

Current Activities of Radiolarian Research

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Abstract. In commemoration of Haeckel's special issue, current activities of radiolarian research are introduced. Microscopic images of recent and fossil (Mesozoic) radiolarians are presented. Some are forms that Haeckel described more than 100 years ago.

1. Introduction

Radiolaria are one of the major groups of marine plankton with silica (SiO₂) skeletons. They appeared in the Cambrian time of about 550 million years ago and are still alive in the modern oceans. Radiolarians have interested many scientists in their great variety in skeletal morphology. Ernst Haeckel is one of the most outstanding pioneers in radiolarian research. He is famous for his monograph of 1887, called *Challenger Report*. In the report, he described 85 families, 739 genera, and 4318 species and presented an exhaustive taxonomic framework based on skeletal morphology. Although his classification is now regarded to be out of date, his monumental monograph is still a principal reference. This paper introduces current activities of radiolarian research and presents microscopic images of recent and fossil (Mesozoic) radiolarians. Some are forms that HAECKEL (1887) described in his monograph.

2. Activities in the World

The International Association of Radiolarian Paleontologists is an international non-profit organization for researchers interested in all aspects of radiolarian taxonomy, morphology, biostratigraphy, biology, ecology, and paleoecology. We call it briefly "INTERRAD". INTERRAD is a Research Group of the International Paleontological Association (IPA) and periodically publishes its newsletter named "RADIOLARIA". The newsletter contains news, working group reports, bibliography, and address directory of members. A total of 297 radiolarian researchers are listed in the latest issue (Vol. 16) of May in 1998. Most specialists are basically paleontologists and scientists working on living radiolarians are very rare.

