

# Hans-Peter Schultze's contribution to our understanding of lower vertebrate evolution

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## Introduction

Lower vertebrate diversity and evolution has fascinated scientists for centuries if not millennia. From the Antiquity to the Renaissance, fossil fishes were reported sporadically in Europe and Asia, although not recognized specifically as remains of past life. One had to await the work of Leonardo DA VINCI (1452-1519) and Niels STENSEN (known also as Nicholas STENO – 1638-1686) to link science and fossil fishes. During the 19<sup>th</sup> and early 20<sup>th</sup> centuries, a few researchers made significant contributions to our understanding of lower vertebrate diversity. Among the leading scientists, J. Louis R. AGASSIZ (1807-1873) described some 1700 fossil fish species in his classical monograph “*Recherches sur les Poissons Fossiles*” (1833-1843) and realized that paleontology, embryology, ecology and biogeography had to be taken into consideration when classifying organisms. During the late 19<sup>th</sup> century, the American surgeon and geologist John S. NEWBERRY (1822-1892) and the paleontologist Edward D. COPE (1840-1897) shaped our field in North America by describing an impressive diversity of Paleozoic lower vertebrates. Arthur Smith WOODWARD (1864-1944), English paleontologist and keeper of fossil fishes at the British Museum (Natural History) in London, provided a detailed classification of living and fossil fishes.

As a consequence of this descriptive period, vertebrate paleontologists and anatomists tried to understand the patterns and processes beyond this diversity. The German vertebrate comparative anatomist Karl GEGENBAUR (1825-1903) was influential in emphasizing the value of comparative anatomy in the study of evolution and of homologies. At the beginning of the 20<sup>th</sup> century, the Russian biologist Ivan I. SCHMALHAUSEN (1884-1963) integrated evolutionary principles, such as natural selection, into our understanding of the origin of tetrapods. Further developments are attributed to the American Alfred S. ROMER (1894-1973), who not only described fossils of lower vertebrates, but elaborated new concepts of the evolutionary biology of these organisms. Two paleohistologists, the Swede, Tor ØRVIG (1916-1994), and the German, Walter R. GROSS (1903-1974), emphasized the importance of histological features in the study of fossil fishes. Over a period of 50 years, the Swedish paleoichthyologist Erik JARVIK (1907-1998) carried out detailed morphological investigations of living and extinct fishes to establish the basic patterns of vertebrate evolution.

Following in the tradition of these pioneers, a modern vertebrate paleontologist who has greatly influenced our field with his views on homology and systematics is Hans-Peter SCHULTZE (Fig. 1). Trained as a geologist [Diploma (M.Sc.) in geology at the University of Tübingen in 1962] and as a paleoichthyologist [Ph.D. under the supervision of Walter R. GROSS (Fig. 2) at the University of Tübingen in 1966], Hans-Peter SCHULTZE has helped to integrate the various perspectives of vertebrate paleontology, namely comparative anatomy, embryology, systematics, paleohistology, paleoecology, paleogeography, and geology.

Shortly after his Ph.D., Hans-Peter SCHULTZE spent a most crucial period of his career at the Risksmuseet (also known as the Swedish Museum of Natural History) in Stockholm, Sweden. From 1965 to 1967, he worked closely with Erik JARVIK (at the time the director), Erik STENSIÖ, and Tor ØRVIG, a group of paleoichthyologists that over time became known as the Swedish School. Stockholm then was one of the leading centers of paleoichthyology and numerous researchers were trained in the department of

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