

Biomechanical Transport Processes

Edited by

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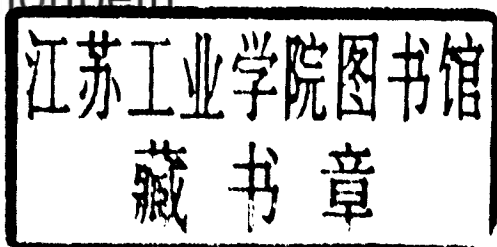
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Biomechanical Transport Processes

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PREFACE

This book contains contributions related to most of the talks given at the European Mechanics Colloquium and NATO workshop : "BIO-MECHANICAL TRANSPORT PROCESSES" held at: "Institut d'Etudes Scientifiques de Cargèse", Corsica France from October 9 - 13, 1989. The following topics were discussed at this meeting:

Transport phenomena, blood vessels and heart thermo-biophysical properties
Arterial, valvular, ventricular and venous flow
Hemorheology and microcirculation
Blood-wall interactions
Instrumentation and hemodynamic investigation

Accordingly, the papers presented in this volume are related to these five topics and reflect the interdisciplinary character of this colloquium.

The meeting brought together a group of active and eminent scientists from theoretical, experimental and clinical disciplines of various countries and provided a forum where major recent discoveries were discussed. The contributions which make up this book are based on those presented at the colloquium and which have been completed after as a result of discussion at the sessions.

The aim of the workshop was to analyse some problems of bio-mechanical transport processes of the cardio-vascular system, to facilitate an understanding of their applications, and ultimately to lead to a cross-fertilization of ideas and the development of new approaches. To this extent, in our opinion, this colloquium was highly successful and a rewarding experience for all the participants. It is our belief that readers of this book will obtain benefits similar to those obtained by all of us during the five days of our meeting.

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Editor and Colloquium Chairperson

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OBJECTIVES AND PERSPECTIVES OF THE COLLOQUIUM:
"BIO-MECHANICAL TRANSPORT PROCESSES"

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Ladies and Gentlemen, Dear Friends and Colleagues,

I am very glad that you all arrived here at the Institut of Research Studies of Cargèse to participate in this European Mechanics Colloquium which is at the same time a NATO workshop.

I should like to thank all members of our Scientific and Organizing Committee: Professor C. Caro from Imperial College, Professor Egon Krause and Professor Holger Schmid-Schönbein from RWTH Aachen, Dr. Charles Baquey from Université de Bordeaux II and Professor Robert Pelissier from Université de Marseille for their help in the overall planning and in executing the details of this colloquium and especially Professor Robert Pelissier who accepted to join me for the local organization.

I am very pleased that the participants and session chairmen accepted my invitation and I want to thank the European Mechanics Committee for the patronage of this meeting and the "Université de Liège", the "Région Corse", the "Association Universitaire de Mécanique" and in particular NATO for their economic and financial support. Without them this meeting could not have been held.

On behalf of all of us I would like to express our gratitude to the General Secretary of this Institute: Mrs. Marie-France Hanseler for her devotion and work in the local organization of this workshop.

The aim of this meeting is to discuss some fundamental processes and their modelling related to the behaviour of blood, its flow properties and the structures with which blood or its components come into direct contact, that is the vessel wall and the surrounding tissues and spaces. Interactions of blood or its components with materials of biological significance originating from the human organism or with materials of non-biological origin employed in the biological system or setting, will be also discussed.

These surface phenomena and the different aspects related to the heat and mass transfer are becoming more and more important in bio-mechanical transport processes of the cardiovascular system. For this reason, I feel certain that the discussions and the contributions of our meeting will generate progress in our knowledge of this field.

There are many scientists with a keen interest in this subject who cannot be with us here this week. Professor Nicolaides from St. Mary's Hospital, London and Professor Geert Schmidt-Schönbein from University of California, San Diego, wrote me at the last moment that they are unable to be present at our colloquium. They expressed their regret and send their best wishes to our meeting. Many others scientists are not present because, as you see, here the Institute has a limited capacity and it was impossible to invite the hundred persons interested in the field. Our Scientific Committee was forced to select the participants. Considering that the progress in this field was done thanks to interdisciplinary researches we decided to choose scientists from different specialties.

It is fortunate that the participation at this meeting is an interdisciplinary one. Engineers, surgeons, physicians, physicists and mathematicians are present. Accordingly, the contributions and discussion will reflect this interdisciplinary character and, I hope for a deep understanding between quite different views of the same subject.

It has long seemed to me that a mathematical and an experimental approach to biologically interesting questions are quite insufficient. The real *sine qua non* in the bio-fluids game is insight into the operative physical processes. We must second-guess Nature in an area where physical complexity presents her endless opportunities to be clever.

The simplest of our systems makes the most complex type of flow. Very little has been said about physiological flows. Not that we know little about them: in fact we know so much that the present state of the art almost defies summarization.

Blood flow is clearly the most important bio-mechanical transport system and is enormously complex. I only dwell on the non-steady flow of a non-isotropic, non-Newtonian fluid through non-rigid pipes without speaking of the boundary conditions which, in almost all biological cases, are not exactly known. Moreover, the different hormonal and neurological factors influence and change all the characteristics of the blood flow following an unknown law. Nevertheless, something of the order of one hundred papers appear on the subject of blood flow each year. This proves that this field of interest is far from being entirely known.

Why ?

Are our mathematical, physical models and experimental approaches inadequate , or partially inadequate ?

Or would a complete non-linear treatment of blood flow be necessary to explain some crucial points ?

If this is the case, the future in this field probably belongs to applications of the chaos theory to the blood flow, and the formulation of new field equations dealing with the unique properties of the cardio-vascular system.

Certainly, I hope that our discussions and presentations will contribute to confirm or infirm my opinion and impel valuable recommendations for future research. I hope also that our colloquium will permit a mutually beneficial exchange of information and lay the bases of new scientific collaboration. If at the end of this workshop we can decide about the usefulness of organizing another meeting in a few years time and can establish now the major topics of this, that is, the directions for further research, we can say that one of the aims of the present colloquium has been accomplished.

I want to repeat what Professor Alfred L. Copley said at the occasion of the Second Conference of the International Society of Hemorheology in 1969 : "Being a research worker, of course, I could never have stopped being a student". So, in my two capacities of student and chairperson of the colloquium: "Bio-mechanical transport processes" I extend to you my very best wishes for the success of our workshop.

The members of the Scientific and Organizing Committee of this meeting hope that your days in Cargèse will be scientifically fruitful and that you and the members of your families will have enjoyable and sunny days here.

TRANSPORT PHENOMENA, BLOOD VESSELS AND HEART
THERMO-BIOPHYSICAL PROPERTIES