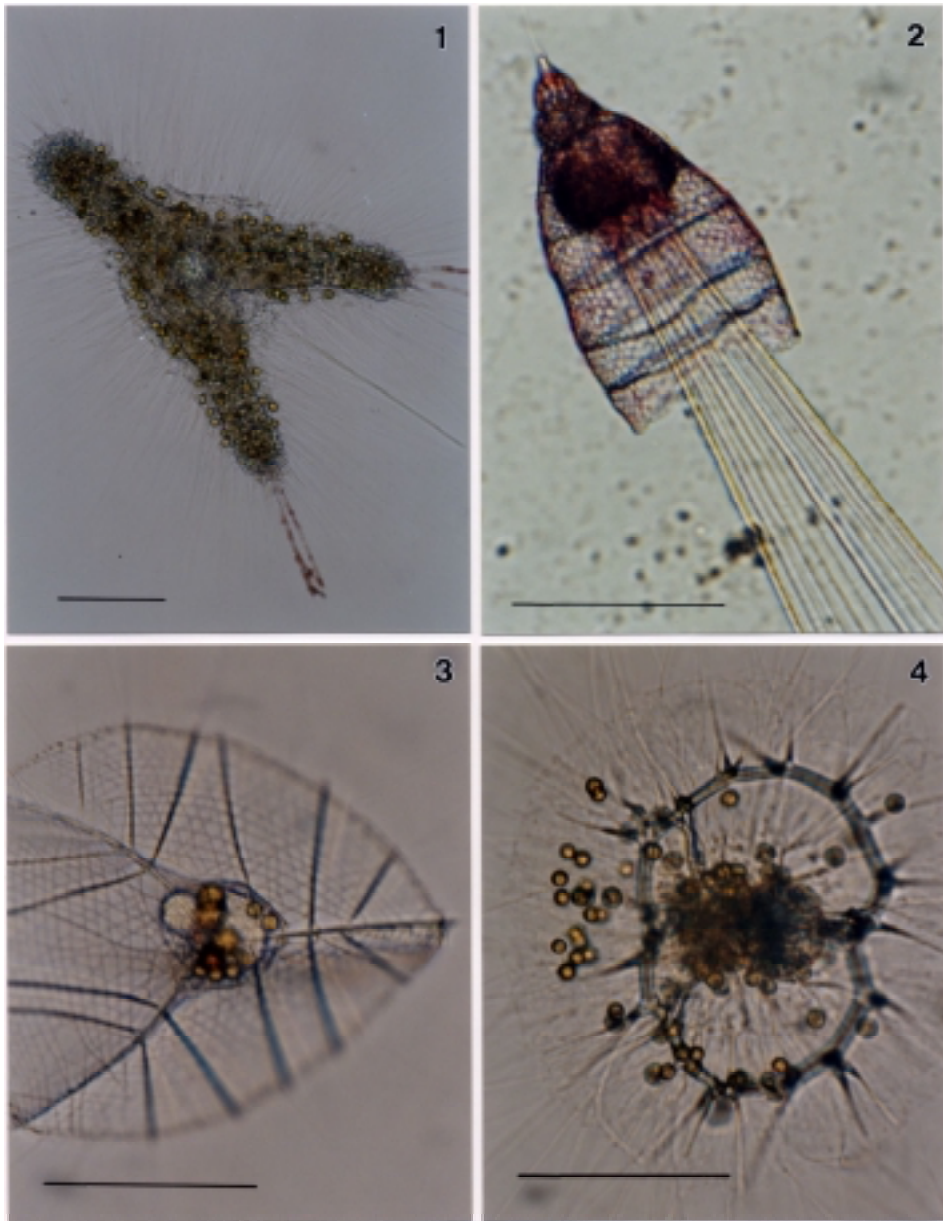


Plate 1. Light microscopic images of living radiolarians from the surface waters in the East China Sea off Okinawa Island, southwest Japan. Scale bar = 0.1 mm. Note that yellow spherules in Figs. 1, 3 and 4 are symbiotic algae. Brown particles along axopodia in Fig. 1 are symbiotic bacteria. 1. *Euchitonia elegans* (Ehrenberg), 2. *Eucyrtidium hexgonatum* Haeckel, 3. *Callimitra emmae* Haeckel, 4. *Acanthodesmia vinculata* Mueller.

