



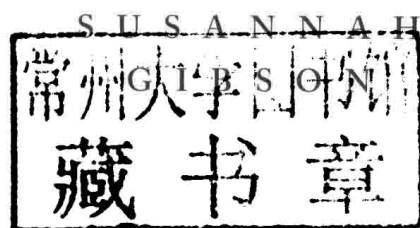
ANIMAL, VEGETABLE, MINERAL?

*How eighteenth-century science
disrupted the natural order*

S U S A N N A H G I B S O N

ANIMAL, VEGETABLE, MINERAL?

*How eighteenth-century science
disrupted the natural order*



OXFORD
UNIVERSITY PRESS

OXFORD
UNIVERSITY PRESS

Great Clarendon Street, Oxford, OX2 6DP,
United Kingdom

Oxford University Press is a department of the University of Oxford.
It furthers the University's objective of excellence in research, scholarship,
and education by publishing worldwide. Oxford is a registered trade mark of
Oxford University Press in the UK and in certain other countries

© Susannah Gibson 2015

The moral rights of the author have been asserted

First Edition published in 2015

Impression: 1

All rights reserved. No part of this publication may be reproduced, stored in
a retrieval system, or transmitted, in any form or by any means, without the
prior permission in writing of Oxford University Press, or as expressly permitted
by law, by licence or under terms agreed with the appropriate reprographics
rights organization. Enquiries concerning reproduction outside the scope of the
above should be sent to the Rights Department, Oxford University Press, at the
address above

You must not circulate this work in any other form
and you must impose this same condition on any acquirer

Published in the United States of America by Oxford University Press
198 Madison Avenue, New York, NY 10016, United States of America

British Library Cataloguing in Publication Data

Data available

Library of Congress Control Number: 2014958938

ISBN 978-0-19-870513-0

Printed in Great Britain by
Clays Ltd, St Ives plc

Links to third party websites are provided by Oxford in good faith and
for information only. Oxford disclaims any responsibility for the materials
contained in any third party website referenced in this work.

ANIMAL, VEGETABLE, MINERAL?

For Philomena and John

ACKNOWLEDGEMENTS

This book grew out of a doctoral thesis and I would like to thank the Arts and Humanities Research Council, the Darwin Trust of Edinburgh, and Corpus Christi College, Cambridge for supporting me during my doctoral studies and funding a significant portion of the research on which this book is based. I am also truly indebted to the Society of Authors whose generosity, in the form of the Authors' Foundation and K. Blundell Trust Awards, allowed me to turn that thesis into this book.

Thanks too to Jim White, Joe Cain, and Jim Secord who, respectively, introduced me to the delights of history of science, history of the life sciences, and history of the eighteenth century. I have been fortunate enough to be affiliated to Cambridge's wonderful Department of History and Philosophy of Science; many thanks to all there who have influenced my ideas and writing, and taken the time to read and comment on early drafts of some of these chapters—especially Jim Secord, Seb Falk, and Nick Jardine. I am also grateful to the staff of the Whipple and University Libraries for their help in locating many an obscure text over the years, and for providing such inspiring places of work.

At OUP, Latha Menon, Emma Ma, Jenny Nugee, Kate Gilks, Carrie Hickman, Jackie Pritchard, Carolyn McAndrew, the anonymous referees, and the rest of the team have been extremely helpful

in giving comments and advice on earlier versions of this work, and shaping it into its final form.

Finally, thanks to Melanie, Katie, and Caitlin for their shared interest in rock pools; to Irene for knowing I would write a book; to Alexi for introducing me to the work of Matthew Darly; to all at the Cambridge Literary Festival; to my ever-supportive family; to Seb for endless encouragement; and to Ridley and Amos for being my constant companions as I completed this manuscript.

*What is this earth and sea of which I have seen so much?
Whence is it produc'd? And what am I and all the other creatures,
wild and tame, humane and brutal? Whence are we?*

Daniel Defoe, Robinson Crusoe, 1719

CONTENTS

<i>List of Figures</i>	xi
1. Animal, Vegetable, Mineral?	1
2. Animal: The Problem of the Zoophyte	43
3. Vegetable: The Creation of New Life	79
4. Mineral: Living Rocks	117
5. The Fourth Kingdom: Perceptive Plants	149
6. Epilogue	179
<i>Notes</i>	191
<i>Bibliography</i>	201
<i>Further Reading</i>	207
<i>Index</i>	211

