

## **Preface for the special issue “Frontier Researches in Japanese Paleontology”**

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## Preface for the special issue “Frontier Researches in Japanese Paleontology”

*How did the Earth become and how will it remain a planet that is filled with living creatures? Where do we come from? What are we? Where are we going?*

These questions arise when serious crises such as the depletion of natural energy resources, environmental destruction by human activity and global warming impact the lives and environments of people on the Earth. Paleontologists are probably in the best position to answer these questions because we have a huge dataset of life history extending back almost 4.6 billion years, and many examples of interactions between organisms and environmental changes throughout Earth history.

The history of life on Earth could be described in terms of the complex gene structures revealed by modern genomic techniques. From this perspective, it consists of a sequence of genetic mutations. However, gene trees cannot be constructed for extinct organisms and paleontologists can only approach the evolution and extinction of organisms through the study of fossils. Furthermore, paleontological data clearly demonstrates that the history of life is related to major environmental changes that are caused by external forcing mechanisms such as meteorites and processes occurring in the Earth's interior, for example, increases in mantle activity. Conversely, organisms have frequently had a major effect on the Earth's environments by changing atmospheric composition and ocean circulation systems. For example, the evolution of cyanobacteria introduced oxygen molecules into the Earth's atmosphere, while the evolution of groups of skeletonized marine phytoplankton, such as dinoflagellates, nannoplankton and diatoms, provided a

major reservoir for the uptake of carbon dioxide during the Phanerozoic.

The purpose of this special issue is to review epoch-making events in the evolution of life on Earth, as revealed by biological sciences (embryology and genetics), paleontology and environmental science, and to explore new frontiers in our understanding of the Earth's life history. This issue contains eight papers that were presented at a special symposium to celebrate the 70<sup>th</sup> anniversary of the foundation of the Palaeontological Society of Japan. This meeting was held at the University of Tokyo on July 1, 2005 and coordinated by the Future Planning Committee of the Palaeontological Society of Japan for 2003 and 2004. During the symposium, many young scientists debated cutting-edge problems in modern biology and paleontology including the origin of life, the development of genetic complexity, life under extreme environmental conditions, and the detailed reconstruction of ancient climates.

We, the Palaeontological Society of Japan, believe that basic sciences are absolutely necessary in order to understand the modern problems that impact human beings and societies, such as global warming, the destruction of the Earth's environment and the biodiversity that inhabits it. Several of the contributions to this issue provide important suggestions concerning ways to combat these threats. These ideas may provide answers to the critical questions posed above.

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