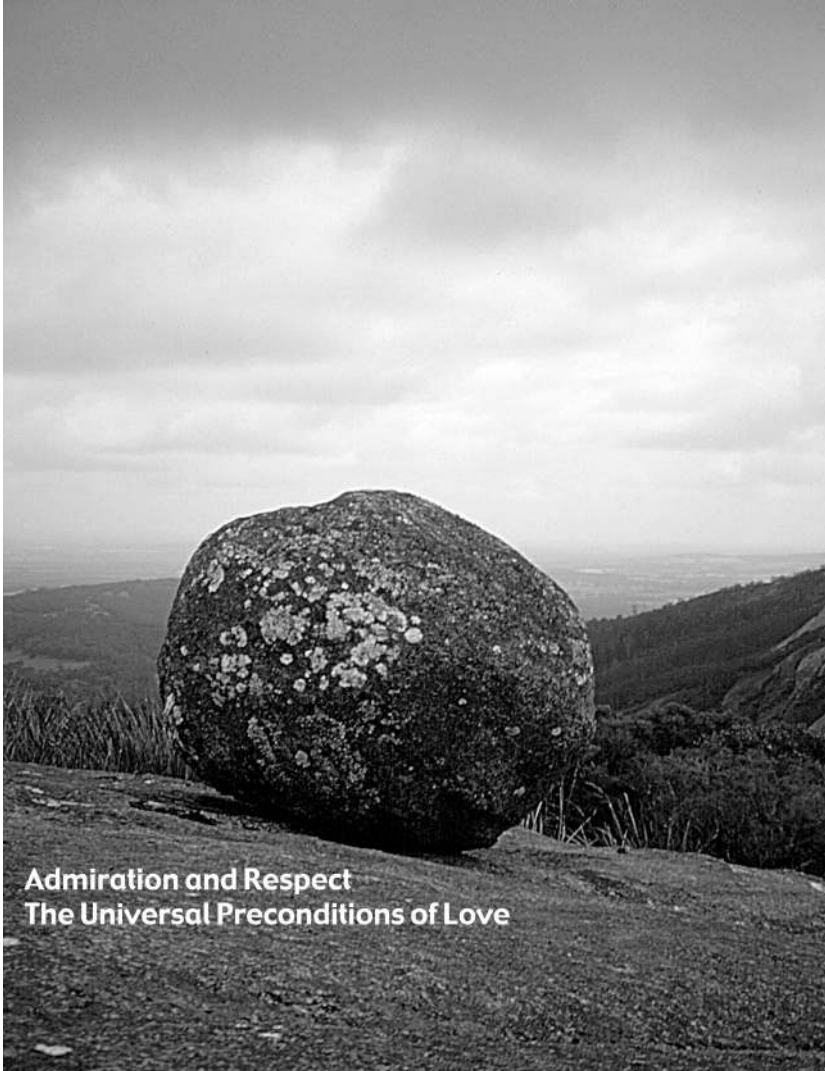


## Bioscience Ethics

Bioscience ethics facilitates free and accurate information transfer from applied science to applied bioethics. Its major elements are: increased understanding of biological systems, responsible use of technology, and curtailment of ethnocentric debates more in tune with new scientific insights. Coined by Irina Pollard in 1994, bioscience ethics has become an internationally recognized discipline, interfacing science and bioethics within professional perspectives such as medical, legal, bioengineering and economics. The fundamental feature of this book is its breadth, which is important because bioscience ethics interweaves many diverse subjects in the process of gathering specialist scientific knowledge for bioethical review. It contains chapters which embrace topics affecting human reproduction, end-of-life care and euthanasia, others which challenge human-dominated ecosystems, and review population growth, economic activity and warfare. A background section describes the evolution of ethical consciousness, explores the future and proposes that the reworking of ethical boundaries can enhance mature decision-making in harmony with changing technology.

IRINA POLLARD is an Associate Professor in the Department of Biological Sciences at Macquarie University in Sydney. In the 1990s, she initiated and developed new ways of communicating science described as bioscience ethics. Her research activities have generated a deep concern for social justice and, as a result, she is active in community education and serves on local and international Institutional Ethics Committees. Through UN-affiliated organizations, she is occupied with international bioscience-bioethics education projects via active membership of UNESCO's School of Ethics and, more recently, as the Chair of the Australian Unit of the International Network of the UNESCO Chair in Bioethics. In 2007 she was elected to the Board of Directors of the International Association of Bioethics. She also founded the Bioscience-Bioethics Friendship Co-operative (BBFC) web portal at <http://www.bioscience-bioethics.org/> which provides free admittance to educational material in the areas of stress physiology, reproduction, toxicology/teratology and environmental ethics, and access to other useful links for those interested in bioscience and bioethics.



