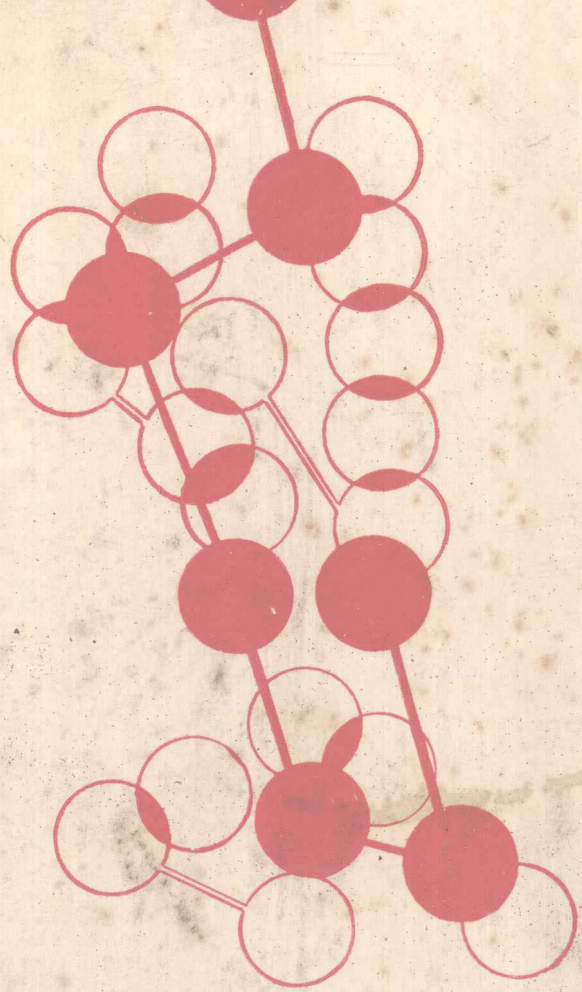
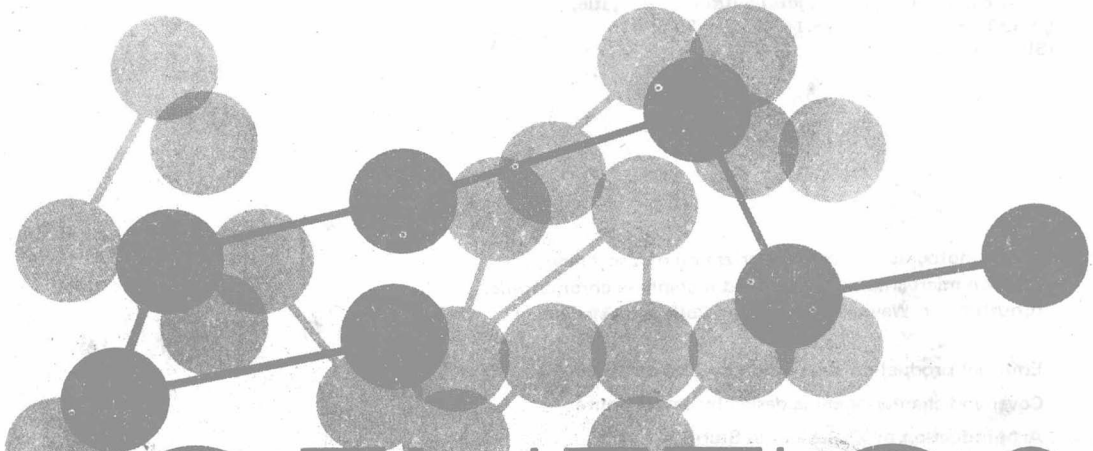
HELEN MARCUS-ROBERTS



GENETICS

Its Concepts and Implications



GENETICS

Its Concepts and Implications

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PRENTICE-HALL, INC., Englewood Cliffs, New Jersey 07632

Library of Congress Cataloging in Publication Data

Pai, Anna C (date)
Genetics, its concepts and implications.

Includes bibliographies and index.
1. Genetics. 2. Genetics—Social aspects.
I. Marcus-Roberts, Helen, joint author. II. Title.
QH430.P35 575.1 80-39616
ISBN 0-13-351007-7

Cover photograph: A color solarization of a scanning electron micrograph of an isolated metaphase chromosome. (Courtesy Dr. Wayne Wray, Baylor College of Medicine.)

Editorial/production supervision by Zita de Schauensee
Cover and chapter-opening design by Jayne Conte
Art production by Diane Doran Sturm
Manufacturing buyer: John Hall

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

Prentice-Hall International, Inc., *London*
Prentice-Hall of Australia Pty. Limited, *Sydney*
Prentice-Hall of Canada, Ltd., *Toronto*
Prentice-Hall of India Private Limited, *New Delhi*
Prentice-Hall of Japan, Inc., *Tokyo*
Prentice-Hall of Southeast Asia Pte. Ltd., *Singapore*
Whitehall Books Limited, *Wellington, New Zealand*

Preface

An organism is judged by biologists to be living if it is capable of (1) self-reproduction, (2) metabolism, and (3) mutation. All these phenomena which distinguish living from nonliving matter are now known to involve genes and gene action. Therefore, central as the gene is to life processes, so the science of genetics, the study of the gene and gene action, has become central to the training of a biologist. Furthermore, important as genetic concepts are to biologists, these concepts have also achieved a unique degree of interest in the eyes of the general public as a result of growing public awareness of the relevance of genetic studies to every living organism including humans.

