

Horse evolution

Review of : *Die Urfeder den Morgenröte. Ursprung und Evolution der Pferde*, by Jens Lorenz Franzen, 2007. Heidelberg: Elsevier / Spektrum Akademischer Verlag. 221 pp. Euro 48.00. ISBN-10: 3-8274-1680-9.

To those who invest time and mind in the observation of horses it is evident that horses are fit for survival. The decline of Quaternary *Equus caballus* during the late Pleistocene-Holocene mass extinction was averted by horses' capability of collaboration with their enemy, man. Domestication and selection through breeding did not eliminate their inquisitive alertness and sensitivity, they are predisposed to learning and form emotional ties with humans they trust. To ancient Eurasian peoples, the taming of horses meant power and development. Man on horseback travelled wider and faster, was stronger and more awe-inspiring than ever before. Through history, horses worked with humans at all levels of society, and national economies depended on them. Accompanying man, horses set hoof on new continents, North America, South America and Australia, where they took land and multiplied.

The cave paintings from the periglacial zone of late Quaternary Eurasia are some of our sources of knowledge of the immediate ancestors of the extant horses, whether "wild" or domestic. They all pertain to species *Equus caballus*. Jens Franzen compares the famous painting of a horse from the Niaux cave in southern France, believed to be 13.000-14.000 years old, with a photograph of a Przewalski horse. He notes the relatively shorter skull and legs of the Pleistocene horse. This may well be an adaptation to cold climate and rough terrain, like in modern Shetland ponies. They are hardy little horses, compact in overall form, furry and at ease on cool North Atlantic rocky islands. Some horses, in contrast to the Shetland ponies, are tall, slim and nervous, while stout giants bred for hauling heavy loads rest peacefully in themselves. Morphologic variability also characterised the horse clade during evolution, though some conservative lineages died out.

The evolution of the horse as a theme became popular through the work of the great North American palaeontologists of the previous centuries. Franzen relates enthusiastically of these fossil hunters and scientists who extracted the hard evidence of horse evolution from the ancient waterlain sediments of the Wild West and made it accessible to humanity. They taught us that the main evolution towards modern *Equus*, i.e., modern horses, asses and zebras, took place in North America. The American *Equus* spread via Beringia to the Old World, but died out in the New World. Franzen's book is principally, however, a comprehensive account of early European horse evolution, with the fossils from the famous Messel site, known to

him from yearlong personal studies, being particularly illuminated. This makes it unique.

A grand predecessor on European horse evolution was the Russian palaeontologist Wladimir Kovalevsky (spelling according to W.K., 1873), who in 1873 described *Anchitherium*, the “old-fashioned” forest equid of Miocene Europe. He compared *Anchitherium* with *Palaeotherium*, known from the Paris Gypsum, and *Hipparion*, common in Miocene-Pliocene Europe, and interpreted *Palaeotherium* – *Anchitherium* – *Hipparion* – *Equus* as a natural series, to a significant degree in conformity with modern evolutionary theory. Increasing numbers of American fossils with features more convincing of true horse ancestry subsequently invalidated the European “horse-line”. Kovalevsky published on horses in French and German, which makes Franzen suggest a language barrier as a reason why the American palaeontologist W.D. Matthew was unacquainted with Kovalevsky’s works despite their relevance to his studies. It may be added that a later American palaeontologist, B.J. MacFadden, made reference to Kovalevsky’s remarkable thoughts and history in his book “Fossil Horses”, using an illustration from a paper by Franzen.

In an early chapter, Franzen focuses on time and how we measure it. To the untrained, geological time is like a vast landscape devoid of objects of known sizes by which to judge distance. By presenting, in clear language, the modern methods of geological age determination, Franzen prepares the minds for the conceptions of age inherent to palaeontology. And in order to evoke a sensation of the immense span of years since the time of the dawn horses, Franzen elegantly combines common knowledge and plate tectonics, as follows : The Alpine Mountains are high and rugged. Due to Africa drifting northwards they are still under formation, however growing only fractions of a millimetre per year. But when the dawn horses lived, the Alps did not yet exist.

Hyracotherium lived around 55 million years ago. It was first described from the Early Eocene London Clay. *Hyracotherium* was a hare-sized forest animal reminiscent of the muntjac in body form, but with four toes on each forelimb and three on the hind limbs. A similar animal was later described from Early Eocene deposits in North America as *Eohippus*. They are regarded as early horse ancestors. Not much different in form, but considerably younger, are the Middle Eocene German “Urpferde” studied by Franzen. They are some of or *the* most completely known long-extinct mammals. Around 60 very well preserved fossils are known to Franzen from the Messel site, and others included in his book are from Geiseltal and Eckfeld. The three sites have also yielded large numbers of other extinct organisms. Less complete specimens are found at other sites in Europe. Supported by photographs and drawings of high quality Franzen relates, where and under which

conditions the fossils were recovered, how they are interpreted, and what may have been the ecological role of “die Urpferde” in life. Besides full body size and skeletal proportions, bone form and dentition, the fossils may show remains of stomach contents, foetuses, hairs on the body and tail, skin in outline and other soft tissue parts. In one fossil, a recognizable ear sits erect above the back of the head, showing outline and bearing of a 47.000.000 years old horse ear. Several species can be distinguished. Knowing these fossils in great detail, Franzen can point out skeletal features which are more primitive than corresponding features in the older American dawn horses. These palaeontologically important observations contribute to the long-standing debate on where Equidae, the horse family, originated by supporting a pre-Eocene Old World origin, as elaborated by Franzen. Europe’s early equids all died out, and later equids in Europe immigrated from North America.

