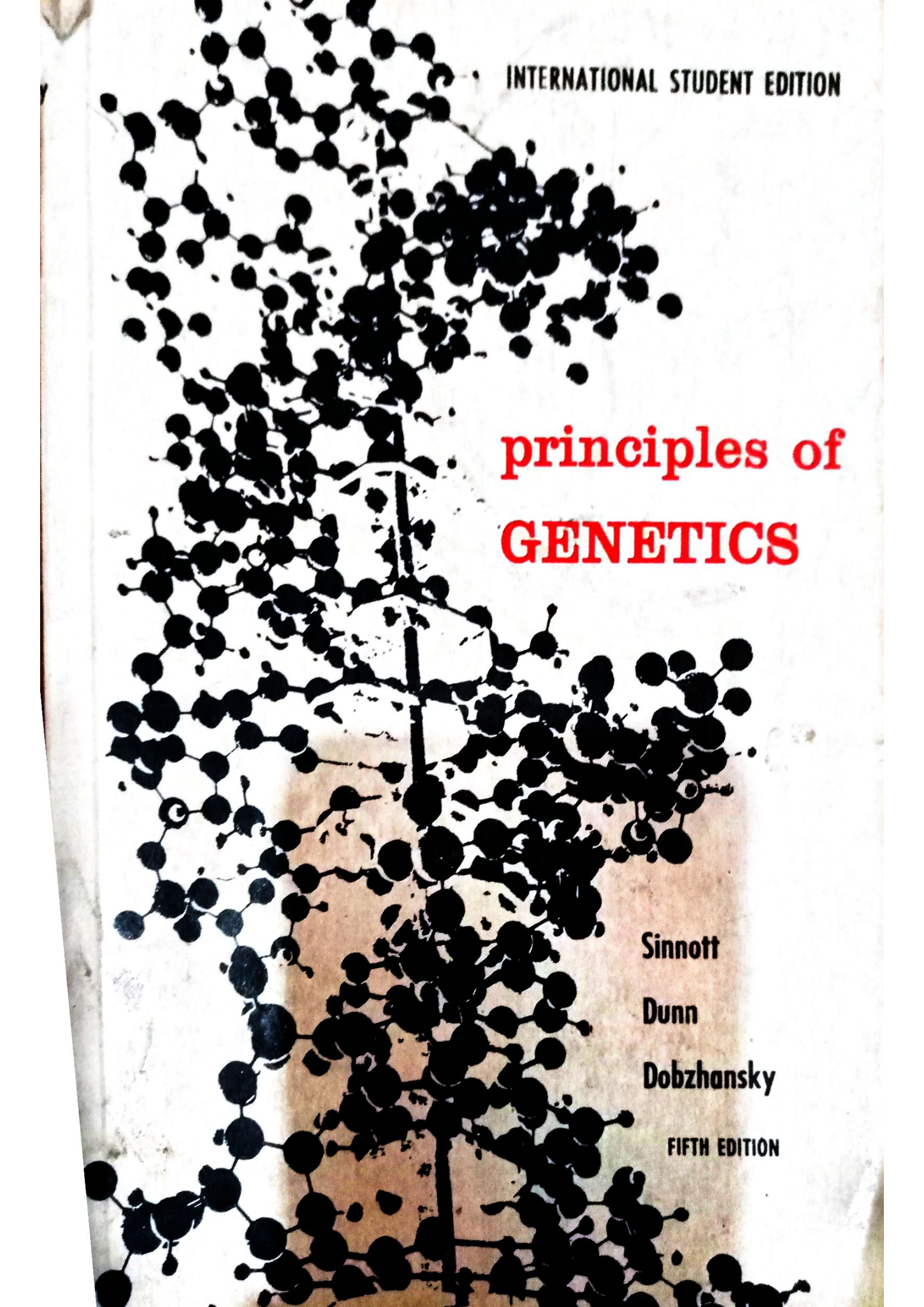




INTERNATIONAL STUDENT EDITION

**principles of
GENETICS**

Sinnott

Dunn

Dobzhansky

FIFTH EDITION

CONTENTS

Preface vii

1

1. HEREDITY AND THE CONTINUITY OF LIFE

Life Comes Only from Life. Viruses, the Living, and the Nonliving. Reproduction. Discovery of Egg, Sperm, and Fertilization. Sexual Reproduction in Plants. Preformation and Epigenesis. Biological and Legal Inheritance. Darwin's Hypothesis of Pangenesis. Inheritance of Acquired Characters. Weismann, a Forerunner of Modern Genetics. The Cellular Basis of Reproduction. The Cell. The Nucleus. Mitosis. Fertilization, or Syngamy. Nuclei and Chromosomes as Transmitters of Heredity.

