REPORT

Origins and Innovations: the first 200 million years of vertebrate evolution

Vaughan College, Leicester, Saturday March 9th 1996.

Under the auspices of our good friends the Leicester Literary and Philosophical Society geology section, this one day meeting was organised by Dick Aldridge and Mark Purnell, both of Leicester University Geology Department. Its purpose was to present, through the medium of invited speakers, a synopsis of some of the more important recent advances in the study of the early vertebrates and vertebrate evolution. These timeless questions, always of great interest to we upright representatives of the phylum Chordata, have once again hit the headlines in recent times as the origins of our ancestors have been pushed ever farther back in time.

Paul Smith of Birmingham University opened proceedings with an overview of vertebrate origins and revealed a veritable Pandora's box of candidates for the earliest chordate, and then even more remarkably gave persuasive evidence of a fish that secreted vertebrate-like hard tissues in the Late Cambrian. Peter Holland of Reading University then showed how useful other disciplines can be in helping geologists unravel vertebrate origins by detailing his work on the genetic structure of vertebrate tissue. It was a tribute to Peter that, despite the complexity of genetics and its unwarranted reputation as a "difficult" subject, he lost no-one in the audience as he compared the genetic codes of primitive chordates with those of their more complex vertebrate relatives to reveal previously unsuspected similarities (and differences). Dick Aldridge has done more than most to put conodonts in their rightful places in the Chordata and his studies on the anatomy of whole-body conodont fossils from Edinburgh and South Africa are recognised as important landmarks in the recent palaeontological literature. He gave a lucid summary of his work to date and, after listening to the wealth of evidence now accumulated, surely few people in the audience (or elsewhere) were left doubting that the true affinities of conodonts lie with the vertebrates. Traditionally, bony tissue adapted for use in vertebrate structures was believed to have evolved via the protective bony armour of early fishes, but the latest work of the next speaker, Mark Purnell, indicated that its genesis was more a response to the predatory needs of those ancient and still somewhat enigmatic vertebrates, the conodonts. Mark's study of wear facets on conodont denticles demonstrates that direct analogies can be drawn with patterns of abrasion on the teeth of undoubted recent and fossil predators. The meeting then paused for the participants to digest the morning's proceedings, and their lunch.

The afternoon's talks began with Ivan Sansom of Birmingham University demonstrating how histology has thrown theories on the early vertebrates back into the melting pot. By careful thin sectioning of conodonts Ivan has discovered that in the Late Cambrian these animals were building tissue indistinguishable from some types of modern dentine and bone, those trademarks of the vertebrates. Also, sectioning of scales from a number of fishes from Ordovician horizons in North America, Bolivia, Australia and Argentina has revealed that a previously unsuspected diversity of armoured fishes (and ?sharks) were secreting vertebrate-like structures in their body armour long before their traditionally proposed radiation in the Silurian and Devonian. Peter Forey of the Natural History Museum admitted at the outset of his talk that he couldn't explain definitively how jaws had evolved, but then proceeded to present a fascinating insight into what may have been the mechanisms behind this most important advance taken by the vertebrates. What struck most forcibly during Peter's talk was the amazing variety of structures evolved by the fish-like vertebrates, past and present, to process their food, an evolution neatly demonstrated as following a line of increasing sophistication from the earliest vertebrates to modern teleost fishes with their remarkably complex jaws. After Moya Smith's (from Guy's Hospital) talk, no-one could have left the room without a considerably enhanced knowledge of lungfishes, past and present. In fact, Moya's talk was a classic example of the present being the key to the past, that most fundamental of geological observations. By comparing fossil and extant lungfish dentition, important insights into aspects of development and growth of the vertebrates were possible. On the way we also saw slides of the Gogo Formation fishes from the Devonian of Australia, surely some of the most beautiful fossils yet described. Per Ahlberg of the Natural History Museum tackled a most important, yet still baffling, aspect of vertebrate evolution when he attempted to explain the development of four-legged vertebrates (tetrapods) from fishes, a process which began in the Devonian. He showed that while some changes took place in an ordered step-by-step fashion according to text-book evolutionary theory, others happened suddenly. The latter may have been triggered by genetic signals, a mechanism harking back to the subject of Peter Holland's talk. The audience had hung on bravely through this last talk as thoughts of tea pervaded the hall, but they perked up considerably when Dave Martill, in typical lively fashion, stepped up to deliver a commendably concise and observant summary of the day's proceedings. It only remained for due thanks to be given to the organisers and their support team for a most successful day, which was well-supported by a nicely mixed audience approaching 60 in number.

Andrew Swift