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# HUMAN BIOCHEMISTRY

外文书库

By

ISRAEL S. KLEINER, Ph.D.

Professor of Biochemistry and Director of the Department of Biochemistry,  
New York Medical College, Flower and Fifth Avenue Hospitals; Formerly Associate,  
The Rockefeller Institute for Medical  
Research, New York



*WITH NINETY-THREE TEXT ILLUSTRATIONS  
AND FIVE COLOUR PLATES*

FOURTH EDITION



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# HUMAN BIOCHEMISTRY



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## Preface to Fourth Edition

Biochemistry continues to advance at great speed and in many directions. In this revision, as before, the author has attempted to keep sight of its vast new horizons. The first objective has of course been to eliminate any concepts which have changed or are of doubtful nature. More difficult has been the task of selecting from the almost limitless researches those advances which seem to be authenticated and at the same time of significant value to the student. From the many pages and volumes of current biochemical literature, it has been necessary to cull those discoveries which are either of proved worth or indicative of exciting trends. The original purpose of *Human Biochemistry*—to create a useful, understandable, and compact volume—has been kept in mind constantly.

Every chapter has been examined critically. In most cases this has been done by an expert in the field, whose advice has been followed as closely as possible. Large areas have been completely rewritten, notably those dealing with blood coagulation, enzymes and coenzymes, physiological oxidations, cholesterol metabolism, urea formation, transmethylation, and the mechanism of insulin action. There has been extensive revision of the sections concerning the tricarboxylic acid cycle, coenzyme A, formation of gastric HCl, biochemistry of tumors, the role of vitamin A in vision, vitamin B<sub>12</sub> and folic acid, electrolyte and acid-base balance, and the metabolism of a number of the amino acids. Pentose and fatty acid metabolism have been given more space, and the use of isotopes is reflected in many chapters.

Among the new topics thought worthy of discussion are the dextrans, triiodothyronine, glucagon, serotonin, the carbonic anhydrase inhibitors, blood iodine, lipoic acid, and the structure of insulin and of oxytocin. A section is devoted to the nomenclature of the steroids.

There have been introduced two new photomicrographs and a number of new figures and diagrams. Some of the latter have appeared elsewhere and are reproduced by kind permission of the authors and publishers. Several illustrations which appeared in the third edition have been modified to agree with current concepts.

The writer expresses his thanks for searching criticism of various chapters or large sections to Dr. Maurice M. Black, Dr. Richard J. Block, Dr. Halvor N. Christensen, Dr. Adam A. Christman, Dr. Charles L. Fox, Jr., Dr. C. E. French, Dr. David Glick, Dr. Franklin Hollander, Dr. Alfonso A. Lombardi, Dr. Walter Menaker, Dr. Walter H. Seegers, Dr. Sam Seifter, Dr. J. A. Stekol, and Dr. R. W. Swift. It is a pleasure to acknowledge the valuable counsel given by Dr. Stefan Ansbacher, Dr. Harry Barowsky, Dr. William H. Beinfeld, Dr. Lyman C. Craig, Dr. Harry J. Deuel, Jr., Dr. Louis B. Dotti, Dr. David L. Drabkin, Dr. Leonard G. Ginger, Dr. Sam Granick, Dr. Charles Haig, Dr.

William B. Langan, Dr. L. Corsan Reid, Dr. Kurt G. Stern, Dr. Carleton R. Treadwell, Dr. Vincent du Vigneaud, Dr. D. Wright Wilson, and Miss Rachel Reed. Continuous aid has come from the writer's associates, Dr. Harry Baron, Dr. Paul Fodor, Mr. Arthur Katchman, and Mr. Sherman Beychok. The advice and encouragement of his colleague, Professor Carl Neuberg, have been particularly gratifying. Thanks are expressed to all of the above and to many others who have sent in criticisms and suggestions. All of their ideas could not be embodied in this work, but for those which have been included (as well as for omissions) the writer assumes full responsibility, despite the fact that he could not hope to be an authority on so many phases of the subject.

Grateful mention should be made of the efficient secretarial assistance of Mrs. Ruth Glantz and the bibliographic work of Mrs. Eugenia Dover. The original line drawings are the work of Miss Natalie Pearlstein, and the photomicrograph of hemin crystals is by Mr. Jacob Glenner, to both of whom thanks are due.

ISRAEL S. KLEINER

New York, N. Y.

