

“The Chengjiang Fauna and the Cambrian Explosion” Sponsord by NSFC won the first-class award of National Natural Sciences Award

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“The Chengjiang Fauna and the Cambrian explosion” sponsord by NSFC won the first-class award of National Natural Sciences Award. The Awarding ceremony was held in the Great Hall of the People in Beijing on February 20, 2004. “The Chengjiang Fauna and the Cambrian explosion” was sponsord by NSFC and carried out by several groups led by Prof. Chen Junyuan of the Nanjing Institute of Geology and Palaeontology, CAGS, Prof. Hou Xianguang of Yunnan University and Prof. Shu Degan of Northwest University. These three professors shared the award, due to their excellent contributions in different areas. The Cambrian explosion is one of the most puzzling questions concerning the origin of early lives. A well-preserved fauna, the Chengjiang Fauna, was found in Chengjiang county of Yuannan in 1984. It is this discovery and the subsequent research that confirm the occurrence of the Cambrian Explosion. The Chengjiang Fauna is “one of the most great discoveries in the 20th Century”. The NSFC attached much importance to the research of the Chengjiang Fauna, and supported it continuously since it surfaced. Seven general programs and two key programs have been granted by NSFC.

1 Revealing for the First time the Outline of a Complete Picture of the Early Cambrian Explosion, and Providing Further Evidence to Support Evolutionism

The research group has not only achieved advancement in investigation on the Protostome super-lineage, such as trilobites, crustaceans, bradorrids and lophophores, but also discovered all the major groups in Deuterostome super-lineage, such as echinoderms, basal hemichordates, cephalochordate, urochordate, true vertebrates, and particularly the most primitive extinct phy-

lum Vetulicolia. The Cambrian had long been known as “the Age of trilobites” and the knowledge about the Early Cambrian faunas was basically limited to the protostomes, but now what we can see is that the Early Cambrian Explosion has actually produced nearly all the principal branches of both the protostome “half-tree” and the deuterostome “half-tree”. A series of research results have appeared in the leading journals such as Nature and Science.

2 The Origin of Extant Phyla (or subphyla) of Animals Including Vertebrates, Euarthropods, Chelicerates and Crustaceans

The fossil findings from Chengjiang fauna have contributed new understanding of the origins of extant animal groups especially vertebrates, euarthropods, chelicerates:

(1) Haikouichthus from Chengjiang fauna bears paired big eyes, olfactory sac and possibly ear, which strongly indicate that the animal has stepped in the evolutionary track of vertebrates. The presence of paired gonads suggests that Haikouichthus is at a primitive status within vertebrate evolutionary tree.

(2) Haikouella represents a bridging fossil between invertebrates and vertebrates and detailed preservation of its anatomical features including brains, paired eyes, nostrils, upper and lower lips, mouth cavity with tentacles, branchial bars and protovertebrae throw much light on the origins of vertebrates including the origin of brains, head sensory organs, branchial bars, feeding style and vertebrae.

(3) Chengjiang fauna preserves with diverse pan-arthropod fossils, which represent different evolutionary history of the pan-arthropods including pre-evolutionary history of euarthropods, stem-lineage groups

both of euarthropods and chelicerates. These fossils have contributed new knowledge of the origins of euarthropods and chelicerates, with a proposal that the Cambrian great appendage arthropods are stem lineage groups of extant chelicerates and the chelicerates are derived among the great appendage arthropods. The anatomical features of the pan-arthropod fossils from Chengjiang fauna strongly indicate that the origin of euarthropods consists of three separated events, e.g. arthropodization, arthropodization and cephalopodization.

3 Tracing the Extant Phyla and Subphyla and Modern Complex Ecosystem Back to the Early Cambrian

The fossil findings of arrow worms, tunicates, vertebrates, crustaceans, stem lineage groups of chelicerates and so on provide strong evidence that Cambrian explosion is a major birth day of the extant animal high taxa. The fossil findings of diverse giant predators and the study of the content of the exoskeletons within large excrements and guts have proposed that the modern complex ecosystem has been well established during the main blast of the Cambrian explosion event.

4 Exploring the Origins and Early Evolution of Several Important Groups Based on the Significant Discoveries of the Early Cambrian Deuterostomes, Especially the Earliest-Known Vertebrates and the Most Primitive Deuterostome Group Vetulicolia, are Discussed

Tracing the evolutionary relationship between vertebrates and invertebrates has long been one of the central topics in evolutionary biology. A number of significant discoveries in deuterostomes have led to the proposal of a “five-step” hypothesis on the early evolution of deuterostomes and the origin of vertebrates. The five steps are:

(1) Vetulicolians, the earliest-known animals with primitive body segmentation and simple pharyngeal slits, represent the first key step in deuterostome evolution. They began a revolution in metabolism, particular-

ly as this relates to feeding and respiration, which has recently been supported by new data from developmental biology.

(2) This was followed by diverse forms including yunnanzoonans (with loss of segmentation in its anterior), hemichordates (with complete loss of segmentation) in one branch, and the extinct vetulocystids (with loss of segmentation and reduction of gill slits in its anterior) and echinoderms (with complete loss of both body segmentation and gill slits) in the other.

(3) The appearance of the urochordate *Cheunggongella* might mark the transition to the first true chordates.

(4) With further evolution, cephalochordate-like animals like *Cathaymyrus* appeared.

(5) Finally, with the appearance of the neural crest, together with cephalization and the formation of vertebrae, “the first fish” has eventually been born on earth. All the fossil material on the five-step evolution has first been published in *Nature* and *Science*.

90 papers have been published, amongst which 13 were in *Nature* and *Science*. 6 monographs and 9 special review papers also have been published. The significance of the Chengjiang fauna research has been highly appreciated internationally by numerous celebrated media and journals. *New York Times* published news commentary listing the fossil findings of Chengjiang fauna as the extraordinary discovery of the 20th century in 1991. In 1995 the newspaper again published a commentary article “From Yunnanzoon to You” about the reinterpretation of Yunnanzoon as a chordate. *Science News* has published two cover articles highlighting the finding of early giant predator in 1994 and the reinterpretation of Yunnanzoon as chordate in 1995. In addition, the Journals including *National Geographic* and *Discovery* have published very positive articles describing Chengjiang fauna as oriental mystery. The achievement won “Top Ten Advancements in Science and Technology in China in 1999”. “Top ten Advancements in Science and Technology in China in 2001”, “Top ten Advancements of Science and Technology in Universities of China in 1999”, “Top ten news on basic science in China in 1999”.