17

2. HEREDITY AND ENVIRONMENT

Heredity, Growth, and Assimilation. Genotype and Phenotype. Heredity and Variation. Distinguishing Hereditary and Environmental Variations. Clones, Pure Lines, and Inbred Lines. Experiments on Races of Plants from Different Environments. Norm of Reaction. Individual Adaptation and Homeostasis. Adaptedness and Genotypic Variation. Hereditary Disease. Phenocopies. What Characters or Traits Are Hereditary?

MENDEL'S LAW OF SEGREGATION

32

Mendel's Methods. Dominance. Segregation. The Gene Hypothesis. Mendelian Ratios. Testing the Validity of the Gene Hypothesis. The Backcross Ratio. Segregation in Crosses without Dominance. Lack of Relation between Dominance and Vigor.

4.	SEGREGATION OF GENES AND CHROMOSOMES Individuality of Chromosomes. Meiosis. Meiotic Pairing of Chromosomes. Chiasmata. The Meiotic Divisions. Reproduction in Plants. Double Fertilization in Plants. Parallel Behavior of Chromosomes and Genes. Time of Segregation.	45
5.	SIMPLE MENDELIAN TRAITS IN MAN Pedigrees. The Inheritance of Albinism. Inheritance of Skin Spotting. Taste Blindness for PTC. Brown and Blue Eye Colors. M-N Blood Groups. Disputed Paternity. Counting Genes in Human Populations. Mendelian Ratios Observed in Human Pedigrees. Genetic Prognosis.	59
6.	MENDEL'S PRINCIPLE OF INDEPENDENT ASSORTMENT Dihybrid Cross. Independent Assortment. Difference between Genotype and Phenotype. Dihybrid Test Cross. Trihybrids. Polyhybrids. The "Blood" Theory and the Gene Theory. Independent Assortment of Genes and Chromosomes.	71
7.	THE EXPRESSION AND INTERACTION OF GENES Combs in Fowls. Complementary Genes for Colors in Corn. The 9 : 7 Ratio. Genetic "Formulas." Reversion. Coat Color in Rodents (the 9 : 3 : 4 Ratio). Epistasis. Analysis of Coat Colors in Mice. Gene Interaction in Cats. Albinism and Spotting in Man. Green Color in Corn.	85
8.	MULTIPLE-FACTOR INHERITANCE Quantitative and Qualitative Traits. Seed Color in Wheat. Skin Color in Negro and White Crosses. Ear Size in Maize. White Spotting in Mice. Modifying Factors. Specific Modifiers.	99
9.	ALLELISM AND PLEIOTROPISM Multiple Alleles. The Albino Series of Coat Colors in Rabbits. Albinism in Other Animals. Mosaic Dominance. The O-A-B Blood Groups in Man. The Discovery of the "Rhesus" Alleles in Man. The Multiple Alleles of the "Rhesus" Series. Self-sterility Alleles. Unit Characters. Pleiotropism.	112
10.	LETHAL GENES, PENETRANCE, AND EXPRESSIVITY Lethal Genes. Lethal Hereditary Diseases in Man. Phenylketonuric Imbecility. Semilethal and Subvital Genes in Man. Subvital Effects in Mutants of <i>Drosophila</i> . Penetrance and Expressivity. Huntington's Chorea. Taste Blindness for PTC. Causes of Variable Penetrance and Expressivity.	125
11.	THE NATURE-NURTURE PROBLEM IN MAN: TWIN STUDIES	133