# Bioscience Ethics

---

IRINA POLLARD

Macquarie University, New South Wales,  
Australia



CAMBRIDGE  
UNIVERSITY PRESS



CAMBRIDGE  
UNIVERSITY PRESS

Shaftesbury Road, Cambridge CB2 8EA, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India

103 Penang Road, #05–06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press is part of Cambridge University Press & Assessment, a department of the University of Cambridge.

We share the University's mission to contribute to society through the pursuit of education, learning and research at the highest international levels of excellence.

[www.cambridge.org](http://www.cambridge.org)

Information on this title: [www.cambridge.org/9780521745277](http://www.cambridge.org/9780521745277)

© I. Pollard 2009

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press & Assessment.

First published 2009

*A catalogue record for this publication is available from the British Library*

*Library of Congress Cataloging-in-Publication data*

Pollard, Irina.

Bioscience ethics / Irina Pollard.

p. cm.

Includes bibliographical references and index.

ISBN 978-0-521-76828-3 (hardback)

1. Medical ethics. 2. Bioethics. I. Title.

R724.P64 2009

174'.957–dc22 2009007322

ISBN 978-0-521-76828-3 Hardback

ISBN 978-0-521-74527-7 Paperback

Cambridge University Press & Assessment has no responsibility for the persistence or accuracy of URLs for external or third-party internet websites referred to in this publication, and does not guarantee that any content on such websites is, or will remain, accurate or appropriate. Information regarding prices, travel timetables, and other factual information given in this work is correct at the time of first printing but Cambridge University Press & Assessment does not guarantee the accuracy of such information thereafter.

## Contents

*Preface* page xi  
*Acknowledgements* xiii

- 1 Human origins, natural selection and the evolution of ethics 1**
  - Modern science, ethics and evolving bioscience ethics 2
  - The hunter-gatherer *Homo sapiens* 5
  - Ethics – our evolutionary heritage 11
  - Neuroethics – unravelling the neural basis of moral judgement 16
  - Evolving bioscience-bioethics 18
  - Principles of bioscience ethics for discussion 22
- 2 Sex determination, brain sex and sexual behaviour 24**
  - Sex determination 25
  - Errors of sexual differentiation 30
  - Brain sex determination 33
  - The socialization of human sexuality 35
  - Sexual orientation 36
  - Transgender and gender recognition 38
  - Principles of bioscience ethics for discussion 43
- 3 Inappropriate lifestyle and congenital disability in children: basic principles of growth, toxicology, teratogenesis and mutagenesis 44**
  - Patterns of human growth 45
  - The embryonic/fetal periods and embryo staging 47
  - The placenta as the maternal-fetal interface 50
  - Abnormal prenatal growth patterns, fetal programming and long-term health consequences 51

vi Contents

|          |   |            |
|----------|---|------------|
|          | Toxicology: basic principles  | 55         |
|          | Teratogenesis, mutagenesis and carcinogenesis   | 58         |
|          | Principles of bioscience ethics for discussion  | 60         |
| <b>4</b> | <b>Substance abuse and parenthood: biological mechanisms – bioethical responsibilities</b>                                | <b>61</b>  |
|          | Introductory background   | 61         |
|          | <i>Behavioural variables – biological consequences</i>  | 64         |
|          | The preconceptional period: male-mediated effects   | 65         |
|          | Specifics   | 65         |
|          | The preconceptional period: female-mediated effects   | 67         |
|          | Drug-induced infertility  | 68         |
|          | The prenatal and neonatal periods   | 69         |
|          | Nicotine  | 70         |
|          | Sudden infant death syndrome (SIDS)   | 71         |
|          | Passive smoking   | 72         |
|          | Attention-deficit hyperactivity disorder (ADHD)   | 72         |
|          | Ethanol (alcohol)   | 73         |
|          | Fetal alcohol syndrome (FAS)  | 74         |
|          | Cocaine   | 76         |
|          | Marijuana   | 77         |
|          | Narcotics   | 78         |
|          | Caffeine  | 79         |
|          | <i>Behavioural variables – bioethical challenges</i>  | 79         |
|          | Socioeconomic factors   | 80         |
|          | An ecologically based model of preventative care – government and citizens in equal partnership                           | 84         |
|          | The emotional brain and the biology of addiction  | 85         |
|          | Principles of bioscience ethics for discussion  | 88         |
| <b>5</b> | <b>Fertility awareness: the ovulatory method of birth control, ageing gametes and congenital malformation in children</b> | <b>90</b>  |
|          | The laws of inheritance   | 91         |
|          | Human fecundity   | 93         |
|          | Female libido: procreational versus recreational sex  | 94         |
|          | Principles of reproductive ageing   | 95         |
|          | Ageing gametes and ovulatory method of birth control  | 98         |
|          | The gametopathy hypothesis and congenital anomalies   | 101        |
|          | Principles of bioscience ethics for discussion  | 105        |
| <b>6</b> | <b>Understanding child abuse and its biological consequences</b>  | <b>106</b> |
|          | Adaptation of the newborn to extrauterine life  | 107        |
|          | Bonding and social relations  | 109        |

