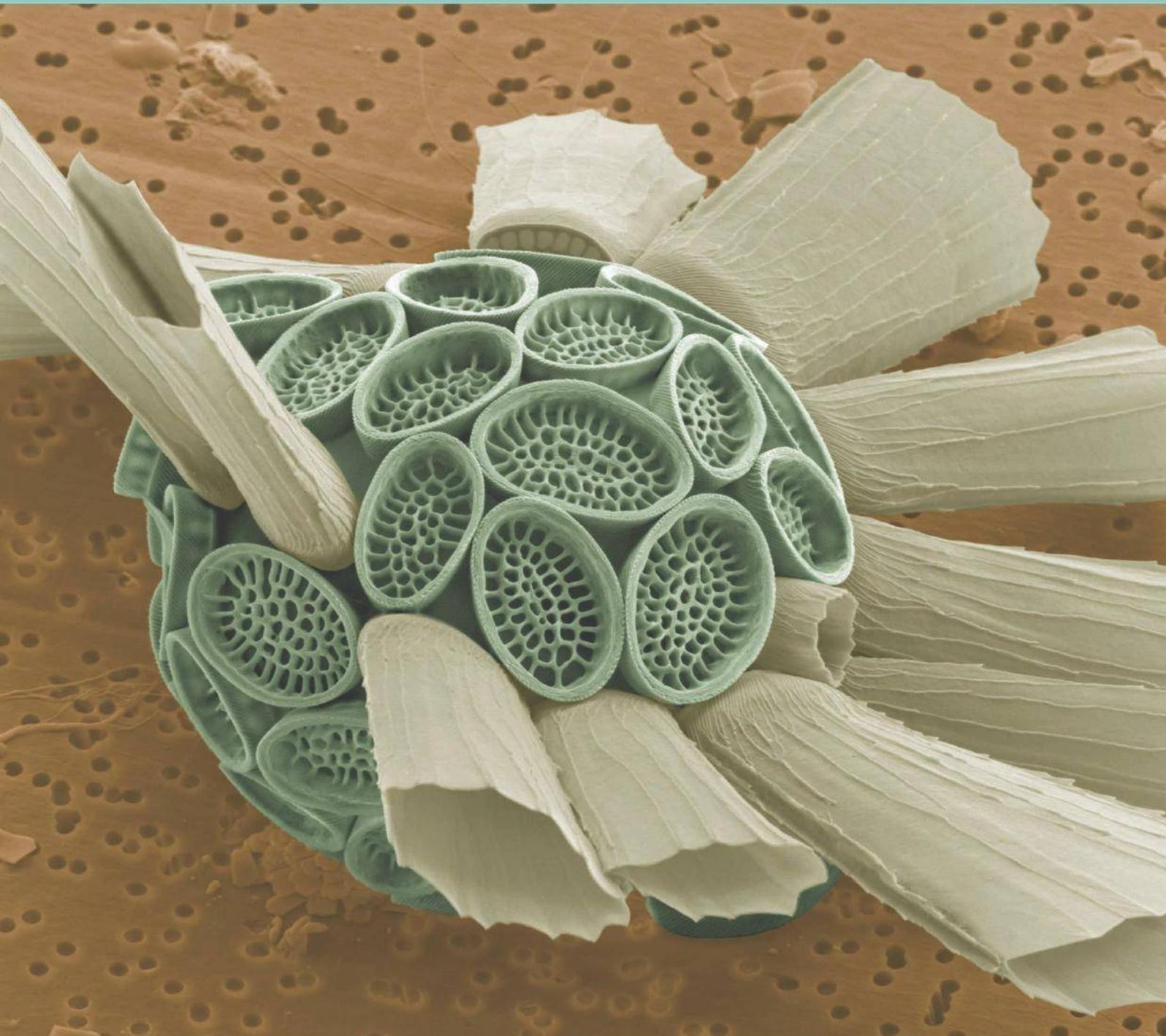


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*85th Birthday of Professor Krzysztof Birkenmajer Session (photo by Prof. Adam Walanus)*

**Book Review: Post-Cambrian Testate Foraminifera as a System in its Evolution, by V.I. Mikhalevich. Nova Publishers, New York, ISBN 978-1-62808-586-0**