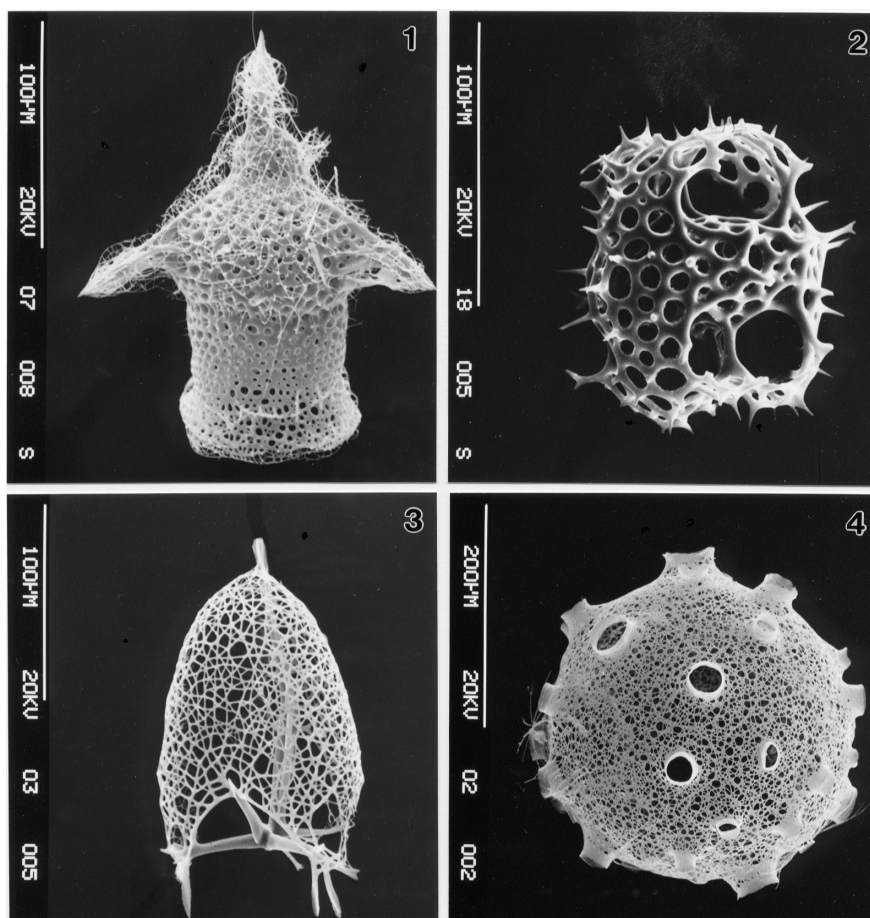


Plate 2. Scanning electron micrographs of skeletons of recent radiolarians from the surface waters in the Caribbean Sea, off Barbados, West Indies. 1. *Lipmanella insectum* (Haeckel), 2. *Tetrapyle octacantha* Mueller, 3. *Cephalospyris cancellata* Haeckel, 4. *Siphonosphaera magnisphaera* Takahashi.

Since 1978 members of INTERRAD meet every three years to present papers and exchange ideas and materials. The eighth meeting of INTERRAD was held in Paris (France) in 1997 and the ninth meeting will be organized in California(U.S.A.) in September, 2000.

3. Activities in Japan

Japan is one of the most active countries in terms of radiolarian research. More than 20 radiolarists are working at universities or museums. The majority belongs to the Geological Society of Japan and the Palaeontological Society of Japan. We present our

