

Essay-review of Valentine's *On the Origin of Phyla*

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On the Origin of Phyla

JAMES W. VALENTINE

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Science, like evolution, ‘is a complex and heterogeneous *historical process*’, Paul Feyerabend (1988, 111) reminded us, and it contains ‘vague and incoherent anticipations of future ideologies side by side with highly sophisticated theoretical systems and ancient and petrified forms of thought’. This mosaic character of scientific progress is worth keeping in mind as we examine James Valentine’s ambitious review of animal phylogeny, *On the Origin of Phyla*, a work that might be best described as a product of mosaic evolution itself.

On the Origin of Phyla is divided into 14 chapters that are grouped into three main sections: ‘Evidence of the Origins of Metazoan Phyla’ (chapters 1–5, pp. 1–196), ‘The Metazoan Phyla’ (chapters 6–11, pp. 197–424), and ‘The Evolution of the Phyla’ (chapters 12–14, pp. 425–520). More than 200 black-and-white line drawings, charts, and diagrams appear throughout, most of them previously published but all clearly reproduced. More than 70 pages of references provide access to the extensive literature of higher-level animal systematics, and an appended glossary will help those who had forgotten, for example, that the ‘jelly’ of a jellyfish is properly called the *mesoglea*.

The zoological core of the book is its second section, a more or less conventional treatment of major animal taxa, arranged in chain-of-being fashion from sponges to cnidarians to ‘worms’ of many kinds, and so onward to arthropods, echinoderms, chordates, and all others in between. These chapters will be a valuable reference for specialists and non-specialists alike, and like all such treatments they are packed full of interesting palaeontological, developmental, anatomical, and ecological detail: the earliest tardigrades appear in Late Cambrian marine deposits from Siberia (264); some helcionelloid molluscs possess a strange shell structure called a ‘snorkel’, the function of which is uncertain (306); the tiny parasitic Cyclophora, perhaps allied to the rotifers, were wholly unknown until they were discovered in 1995 living on the mouth-parts of lobsters, ‘giving rise to dreams that other yet-undiscovered bodyplans might still be lurking in unusual places’ (370); and much more. Figure 4.17 presents the volume’s phylogenetic summary: the bilateral animals comprise three main clades, the Protostomia, the Deuterostomia, and the Acoelomorpha (sister to the previous two); the Bilateria themselves are sister to either the Cnidaria or the Placozoa; and the Ctenophora are sister to all these. The sponges (Porifera) are shown in figure 4.17 as the sister clade of all other animals, but elsewhere the sponges are said to be paraphyletic and so not a clade (38). In the chapter discussions Valentine does his best to place many fossil taxa that are poorly known: the Cambrian trace fossils called *Bergaueria* (224) are probably sea anemone burrows, for example, and the sclerite-covered Ordovician fossils called Turrilepadida are probably eutrochozoan protostomes (335). The voluminous comparative literature on all these organisms has been thoroughly

processed right up to the present, and Valentine has done a great service by synthesizing this research for all of us.

Philosophically inclined readers will be most interested in first and third sections of the book, treating phylogenetic principles and macroevolution respectively. These are rich in detail but many of the positions they adopt are open to debate, or rather, have been debated extensively already. Readers who have not followed the conceptual upheavals that have shaken systematics over the last few decades may have difficulty grasping the points in dispute here, but these points are substantial. (For a non-specialist's review of the recent history of systematics, see Robinson and O'Hara 1996.)

To begin to characterize Valentine's views on systematics, we must first make two clear distinctions, one between *taxa* and *ranks*, and the other between *classification* and *phylogeny*. Valentine understands these distinctions, but he regards them very differently from the way most systematists now regard them.

