The collection connection

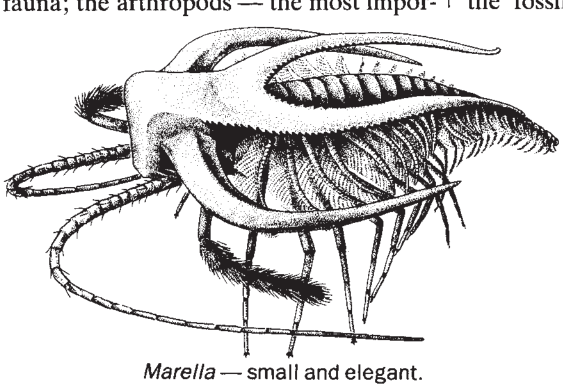
Richard A. Fortey

Wonderful Life: The Burgess Shale and the Nature of History. By Stephen Jay Gould. *W. W. Norton: 1989. Pp. 346. $19.95. To be published in Britain by Hutchinson, February 1990.*

THE Burgess Shale, which crops out high in the Rockies of western Canada, is a deposit of mid-Cambrian age. It was discovered in the last century by the great American palaeontologist C.D. Walcott, and preserves an astonishing array of soft-bodied animals which allows us a glimpse of the true range of organisms present at an early stage in metazoan history. In *Wonderful Life* Stephen Jay Gould describes the investigation of this famous fossil fauna: "the world's most important fossil animals".

Gould brings alive the monographs and descriptions of these animals which H.B. Whittington and his colleagues have prepared with such care over the past two decades. He presents the unravelling of the morphology of the remarkable finds as an intense psycho-drama, slapping on a bit of hyperbole here, and a colourful analogy there, to buoy the reader through passages that might seem too technical in any other hands. There is no question about the historical importance of the Burgess Shale, and Gould is right when he says that it deserves a place in the public consciousness along with big bangs and black holes.

But the story is directed to a particular end, and it is this end which, to Gould, lends the Burgess fauna its real interest. His contention is that here we see "a disparity in design far exceeding the modern range throughout the world" (p.62). Organisms from the Burgess Shale may belong to phyla unknown in the living fauna; the arthropods — the most important element in the fauna — do not conform to modern groups, with few but important exceptions. Instead we have a time of wild experiment, with morphological components picked like items from a menu in a Chinese restaurant, and placed together in combinations that no longer exist. The subsequent, post-Cambrian, history of life is seen as one of loss of designs — impoverishment, if you like — in spite of the wondrous variety of the modern world. This is surely a dramatic story, but is it true?

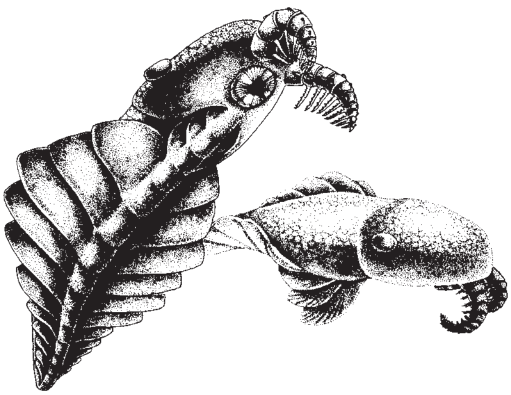


Marella — small and elegant.

Gould follows a traditional line in taxonomic attitude. The taxonomic status (equivalent to importance) of a group is decided by what he terms 'disparity', which means the morphological 'distance' from other groups. A breakthrough occurred, he maintains, when the Burgess arthropods were recognized as including "a series of unique designs, beyond the range of later groups" (p.168). The most peculiar animals of all might be designated as hitherto unknown phyla, the highest taxonomic division below the Kingdom. Curiously, Gould hardly mentions the new discipline of cladistics, which was being developed at exactly the same time as Conway Morris, Briggs and Whittington were patiently chipping out Burgess oddities. The cladistic method works by analysing shared similarities, and produces a classification based on derived, homologous characters; and it does not make value judgements about 'disparity'.

The problem with 'disparity' is that its estimation depends on the authority of the expert: how is he to know what makes — what is 'worth' — a phylum? Or what a class? For the Burgess Shale the answer seems to be lack of success in assigning the taxon into a known, living group, so that the fossil becomes 'an animal with no modern relatives'. But unless the animal arose afresh from the mud it *has* to have some modern relatives, be they ever so distant. The end product of the 'disparity' approach seems to be the insouciant recognition of a new phylum, as if it were only to be expected (on p.143 Gould quotes one prominent researcher as remarking, "Oh fuck, another new phylum", on the discovery of a new form).

For systematic affinities to be discovered, the arthropods from the Burgess Shale *can* and should be analysed in terms of the characters they share rather than those they uniquely possess. They seem to fall into a rather ordered array, with *Marrella*, Walcott's original 'lace crab', as the most primitive member, and the trilobites surprisingly advanced. A similar exercise on echinoderms has seen the positioning of numerous so-called Cambrian 'classes' within a coherent phylogenetic picture. The advantage of this kind of analysis is that it suggests further fruitful questions. For example, the arthropods are metameric organisms, and the characteristic arrangements of appendages (legs, gills and the like) of groups living today may have been assembled piecemeal; the Burgess Shale animals, for all their oddity, may record the stages in this assembly. Hence the fossils may be vital to the understanding of arthropod phylogeny; their apparent 'disparity' may partly reflect the process of assembly of advanced clades.



Anomalocaris — a "capable swimmer".

Scientific discussion will centre on the homology of particular characters, which is always controversial in arthropods. But sorting out such complex questions provides more constructive insights into the classification of these arthropods than simply saying: "Gee isn't that weird — it must be a new class!". One might suspect that if, say, the stalked goose barnacles had been known from the Burgess Shale alone ("an arthropod-like animal covered in calcareous plates and with a flexible stalk — goodness gracious!") they would have found themselves in a new phylum. Yet we know from their development that they are specialized crustaceans. It is about time that organisms were classified by characters they share rather than by intuitions about 'disparity'.

Whatever one makes of their relationships, Gould is surely correct in saying that these animals are among the most important for understanding the history of life. Study of them has demanded patience and persistence, and has mostly been carried out with microscope and pencil and paper rather than the high-technology, high-expenditure approach typical of fashionable science. *Wonderful Life* is a compelling story, told with characteristic verve. □

Richard A. Fortey is in the Department of Palaeontology, British Museum (Natural History), Cromwell Road, London SW7 5BD, UK.

Drawings, by Marianne Collins, are taken from the book reviewed here.