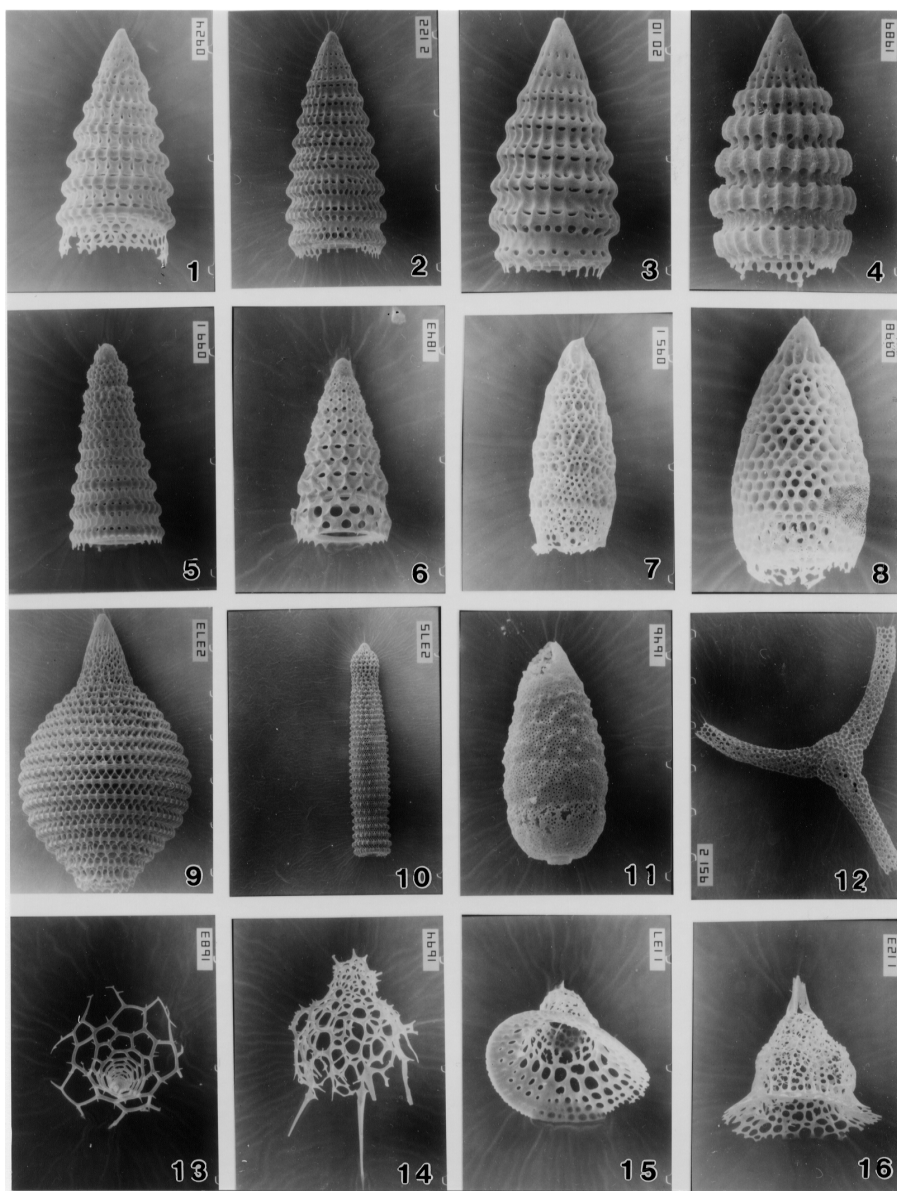


Plate 3. Scanning electron micrographs of skeletons of Early Cretaceous radiolarian fossils from the Mariana Trench, west Pacific. One interval of the scale put in the margin of each photograph indicates 0.1 mm, except for 10, which is 1.0 mm. Reproduced from Plate 9 in MATSUOKA (1998). 1. *Praecaneta*(?) sp. 6, 2. *Svinitzium pseudopuga* Dumitrica, 3. *Svinitzium* sp. aff. *S. depressum* (Baumgartner), 4. *Svinitzium depressum* (Baumgartner), 5. *Svinitzium*(?) sp. 2, 6. *Amphipyndax*(?) sp. 1, 7. *Xitus* sp. 3, 8. *Amphipyndax*(?) sp. 2, 9. *Mirifusus diana*e (Karrer), 10. *Ristola altissima* (Ruest), 11. *Solenotryma*(?) *ichikawai* Matsuoka & Yao, 12. *Parapodocapsa furcata* (Steiger), 13. *Nassellaria* gen. et sp. indet, 14. *Nassellaria* gen. et sp. indet, 15. *Sciadiocapsa*(?) sp. 1, 16. *Deflandrecyrtium*(?) sp. 1.

scientific results in the annual meetings or symposia under these societies. As many as 1,000 papers on radiolarians were published by Japanese paleontologists and stratigraphers up to now (according to KUWAHARA and YAO, 1998).

In addition, we sometimes organize radiolarian meetings in Japan. The latest meeting was held in Niigata in June, 1997. It was jointly organized as a symposium with the Society for Science on Form, Japan. The theme of the symposium was "Radiolarians and Science on Form". Most papers presented in the symposium were published in the Proceedings of the Sixth Radiolarian Symposium as a Special Volume of "News of Osaka Micropaleontologists (NOM)" (see Appendix). The Seventh Radiolarian Symposium is planned to be held in Hyogo in 2000.

4. Morphology of Radiolarians

Representative forms of living and fossil radiolarians are presented in Plates 1–3. Living radiolarians float in seawaters extending stringy axopodia (Plate 1). Many shallow-living forms bear symbiotic organisms such as algae (Plate 1, Figs. 1, 3 and 4) and bacteria (Plate 1, Fig. 1). Plate 1, Fig. 3 is a living individual of *Callimitra* which D'ARCY THOMPSON (1963) introduced in his book "On Growth and Form". Scanning electron microscopic images demonstrate fine and delicate skeletal structure composed of silica (SiO_2) (Plates 2–3). More than 100 different species can be obtained in a single surface tow of plankton net in tropical waters. In fossil records, we often encounter highly diversified faunas which include as many as several hundred species. An example of Mesozoic (Cretaceous) radiolarians is presented in Plate 3. A total of 256 species from the same rock sample are shown elsewhere (MATSUOKA, 1998). It is known that radiolarians maintain high diversity in morphology throughout their evolutionary history. Many still remain undescribed.

