

The Bioengineer's Bookshelf

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Biology of Collagen, edited by Andrus Viidik and Jens Vuust, University of Aarhus, Denmark, 384 pp., \$84.00, Academic Press, London, 1980.

Collogen is the basic structural material of biological tissues, and thus is of great interest to all bioengineers, and especially to workers in the field of biomechanics. It is a material on which a very large research effort is lavished all over the world by people in many different professions: biologists, biochemists, biomechanical engineers, immunologists, clinicians, hematologists, orthopedic surgeons, and industrialists (e.g., leather industry). The literature is, therefore, scattered and it is especially welcome to see this volume published. This book provides a convenient and up-to-date summary and review of the present state of collagen research. And it also provides many diversified perspectives of the future by various authors.

This book grew out of an international symposium commemorating the 50th anniversary of the University of Aarhus, Denmark, in 1978. It contains 26 chapters as follows:

1	Molecular Structure and Higher Organization of Different Collagen Types	1
	Klaus Kühn and Robert W. Glanville	
2	Molecular Structure and Stabilization of the Collagen Fibre	15
	Nicholas D. Light and Allen J. Bailey	
3	Structural Studies on Connective Tissue	39
	Andrew Miller	
4	Structural Studies of Collagen in Cartilage	53
	Carmen Berthet-Colominas, Catherine Mason, Andrew Miller and Defendente Tochetti	53
5	The Biosynthesis, Secretion and Processing of Procollagen	61
	Paul Bornstein	
6	Proline Analogues as Inhibitors for the Synthesis of Collagen Fibres	77
	Jonathan C. Javitt and Darwin J. Prockop	
7	Collagen Synthesis in Cultured Cells	87
	Risto Penttinen, Harry Frey, Maija Aalto, Eero Vuorio and Taina Marttala	
8	Collagen Production by Arterial Smooth-Muscle Cells in Culture	105
	Thomas Ledet and Jens Vuust	
9	Collagen Degradation: A Defended Multi-enzyme System	113
	Jacqueline B. Weiss, Kofi Sedowofia and Carolyn Jones	
10	Turnover of Collagen and its Precursors	135
	Simon P. Robins	
11	Inherited Disorders of Collagen Metabolism	153
	Bjørn Reino Olsen	
12	Collagen Abnormalities in Idiopathic Scoliosis	175
	Alf Udén	
13	Genetic Control of Collagen Expression	183
	Bryan Sykes and Ellen Solomon	
14	Coevolution of Collagen	193
	Martin B. Mathews	
15	Immunochemistry and Immunohistology of Collagens	211
	Rupert Timpl, Klaus Von Der Mark and Helga Von Der Mark	
16	Fibronectin, Procollagen and the Pericellular Matrix in Normal and Transformed Fibroblast Cultures	223
	Markku Kurkinen, Kari Alitalo, Klaus Hedman and Antti Vaheri	
17	Mechanical Properties of Parallel-Fibered Collagenous Tissues	237
	Andrus Viidik	
18	Interdependence between Structure and Function in Collagenous Tissues	257
	Andrus Viidik	
19	Brillouin Light Scattering and the Elastic Constants of Collagen	281
	Stephen Cusack	
20	A Mathematical Model for the Changes of the Long-Period	

	Structure in Collagen	289
	Hans Riedl, Theobald Nemetschek and Rainer Jonak	
21	A Commentary on the Use of Enzyme Probes to Elucidate the Contributions of Individual Components to Soft-tissue Biomechanics <i>in Vitro</i>	297
	Allan S. Hoffman and Colin H. Daly	
22	Reconstituted Collagen	313
	Milos Chvapil	
23	The Excessive Proliferation of the Connective Tissue as a Medical Problem	325
	Eino Kulonen, Maija Aalto, Sirpa Aho, Pirjo Lehtinen and Marita Potila	
24	Sponge-Induced Granulation Tissue as a Pharmacological Test System	339
	Troels Mork Hansen	
25	Factors Influencing Wound Healing	347
	Bengt Zedefelt	
26	Biomechanical Methods in Wound-Healing Research with Special Reference to Skin and Gastrointestinal Tract	363
	Ingemar Fogdestam and Finn Gottrup	

The scope is thus seen to be very broad. The authors are from all over the world. It is not possible to summarize or review the contents, but I must say that the book is well prepared, well edited, and well printed.