- Unwanted birth and crime 111
- Post-traumatic stress disorder or the physical signature of unresolved trauma 114
- The biology of behaviour and cognition 117
- Stress and psychosocial short stature 119
- Future prospects 120
- Principles of bioscience ethics for discussion 122
- 7 The state of wellbeing: basic principles, coping strategies and individual mastery 124**
  - The link between population density and reproduction 126
  - Stress – the General Adaptation Syndrome (GAS), allostasis and disease 127
  - Adaptive strategies 131
  - Principles of bioscience ethics for discussion 134
- 8 The state of wellbeing: on the end-of-life care and euthanasia 135**
  - Life's balance sheet 136
  - End-of-life care, advanced directives and 'do not resuscitate' orders 137
  - Euthanasia, an evolving concept 140
  - Principles of bioscience ethics for discussion 143
- 9 Current reproductive technologies: achievements and desired goals 145**
  - Lifestyle, fertility and the Assisted Reproductive Technologies (ARTs) 145*
    - Fertility control – the evolutionary perspective 146
    - Infertility – the price of excess fecundity 148
    - Assisted reproduction: social considerations 150
    - Assisted reproduction: technological considerations 152
    - Artificial insemination 156
    - In vitro fertilization and related technologies 158
    - Intracytoplasmic sperm injection and cytoplasmic transfer technologies 161
    - Maturing human eggs in the laboratory 162
    - Epigenetics, imprinting and assisted reproduction 163
    - Surrogacy 164
  - Assisted reproduction, genetic diversity and the biology of conservation 165*
    - Inbreeding depression 166
    - The role of ART in conservation 166
    - Principles of bioscience ethics for discussion 170

viii Contents

- 10 **The recombinant DNA technologies 171**
  - Genetic engineering and related technologies – biological perspective* 171
  - Gene therapy 173
  - Prenatal genetic screening and diagnosis 179
  - Preimplantation genetic screening and diagnosis 181
  - Neonatal genetic screening and diagnosis 182
  - Presymptomatic screening for individuals and populations 182
  - The use of genetic technology for social purposes 183
  - The Human Genome and the Human Genome Diversity Projects* 184
  - Access to the ownership of genomes 188
  - Principles of bioscience ethics for discussion 190
- 11 **Stem cells, nuclear transfer and cloning technology 192**
  - What is a clone? 193
  - Reproductive cloning: basic principles 196
  - Embryonic stem cell (aka therapeutic or biomedical) cloning 197
  - Adult stem cell alternatives 200
  - Reproductive cloning: ethical considerations 200
  - Principles of bioscience ethics for discussion 203
- 12 **Human-dominated ecosystems: re-evaluating environmental priorities 204**
  - Population growth and economic activity – are we overstraining our limits?* 204
  - Extinction and conservation of biodiversity 207
  - Genetic diversity and environmental adaptability 211
  - Human-driven climate change 212
  - Stress and adaptation 216
  - Living within Nature's constraints 217
  - Understanding living cycles and anticipating environmental policies rather than relying on remedial measures* 219
  - Fundamental symbiosis: the biogeochemical or nutrient cycle 220
  - Losing the food race 223
  - Deep design: the synthesis of Nature and culture 225
  - Principles of bioscience ethics for discussion 228
- 13 **Human-dominated ecosystems: reclaiming the future for following generations 229**
  - Self-destructive behaviour and overexploitation of the environment* 229
  - The tragedy of the commons 229



|    |   |     |
|----|---|-----|
|    | <b><i>Chemical exposure, sex determination and sexual behaviour</i></b>   | 233 |
|    | The endocrine system: an overview   | 233 |
|    | Epigenetic transgenerational actions of synthetic endocrine disruptors  | 234 |
|    | Wildlife and laboratory findings  | 237 |
|    | Human findings and the precautionary principle  | 238 |
|    | Principles of bioscience ethics for discussion  | 242 |
| 14 | <b>Human-dominated ecosystems: warfare = fitness enhancement or losing strategy?</b>                                | 243 |
|    | The institution of war  | 245 |
|    | The tragedy of conflict   | 248 |
|    | Biological warfare  | 252 |
|    | Computer technology, cyber-electronics and virtual warfare  | 256 |
|    | The legacy of war on future generations   | 257 |
|    | Child soldiers  | 259 |
|    | Principles of bioscience ethics for discussion  | 262 |
| 15 | <b>Human-dominated ecosystems: reworking bioethical frontiers</b>   | 263 |
|    | <b><i>Global responsibility – a transboundary détente to developmental needs and environmental preservation</i></b> | 264 |
|    | The power of the collective – endorsing multiple-entry bookkeeping  | 265 |
|    | The power of the individual   | 266 |
|    | <b><i>Stewardship of Mother Earth – in defence of the global commons</i></b>  | 268 |
|    | Gaia – Earth’s evolving physiology  | 270 |
|    | Gaia’s three principles   | 272 |
|    | Living within Nature’s bounty   | 277 |
|    | Principles of bioscience ethics for discussion  | 280 |
|    | <i>Further reading</i>  | 281 |
|    | <i>Index</i>  | 298 |