	<i>Variances, and Correlations. Amino-acid Excretion in Urine. Twins Reared Apart. Is Criminality Inherited? Critique of the Twin Method.</i>	
12.	SEX-LINKED INHERITANCE <i>Discovery of Sex Chromosomes. The Two Types of Sex Determination. Sex Linkage in Drosophila. Sex-linked Genes in Man. Heredity through the Y Chromosome. Sex-linked Genes in Poultry and in Moths. Primary Nondisjunction of X Chromosomes in Drosophila. Secondary Nondisjunction of X Chromosomes in Drosophila. Attached-X Chromosomes in Drosophila.</i>	143
13.	LINKAGE AND CROSSING OVER <i>Linkage. Crossing Over. Crossing Over and Chromosome Behavior at Meiosis. Absence of Crossing Over in Drosophila Males. Linkage Groups and Chromosomes. Recombination and Crossing Over. Factors Affecting the Strength of Linkage. Measurement of Linkage from F₂ Data. Cytological Demonstration of Crossing Over.</i>	160
14.	GENETIC MAPS OF CHROMOSOMES <i>Linear Arrangement of Genes in Chromosomes. Double Crossing Over. Interference and Coincidence. Linkage Maps of Drosophila Chromosomes. Linkage Maps of Maize Chromosomes. Maps of Human Chromosomes. Chromosome Morphology and Chromosomes. Chromosomes and Linkage Maps in Maize. Giant Chromosomes in the Salivary Glands of Flies.</i>	181
15.	CHROMOSOME ABERRATIONS AND CYTOLOGICAL MAPS <i>Classification of Chromosomal Aberrations. Trisomics and Monosomics. Deficiency. Duplication. Translocation. Inversion. Permanence of the Centromere. Cytological Maps. Euchromatin and Heterochromatin.</i>	195
16.	SPONTANEOUS MUTATION <i>Continuous and Discontinuous Variability. Mutations in Oenothera. Mutations in Drosophila and Other Organisms. Phenotypic Traits Changed by Mutation. Stages at Which Mutations Occur. Quantitative Studies of Mutations. Detection of Sex-linked Mutations. Measurement of the Mutation Rates in Autosomes of Drosophila. Total Mutation Rate in Drosophila. Frequency of Mutation in Individual Genes. Biochemical Mutants in Neurospora. Mutations in Bacteria. Mutation in Man. Genetic Modifiers of Mutability. Reversibility of Mutation.</i>	214
17.	INDUCED MUTATION <i>Muller's Experiment. Time-Intensity Rule. Equivalence of Different Radiations. Natural Radiations and Spontaneous Mutability. The</i>	231

Target Theory. Induction of Chromosomal Aberrations.
Chromosome Breakage and Reunion. Comparison of Spontaneous
and Induced Mutations. Mutagenic Effects of Ultraviolet Rays.
Chemical Mutagens. Directed Mutation.

18. **GENES IN POPULATIONS** 241
The Hardy-Weinberg Law. Gene Frequency and Phenotype Frequency.
Factors of Evolution. Mutants in Populations. Natural Selection.
Genetic Death. Equilibrium between Mutation and Opposing Selection.
Deleterious Genes in Natural Populations of Drosophila. Deleterious
Genes in Populations Other Than Drosophila. Selection against
Dominant Defects. Selection against Recessive Defects.
19. **CROSSING, SELFING, INBREEDING, AND HETEROSIS** 254
Early Work on Inbreeding. Inbreeding and Heterosis in Corn.
Hybrid Corn. Mutational Heterosis. Balanced Polymorphism and
Balanced Heterosis. How Widespread Is Balanced Heterosis?
Genetic Effects of Radiations on Populations. Experiments on Irradiated
Populations. Weakness of Heterosis in Self-fertilizing Forms.
Permanent Heterozygotes in Oenothera. Parthenogenesis, Apogamy,
and Asexual Reproduction.
20. **GENETICS OF RACE FORMATION** 270
Mutation and Adaptedness. Adaptive Changes in Experiments.
Artificial Selection in Self-fertilizing Forms. Artificial Selection in
Cross-fertilizing Species. Heritability and Selection. Adaptive
Changes in Natural Populations of Drosophila. Geographic
Chromosomal Races in Drosophila. Geographic Distribution of Blood
Groups. Externally Visible Race Differences. Genetic Drift.
Races and Individuals. Race Divergence.
21. **GENETICS OF SPECIES FORMATION** 286
Reproductive Isolation and Speciation. Introgressive Hybridization.
Morphological and Genetic Differences between Species. Origin of
Reproductive Isolation. Chromosome Differences between Species.
Inversions and Chromosomal Differentiation of Species. Genic and
Chromosomal Sterility. Autopolyploids. Allopolyploids.
Polyploidy as a Method of Origin of Species. Animal Polyploids.
22. **DETERMINATION OF SEX** 303
The Chromosomal Theory of Sex Determination. The Sexual Function
of X and Y Chromosomes. Gynandromorphs. Intersexes and
Supersexes in Drosophila. Genic Balance and Determination of Sex.
Intersexes and Environment. Factor of Safety. Diploid Intersexes in
the Gypsy Moth. How Many Genes Determine Sex? Sex

