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Timely fossils: the past, present and future roles of biostratigraphy in constructing time scales

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Although biostratigraphy is formally defined as the grouping together and correlation of rocks on the basis of their biotic content, contemporary biostratigraphy is often used to achieve a dynamic mix formal biostratigraphy, lithostratigraphy (e.g., in the sense of geochemical markers derived from fossils), chronostratigraphy, geochronology, and even some of the newer stratigraphies (e.g., 'event stratigraphy'). However, the dangers of taking too liberal an approach to biostratigraphic inference are many and copiously illustrated by the stratigraphic literature, old and new. The classic, and still too often neglected, summary of what can only be termed the modern approach to biostratigraphy—Alan Shaw's *Time in Stratigraphy* (1964)—set out the logical basis for relating biostratigraphic observations to lithostratigraphy, chronostratigraphy, and geochronology in addition to anticipating many later developments, some of which have entered mainstream palaeontological thought only recently (e.g., Signor-Lipps effect, gap analysis, stratigraphic confidence intervals). Of particular importance to a contemporary interest in using biostratigraphic data to construct time scales is the existence of diachrony in all biostratigraphic datums, inconsistency in the identification of fossil species, bad logic in the interpretation of biostratigraphic data, failure to use all available information that can be derived from fossil data, and resolution of the often unacknowledged tension existing between the concept of the stratotype and Shaw's 'composite reference section'. While stratotypes have their uses, it will be necessary to move beyond the typological approach to stratotype designation, and adopt a more integrative and model-based approach if biostratigraphy is to realize its true potential. This, of course, parallels the situation of systematics which moved away from a strictly typological approach to species definition in favor of a population-based concept during the first half of the 20^{th} century, largely for the similar reasons. More-

over, as conceptual developments in the nature of biostratigraphic data continue to be made (e.g., morphologs, ecologs), and as new techniques for collecting, summarizing, and integrating biostratigraphic data continue to be developed (e.g., neural nets, constrained optimization), biostratigraphers of the future will be able to construct logically consistent syntheses of diverse data types quickly, easily, and at unprecedented levels of both temporal and spatial resolution. Such syntheses as are already available only hint at the rich and exciting field biostratigraphy will become in the 21^{st} century.