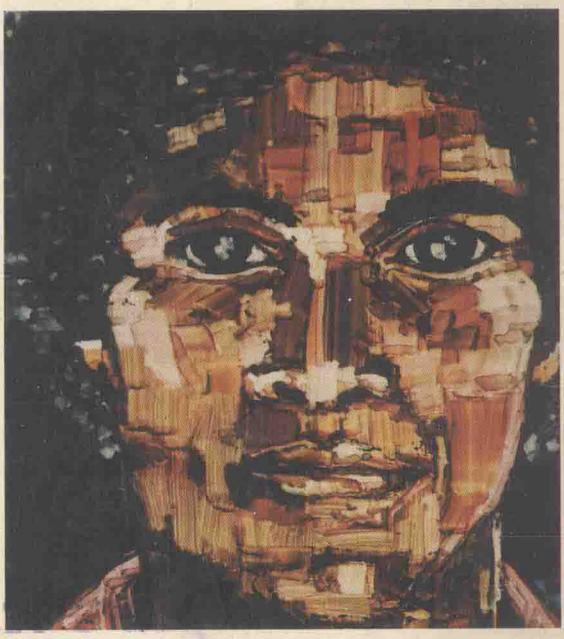
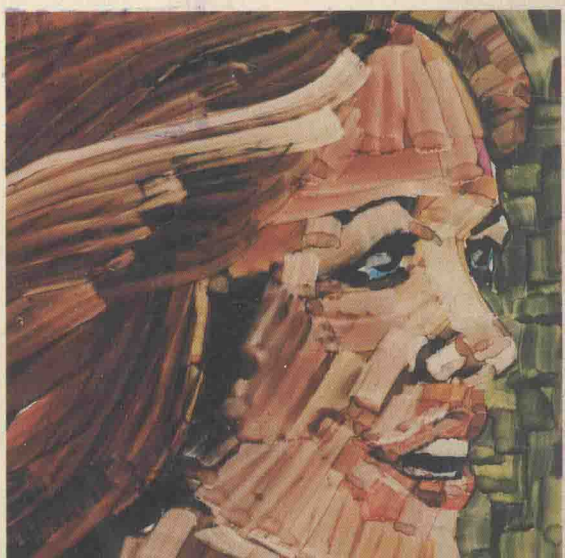
SECOND EDITION

Heredity and Human Affairs

James J. Nagle





Heredity and Human Affairs

James J. Nagle

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SECOND EDITION

with **305** illustrations

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HEREDITY AND HUMAN AFFAIRS

To the professors who influenced me most

Donald D. Rabb

and

Carey H. Bostian

PREFACE

One does not have to be a biologist to have an interest in and curiosity about human heredity and the social ramifications of modern genetic technology. This book was developed out of my experiences in trying to relate some of the major biological principles associated with the science of genetics in a meaningful way to students who are not biology majors. I have concentrated on three broad areas of biology—evolution, reproduction, and genetics—placed into the context of human heredity. My objective is to provide a reasonably sophisticated approach to understanding the factual and theoretical foundations of these areas of biological knowledge so that the educated person may be able to act and react more rationally and responsibly to the social, ethical, and moral problems so prevalent today as a result of the so-called biological revolution.

The book is divided into three sections—evolutionary processes, reproductive processes, and hereditary processes. Capitalizing on our "natural interest" in ourselves, I have chosen to concentrate exclusively on those aspects of the areas under study that relate *directly* to human concerns. Any subarea of evolution, reproduction, or genetics that does not lend itself to human example or concern has been deliberately omitted from the text. This is not because I do not appreciate or acknowledge the value of biological knowledge peripheral to direct human application but because it does not fit the purpose of *this* text for nonmajors.

A discussion of the evolutionary processes, beginning with the origin of life, is placed first in the book to give perspective to subsequent discussions by providing a suitable background to which structures, functions, and mechanisms of reproduction and heredity can be related. For the sake of what I consider to be a coherent approach to fully understanding human heredity in its proper context, I have purposely employed evolutionary theory to set the stage for studying human heredity, forsaking "genetic depth" in the evolutionary processes themselves.

Reproductive processes are discussed next because an understanding of the mechanisms involved in them is prerequisite to comprehending hereditary transmission and the important role of genes in development. Far too many persons lack the basic knowledge of sexual reproduction. This is particularly perplexing given the social controversies within this area in which the average

citizen becomes involved today. These range from debates about sex education in the public schools to legislative decisions on abortions and the human status of the fetus.