## Preface to First Edition

It is not so many years since physiological chemistry was essentially a pure science course in medical schools and reference to clinical applications was incidental if not accidental. Medical and dental students, reasonably enough, questioned the necessity of the subject in the curriculum, feeling it was not much more than a mental exercise, as Latin is so often considered in the academic curriculum. But those days have passed. The name biochemistry has now, in most instances, replaced the term physiological chemistry, and that bit of streamlining has been accompanied by a modern approach on the part of the chemistry faculty. The biochemist has come halfway from the laboratory toward the clinic.

The student now is shown the subject as an integral part of the practice of medicine—not just as a part of the medical curriculum. He learns that advances in every branch of medicine, surgery, and dentistry have been made as a result of biochemical research, that the human body is applied biochemistry, that the entire field of physiology is a series of biochemical reactions and pathological phenomena result from disturbances of these same reactions, and that biochemical discoveries are more and more responsible for progress in diagnosis and therapeutics. The present volume is an attempt to bring home to the student these clinical aspects of biochemistry without usurping any clinician's domain and without neglecting the fundamentals.

Since the preparatory years of medical and dental students are today being curtailed in many instances, it is necessary to keep in mind the fact that the classes for a few years will include some who are not so well equipped as one would wish. It is hoped that this text is neither too advanced for them nor too elementary for students who are well prepared.

The question of mentioning investigators' names and quoting references has given the writer considerable concern. However, consideration has been given primarily to the student and secondarily to the instructor or advanced student. Therefore, the number of such references has been kept as low as possible. The student should be familiar with the names of some of the scientists who are responsible for fundamental discoveries. There should also be available to him references to the more recent experimental studies which seem to be establishing new trends. The instructor may want to ask the student to go to the original sources, particularly if the subject is controversial. Many such references have been given, and reviews or monographs have been cited to permit a more extended study of some of the topics discussed, but it has been impossible to mention more than a small fraction of the names of competent investigators and authorities. In many instances, distinguished names have been omitted in order to improve the "readability" of the text.

Thanks are due to the following biochemists, physiologists, and specialists in other fields who read and criticized parts of the manuscript and who made

many valuable contributions: Dr. Alfred Angrist, Dr. Cameron V. Bailey, Mr. Harry Baron, Dr. Maurice M. Black, Dr. Richard J. Block, Dr. W. R. Bloor, Dr. Robert K. Brewer, Dr. Otis M. Cope, Dr. Louis B. Dotti, Dr. Charles Haig, Dr. Franklin Hollander, Dr. Arthur Knudson, Dr. William B. Langan, Dr. Joseph I. Linde, Dr. Fritz Lipmann, Dr. C. N. H. Long, Dr. Edgar G. Miller, Jr., Dr. Victor C. Myers, Dr. Marie O'Donahoe, Dr. Arnold H. Schein, Dr. Arthur H. Smith, Dr. Eric G. Snyder, Dr. Francis D. Speer, Dr. Henry Tauber, Dr. Abraham White.

The author's thanks also go to Mr. E. R. Capps, Mr. Stanley Beard, and to others who have been consulted at various times. Acknowledgment is gratefully made to Dr. Mary B. Stark, for the original diagram of a liver lobule; to Miss Ednita Bernabeu, for sketches of crystals; and to Mr. Christopher Tritsch, for the line drawings of diagrams. The invaluable aid, advice, and criticism of Mr. Frank L. Pollack is greatly appreciated.

No textbook can be original. It is in the nature of a compilation of fundamental facts and recent advances. As a result it is built upon the work of many others which have preceded it. The present work is no exception. Many textbooks, reviews, and original articles have been consulted and their contents digested and assimilated into this volume. Acknowledgment is hereby made of this debt to many authors. Some copyrighted material has been used with the generous consent of the various authors and publishers.