LIST OF FIGURES

1. The fifth day of creation: God creates the birds and the fishes. From *The Ashmole Bestiary*, 13th century, England. 26
MS Ashmole 1511, fo. 6^r. The Bodleian Libraries, The University of Oxford.
2. How to catch a unicorn. From a bestiary, 13th century, England. 32
MS Ashmole 1511, fo. 6^r. The Bodleian Libraries, The University of Oxford.
3. Abraham Trembley hunting for polyps in the grounds of Sorgvliet with his two young students, Jean and Antoine. From Abraham Trembley, *Mémoires pour servir à l'histoire d'un genre de polypes d'eau douce à bras en forme de cornes*, 1744. 47
CC 57 Art. Seld., p. 149. The Bodleian Libraries, The University of Oxford.
4. Drawing showing two modes of polyp locomotion: (top) through an inch-worm-like motion and (bottom) through an extraordinary series of somersaults. From Abraham Trembley, *Mémoires pour servir à l'histoire d'un genre de polypes d'eau douce à bras en forme de cornes*, 1744. 49
CC 57 Art. Seld., Pl. 3, Mem I. The Bodleian Libraries, The University of Oxford.

5. A clustered animal-flower from the West Indies. This creature had shared roots like a plant, but ate like an animal. 65
 John Ellis, 'An Account of the Actinia Sociata, or Clustered Animal-Flower, Lately Found on the Sea-Coasts of the New-Ceded Islands: In a Letter from John Ellis, Esquire, F. R. S. to the Right Honourable the Earl of Hillsborough, F. R. S.', *Philosophical Transactions of the Royal Society*, 57 (1 January 1767), 428–37, plate XXX, figure 1. doi: 10.1098/rstl.1767.0043.
6. An illustration of the Linnean sexual system of classification. Plants were classified based on the number of stamens in their flowers. The first class consisted of plants which had flowers with a single stamen (first column); the second class consisted of plants which had flowers containing two stamens (second column); and so on. Order was then determined based on the number of pistils in a flower. The plant whose flower is shown in fig. 1 would have been categorized as 'class monandria, order monogynia'. From Carl Linnæus, *Systema natura*, 1735. 83
 Per. 199 d. 77 (8), Carli Linnæi, Classes S. Literai. The Bodleian Libraries, The University of Oxford.
7. The popularity of Linnæus' classification system in fashionable society meant that it was often satirized in the popular culture of the day. Matthew Darly, *The flower garden*, 1777. This image shows flower beds, systematically arranged according to a particular taxonomic system (with their own gardener), atop an elaborate and oversized example of the kind of wig worn by society belles. 86
 Image copyright The Metropolitan Museum of Art/Art Resource/Scala, Florence.

8. Illustrations, based on dissections of chick eggs and other embryos, showing the formation of new parts in an embryo. From Caspar Friedrich Wolff, *Theoria generationis*, 1774, tab. II. 106
189129 e. 82, TAB. I and II. The Bodleian Libraries, The University of Oxford.
9. A botanical description of the man plant. This racy and highly sexualized description of a woman would have been instantly recognizable to an eighteenth-century reader as a satire of the Linnean method of describing plants. The description was in Latin to protect female readers from the cruder references. From Prof. Vincent Miller, *The Man Plant, or, scheme for increasing and improving the British Breed*, c.1752, 10–11. 112
Douce G. 513(4), p. 10. The Bodleian Libraries, The University of Oxford.
10. One of the many illustrations of the Mount Eivelstadt fossils produced by Johann Beringer. It is unusual for soft tissues to be fossilized, and particularly unusual to see mineralized impressions of, for example, an insect landing on a flower. From Johann Beringer, *Lithographiae Wirceburgensis*, 1726, plate VI. 136
RR. X. 44, TAB. V. The Bodleian Libraries, The University of Oxford.
11. William Smith's geological map of England and Wales, which was made possible by the study of fossils within strata, 1815. 146
Reproduced by permission of the Geological Society of London.
12. The first European image of a Venus fly-trap. 'Each leaf is a miniature figure of a rat trap with teeth, closing on

- every fly or other insect that creeps between its lobes, and squeezing it to death.' From John Ellis, *A botanical description of the Dionaea Muscipula, or Venus's Fly-Trap*, 1770. 151
 Courtesy of Hunt Institute for Botanical Documentation, Carnegie Mellon University, Pittsburgh, PA.
13. This illustration shows the experimental set-up used by Stephen Hales to prove that plants absorb and release airs. From Stephen Hales, *Vegetable Staticks*, 1727. 159
 Savile Hh 12, facing p. 150. The Bodleian Libraries, The University of Oxford.

Animal, Vegetable, Mineral?