## Preface

The ethical dimension of science is significant because all of us will need to participate, as citizens, in making informed choices about its uses and abuses. Biological education, while consistent with new knowledge, ought also to be relevant to real-life experiences within sociocultural and ethical contexts. The indiscriminate use, abuse and misunderstanding of science's valuable technological developments are, beyond doubt, a matter of ethical concern and collective responsibility. To adequately respond to the challenges that our technological-based predicaments have created, a deeper understanding of biological systems is essential. To this end, the new transdisciplinary field dubbed 'bioscience ethics' provides unique opportunities for advancing biological understanding within the scaffolding of ethics. Without free and accurate access to scientific, medical and technological expertise – factors which drive present-day social change – the search for a bioethics in tune with modern reality is severely disadvantaged. Bioscience ethics provides a source of information that bridges the gap between applied science and applied ethics. The concept does not displace bioethics; rather it aims to assist its growth. As the interface between scientific endeavour and its application into acceptable forms of bioethical consensus, bioscience ethics demands increased understanding of biological systems, the responsible use of technology and curtailment of ethnocentric debate in tune with scientific insight. The fundamental feature of this book is its breadth – by integrating ethics with the life sciences and by emphasizing that the human condition is the product of past and present circumstance, it highlights the ethics that emerging scientific insights may involve. Publications such as my introductory text, *Life, Love and Children: A Practical Introduction to Bioscience Ethics and Bioethics* (developed for open-access educational purposes), have generated growing interest in bioscience ethics by students and academics as well as the general public. This book responds to the growing interest by adaptively integrating traditional

xii Preface

reductionist insights within broader cross-disciplinary levels of bioethical significance. My hope is that, with deepened biological understanding, new standards of social conduct, more in cooperation and harmony with the environment and ourselves, will evolve.

IRINA POLLARD

## *Acknowledgements*

Any enterprise of breadth rests heavily on the scholarship of others. Therefore, I would like to thank all authors from the extensive published literature whose material I have freely used but, owing to space constraints, only a selection is provided in the Further reading. Predominantly I owe a debt to my partner Roger Hiller who critically read all my drafts, insisted on clarity of expression, and who generously gave expert guidance throughout the book's development. It's been instructive to see how Roger's well-judged assessments resulted in important content/textual modifications which so effectively highlighted the intended essence of my writing. I'm also considerably indebted to my son Morgan Pollard for engaging me in probing discussions, especially in the environmental sections. I also extend my thanks to numerous friends and colleagues who helped me focus my thoughts throughout the laborious writing process, and to the students who gave enthusiastically of themselves during their reading of the subject as taught at Macquarie University. I especially owe a debt to bioscience ethics students and staff who strongly supported my fledgling subject, initially taught as an introductory vacation unit, and insisted that bioscience ethics needs to be expanded and recognized in any science curriculum. I also want to acknowledge friends, of like mind, who in the course of various collaborative educational projects within UNESCO's School of Ethics and elsewhere, provided valuable opportunities to stretch my interests in bioscience ethics. In this regard I particularly want to thank Darryl Macer for being an excellent friend and invaluable colleague. To all, I extend a warm thank you.

The original scientific illustrations are an integral part of the book's text and for these I owe a special thanks to the scientific illustrator and artist Barbara Duckworth who, without fail, was able to create meaningful illustrations from my roughest sketches. I'm also very grateful to Ray Duell for skillfully generating eloquent electronic diagrams based on my amateur drafts and for

#### xiv Acknowledgments

his ongoing assistance in computing matters essential in the preparation of this volume. Ray's IT expertise is astounding, as can be demonstrated by inspecting our web-based education portal, freely accessible at <http://www.bioscience-bioethics.org/>.

Finally, I want to acknowledge my two editors at Cambridge University Press – Alan Crowden and Dominic Lewis – for enthusiastically embracing bioscience ethics and assisting in its promotion. Thanks are also due to all at Cambridge University Press who helped to bring this book to fruition. For me the journey has been both challenging and enlightening.