ISRAEL S. KLEINER

New York

# Contents

	CHAPTER 1	PAGE
INTRODUCTION - - - - -		17
Protoplasm, 17; Water of Tissues, 18; Inorganic and Organic Constituents, 18; Classification of Biological Elements, 19; Isotopes, 20.		
	CHAPTER 2	
PHYSICAL CHEMISTRY - - - - -		21
Law of Mass Action, 21; Hydrogen Ion and Hydroxyl Ion Concentration, 22; Buffers, 24; Indicators, 25; Indicator Method of Determining Hydrogen Ion Con- centration, 26; Titratable Acidity, 28; The Colloidal State, 30; Types of Colloids, 31; Electrical Charges on Colloids, 31; Surface Reactions of Colloids, 33; Surface Tension, 34; Gas Laws, 35; Diffusion, Osmosis, and Dialysis, 36; Membranes in the Animal Body, 39; Gibbs-Donnan Equilibrium, 39; Viscosity, 41; Emulsions, 41; Ion Exchange Resins, 41; Chromatography, 42.		
	CHAPTER 3	
CARBOHYDRATES - - - - -		44
Classification, 44; Monosaccharides, 44; Disaccharides, 45; Polysaccharides, 45; Structure of the Monosaccharides, 45; The Asymmetric Carbon, 46; Specific Ro- tation, 50; Sugars as Reducing Agents, 51; Formation of Osazones, 52; Desoxy- sugars, 54; Action of Alkalies on Sugars, 54; Action of Acids on Sugars, 55; Glycosides, 56; Mutarotation and the Structure of the Monosaccharides, 57; Structure of Disaccharides, 58; Monosaccharide Phosphates, 59; Fermentation, 60; Monosaccharides, 61; Disaccharides, 64; Sweetness of Sugars, 65; Polysac- charides, 66; Carbohydrate Derivatives, 72.		
	CHAPTER 4	
LIPIDS - - - - -		75
Fats, 76; Physical Properties of Fats, 78; Hydrolysis of Fats, 78; Glycerol, 79; Soaps, 79; Unsaturation, 82; Rancidity, 82; Identification of Fats and Oils, 83; Essential Fatty Acids, 84; Waxes, 85; Sterols, 85; Cholesterol, 87; Other Im- portant Sterols, 88; Phospholipids, 90; Lecithins, 90; Cephalins, 91; Sphingo- myelins, 92; Cardiolipins, 92; Glycolipids, 93.		
	CHAPTER 5	
PROTEINS - - - - -		95
Classification, 96; Simple Proteins, 96; Compound Proteins, 97; Derived Pro- teins, 97; Occurrence and Properties of the Proteins, 98; General Properties of Proteins, 102; Amino Acids, 104; Peptide Linkage, 110; Isoelectric Point, 111; Denaturation and Coagulation, 115; Nutritional Importance of Proteins, 118.		
	CHAPTER 6	
TISSUES - - - - -		128
The Cell, 128; General Composition of Tissues, 131; Epidermal Tissues, 132; Connective Tissues, 133; Bone, 135; Bone Formation, 136; Bone Marrow, 138; Teeth, 138; Adipose Tissue, 140; Nervous Tissue, 140; Muscle Tissue, 143.		
	CHAPTER 7	
MILK - - - - -		148
General Composition of Milk and Factors Modifying It, 148; Species, 149; Indi- vidual Variations, Age, 150; Period of Lactation, 150; Diet, 151; Physical and		

Mental Conditions, etc., 152; Fractions of a Single Nursing, 152; Composition of Human and Cow's Milk, 152; Physical Characteristics and Reaction, 153; Lactose, 153; Proteins, 154; Lipids, 156; Ash, 157; Vitamins, 157; Nutritive Importance of Milk, 162.

## CHAPTER 8

BLOOD	164
Functions, 164; General Composition, 165; Physical Characteristics, 166; Blood Plasma, 167; Albumin and Globulin, 169; Red Blood Cells, 175; Hemoglobin, 176; White Blood Cells, 184; Platelets, 184; Blood Coagulation, 184; Anemias, 194; Blood Transfusion and Blood Substitution, 196; Lymph, 200; Other Body Fluids, 201; Cerebrospinal Fluid, 201; Semen, 202; Transudates and Exudates, 202; Medicolegal Tests for Blood, 203.	

## CHAPTER 9

ENZYMES	206
History of Enzyme Chemistry, 206; Preparation of Enzyme Material, 207; Chemical Nature of Enzymes, 208; Terminology of Enzymes, 208; Classification, 210; Specificity, 211; Factors Influencing Enzyme Action, 212; Reversibility and Synthetic Action, 215; Inhibitors and Activators, 216.	

## CHAPTER 10

DIGESTION	219
Saliva, 219; Functions of Saliva, 221; Enzymes of Saliva, 221; Gastric Digestion, 222; Gastric Juice, 223; Hydrochloric Acid, 224; Enzymes, 227; Digestion in the Small Intestine, 230; Reaction of the Intestine, 231; Pancreatic Juice, 231; Intestinal Juice, 234; Bile, 235.	

