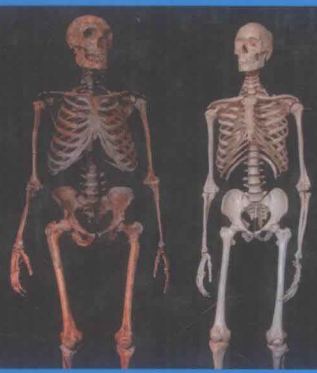
PERSPECTIVES IN BIOANALYSIS

VOLUME 2

NEW HIGH THROUGHPUT TECHNOLOGIES FOR DNA SEQUENCING AND GENOMICS



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(EDITOR)

PERSPECTIVES IN BIOANALYSIS

NEW HIGH THROUGHPUT TECHNOLOGIES FOR DNA SEQUENCING AND GENOMICS

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VOLUME 2

AMSTERDAM – BOSTON – HEIDELBERG – LONDON – NEW YORK – OXFORD
PARIS – SAN DIEGO – SAN FRANCISCO – SINGAPORE – SYDNEY – TOKYO

Elsevier
Radarweg 29, PO Box 211, 1000 AE Amsterdam, The Netherlands
The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, UK

First edition 2007

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Library of Congress Cataloging-in-Publication Data
A catalog record for this book is available from the Library of Congress

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN-13: 978-0-444-52223-8
ISBN-10: 0-444-52223-9
ISSN: 1871-0069

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Printed and bound in Italy

07 08 09 10 11 10 9 8 7 6 5 4 3 2 1

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Cover image: Ian Tattersall, American Museum of Natural History

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Preface

Since the independent invention of DNA sequencing by Sanger and by Gilbert 30 years ago, it has grown from a small-scale technique capable of reading several kilobase-pair of sequence per day into today's multibillion dollar 'industry', with large Sequencing Centers for large-scale delineation of entire genomes, and supporting DNA sequencing activity at some level at virtually all Universities and larger hospitals throughout the world. We are now in a "post-genomic era" with possibly more than 150 billion base-pair of sequence information held at international Bioinformatics Centers, yet DNA sequencing continues as a major diagnostic and research activity in many areas of life science and medicine. This growth has spurred the development of new sequencing technologies that do not involve either electrophoresis or Sanger sequencing chemistries. Sequencing by synthesis (SBS) involves multiple parallel micro-sequencing addition events occurring on a surface, where data from each round is detected by imaging. The recent plan to sequence a complete Neandertal genome (*Homo sapiens neanderthalensis*) by the 454 Life Sciences and the Max Planck Institute using SBS underlines the relevance of these new sequencing technologies to post-genomic science. This will be the second entire human genome project, and it is expected to radically advance knowledge of the human genomic biology and provide profound new insights into genetic diseases in man.

This volume brings together some of the new developments in DNA sequencing technology. Reviews of complementary developments in Sanger and SBS sequencing chemistries (Kumar and Fuller), capillary electrophoresis and micro-device integration (Xiong and Cheng), MS sequencing (Ehrich *et al.*) and applications (Mitchelson *et al.*) set the framework. Reviews of new developments in SBS technology (Margulies *et al.*), the chemistry of nucleotide-dye SBS sequencing (Edwards *et al.*), and steps toward realizing the sequencing of single DNA molecules by cyclic synthesis (Hebert and Braslavsky), nano-pore sequencing (Lee and Meller) and optical mapping of arrayed DNA (Schwartz *et al.*) indicate the latest advances. Finally, bioinformatics tools for genome assembly (McGrath), sequencing ancient and environmental DNA samples (Kowalchuk *et al.*) and support for SBS sequence assembly (Keith *et al.*) discuss many issues relevant to new applications using SBS sequencing. The authors hope this volume will provide stimulus to both students and researchers interested in this vital field of chemistry and technological innovation.

July 2006 Keith Mitchelson

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Enabling Technologies

Chapter 1
Overview: Developments in DNA Sequencing

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PERSPECTIVES IN BIOANALYSIS, VOLUME 2
ISSN 1871-0069 DOI: 10.1016/S1871-0069(06)02001-5

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