Fossil plants and other evidence from Messel indicate environmental conditions vividly described by Franzen as “ein schwül-heisses Klima eines üppig wuchernden Regenwaldes tropisch-subtropischen Charakters”. Warm rainforests usually have no marked seasonal changes, although in the case of Messel the intensity of sunlight varied seasonally through the year as a consequence of its geographical position. Franzen’s question : Do all fossil equids from Messel represent the same annual season?, relates to the high number among the fossils of pregnant mares of *Eurohippus parvulus*. Among these pregnant mares are many very young individuals (seen from their preserved deciduous teeth). According to Franzen, this shows clearly, how important it was for each mother animal to bring a maximum number of progeny into the world in order to transfer a maximum number of her own genes to the next generation. I doubt the postulate. Young mammals depend for their survival on learning from their elders. Fillies become fertilised without knowing the consequences, and burdened by pregnancy they are far more vulnerable than experienced mares. Practical considerations, if any, would rather have postponed fertilisation until the fertilized animal could better protect herself and her progeny.

Compilative works of the thematic size of Franzen’s book will always have stronger parts and weaker parts. Geology, necessary to palaeontology, is included with the author’s open, however not quite well-tuned mind. Franzen describes the European continent in the Eocene as positioned about ten degrees of latitude or 1200 km south of its present position. The idea prevailed among some geologists to explain the presence of subtropical/tropical organisms in Eocene Europe. If so were, then the reader will wonder, why Franzen regards Spitzbergen, with an Eocene flora closely related to the actual mid-European flora, as positioned in the Eocene at its present latitude, although it is part of the European continental plate. When, in a later chapter, Franzen outlines the particular warm climatic conditions at the Paleocene/Eocene boundary in accordance with modern interpretations, he seems to be unaware that

these interpretations do not imply the said southern location of Europe in the Eocene, a matter of interest to speculations of the spreading of *Hyracotherium*. Concerning Franzen's understanding of the North Atlantic land bridges in the earliest Eocene, and of the contemporaneous volcanism deduced from ash layers now exposed in Jutland, Denmark, modern earth scientists working in these fields explain both land connection and ashes as consequences of the tectonic rifting and opening between Europe and Greenland-North America. The continental break-up around 55 million years ago was introduced by a rise of the lithosphere in the rift zone, which created land between Europe and Greenland-North America; the associated volcanism contributed the ashes which spread over the North Sea region. The gigantic outbursts from the North Atlantic volcanic field constitute another potential source of the atmospheric warming at the Paleocene/Eocene boundary through the extrusion of "greenhouse gasses".

Franzen's book is copious in themes. The anatomy, physiology and mechanics of horses, to some extent compared with those of other ungulates, are outlined and traced back into the Messel-fossils. The preserved features of the German Eocene horse fossils are illustrated in breathtaking details, and the evolution of the horses and of their relatives among the perissodactyls is reviewed. A chapter informs of German museum exhibitions where much of the material evidence can be seen. During the sections on science history, several palaeontologists are mentioned for their valuable contributions, and a bibliography comprising important scientific literature suggests further reading. French literature is underrepresented. Omissions of non-German titles and texts may serve the reasonable purpose of presenting German work to German readers. The French studies of relevance to the geographical origin of Equidae, by such authors as E. Gheerbrant and J.-C. Rage, are, however, sufficiently important to Franzen's hypothesis as to merit mentioning. The German language of Franzen's book is a true delight to the reader, varied and drawing from the rich vocabulary of skilful workers, whether these be layman or scientist. Classical spirit is encountered in such edifying thoughts as "Die Wissenschaft ist eben unteilbar. Man kann sie nicht sortieren in gute, weil für den Menschen nützliche Wissenschaft, und so genannte Orchideenfächer, welche manch einem überflüssig erscheinen".

The book appeals to the cultured audience whom the author addressed as a much appreciated speaker during his professional life at the Senckenberg Museum in Frankfurt. It is also a fine exposure of evolution history to students of the natural sciences, who are increasingly being guided into narrow lanes of professional knowledge. The book is obviously recommendable to vertebrate palaeontologists. As the experienced orator, Jens Franzen opens by the known and beloved, the farm horses of great personal integrity that survive in the childhood memories of many Europeans. Be it added by the reviewer that they became lost to economic

development, and children no longer grow up respectful of working animals. Horses now, when discarded from entertainment, may become loaded on trucks, tightly packed, and transported through Europe to serve, mutilated and quivering, as live meat to foreign slaughterhouses. By mindfully bridging science and the humanities Franzen's book on horse evolution will reach thinking people whose comprehension and informed attitudes may influence civil behaviour.

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