

# **THE EVOLUTION OF MAMMALIAN CHARACTERS**

# **The Evolution of Mammalian Characters**

D. M. Kermack and K. A. Kermack  
*Illustrated by A. J. Lee*



CROOM HELM  
London & Sydney

KAPITAN SZABO PUBLISHERS  
Washington DC

© 1984 Doris M. Kermack and Kenneth A. Kermack  
Softcover reprint of the hardcover 1st edition 1984

Croom Helm Ltd, Provident House, Burrell Row,  
Beckenham, Kent BR3 1AT  
Croom Helm Australia Pty Ltd, First Floor,  
139 King Street, Sydney, NSW 2001, Australia

British Library Cataloguing in Publication Data

Kermack, D. M.

The evolution of mammalian characters.

I. Mammals — Evolution

I. Title II. Kermack, K. A.

599.03 QL708.5

ISBN 978-1-4684-7819-8 ISBN 978-1-4684-7817-4 (eBook)

DOI 10.1007/978-1-4684-7817-4

Published by KAPITAN SZABO PUBLISHERS  
in the United States and Canada  
1740 Lanier Place N W  
Washington D C 20009

Library of Congress Cataloging in Publication Data

Kermack, D. M.

The evolution of mammalian characters.

Includes bibliographies and index.

1. Mammals, Fossil. 2. Mammals—Evolution.

I. Kermack, K. A. II. Title.

QE881.K45 1984 569 84-5783

ISBN 978-1-4684-7819-8 (Kapitan Szabo)

# CONTENTS

<b>Introduction</b>	vii
<b><i>Chapter 1 The Ancestors of the Mammals</i></b>	<b>1</b>
Earliest vertebrates	1
Anamniotes and amniotes	5
Sauropsida and Theropsida	6
The Synapsida	10
The Pelycosauria	11
References	17
<b><i>Chapter 2 The Therapsids</i></b>	<b>18</b>
Anomodontia	18
Theriodontia	19
Gorgonopsia	19
Therocephalia	23
Bauriomorpha	25
Cynodontia	27
References	36
<b><i>Chapter 3 Specialised Cynodont Derivatives</i></b>	<b>37</b>
Chiniquodontidae	37
Ictidosauria	39
<i>Dromatherium</i> and <i>Microconodon</i>	40
Teeth from the Württemberg Bone-bed	40
Tritylodontidae	40
Haramiyidae	44
References	46
<b><i>Chapter 4 The First Mammals</i></b>	<b>48</b>
The definition of a mammal	48
The time of origin of the mammals	49
Primitive mammals	51
<i>Morganucodon</i> — an early atherian mammal	53
<i>Kuehneotherium</i> — an early therian mammal	59
References	64
<b><i>Chapter 5 Dentitions, Tooth-replacement and Jaw Articulation</i></b>	<b>66</b>
Dental terminology	66
Tooth replacement	66

vi *Contents*

Evolution of mammalian canines	68
Evolution of mammalian cheek-teeth	79
The bones of the lower jaw	85
References	87
<b><i>Chapter 6 The Evolution of Mammalian Sight and Hearing</i></b>	<b>89</b>
The competitors of early mammals	89
Sight in a nocturnal environment	90
The olfactory sense in the nocturnal environment	91
Hearing in mammal-like reptiles	91
The location of the tympanic membrane	93
Location by sound	95
The evolution of the mammalian middle ear	97
References	99
<b><i>Chapter 7 The Completion of the First Stage of Mammalian Evolution in the Middle Jurassic</i></b>	<b>100</b>
Stonesfield mammals	100
Other Middle Jurassic mammals	104
References	105
<b><i>Chapter 8 The Mammals of the Upper Jurassic</i></b>	<b>106</b>
The Durdlestone (Durlston) Bay mammals	106
The mammals of the Morrison Formation	108
The Guimarota mammals	109
Other Upper Jurassic faunas	111
Triconodonta	111
Docodonta	115
Multituberculata	117
Pantotheria	124
References	129
<b><i>Chapter 9 The Mammals of the Lower Cretaceous</i></b>	<b>131</b>
Wealden Mammals	131
Asian Lower Cretaceous mammals	134
The origin of marsupials and placentals	135
References	138
<b><i>Chapter 10 Epilogue</i></b>	<b>140</b>
<b>Index</b>	<b>143</b>

## INTRODUCTION

This book is not intended to give a full and comprehensive account of the Mesozoic mammals, and nor is it intended as a handbook for research workers studying pre-Tertiary mammals. Our intention is to give an account of the origin and evolution of certain of the characters of the Mammalia. We have tried to portray the fossils we describe as the living animals they once were, not as dead bones. Our account ends with the end of the Lower Cretaceous, since by that time the major characters of the mammals had become established.

There exist a number of characters which, at the present day, are confined to the Mammalia. These include:

- (1) a jaw articulation formed by the squamosal and the dentary;
- (2) a chain of three bones, malleus, incus and stapes connecting the tympanic membrane to the inner ear;
- (3) the presence of hair or fur;
- (4) the presence of milk-glands in the female;
- (5) the left aortic arch is the systemic arch;
- (6) the phalangeal formula in both manus and pes is 2.3.3.3.3;
- (7) some of the teeth have more than one root.