Historically, there has existed a sometimes considerable gap of communication and/or interest between the laboratory sciences and a society which more often than not felt only remotely affected by the activity within the laboratories. More than any other science in modern times, genetics has bridged this gap. Geneticists recognize that their work has bearing on many aspects of the natural world and human society. By informing the nonscientific community about the potential of genetic research, geneticists themselves have encouraged a broadening of communication between scientists and the public which is both necessary and desirable. A geneticist today must not only be knowledgeable but also able to relate his knowledge to the community at large.

In this textbook, the authors aim to present the concepts of genetics as a

aspects of material covered in the text. Answers to some of the problems and an extensive glossary are included in the appendixes.

We hope that students who use this textbook will share both in our excitement over developments in a fascinating and rapidly moving science, and in our concern that the new knowledge will be used with wisdom.

We wish to acknowledge the persuasive encouragement of Mary Ann Richter, who was directly responsible for the initiation of this project. Her untimely death cut short a promising career in publishing and removed a bright spot from the lives of all who knew her.

We further wish to thank the staff of Prentice-Hall and reviewers for their helpful comments. We would like to express our appreciation to the following reviewers: Audrey Barnett, C. William Birky, Jr., Allyn A. Bregman, Loy V. Crowder, Robert G. Fowler, Stephen L. Goldman, David Knauft, Paul A. Roberts, Howard Rosen, and R. C. Vrijenhoek. Thanks also to Marie Hromin for verifying the calculations in Chapter 16; to Sue Rowley, Victoria Berutti, Jane Freund, and Roger Korey for their help in preparing the manuscript; and not least, to my (ACP) students who used the manuscript and contributed constructive suggestions.

We are grateful to the Literary Executor of the late Sir Ronald A. Fisher, F.R.S., to Dr. Frank Yates, F.R.S., and to Longman Group Ltd., London, for permission to reprint portions of Table IV from their book *Statistical Tables for Biological, Agricultural and Medical Research.* (Sixth edition, 1974.)

In addition, Anna Pai acknowledges the moral support of her family and Dina Campos, which was invaluable. Helen Marcus-Roberts wishes to acknowledge the encouragement of her parents and friends. In particular she wishes to acknowledge the love, encouragement, and help of her husband, Fred, and the love of her daughter, Sarah.

Livingston, New Jersey — Anna C. Pai
Westfield, New Jersey — Helen Marcus-Roberts

focal topic in biology to students who may advance to specialize in one of its many subdivisions. The first seven chapters deal with various aspects of heredity, such as the roles of mitosis and meiosis, patterns of transmission, chromosome structure and mapping, and gene interaction. A thorough but simply presented discussion of the application of probability and statistics to the analysis of heredity (as in genetic counseling) is also included. Students are introduced to current techniques being used in these areas, such as somatic cell fusion in mapping human chromosomes.

With a firm understanding of the basic concepts of heredity after study of these first chapters, we turn our attention to the physical structure of genes, and how they function. Historically, the Age of Molecular Genetics began with the discovery that microorganisms such as bacteria and viruses can be used in genetic studies, and accordingly, we begin our chapters on molecular genetics with a discussion of the genetics of bacteria and viruses. From there we proceed to the ingenious experiments which gave us the structure of the double helix of DNA, and the relationship between protein synthesis and gene function.

More recently, much attention has been focused on the manner in which gene activity is regulated, because we are now aware that many biological phenomena, both normal and abnormal, are due to aspects of gene regulation. For example, immune phenomena and the transformation of normal cells into malignant cells in the development of cancer all reflect enormous complexity of regulative processes, and the results when regulation becomes abnormal. Therefore, we include these and other topics in our text, even though they are topics heretofore seldom found in genetics texts.

The controversy which has recently arisen in both the scientific and lay communities over the implications of certain experiments in genetic engineering will be considered at length. With our ever-increasing understanding of life processes, the debate on genetic engineering clearly illustrates the concerns of many as we approach the point where we may be able to control those processes.

We center our attention in the last few chapters on various aspects of mutation: its molecular basis, natural repair processes, agents that cause mutations, and tests for mutagens. Fluctuation in the frequencies of mutations and genes in populations leads from a consideration of population genetics to the genetic basis of evolutionary change.

It is our feeling that a discussion of our evolutionary origins is important for a better understanding of the human species and its part in the natural world. We hope that including a discussion of the genetic basis to race formation and IQ in this context will bring to light misconceptions which have caused so much unnecessary grief to our society. Our concern for the societal implications of genetics carries into the final chapter which explores the promises and perils of genetic research and methodology in the near future.

To present genetic concepts and their implications and yet have a textbook which can be handled within the limits of a one-semester course, we have stressed principles and ideas in the text. Students who desire more details (for example, of experiments) should consult the extensive bibliography listed at the end of each chapter. Central ideas are emphasized by special print within the text. In addition, a number of appendixes have been provided which deal in greater depth with some

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