Animal, vegetable, or mineral: today, this is a simple parlour game for children but in the eighteenth century it was a problem that exercised some of the finest minds of Europe. The question of distinguishing animal from plant from mineral may seem like a straightforward one but in fact it can very quickly lead to incredibly complex problems: how do we differentiate the kingdoms? are there different kinds of life? how does generation of life occur? What is life? It may be an easy task to say that an elephant is an animal while an oak tree is a plant, but what is a sponge, a coral, a Venus fly-trap, a fossil? These curious objects seem to combine properties from across the animal, vegetable, and mineral kingdoms and blur the lines between them. Today, we have developed an agreed set of rules for establishing an object's kingdom, but it wasn't always so. The problem really came to a head in the eighteenth century: this was a time when some very strange creatures became known to naturalists; when better tools like microscopes enabled naturalists to make more minute examinations of natural objects; when a classification craze was sweeping across Europe; and when Enlightenment culture was encouraging people to rethink old ideas. This combination of

factors led naturalists to ask hard questions about how we know whether or not something is alive, and what kind of life it possesses. These questions—so fundamental, yet so complicated—puzzled men of science. In the wider world, their answers had the power to incite tremendous controversy about the role of God in the universe and about the natural order of society.

The eighteenth century was a time of Enlightenment, of empire, and of industrialization. Social, political, economic, and scientific changes were happening at a faster pace than ever before. Agricultural societies became urban societies, farm labourers became factory employees, new wealth was created and distributed in different ways, Enlightenment ideas began to roll out of Germany and France to reshape the intellectual landscape of all Europe, empires expanded their reach into ever-further corners of the globe, and revolutionary ideas began to ferment. These changes were intricately interlinked, each having complex and unforeseen repercussions across society. Naturally, they were also keenly felt by the scientific community of the day. Increased exploration and the expansion of European empires brought Europeans into contact with peoples they had never met before, with new terrains, new languages, new customs, and, of course, new species of plants and animals. The mass move from rural to urban settings changed man's relationship with, and view of, nature. New wealth allowed some groups more leisure time, and made scientific books and instruments more accessible to a larger section of society. Industrialization necessitated new technologies and fostered bold innovations. The Enlightenment movement encouraged learning and rational discourse, and opened the scientific world to new audiences. And revolutionary sentiments allowed people to question traditional beliefs about God, society, and nature.

This colourful century saw the creation of everything from the piano to the steam engine, steel to the smallpox vaccination. Simultaneous European discoveries of new celestial bodies in our solar system and of remote Pacific islands showed how much of the world was still to be explored and how many questions about the natural world were still unanswered. The search for these answers was set against the backdrop of the music of Bach and Mozart, the poetry of Pope and Goethe, the philosophies of Kant and Rousseau, the inventions of Watt and Newcomen, the teachings of Smith and Hume, the courts of the Hanoverians and the Bourbons, the revolutionary zeal of Washington and Robespierre, the writings of Casanova and Swift. The eighteenth century was an exciting time not just for music, literature, or politics, but also for the sciences: Isaac Newton's work on gravity, motion, optics, and calculus had inspired new generations to devote themselves to the study of physics and mathematics; demonstrations of the dazzling new science of electricity attracted hundreds of spectators; chemistry, sometimes just as spectacular as electricity, was unearthing new elements at an astonishing rate; astronomy, powered by ever-more sophisticated telescopes, caught the public imagination as high-profile astronomers tracked the transit of Venus or discovered new planets like distant Uranus; the life sciences exploded as strange new creatures were brought back to Europe from distant lands and tales of heroic exploration abounded.

This vibrant scientific milieu was the perfect breeding ground for hard questions about how the world worked. Men of science, particularly naturalists who focused on studying the animal, vegetable, and mineral kingdoms, strove to uncover the secrets of nature.¹ One of the most basic questions for a naturalist

was: how were the natural kingdoms arranged? Had God imposed a particular order on them, clearly separating animal from vegetable? If so, how could humans begin to make sense of this order and find workable definitions of the different kingdoms? Or was it possible, as some were beginning to suggest, that there were no clear-cut boundaries between the natural kingdoms and that God was far less involved in the regulation of nature than previously believed? The stories in this book—which feature strange creatures like Abraham Trembley’s somersaulting polyps, Lazzaro Spallanzani’s smartly trousered frogs, or Jean André Peyssonnel’s blossoming corals—show how apparently straightforward investigations into particular species could quickly spiral into complex and nuanced philosophical debates about the very meaning of life. But before we meet these eighteenth-century luminaries of the life sciences, we must understand the developments that led to their work.

Aristotle’s animals

It is impossible to understand eighteenth-century life sciences without an appreciation for the work of one central figure: Aristotle. More than anyone else, this man shaped the study of nature. From his own lifetime in the fourth century BC right up until the time of Charles Darwin in the nineteenth century, Aristotle’s teachings were considered of primary importance to any student of the natural world. Every character who appears in this book had read Aristotle’s animal writings, and so it seems appropriate to start where they started—with an understanding of Aristotle.

Aristotle was born in 384 BC in the northern Greek town of Stagira to a wealthy and well-educated family. His father,