With the evolutionary background and reproductive mechanisms established, the final portion of the book addresses the hereditary processes. This section begins with a description of the gene and its function, which is followed by a consideration of the various modes of genetic transmission. The reason for introducing gene function before Mendelian inheritance is that even simply inherited human genetic diseases such as sickle cell anemia, cystic fibrosis, and Tay-Sachs disease cannot be clearly understood without knowing what the gene product is, how the genetic code operates, and what a genic mutation does. The subsequent discussions on genetic transmission are aimed at developing an understanding of how it is possible to account for the wide, and seemingly complex, array of hereditary patterns observed for various traits. In this section the text becomes more technical, because without delving into the "guts" of hereditary transmission the student would be left with nothing but a set of "interesting facts" about human inheritance. My interpretation of the difference between a popular book written strictly for the reading public and a textbook written for the nonmajor college student is that the latter, which is my objective, is designed to be *studied* with the expectation of gaining fundamental knowledge, whereas the former is designed to be *read only* with the objective of broadening one's horizons in a more informal and unstructured manner.

No previous course in college biology is assumed to be necessary for the discussions in this book. Chemistry is not practiced in the text. Only *descriptions* of chemical processes are used, along with the chemical "names" for identification purposes. The mathematics required is hardly more than the arithmetic of fractions and decimals; nevertheless, that is the most common "hang-up" of students I have taught. Recognizing this fact, I have tried to explain all mathematical manipulations fully and in elementary terms. The quantitative nature of genetics and, in fact, all science is too important to ignore. Indeed, it would be an injustice to our science and our students to portray genetics as being nonquantitative. I have tried to introduce the student to the quantitative nature of genetics without unduly complicating the text with formulations beyond those essential to basic principles.

I have made numerous changes in this new edition in an attempt to improve the usefulness of the book. I have converted the entire text to nonsexist language. This was not done to conform to a fad or in response to any particular pressure; merely becoming aware of the situation of women in our society has led me to become sensitive to the needless masculine bias in our writing. Nonsexist language strikes me as being a clearer and more accurate form of exposition than a strictly male-oriented style. This is especially true in the biological sciences, in which male and female distinctions are indeed meaningful.

Within the textual material of this new edition I have added many more divisions and subdivisions of the chapters. It is hoped that this will provide a better overview of the material and aid students in their study and review. Additions to various chapters include discussion on the naked gene hypothesis, aging and heredity, discovery of DNA as the genetic material, "catching" genetic disease, objectives of genetic counseling, mapping human genes, and carrier detection and fetal monitoring in the population. In addition, Chapter 14 was entirely reorganized and rewritten to incorporate developments in the area of genetic engineering. Besides these major changes, more human examples, particularly of diseases and disorders, were added throughout, several new illustrations and tables were designed, and many previously used illustrations were modified. The final textual change involved reversing the order of Chapters 8 and 9 of the first edition. This places the discussion of sex-linked inheritance directly after Mendelian transmission and before the more complex patterns such as multiple alleles and interaction.

Additions have also been made to the end of each chapter that are intended to stimulate the intellectual curiosity of students. To stress the importance of "heredity and human affairs" rather than the routine problem solving of a technical course in genetics for biological sciences majors, I have included "Points to Ponder." These are designed to help involve the students in social and ethical implications of our advanced biological knowledge and research. There are, of course, no universal answers to these questions. Their objective is to serve as linkages between the text and the real world. I am sure that teachers and students alike will be able to develop even more stimulating and perplexing points to ponder than those I offer. I hope, however, that my attempts will stimulate serious thinking on issues important to our society and its future.

The second addition provides selected readings through which students may advance their in-depth study of particular subjects. To emphasize the depth-in-subject nature of these readings, the list has been partitioned into particular subject areas. This was done to help students focus on important subjects that are often obscured by the alphabetizing of many diverse references in one listing.

Finally, the glossary was revised to match changes in the text and sixty new entries were added. I also enhanced the cross-references in the glossary. My objective in this extensive cross-referencing is to lead the student to all sequentially and conceptually related terms. I hope that students will be encouraged to use the glossary in this manner.

Thanks are due the following individuals, whose comments, recommendations, and criticisms have helped me make this new edition more responsive to the needs of the students and faculty who use this book: K. Baumgartner, Algonquin College; R. Bernstein, San Francisco State University; C. Bottrell, Tarrant County Junior College; L. Cohen, Pomona College; R. Colby, Stockton State College; M. Eleuterio, West Chester State College; J. Erickson, Western

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I also wish to specifically acknowledge the support and endurance of my wife, Jan, and my sons, Doug and Matt. Their tolerance of my poor humor and lack of attention while I worked on this volume is deeply appreciated.

James J. Nagle

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