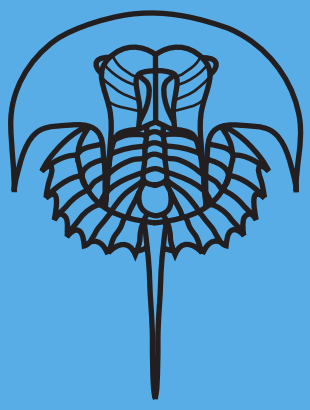

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PART E, REVISED, VOLUME 4, CHAPTER 9A: PALEOZOIC STROMATOPOROIDEA: GENERAL INTRODUCTION

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The stromatoporoids are a group of fossil organisms, now extinct, that lived during the Ordovician, Silurian, and Devonian periods and are preserved in rocks of these systems as large carbonate fossils in the shapes of plates, crusts, domes, fingers, and bulbs, consisting internally of a network of regularly repeating structural elements such as pillars, laminae, cysts, and walls. Although recognized as a class of sponges, these fossils, unlike most sponges, are lacking in siliceous or evident calcareous spicules.

The previous volume of the *Treatise on Invertebrate Paleontology* that included a section on the stromatoporoids was published over 50 years ago as Part F (MOORE, 1956). At that time, the group was considered to belong in the phylum Coelenterata (subphylum Cnidaria). The section's author, Marius LECOMPTE, integrated the Mesozoic fossils that closely resemble the Paleozoic stromatoporoids into the order Stromatoporoidea. In this revised treatment, the Paleozoic fossils are considered to be a class of the Porifera, and the similar forms of the Mesozoic are divided into those fossils with spicules that can be assigned to taxa of living sponges and the aspiculate group that can be classified only on their calcareous basal skeletons. In this revised treatment of the Paleozoic Stromatoporoidea, they are placed in the hypercalcified sponges of Part E (Revised), Volume 4.

Consensus for the change from the Cnidaria to the phylum Porifera was largely due to discoveries during the past 50 years. The first was the detailed description by HARTMAN and GOREAU (1970) of the stromatoporoid-like hypercalcified sponges (they called them sclerosponges) from the northern coast of Jamaica. The second was the recognition that the exhalant current systems of these sponges were almost identical to, and probably analogous to, the radial canal systems on the surfaces of stromatoporoids. The third was the discovery of spicules in some of the Mesozoic so-called stromatoporoids by WOOD and REITNER (1986). Aspects of both these discoveries had been published before by KIRKPATRICK (1912) but had attracted little attention among paleontologists (see *Treatise Online,* Part E, Revised, Volume 4, Chapter 9F, for further discussion). The rediscovery of the so-called sclerosponges demonstrated that the carbonate architecture like that of the Paleozoic stromatoporoids was duplicated in living sponges; the recognition of the remains of siliceous spicules, a unique skeletal feature of living sponges, in the carbonate skeletons of Mesozoic fossils of stromatoporoid architecture confirmed the close relationship between living sponges and fossils with similar carbonate skeletons.

The Stromatoporoidea are considered in this volume to be a class of the Porifera defined by characteristic internal structures of the basal skeleton and lack of spicules, but the term stromatoporoid also has been used to describe a grade of evolution of hypercalcified sponges that evolved in several lineages belonging to a range of other poriferan classes. The concept can be found in the works of VACELET (1985), REITNER (1987), and WOOD (1987, 1990, 1991). For example, certain Cambrian archaeocyaths, a number of early Paleozoic verticillitid and agelasid demosponges, Mesozoic demosponges, and modern demosponges such as *Astrosclera* and *Calcifibrospongia*, have all been considered to be of stromatoporoid grade. According to WOOD

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(1991, p. 119), this grade is characterized by " . . . a multi-oscular, 'compound,' 'colonial' or modular aquiferous system and a layered organization of radial and concentric skeletal elements . . . ." Division of the forms of this stromatoporoid grade into various higher taxa of the Porifera is not on the basis of their basal skeletons, which may mimic each other, but on their preserved spicules or, in living forms, on the basis of their soft tissues as well. The groups defined on the basis of their stromatoporoid architecture are therefore polyphyletic and should not be placed together as a taxonomic group. Although this architecture has evolved several times in disparate poriferan lineages, this does not prove that the group here recognized as the Paleozoic stromatoporoids is itself a polyphyletic collection of fossils of various poriferan classes; but this possibility needs to be addressed. For example, the labechiids have been considered to be a separate lineage from the rest of the stromatoporoids (Heinrich, 1914, 1916; Kühn, 1927, 1939; but see also discussions by Nestor, 1966; Stearn, 1982; and Webby, 1993). That the class Stromatoporoidea is either polyphyletic or monophyletic can only be decided on the basis of evidence available from the basal skeletons of the group itself.

The formal class Stromatoporoidea applies only to a unified, nonspiculate group of lower Paleozoic–middle Paleozoic taxa, whereas the informal term stromatoporoid has been given a much wider application. Late Paleozoic to Mesozoic and Recent hypercalcified sponges that show features such as latilamination, laminar to bulbous or branching growth form, and astrorhizae have been considered to exhibit a stromatoporoid grade of organization, but these forms do not belong taxonomically in the class Stromatoporoidea. The late Paleozoic to Mesozoic forms are subdivided in this volume into the nonspiculate fossils of stromatoporoid architecture that are here referred to informally as stromatoporoid-like genera (see *Treatise Online,* Part E, Revised, Volume 4, Chapter 5), and the Mesozoic taxa that have spicules or spicule pseudomorphs are included in the class Demospongiae (see *Treatise Online,* Part E, Revised, Volume 4, Chapter 3).

As assignment to major divisions of the Porifera by zoologists is largely on the basis of spicule types, strict application of the grade concept to fossil sponges without preserved spicules means that such fossils cannot be placed in a taxonomy based on living forms and spiculate fossils. Without the aid of spicules, demonstrating that the Paleozoic stromatoporoids are a collection of other sponge classes is difficult, maybe impossible. Vacelet (1985), Wood (1990), and Reitner and Wörheide (2002) have emphasized that the basal skeleton of hypercalcified sponges is facultative (see *Treatise Online,* Part E, Revised, Volume 4, Chapter 15A, p. 16–17; *Treatise Online,* Part E, Revised, Volume 4, Chapter 9D, p. 14, 18); that is, it is easy to secrete and is laid down by the sponge with little or no vital effect on the composition of the ions passing through the sponge tissues (see *Treatise Online,* Part E, Revised, Volume 4, Chapter 9F). They concluded that the basal skeleton in fossil sponges is invalid as a basis for classification, and without the evidence of spicules, the mid-Paleozoic fossils of stromatoporoid grade cannot be validly classified. However, for the group to be useful for interpreting biostratigraphy, paleoecology, paleogeography, and life history, they must be described and classified. The only basis available to the paleontologist to systematize the description of these fossils is their basal skeletons; that is all that remains of them. Similar failures to connect paleontological and zoological classifications are common in invertebrate paleontology where preservational factors stand in the way of ideal taxonomic solutions. Stromatoporoids are classified on the basis of the structural elements of their basal skeletons, because these incorporate the only criteria that are available to divide them into groups for description.

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