## CHAPTER 11

CHEMICAL CHANGES WITHIN THE LARGE INTESTINE	245
General Character of Feces of Adult, 246; Action of Microorganisms on Carbohydrates and Fats, 247; Fecal Lipids, 247; Action of Microorganisms on Proteins, 248; The Question of Autointoxication, 250.	

## CHAPTER 12

VITAMINS	254
Historical, 254; The Fat-Soluble Vitamins, 257; Vitamin A, 257; Vitamin D, 264; Vitamin E, 272; Vitamin K, 274; The Water-Soluble Vitamins, 277; Vitamin C, 278; The Vitamin B Complex, 285; Vitamin B <sub>1</sub> , 286; The Heat-Stable B Vitamins, 289; Riboflavin, 289; Niacin (Nicotinic Acid), 291; Pyridoxine, 293; Pantothenic Acid, 295; Biotin, 298; Para-Aminobenzoic Acid, 298; Pteroyl-glutamic Acid ("Folic Acid"), 300; Vitamin B <sub>12</sub> , 302; Other Essential Nutritional Factors, 304; Choline, 304; Inositol, 305; $\alpha$ -Lipoic Acid, 306; Biosynthesis of Vitamins, 306; Subacute and Multiple Avitaminoses, 306; Vitamins in Daily Life, 308; Vitamins as Drugs, 308; Conditioned Vitamin Deficiencies, 309.	

## CHAPTER 13

FOODS	314
The Energy Factor, 314; The Protein Factor, 315; The Carbohydrate Factor, 319; The Fat Factor, 320; The Mineral Factor, 321; Acid- and Base-Forming Properties of Foods, 323; Vitamins in Food, 324; Recommended Dietary Allowances, 325; Preservation of Foods, 328; Food Allergy, 330; Diet Therapy, 331; Unbalanced and Incomplete Diets, 338.	

## CHAPTER 14

PAGE

PHYSIOLOGICAL OXIDATIONS - - - - -	341
Oxidations, 341; Energy Relationships, 342; Respiratory Enzymes and Carriers, 346; Hydrogen Activation, 346; The Coenzymes, 346; Flavoproteins, 348; The Cytochromes, 349; Other Possible Agents, 351; Peroxidases and Catalases, 353; Energy Production and Utilization, 353; Oxidative Decarboxylations, 356.	

## CHAPTER 15

NITROGEN METABOLISM - - - - -	362
Absorption, 362; General Path of the Amino Acids in the Body, 363; Nitrogen Balance, 364; Uses of Amino Acids, 365; Urea Formation, 371; Ammonia Formation, 374; Metabolism of Some Individual Amino Acids, 376; Creatine and Creatinine, 393; Purine and Pyrimidine Metabolism, 396; Synthesis of Purines and Pyrimidines, 402; Clinical Uses of Amino Acids, 405; Essential Amino Acids, 406.	

## CHAPTER 16

CARBOHYDRATE METABOLISM - - - - -	412
Absorption, 413; The Blood Sugar, 414; Glycogen Formation in the Liver, 415; Phosphorylation and Phosphorolysis, 415; Glycogenolysis in the Liver, 417; Glycogenesis in Muscle, 419; Glycogenolysis in Muscle, 419; Utilization of Glucose, 420; Carbohydrate Metabolism in Striated Muscle Contraction, 421; Fate of Lactic Acid and of Pyruvic Acid, 425; Carbohydrate Metabolism in Heart Muscle, 429; Carbohydrate Metabolism in Nervous Tissue, 430; Metabolism of Pentoses, 430; Abnormal Carbohydrate Metabolism, 431; Insulin, 434; Action of Insulin, 436; Influence of Other Endocrine Glands Upon Carbohydrate Metabolism, 442.	

## CHAPTER 17

LIPID METABOLISM - - - - -	446
Physiological Value of Fats, 446; Absorption of Fat, 446; Fat From Carbohydrates and Proteins, 448; Transport of Fat, 448; Changes Occurring in the Liver, 449; Fate of Fat in the Body, 450; Storage of Fats, 450; Oxidation of Fatty Acids, 454; Ketogenesis, 459; Ketosis, 460; Ketogenic and Antiketogenic Substances, 461; Essential Fatty Acids, 463; Rancidity of Fat, 464; Metabolism of Lecithin, 464; Metabolism of Cholesterol, 465; Abnormalities of Lipid Metabolism, 468.	