Appendix 1

Supplementary reading

The following text books provide additional information on biology, ecology, taxonomy, phylogeny, and other aspects of radiolarians.

- ANDERSON, O. R. (1983) *Radiolaria*, Springer-Verlag, NY, pp. 1–355.
- CASEY, R. D. (1993) Radiolaria, in *Fossil Prokaryotes and Protists* (ed. J. E. Lipps), Blackwell Scientific Publications, Cambridge, pp. 249–284.
- KLING, S. L. (1978) Radiolaria, in *Introduction to Marine Micropaleontology* (ed. B. U. Haq, and A. Boersma), Elsevier, pp. 203–244.
- SANFILIPPO, A. and RIEDEL, W. R., 1985, Cretaceous radiolaria, in *Plankton Stratigraphy* (ed. H. M. Bolli, J. B. Saunders, and K. Perch-Nielsen), Cambridge Univ. Press, Cambridge, pp. 573–630.
- SANFILIPPO, A., WESTBERG-SMITH, M. J., and RIEDEL, W. R., 1985, Cenozoic radiolaria, In *Plankton Stratigraphy* (ed. H. M. Bolli, J. B. Saunders, and K. Perch-Nielsen), Cambridge Univ. Press, Cambridge, pp. 631–712.

Appendix 2

Many papers on radiolarians are included in the Proceedings of the Radiolarian Symposium listed below. Further information is available at the web site of “News of Osaka Micropaleontologists” (<http://www.sci.osaka-cu.ac.jp/~geos/geo6/nommain.htm>).

Proceedings of the First Japanese Radiolarian Symposium (NOM Spec. Vol. No. 5), 1982
Radiolarians from the Nankai Trough in the Northwest Pacific (NOM Spec. Vol. No. 6), 1984

Recent Progress of Research on Radiolarians and Radiolarian Terranes (NOM Spec. Vol. No. 7), 1986

Proceedings of the Third Radiolarian Symposium (NOM Spec. Vol. No. 8), 1992

Proceedings of the Fourth Radiolarian Symposium (NOM Spec. Vol. No. 9), 1993

Proceedings of the Fifth Radiolarian Symposium (NOM Spec. Vol. No. 10), 1997

Proceedings of the Sixth Radiolarian Symposium (NOM Spec. Vol. No. 11), 1998

O. R. Anderson (Lamont-Doherty Earth Observatory, Columbia University) instructed the author in recent radiolarian work. P. Bennett and the staff of the Bellairs Research Institute, St. James, Barbados gave technical assistance in collecting samples. S. Nakamura and Y. Nakano (Tropical Biosphere Research Center, University of the Ryukyus) assisted in collecting living radiolarians. Y. Ogawa (University Tsukuba) and K. Fujioka (Japan Marine and Technology Center) provided rock samples from the Mariana Trench. The author thanks all these persons.

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- D'ARCY THOMPSON, W. (1963) *On Growth and Form*, 2nd. Ed. Cambridge Univ. Press, Cambridge.
- HAECKEL, E. (1887) Report on the Radiolaria collected by H. M. S. Challenger during the years 1873–1876. *Rep. Sci. Results, Challenger, Zool.*, **18**, clxxxviii + 1803 pp.
- KUWAHARA, K. and YAO, A. (1998) List of papers (after Yao, Mizutani and Kuwahara, 1997) on Radiolarian Fossil and Radiolarian Biostratigraphy by Japanese Paleontologists and Stratigraphers, *News of Osaka Micropaleontologists, Special Volume*, No. 11, 303–323.
- MATSUOKA, A. (1998) Faunal composition of earliest Cretaceous (Berriasian) radiolaria from the Mariana Trench in the western Pacific, *News of Osaka Micropaleontologists, Special Volume*, No. 11, 165–187.