



## THE BILBAO CONFERENCE "PALAEOLOGY AND EVOLUTION: EXTINCTION EVENTS": A BIG STEP FORWARD IN UNDERSTANDING EXCEPTIONAL GLOBAL CHANGES

An important precondition to master the problems of mankind's future is to understand evolution in respect to evolutionary mechanisms, including the manifold interactions between abiotic parameters and the biota, which means the complex interplay between biosphere, hydrosphere, atmosphere and geosphere.

The contribution of the palaeontological science to approach this aim is to investigate and to analyze those cases in earth history in which such abiotic influences on the biota have to be supposed. That is the case with one certain kind of the so-called global biological events, namely the extinction events.

Before discussing the extinction events it should be noticed that there are two additional, differing patterns of bio-events: biological innovation events and radiation events. The first one is either independent of abiotic influences or at least dominated by pure biological parameters and processes. Radiation events occur subsequent to innovation events ( $R_{pi}$  = post-innovation radiation), but also after extinction events ( $R_{pe}$  = post-extinction radiation). The  $R_{pe}$  mirrors the relatively short-termed occupation of those niches which occurred due to the extinction event. Between the latter and the  $R_{pe}$  normally exists a certain time interval in which the selectional stress is more or less strongly reduced. This causes a relatively rapid evolution and enables the concerned taxa to enlarge their potency to intrude into the adjacent niches. In this sequence—extinctions, interval, radiations—the causing global event leads not only to extinctions, i.e. to an interruption of the evolution within certain phyletic lines, but it triggers also an acceleration of the evolution, visible in the subsequent radiations.

Extinction events are characterized by a relatively high rate of extinction within a relatively short time. "Relatively" means in comparison with the long intervals of relatively stable conditions, in which the rate of background extinctions equals more or less the originating rate. Thus, extinction events are characterized by short-termed floral and/or faunal changes which are globally traceable. Already since the very beginning of our science those major changes have been recognized. They gave rise to the subdivision of the Phanerozoic into systems, series and stages. However, the discussion about the causation has always been controversial. Catastrophism (e.g. G. v. Cuvier; early 19th century) stood against gradualism (at least since Ch. Darwin, late 19th century), the latter explaining the faunal break as caused by a lack of information. The really essential question behind this discussion is whether evolution is influenced or even driven by abiotic, environmental forces.

The discussion about the causation of bio-events became a new impetus by the discovery of the Iridium-event at the Cretaceous/Tertiary boundary and the resulting hypotheses about impacts, Nemesis and periodicity\*. Shortly before, the International Palaeontological Association (IPA) decided to initiate an international research programme about "Global Biological Events in Earth History", which in 1984 became Project 216 of the International Geological Correlation Programme (IGCP). The main aim of this programme is to analyze global bio-events by new investigations which should be carried out as detailed as possible, using all modern possibilities concerning technics, methods and interdisciplinary, international cooperation.

\* In these introductory remarks I have to reclaim references (e.g. in this case the papers of L. W. and W. Alvarez, D. M. Raup, J. J. Sepkoski). The many contributions to our theme can easily be learned from the following papers in this volume, or from the contributions, in the special volume about "Global Bio-Events" (edited by O. H. Walliser): Lecture Notes in Earth Science, vol. 8; Springer-Verlag.

The Bilbao Conference from October 20-23, 1987, gave the possibility to discuss the state-of-the-art in the bio-event research, based on new results. The papers published in this volume reflect only some aspects of the whole spectrum presented in more than 60 presentations. A further part will be published simultaneously in a second volume about Global Bio-Events. Because it is not possible at this place to value all contributions in detail, only a few general, but important aspects shall be mentioned.

If we recall the discussions we had only a few years ago, there have been mainly two extremely opposite camps: the one took impacts of extratelluric bodies as the only cause for major bio-events and an assumed periodicity, whereas the other one denied at all any influence of impacts. The large progress which has been reached in the meantime and which clearly came up in most of the lectures, is the recognition and general acceptance that (a) the different bio-events in earth history differ from each other in respect of causes, patterns and extent and (b) the causes and processes which lead to an event are highly complex. Most of the participants now accept the possibility of impacts and their possible influence on the biota, and vice versa the advocates of the impact hypothesis conceded that in addition, impact-independent earth-born, i.e. geologic causes, might have been involved.

The complexity of bio-events and the concurrence of different parameters is also expressed in the discovery of a stepwise pattern of extinctions within a short-termed extinction event. The recognition of this phenomenon requires an extremely detailed investigation of the concerned sequences. If such a stepwise pattern is proved to be global, it provides us with an extremely high time-resolution. Insofar also the stratigraphy and the correlation methods have been enormously brought forward by the event-stratigraphy.

A further advantage of the Bilbao Conference was that not only bio-events in marine facies have been discussed, but also those in terrestrial environments, documented by the evolution of fresh-water ostracodes and of mammals.

It will be one of the future important tasks to examine which of the known bio-events are restricted to either the marine or the terrestrial facies or which of them are common to both magnafacies.

An important additional question has been discussed in several presentations, namely the problem of selectivity of extinction events. Already before it has been assumed that such global events might cause extinctions only within certain biotopes or even special niches. But up to now only very few is known about the potency of members of fossil communities in respect to environmental changes. Also fairly unknown is the ecological valence of fossils for example in respect to their position and effectivity within the food-chain. It is one of the merits of the Bilbao Conference to have directed our attention to those open problems, i.e. to important tasks for research in the near future.

The international community of bio-event researchers greatly appreciated the possibility to discuss the new results and the state-of-the-art at the Bilbao Conference. It is the merit of the Sociedad Española de Paleontología, of the Universidad del País Vasco and especially of Prof. Marcos A. Lamolda that the conference passed in such a successful way providing all participants with a new, more critical view of an important but very complex evolutionary process. Thus, the conference also stimulated further intensive investigations and discussions about global bio-events.

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