To a biomechanical engineer the material of particular interest are the two chapters written by Viidik: one on the mechanical properties of parallel-fibered collagenous tissues (17) and one on the interdependence between structure and function (18). Dr. Viidik is, of course, well known in biomechanics. He is known for the "Viidik model" of the nonlinear behavior of the collagenous tissues. He has contributed much to the understanding of the rapid changes in the mechanical properties of uterian and vaginal tissues just before and after childbirth. He contributed a body of data on the viscoelasticity of parallel-fibered collagen tissues. In this book he summarized briefly these results, and reviewed the whole field with a set of up-to-date references.

If any complaint can be brought forward, I would complain about the brevity of Chapter 18. Perhaps due to a restriction on length, the spectacular micrographs shown on pp. 261, 265, and 268 are not explained in detail. The meaning of the light and dark bands are obscured. The reader is given a taste of a good dish, but not of enough quantity to satisfy the hunger.

Dr. Cusack's article (Chapter 19) on Brillouin light scattering and the elastic constants of collagen is also excellent. It is concise and full of meaningful information. Drs. Riedl, Nemetschek, and Jonak's article (Chapter 20) on mathematical model, and Drs. Hoffman and Daly's article (Chapter 21) on the use of enzymes to analyze the models, are both superb. As enzyme probes are becoming more popular, Drs. Hoffman, et al.'s comments will be appreciated.

There are many other interesting materials in this book. The reviewer is not an expert in biochemistry, yet he finds much of the chemical articles very interesting. And who would not be fascinated by Dr. Olsen's article (Chapter 11) on the inherited disorders of collagen metabolism! The genetic defects illustrated in the photographs on pp. 157, 159, 163, and 164 would leave indelible imprints on any reader's brain.

The last four chapters are concerned with wound healing. Chapter 23 by Kulonen, et al., discusses the kind of problem we often see on the faces of burn patients (excessive scars).

Chapter 24 by T. M. Hansen is concerned with the production of collagen in granulation tissue from the point of view of the antigenic and immunologic properties of collagen. The ability of collagen to bind antigens to aggregate thrombocytes, to exhibit chemotaxis and to inactivate complement may be of pathogenic relevance for the development of chronic inflammatory processes in connective tissue. Hansen's paper presents a method of producing granulated tissue by implanting synthetic sponges subcutaneously. Chapter 25 by Zederfeldt discusses various factors influencing wound healing. This is a truly well-written short introduction to the subject. Chapter 26 by Fogdestam and Gottrup discusses method of measuring strength of tissues during wound healing.

I believe that the wound healing process is stress modulated. But the influence of stress field on wound healing is not mentioned by any of these papers! This marks a fundamental difference in the points of view between orthopedic surgeons and plastic and general surgeons. In bone research, Wolff's law has been accepted for a long time. Healing of bone requires an appropriate stress being applied to the bone: the stress must not be too large, neither should it be too small. An optimal range exists for growth. Stresses outside the range lead to resorption. There is evidence that the growth of soft tissue is also stress modulated. Perhaps we will hear more about this in the future.

In conclusion, I recommend this book for any bioengineer's bookshelf.

The Biomechanics of Sports Techniques, 2nd Edition, by James G. Hay, University of Iowa, 519 pp. Prentice-Hall, Englewood Cliffs, N.J. 1978.