Of these characters (1) or (2) are sufficient by themselves to define a mammal; characters (6) and (7) are known to have been already in existence in some of the mammal-like reptiles — the ancestors of the mammals. Characters (3)\*, (4) and (5) leave no impression on the skeleton, which by and large is what comprises the fossil record, so that we do not know if they were also present in the mammal-like reptiles. Character (5), however, on strong indirect grounds of inference, almost certainly existed in all the mammal-like reptiles as well as in the mammals.

Other characters, which are not confined to the mammals but which we always associate with them are:

- (8) warm-bloodedness or homiothermy (also found in birds);
- (9) viviparity (not found in monotremes, found in some representatives of all other living classes of gnathostomes except birds);
- (10) growth by epiphyses (found in some lizards).

\*Pterosaurs were claimed to be covered in fur. The 'fur' has now been identified as collagen fibres, in fairness to her, by the same worker who announced the original discovery.

The only one of these which could appear in the fossil record is (10), and, quite unexpectedly, it does not. It probably did not evolve until the mammals had come into existence, when the remarkably poor record of post-cranial skeletal material of Mesozoic mammals would explain its absence from the fossil record.

This book will deal with the interpretation of the facts as they are known from the fossil history of the mammals and the mammal-like reptiles; and it will only discuss soft parts when their nature can be unequivocally inferred from the skeleton (for example: the position of the tympanic membrane). In particular homiothermy and viviparity will not be discussed, nor will mammary glands.

There is a real danger that our ignorance of the evolution of the soft parts and physiological mechanisms will lead us to forget their importance to the living animal. A simple example of this, taken from a group alive at the present day, may be salutary. On their skeletal features cats are the most specialised of the living carnivores (Fissipedia). The cats were also the first group of the living fissipedes to differentiate: perfectly good cats were in existence at the beginning of the Oligocene, if not earlier. Dogs are less specialised skeletally than cats, and typical dogs do not become conspicuous until the Miocene. Cats are rather unspecialised physiologically, while dogs show great physiological specialisations for their cursorial mode of life; notably by being able to run fast for long periods without going into oxygen debt — a thing quite impossible to a cat. But this highly important physiological specialisation of the dogs leaves no record on the skeleton, and if the fissipedes were an entirely extinct group we would have no record that this specialisation ever existed.

Thus, by studying evolution by studying vertebrate palaeontology we inevitably get an incomplete and to some extent biased picture. We can only study the evidence we have, incomplete though it may be. But we should beware of the danger of so doing, even if we can do little about it.

We have concentrated on those aspects of the study of mammalian origins where we ourselves have made contributions to knowledge. This is a personal book. Jaw articulations, teeth and hearing consequently figure prominently; and in dealing with the fossil forms we have given most prominence to those upon which we have worked. In the references we have tried to include all papers on the subject published within the last ten years. We think that the book will be useful to those people who are interested in our ultimate ancestors, as well as to those carrying out research in the field.

The illustrations in the book are all by Mr A. J. Lee. The majority of them have been drawn either from the actual specimens or by redrawing and sometimes combining drawings in the original papers describing the material. We think that the illustrations will add greatly to the value of the book.

Finally we should like to express our thanks to our colleagues Mrs Frances Mussett and Miss P. M. Lees, without whose cooperation much of the

research mentioned in this book would never have come to fulfilment.

K. A. Kermack,  
Department of Zoology,  
University College, London,  
Gower Street,  
London WC1E 6BT

D. M. Kermack,  
Department of Pure & Applied  
Biology,  
Imperial College,  
Prince Consort Road,  
London SW7 2BB

# CLASSIFICATION OF MESOZOIC MAMMALS USED IN THIS WORK

## *Class Mammalia*

Subclass Atheria Kermack, Mussett and Rigney 1973

Order Triconodonta Osborn 1888

Suborder Eutriconodonta Kermack, Mussett and Rigney 1973

Family Triconodontidae Marsh 1887

Family Amphilestidae Kühne 1958

Suborder Morganucodonta Kermack, Mussett and Rigney 1973

Family Morganucodontidae Kühne 1958

Family Sinoconodontidae Mills 1971

Suborder Docodonta Kretzoi 1946

Family Docodontidae Simpson 1929

Order Multituberculata Cope 1884

Suborder Plagiaulacoidea Simpson 1925

Suborder Ptilodontoidea Sloan and Van Valen 1965

Suborder Taeniolaboidea Sloan and Van Valen 1965

Multituberculata *incertae sedis*

Family Haramiyidae Simpson 1947

Order Monotremata Bonaparte 1834

Subclass Theria Parker and Haswell 1897

Infraclass Pantotheria Simpson 1929

Order Eupantotheria Kermack and Mussett 1958

Suborder Amphitheria Kermack, Kermack and Mussett 1968

Family Kuehneotheriidae Kermack, Kermack and Mussett 1968

Family Amphitheriidae Owen 1846

Family Peramuridae Kretzoi 1960

Family Paurodontidae Marsh 1887

Suborder Dryolestoidea Butler 1939

Family Dryolestidae Marsh 1879

Suborder Symmetrodonta Simpson 1925

Family Amphiodontidae Simpson 1925

Family Spalacotheriidae Marsh 1887

?Family Aegialodontidae Kermack, Lees and Mussett 1965  
(may be better classified as eutherian)

Infraclass Marsupialia Illiger 1811

Infraclass Placentalia Owen 1841

} Eutheria Gill 1872