## CHAPTER 18

MINERAL METABOLISM AND WATER BALANCE - - - - -	472
The Mineral Composition of the Body, 472; Calcium and Phosphorus, 474; Magnesium, 478; Iron, 478; Iodine, 482; Sodium, Potassium, and Chlorine, 486; Water Balance, 489; Pathways of Salts and Water, 489; General Distribution of Body Fluids, 489; Electrolyte Content of Body Fluids, 491; Intake of Water, 494; Output of Water and Salts, 494; Pathological Dehydration and Related Conditions, 498.	

## CHAPTER 19

URINE - - - - -	505
General Characteristics, 505; General Composition of Urine, 512; Pathological Constituents, 523; Inborn Errors of Metabolism, 531.	

## CHAPTER 20

THE CHEMISTRY OF RESPIRATION AND ACID-BASE BALANCE - - - - -	534
Flow of Respiratory Gases, 534; The Carriage of Oxygen, 535; The Carriage of	

## CONTENTS

	PAGE
Carbon Dioxide, 537; The Chloride Shift, 538; Acid-Base Balance, 542; The Buffer Systems of the Blood, 543; The Role of the Kidney, 545; Acidosis and Alkalosis, 548; Disturbances in Acid-Base Balance, 549.	
CHAPTER 21	
ENERGY METABOLISM - - - - -	552
Heat Regulation of the Body, 552; Measurement of Heat, 554; The Respiratory Quotient, 556; Metabolism of Ethyl Alcohol, 559; Basal Metabolism, 560; Normal Influences, 566; Pathological Influences, 568; Specific Dynamic Action of Foods, 570; Influence of Muscular Work Upon Total Metabolism, 572; Influence of Mental Work Upon Total Metabolism, 573; Influence of Sleep, 573; Total Heat Production, 573; Metabolism of Children, 574; Practical Considerations, 575.	
CHAPTER 22	
CHANGES IN THE CHEMICAL COMPOSITION OF BLOOD - - - - -	577
General Composition of Blood, 577; Glucose, 580; Nonprotein Nitrogenous Constituents, 582; Total Nonprotein Nitrogen, 582; Blood Urea, 583; Uric Acid, 584; Creatinine, 586; Cholesterol, 587; Proteins, 589; Hemoglobin, 589; Albumins, Globulins, and Fibrinogen, 591; Calcium and Phosphorus, 593; Sodium and Potassium, 594; Chloride, 594; Iodine, 595; Carbon Dioxide Combining Power, 595; pH, 596; Bile Pigments, 596; Enzymes, 598.	
CHAPTER 23	
HORMONES - - - - -	601
Hormones of the Gastrointestinal Tract, 601; Insulin, 602; Epinephrine, 604; Adrenal Cortex, 606; Thyroid Gland, 614; The Parathyroid Glands, 619; The Pituitary Gland, 620; The Posterior Pituitary Lobe, 621; The Anterior Pituitary Lobe, 623; Chorionic Gonadotrophin, 631; Ovarian Hormones, 631; Corpus Luteum Hormone, 633; The Testicular Hormone, 635.	
CHAPTER 24	
CHEMICAL STRUCTURE IN RELATION TO BIOLOGICAL PHENOMENA - - - - -	642
Detoxication, 643; Biochemical Antagonism, 649.	
CHAPTER 25	
RECENT CLINICAL APPLICATIONS - - - - -	656
Liver Function Tests, 656; Kidney Function Tests, 657; Pancreatic Function Test, 660; Blood Pressure, 660; Dental Caries, 661; Biochemistry of Inflammation, 663; The Biochemistry of Tumors, 663; Acid Phosphatase and the Prostate Gland, 668; Penicillin and Other Antibiotics, 668; The Sulfa Drugs, 673; Radioactive Isotopes, 676; Enzymes and Enzyme Inhibitors, 676; Cortisone and ACTH in Rheumatoid Arthritis, 679; Pyrogens, 680.	
APPENDIX	
APPENDIX - - - - -	685

## Color Plates

PLATE	PAGE
I. Gingivitis in latent scurvy - - - - -	278
II. Pitting edema of the leg in thiamine deficiency - - - - -	286
III. Cheilitis and photophobia following vitamin B complex deficiency - - - - -	290
IV. Early glossitis of vitamin B complex deficiency - - - - -	290
V. Results of severe niacin deficiency - - - - -	292



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# HUMAN BIOCHEMISTRY