*Chromosomes in Different Organisms. Sex Chromosomes in Man.
The Effects of Hormones.*

- 23. VARIETIES OF SEXUAL REPRODUCTION** 314
Sex in Bacteria. Recombination in Bacteriophages. Bacterial Transformations. Mating Types and Multiple Sexuality in Infusoria. Sex in Fungi. Heterocaryons and Parasexuality. Hermaphroditism and Bisexuality. Sex in Higher Plants. Sex Determination by Male Haploidy. Sex in Bonellia.
- 24. PHYSIOLOGICAL GENETICS** 326
Genic Control of Pigments in Flowering Plants. Genic Control of Antigens. Genic Control of Protein Structure. Genic Control of Metabolic Patterns. Biochemical Synthesis. Human Biochemical Genetics. Enzymes as Agents of Genic Control.
- 25. THE GENIC CONTROL OF DEVELOPMENT** 339
Genic Control of Developmental Processes. Gene and Character. Genic Balance. Eye Color in Ephesia. Eye Color in Drosophila. Genic Control of Morphogenetic Processes. General Metabolic Effects. Effects of Genes on "Organizer" Relationships. Pedigree of Symptoms in Pleiotropism. Effects of Deficiencies on Differentiation. Cell-lethality. Genic Control of Hormonal Coordination. Plant Hormones. Plumage Patterns. Genic Control of Growth. Genic Control of Form. Summary.
- 26. CYTOPLASM IN HEREDITY AND DEVELOPMENT** 359
Cytoplasmic Inheritance. Predetermination. Viruslike Inclusions and Infective Particles. The Milk Factor. The Kappa Particles of Paramecium. The Sigma Substance in Drosophila. Plastid Inheritance. Induction of Cytoplasmic Characters in Microorganisms. Other Cases of Cytoplasmic Transmission. Merogonic Hybrids. The Spread of Pigment in the Skin.
- 27. THE ELEMENTS OF THE GENETIC SYSTEM** 370
Crossing Over within Series of Alleles. Resolution of a Gene in Maize. The Gene as a Unit of Function. The Physical Structure of the Genetic Material. Cytooptical Studies of DNA. Cytochemical Studies. The Structure of DNA. Replication. Mutation. RNA in Heredity.
- 28. ORGANIZATION OF THE GENETIC MATERIAL** 379
Position Effects. Position Alleles. Blocks of Genes with Related Effects. The Origin of New Genes through Duplication. The Importance of Pattern.

29. STATISTICAL INFERENCE IN GENETICS

1. Introduction.	388	15. The Frequency Distribution.	
• <i>Statistics of Segregation Ratios.</i>	388	16. Histograms.	
2. A Simple Problem.	388	17. The Mean and Standard Deviation.	
3. A Decision Rule.	389	18. Sample and Population.	
4. Probability: Binomial Trials.	390	19. Theoretical Distributions.	
5. Testing a Statistical Hypothesis.	391	20. The Normal Curve.	
6. The Power Curve.	392	21. Theoretical Basis of the Normal Curve.	
7. Another Approach to Tests of Hypotheses.	393	22. Distribution of the Sample Mean.	
8. Confidence Intervals.	394	23. Testing Hypotheses about the Mean.	
• <i>The Chi-square Method.</i>	396	24. Student's Distribution.	
9. An Approximation to the Binomial Test.	396	25. Confidence Intervals for the True Mean.	
10. The More General Case of the Chi-square Test.	397	26. The Distribution of Sums and Differences.	
11. The Chi-square Test for Linkage.	398	27. Inferences about the Difference of Two Means.	
12. Contingency Tables.	399	28. The Method of Paired Comparisons.	
• <i>The Analysis of Quantitative Variation.</i>	400	29. The Normal Approximation to the Binomial Distribution.	
13. The Nature of Quantitative Variation.	400	30. The Standard Error.	
14. Human Height.	401	31. The Study of Variability.	
		32. Two Tails or One?	

APPENDIX Experiments in Plant Hybridization, by Gregor Mendel 411

BIBLIOGRAPHY 44

INDEX 44