**Mike Kaminski, King Fahd University of Petroleum & Minerals**

Valeria Mikhalevich is not only the leading world's expert on foraminiferal taxonomy, but she is also an accomplished poet, artist, and was recently named „Woman of the Year” in her native St. Petersburg. For the past 35 years, she has almost single-handedly revised the entire classification of the Foraminifera, providing the only comprehensive alternative to the classification of Loeblich & Tappan (1964, 1987, 1992). Although other foraminiferal workers have revised and updated certain smaller groups of Foraminifera, Mikhalevich has uniquely taken a top-down approach that considers the position of the Foraminifera alongside other protist groups. She was the author of the foraminiferal chapter of the Russian encyclopaedia of Protozoans, and therefore has the prospective of working with other Protozoologists on the classification of the whole protozoan kingdom.

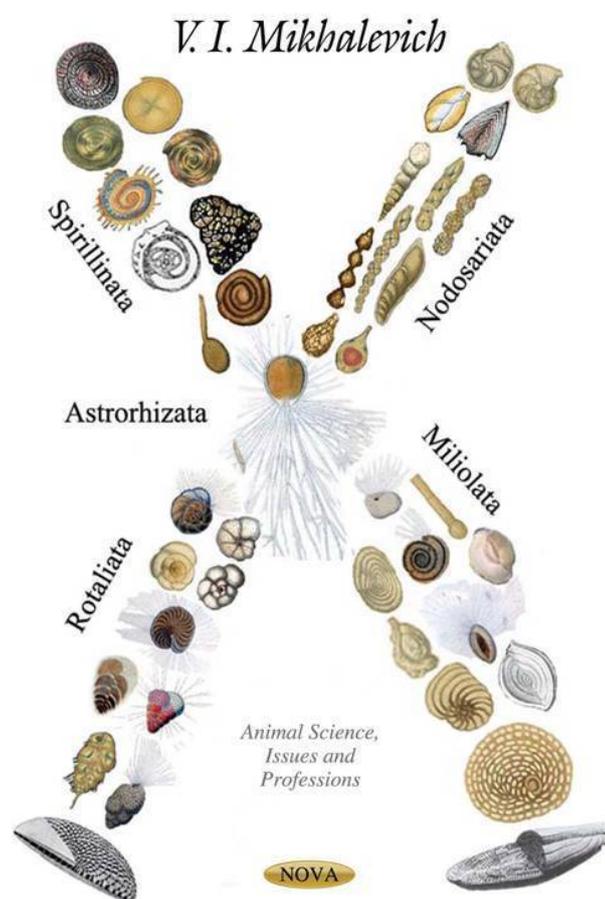
While Loeblich and Tappan (1987, 1992) regarded the wall structure of foraminifera as the defining criterion for classification of the group, Mikhalevich has pointed out the many examples of morphological isomorphism between many agglutinated, microgranular, and calcareous genera, suggesting that they are more closely related than we think. Using gross morphology of the test as a defining criterion, Mikhalevich came up with a conceptually simple subdivision of the Foraminifera into five classes, which combine isomorphic agglutinated and calcareous genera.

Most students prefer the Mikhalevich classification because of its simplicity. This is seen in the figure on the front cover of her book.

The book begins with a historical review of the previous attempts at classifying the Foraminifera beginning with d'Orbigny. Both western and Russian sources are quoted, so the review is quite comprehensive and an impressive list of references is cited. The review also mentions important breakthroughs in the study of Foraminifera, such as ultrastructural and cytoplasmic studies and molecular biology. She concludes that „foraminiferal research still represents a vast field of investigation: the taxonomy within the main phyletic lines, the inner shell structure of many taxa, shell wall ultrastructure of some large taxa, life cycles, cytoplasmic and nuclear structure”.

