

# Preface

In Volume 2 of *The Vertebrate Integument* the emphasis is on the structure and functional design of the integument (including its derivatives) and contribution to locomotion in phylogenetically diverse vertebrates. The need for such a book was precipitated by seminal research by many workers, some who have become close colleagues but all whose work is inspirational. The subject of the book may appear complex but again as in Volume 1, it is profusely illustrated with figures and photographs. The primary discussions involve motion in fluid—swimming and aerial flight. The book starts with a discussion on some of the physics involved in motion in fluid, including Newton's Three Laws of Motion.

Our knowledge of how the integument contributes to vertebrate flight dynamics has expanded exponentially from about the last half of the twentieth century and in swimming major developments were seen from about the last quarter of the last century. The integument of fast swimming marine vertebrates revealed a design mechanism of crossed-fibers that are in many cases directly connected with high speed. Among vertebrates besides snakes, the role of the integument in terrestrial locomotion may not have the same mechanical implications in comparison with marine vertebrates. However, many of the principles associated with the crossed-fiber architecture in marine animals can be applied to the design structure of organ systems in terrestrial vertebrates, e.g., in medicine the same mechanical principles are involved to achieve stiffness and flexibility in blood vessels, the linea alba, and the gut. In dinosaurs the crossed-fiber architecture is found in many parts of the animal, for instance in a *Psittacosaurus* dinosaur the skin reinforces the ribs by forming a Fink truss and in another part of the dinosaur over 20 layers of oppositely oriented fibers reinforce the gut.

The role of the skin in flight in a number of modern-day and extinct gliders is considered and discussed in the context of the latest research. Among these gliders is the tree snake, *Chrysopelea*, which rather than being flattened as previously thought, the latest research shows that it flattens the body during the glide by special modified ribs. Pterosaurs were the first vertebrates to use the integument as a membrane in true flapping flight. We look at these interesting extinct animals through past and present research with respect to their giant size

and flight potential, quadrupedal or bipedal launch, and perhaps most intriguingly the structure of the flight membrane. Classic research on bat flight is described and the book brings us up-to-date with the latest research that shows the complexities of the wing beat cycle, significantly different from birds, as revealed by particle image velocimetry.

The largest chapter in the book is occupied by birds and includes the most complex derivative of the integument to be found in any vertebrate animal, the feather. The chapter starts with *Archaeopteryx* and some of the controversies associated with it right up to the present and continues with over the past 50 years or more seminal research into bird flight and ends with the material that made it all possible,  $\beta$ -keratin and the most recent developments on the microstructure of the feather and the associated biomechanics. Biomimetics may be mentioned only briefly but there is no question that studies on structure and design at macro- to nano-structural levels in birds and many of the other vertebrates mentioned in the book will have a profound effect on the subject

In recent years it has been alleged that fine filamentous structures associated with the preserved soft tissue of a number of dinosaurs in the Jehol biota and elsewhere represent primal feathers, i.e., protofeathers. Chapter 6 takes a hard look at these allegations through mainly published critiques.

The last chapter of the book is concerned with the highly polarized question of the origin of birds and of the feather and the extent to which the freedom of the press has been compromised in recent years, the latter shown to be of grave concern by a number of prominent editors. This new absolutist censorship is encapsulated in public outbursts by scientists and editor such as, “[b]irds are dinosaurs. The debate is over.” It is the climate created by such intolerance that has led to some of the poorest and/or highly biased articles being accepted in ‘primetime’ journals of which numerous examples, all on record, are presented in the chapter. Scientific values have given way to sensationalism and dogma and the harm that is being done to evolutionary biology and the future of secular societies by some of the leading journals in the world will impact for years to come.

It is hoped that the book will be useful to students at both undergraduate and postgraduate levels. Perhaps, it may also help young scientists to reevaluate the aims of science, which was beautifully expressed by an author writing an article for a children’s magazine who wanted my view on the origin of birds, saying, “I want this article to present both views and be as fair as possible. That’s why I need your help.”

The Vertebrate Integument Volume 2

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