iron-free and iron-containing model systems provide new quantitative P-T-f_{O_2} constraints for the greenschist $\rightleftarrows$ blueschist facies transition (Maruyama *et al.*); the Al_2O_3 content of blue amphibole in the low-variance assemblage glaucophane, epidote, actinolite, chlorite, albite, and quartz may be utilized as a geobarometer in the 4- to 8-kbar range. Much higher pressure assemblages—approaching 25 kbar—appear to be required by experimentally synthesized phases such as ellenbergerite, pyrope, coesite, magnesium-carpholite and magnesium-chloritoid, which have rare natural analogs in aluminous rocks of the western Alps (Chopin); this discovery testifies to the remarkable depths evidently reached by supracrustal rocks during subduction accompanying consumption of Mesozoic Tethys. Generally landward-rooting thrust and/or strike-slip fault systems, involvement of oceanic tholeiite (with or without alkali basalt), and late Triassic to latest Cretaceous metamorphic ages (Mattinson; Armstrong *et al.*) characterize preserved glaucophane schist assemblages in the western North American cordillera. Fragments of this convergent history are preserved in telescoped lithologic sections (Moore; Sorensen; Cloos; Jayko *et al.*; Helper; Brown; Brown and Forbes; Roeske). Plate tectonic settings, protoliths, mineral parageneses, and ages of recrystallization of early Paleozoic blueschists and related rocks from scattered localities in northern and western Europe are documented (Ohta *et al.*; Gibbons and Gyopari; Peucat). The parageneses and structural relations of late Cretaceous–earliest Cenozoic high-pressure–low-temperature mafic blueschists, eclogites, and associated metasediments in the Alpine-Tethyan realm are summarized for the western Alps (Oberhänsli; Dal Piaz and Lombardo; Mottana), Corsica (Gibbons *et al.*; Warburton), and Turkey (Okay). Of particular significance is evidence summarized by Dal Piaz and Lombardo for recurrent or continuous generation of high-pressure–low-temperature mineral assemblages over the interval 130 to 60 million years ago, an age span similar to those of blueschist-eclogite assemblages from California, Washington, Alaska, and Japan. Participation of preexisting continental crust in the subduction metamorphism is characteristic of circum-Tethyan orogenic belts, in contrast to dominantly oceanic basement caught up in circum-Pacific blue-