Chapter IV gives the outline classification of the Phylum Foraminifera d'Orbigny, 1826. By regarding the Foraminifera to be a phylum (which is more in line with the classifications adopted by Protozoologists), there is more room for higher taxonomic groups with as subclasses and superorders. The subdivision of the Foraminifera into five classes is an elegant solution, and it to a large extent is backed up by SSU RNA

# Post-Cambrian Testate Foraminifera as a System in its Evolution



studies carried out by the research group of Pawlowski. In fact, in the Mikhalevich classification, Pawlowski's "monothalamids" is regarded to be a junior synonym of her class *Astrorhizata* Saidova, 1981. The Class *Spirillinata* Mikhalevich, 1992 is regarded to be the senior synonym of "Tubothalamea" of Pawlowski et al. (2013), while the "Globothalamea" of Pawlowski et al., 2012 is synonymized partly under the Class *Miliolata* Saidova, 1981 and partly under the Class *Rotaliata* Mikhalevich, 1980. Of course with a Five-Class system there must be some foraminiferal groups from the Loeblich & Tappan classification that fall by the wayside. The *Miliolata* turns out to be the "Borg collective" of the Foraminifera, and has assimilated the agglutinated *Schlumbergerinana*, *Haplophragmiida*, *Lituolida*, *Cyclolinida*, and *Loftusiida*, as well as the microgranular Superorders *Endothyroida* and *Fusulinoida*, alongside the group of superorders that constitute the milioloids of Delage & Herouard,

1896. Mikhalevich regards the *Silicoloculinina* as enigmatic: "the secreted origin of silica in the foraminiferal shell has not yet been convincingly demonstrated and hence the taxonomic position of all such foraminifera is still problematic".

In this chapter two new orders are erected (*Cymbaloporida*, *Cassigerinellida*), bringing the total number of foraminiferal orders to 76 in her scheme. Notice that the "Agglutinated Foraminifera" no longer constitute a separate group of foraminifera, but have been split up and appear as subclasses of the *Spirillinata*, *Miliolata*, *Nodosariata* and *Rotaliata*. The systematics of the groups and the logic behind the classification are explained in detail in Chapter XI, which occupies over a third of the book. In this chapter, Mikhalevich reviews recent work and discusses some of the problems that remain open, such as the

position of the komoki within the Astrorhizata, and why other groups have been omitted, such as the xenophyophores, etc.

Chapter V on shell morphology and wall structure presents an excellent review of the subject and gives necessary information in support of the classification. Also, the author does not let us forget that we are dealing with living animals (not just fossils), and provides chapters on “Cytology & Physiology”, and “Observations of Recent miliolids in culture”. Finally, no book of this nature would be complete without a discussion of the main trends in foraminiferal evolution, which is alluded to in the book’s title. This topic is covered in Chapter VIII.

One of the main points the author makes in the conclusions is the fact that the morphology of agglutinated and calcareous forms within a class is the same – she writes “I came to the conclusion to regard the different groups of the agglutinated foraminifera as the earlier step in the development of their calcareous analogues, and hence the latter ones may be their direct descendants (Mikhalevich, 1980a,b)”. This is astonishing in the fact that these morphological studies predate the molecular studies by more than a decade. Her conclusion is that “different kinds of calcareous wall appeared in the evolutionary development of foraminifera independently, in parallel in different phyletic lineages and at the different times in geological history”. In view of the new work by Pawlowski’s group, we have to concede that

Loeblich & Tappan were wrong, and that Mikhalevich is basically right...

The final chapter is a discourse on the Universal Character of Evolutionary Regularities (Foraminifera as part of the Universe), in which some of the ideas of the Russian evolutionary school are explained for the benefit of the uninitiated (the late Stephen J. Gould would have taken delight in this chapter). The author points out the analogies between the increasing complexity of human society, institutions, and government, and the increasing complexity of foraminiferal morphology. In her view, the “basic evolutionary regularities elaborated first for living organisms represent general evolutionary principles applied to all levels of organization of the matter of the universe (Mikhalevich, 2008)”. This chapter is worth reading, and is unique in the Foraminiferal literature. The author concludes her book by stating “This book presents a new approach to foraminiferal systematics and evolution. The implications require profound revisions of many taxa, especially of agglutinated groups, of the class Spirillinata, and of several major groups within the subclass Rotaliana. The unifying trends and patterns revealed in this study provide a roadmap for such revision”. In my humble opinion, this is the foraminiferal book of the decade.

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