Nerve Cells and Animal Behaviour
Second Edition

This new edition of **Nerve Cells and Animal Behaviour** has been updated and expanded by Peter Simmons and David Young in order to offer a comprehensive introduction to the field of neuroethology while still maintaining the accessibility of the book to university students. Two new chapters have been added, broadening the scope of the book by describing changes in behaviour and how networks of nerve cells control behaviour.

The book explains the way in which the nervous systems of animals control behaviour without assuming that the reader has any prior knowledge of neurophysiology. Using a carefully selected series of behaviour patterns, students are taken from an elementary-level introduction to a point at which sufficient detail has been assimilated to allow a satisfying insight into current research on how nervous systems control and generate behaviour. Only examples for which it has been possible to establish a clear link between the activity of particular nerve cells and a pattern of behaviour have been used.

Important and possibly unfamiliar terminology is defined directly or by context when it first appears and is printed in bold type. At the end of each chapter, the authors have added a list of suggestions for further reading, and specific topics are highlighted in boxes within the text.

Nerve Cells and Animal Behaviour is essential reading for undergraduate and graduate students of zoology, psychology and physiology and serves as a clear introduction to the field of neuroethology.

PETER SIMMONS is a Lecturer in the Department of Neurobiology, University of Newcastle upon Tyne, UK, and DAVID YOUNG is a Reader in the Department of Zoology, University of Melbourne, Australia. Both authors regularly publish their research in insect neuroethology.

Nerve cells and animal behaviour

SECOND EDITION

PETER J SIMMONS and DAVID YOUNG

CAMBRIDGE UNIVERSITY PRESS

PUBLISHED BY THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE
The Pitt Building, Trumpington Street, Cambridge, United Kingdom

CAMBRIDGE UNIVERSITY PRESS
The Edinburgh Building, Cambridge CB2 2RU, UK www.cup.cam.ac.uk
40 West 20th Street, New York, NY 10011-4211, USA www.cup.org
10 Stamford Road, Oakleigh, Melbourne 3166, Australia
Ruiz de Alarcón 13, 28014 Madrid, Spain

First edition published 1989
Second edition published 1999

Typeface Utopia 9.25/14 pt. *System* QuarkXPress® [SE]

A catalogue record for this book is available from the British Library

Library of Congress Cataloguing in Publication data

Simmons, Peter (Peter John), 1952–
Nerve cells and animal behaviour / Peter Simmons and David Young.
– 2nd ed.
p. cm.
Rev. ed. of: Nerve cells and animal behaviour / David Young. 1989.
ISBN 0 521 62216 6 (hardcover)
1. Neurobiology. 2. Neurons. 3. Animal behavior.
4. Neurophysiology. I. Young, David, 1942 Feb. 25– II. Young, David, 1942 Feb. 25–. Nerve cells and animal behaviour.
III. Title.
QP356.Y68 1999
573.8′6–dc21 99-11620 CIP

ISBN 0 521 62216 6 hardback
ISBN 0 521 62726 5 paperback

Transferred to digital printing 2003

CONTENTS

PREFACE

Our aim in this book is to introduce university students to research on nervous systems that is directly relevant to animal behaviour, and to do so at a level that assumes no detailed knowledge of neurophysiology. Many topics that fall within the scope of neurobiology are omitted or passed over lightly, and attention is concentrated on particular examples that illustrate clearly how the activity of nerve cells is linked with animal behaviour. Since the first edition was published, many new books on neurobiology have appeared, but most concentrate on the cellular and physiological aspects of the nervous system. By reviewing some of the modern stories in neuroethology, we hope that this book will also be useful to postgraduate students and others who wish to learn something of the way in which behaviour is controlled.

Each major topic in Chapters 3–9 is dealt with as far as possible by introducing a particular type of behaviour and then working towards a description of how nerve cells control it. We have selected subjects from studies in which the links between nerve cells and animal behaviour are particularly clear. In doing this, we hope to illustrate the principles that have been revealed in modern research in neuroethology. Inevitably, there are many interesting stories that we have not been able to touch upon.

Readers who are familiar with the first edition of the book will notice several changes in content and arrangement. The final two chapters, on circuits of nerve cells and on plasticity in behaviour, are completely new. In order to provide an early illustration of how activity in nerve cells can be related to animal behaviour, we now describe work on prey detection by toads in the first chapter, and the chapter on startle behaviour is placed earlier in the book than it was in the previous edition. New material has been added in several places, particularly in Chapters 3, 5 and 7. In order to

make room for this new material, we have had to omit the chapter on intraspecific communication.

To help readers to come to grips with unfamiliar terms and concepts, many of these are set in **bold type** the first time they appear in the book, as well as in the index. Anyone who studies neurobiology will soon discover that it has many side branches, linking one story to another or to other branches of biology. We have included brief introductions to a few of these by means of boxes in some chapters. These boxes do not have to be read as part of the main text, but are meant to complement it by providing useful and interesting, relevant information.

Suggestions for further reading are given at the end of each chapter, and major references to points of detail are scattered through the text and listed at the end of the book. The references in the figure legends also draw attention to relevant papers as well as indicating our grateful acknowledgement of material from other authors that we have incorporated into the figures.

We would like to thank many colleagues who have given useful comments on various aspects of the book, particularly Claire Rind and a number of undergraduate and postgraduate students. We are also very grateful to members of our families for their support during the preparation of the book.