Taxa are groups of organisms, such as Hominidae, Enteropneusta, Chordata, or Pogonophora. *Ranks* are the 'levels' assigned to taxa within a given systematic hierarchy: kingdom, phylum, class, order, family, genus, species. Although the notion of rank has been a part of systematics from the time of Linnaeus, since the rise of phylogenetic systematics (cladistics) in the 1960s and 1970s more and more systematists have come regard rank as dispensable, and they tend to speak now only of taxa rather than ranked taxa. Saying 'phylum Chordata' does not communicate anything that 'Chordata' alone does not already communicate, and saying 'phylum Chordata' gives the impression that equivalently ranked taxa are comparable in some special way, an impression that is almost certainly misleading. For those who hold this position, the very title of Valentine's book, *On the Origin of Phyla*, is problematic, since *phyla* per se—as opposed to just large, distinctive, or old *taxa*—may not mean much. Would anyone think that 'On the Origin of Subclasses' would somehow be a conceptually different book from 'On the Origin of Superorders'? Each could be no more than an account of the history of the *particular* taxa that *happen* to have been given those ranks: 'On the Origin of *the* Taxa Ranked as Subclasses' or 'On the Origin of *the* Taxa Ranked as Superorders'. So it should be with the origin of *the* taxa ranked as phyla.

Valentine attempts to retain 'phylum' as a meaningful notion by associating it with the concept of *body plan*: taxa having different body plans belong to different phyla. While I commend Valentine for using the English *body plan* in preference to the equally popular German word *Bauplan*—which sometimes seems to carry an almost pseudo-mystical connotation—even so, whether in German or English, the notion of 'body plan' strikes me as no less problematic than the notion of 'phylum'. Since Valentine's body plans can be composed of both ancestral and derived character states and may even be polythetic (33), 'body plan' is not likely to have much utility as a concept. A more modern method of characterization, by identifying (say) 'the derived character states that define a clade', would be far more constructive. Readers who wish to make sense of 'phyla' as such would be better off extending Scott Atran's studies of cognitive anthropology (Atran 1990) than attempting to make technical sense of 'body plans'.

Turning from the distinction between taxa and ranks, let us consider the distinction between classification and phylogeny. The rise of cladistic systematics in the 1960s brought this distinction into sharp relief, and three schools of thought emerged with respect to *classification*: the phenetic school, the cladistic school, and the ‘evolutionary’ school (Mayr 1974). The phenetic school is long-extinct, and I had thought that—for those who regard classification as important—the evolutionary school was as well, but apparently it is not since that is clearly the camp to which Valentine still belongs. The remaining members of that school will probably find Valentine’s views on classification to be congenial, while most others will not.

An even deeper transformation took place when systematists began to distinguish clearly between classification and phylogeny, however: many came to regard *classification* per se, like *rank* per se, as a dispensable idea (de Queiroz and Gauthier 1992). The object of systematics today, in the eyes of many of its practitioners, has become entirely the reconstruction of *phylogeny*—the evolutionary tree of life—and *classification* as such has come to be seen as a flickering shadow that maps onto phylogeny in uncertain, and what is worse, unpredictable ways.

As an example, consider Valentine’s table 11.1, ‘Subphyla and classes of Echinodermata’. Five subphyla are listed—Crinozoa, Blastozoa, Asterozoa, Homalozoa, and Echinozoa—and 21 classes within them. This may appear to be a substantial chunk of information, but what exactly does it tell us? From the point of view of phylogeny, all this detail tells us next to nothing. Are any or all of these subphyla clades? If so, how are they interrelated? If not, which ones are paraphyletic with respect to which? It is impossible to estimate even the rough outlines of the phylogeny from an ‘evolutionary’ classification of this sort, and it renders phylogenetic ‘tree thinking’ (O’Hara 1997) impossible.

Valentine might object that these brief characterizations do not do justice to the details of his position, and such an objection would have merit. But for the purpose of a brief review, the point to be taken away is simply that Valentine’s perspective on systematics is now a comparatively unusual one, and novices should be forewarned.

On the Origin of Phyla is a comprehensive work from a scientifically transitional era. The publisher’s advertisement describes it as ‘one of the classic scientific texts of the twentieth century’. For us in the 21st century, that may be the best way to regard it. It will be of greatest value to two groups of readers: zoologists who want a good compendium of current comparative data with excellent access to the literature, and historians and philosophers of science who have an interest in the conceptual and linguistic swirl that continues to envelop the spread of tree thinking in biology.

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