This is a delightful book. It is written for physical educators, coaches of athletic teams, and athletes. In this book the basic concepts are very clearly presented, and then applied to the analysis of sports techniques. Chapter 1 is an introduction (8 pp.) Chapters 2-7 (157 pp.) deal with basic concepts: forms of motion, linear kinematics, angular kinematics, linear kinetics, angular kinetics, and fluid mechanics. Chapters 8-17 are analysis of sports techniques. The successive chapter headings are: Baseball, Basketball, Football, Golf, Gymnastics, Softball, Swimming, Track and Field, Running, Jumping, and Throwing. This part occupies 314 pages, and is quite exhaustive. For each sport, the analysis is divided into two parts: Basic Considerations and Techniques. The former deals with the factors involved. The latter gives details with particular emphasis on those areas where there are known to be disagreements among teachers and coaches.

The new edition incorporates new findings of current research. As the author says: "The techniques employed in sports sometimes change at an almost bewildering rate, so that those concerned have a difficult time keeping abreast of them." For example, in the few years since the text was first published, the grab start has almost universally accepted as the fastest starting technique in swimming; the rotational technique has become accepted as a viable alternative to the long-dominant O'Brien technique in short putting; the standing start, recently thought to be a similarly viable alternative to the traditional crouch start in sprinting, has been outlawed by a rule change; and the somersault long-jumping technique has arrived, been banned, and departed. The new techniques are discussed in the book.

I recommend this book to all people interested in biomechanics, not only athletes and coaches, but also to bioengineers, orthopedic surgeons, physiologists, and general readers. It is easy to read and easy to understand, and will make people enjoy sports more.

Fundamentals of Sports Biomechanics, by Charles Simonian, Ohio State University, 221 pp., Prentice-Hall, Englewood Cliffs, N.J. 1981.

This is a textbook for students of physical education, athletic coaching, and dance. It is written in an elementary manner. No prerequisite knowledge of physics or mathematics beyond what is ordinarily taken in high school is necessary. It discusses force, motion, work, energy, and concludes with a chapter on applications to physical education and sports. The treatment is quite brief, with one page on swimming, one page on bowling, one page on diving, one page on gymnastics, etc. Well written and smooth, this book requires little effort on the part of the reader.

Rheological Techniques by R. W. Whorlow, 447 pages, \$94.95, first published by Ellis Horwood Ltd., Chichester, distributed by Halsted Press, a division of Wiley, New York, 1980.

Biorheology is a bioengineer's intimate concern, and this book is important to bioengineering. In this book various rheological techniques and instruments are discussed in detail. It is written as a textbook, but is also a reference book. At the end of the book there is an Appendix on commercially available apparatus, including a list of addresses of manufacturers. This will be very useful to people who are choosing instruments.

The chapters headings are as follows:

1. Deformation and Stress
2. Tube Viscometers
3. Rotational Viscometers
4. Creep and Stress Relaxation
5. Dynamic Tests
6. Wave Propagation
7. Analysis of Viscoelasticity Measurements

The mathematical level is elementary. The text is lucid. The references list is comprehensive and up-to-date. Illustrations are good, well drawn and nicely printed. I strongly recommend this book to bioengineers who are concerned with biorheology.

Foundations of Physiological Instrumentation, A Source Book with Experiments, by Normal N. Goldstein and Michael J. Free, 384 p., \$39.50, Charles C. Thomas, Springfield, Ill., 1979.

I was looking for a textbook for the undergraduate course in laboratory experiments in bioengineering, and was delighted to find this book. It is well written, and sufficiently comprehensive and detailed for the students. It will be convenient for the instructor to use.

The book is divided into two parts. Part One, entitled *Foundations*, contains the following chapters:

- 1 Basics and Overview
- 2 DC and AC Theory
- 3 Principles of Amplification
- 4 Noise
- 5 Instruments and Systems
- 6 Transducers
- 7 Processing Signals
- 8 Electric Safety

Part Two, entitled *Experiments*, contains the following:

- 1 Membranes, Selective Permeability
- 2 Frog Sciatic Nerve