

**ON THE WAY TO UNDERSTANDING  
THE TIME PHENOMENON:  
The Constructions of Time  
in Natural Science**

**Part 1. Interdisciplinary Time Studies**

Editor

**A P Levich**

*Moscow University*



**World Scientific**

*Singapore • New Jersey • London • Hong Kong*

*Published by*

World Scientific Publishing Co. Pte. Ltd.

P O Box 128, Farrer Road, Singapore 9128

*USA office:* Suite 1B, 1060 Main Street, River Edge, NJ 07661

*UK office:* 57 Shelton Street, Covent Garden, London WC2H 9HE

### **Library of Congress Cataloging-in-Publication Data**

On the way to understanding the time phenomenon : the constructions of  
time in natural science / edited by A. P. Levich.

p. cm. -- (Series on advances in mathematics for applied sciences, Vol. 32)

Contents: Pt. 1. Interdisciplinary time studies.

ISBN 9810213603

1. Time. 2. Space and time. I. Levich, A. P. (Alexander P.)

II. Series.

QC173.59.S6505 1995

529'.7--dc20

95-1808

CIP

Copyright © 1995 by World Scientific Publishing Co. Pte. Ltd.

*All rights reserved. This book, or parts thereof, may not be reproduced in any form or by any means, electronic or mechanical, including photocopying, recording or any information storage and retrieval system now known or to be invented, without written permission from the Publisher.*

For photocopying of material in this volume, please pay a copying fee through the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, Massachusetts 01923, USA.

This book is printed on acid-free paper.

Printed in Singapore by Uto-Print

# CONTENTS

<b>Preface</b> .....	v
<b>Introduction. Motivations and Problems of Studying Time</b> .....	1
<i>A. P. Levich</i>	
1. Two images of time .....	1
2. Motivations of studying time .....	2
2.1. Deepening of special scientific concepts.....	2
2.2. Measuring the age of natural systems.....	4
2.3. Scientific forecasting .....	4
2.4. Manipulations with time .....	5
2.5. Time as a component of theoretical knowledge.....	5
3. The basic tasks of the studies of time .....	9
4. The properties and problems of time .....	10
4.1. The properties of time .....	11
4.2. The status of time.....	11
4.3. The problems of time.....	11
<b>Chapter 1. Physics</b> .....	17
<b>Structure of Physical Space-Time</b> .....	17
<i>Yu. S. Vladimirov</i>	
<b>Relative Statistical Model of Clocks and Physical Properties of Time</b> .....	26
<i>V. V. Aristov</i>	
1. About relative concept of time .....	26
2. The basic definitions of the model and obtaining the classical kinematic relationships .....	28
3. Obtaining the relationships of dynamics in the model .....	32
4. Effects due to the statistical character of the model and correspondence to the traditional theory.....	35
5. Relativistic generalization of the model .....	37
6. Properties of time and possible improvements of the model .....	41
<b>Chapter 2. Biology</b> .....	47
<b>G. Backman's Conception of Organic Time and the Experience of its Application</b> .....	47
<i>A. M. Maurins</i>	
1. Presuppositions.....	47
2. The function of organic time .....	48

3. Quanta of life and temporal acceleration.....	49
4. Applications of Backman's function.....	50
5. Conclusion.....	54
<b>Analysis of Meyen's Typological Concept of Time</b> .....	57
<i>A. A. Sharov</i>	
1. The concept.....	57
2. Principles of historic reconstruction.....	59
3. Problems of the typological concept of time.....	61
3.1. Object boundaries in space and time.....	61
3.2. Time and system interactions.....	63
3.3. Multi-dimensional nature of time.....	64
<b>Biological Time, its Organization, Hierarchy and Presentation by Complex Values</b> .....	68
<i>G. E. Mikhailovsky</i>	
1. Biological time organization.....	68
2. The structure of the biological present and determinancy by future.....	70
3. Two-dimensionality of time in biological systems and the hierarchy of two-dimensional biological times.....	75
4. Presentation of two-dimensional biological time by means of complex values.....	78
5. The dynamics equation for open biological systems in complex time.....	79
6. Conclusion.....	82
<b>Clocks for Studying Temporal Laws of Animal Development</b> .....	85
<i>T. A. Dettlaff</i>	
1. Biological measure of time.....	86
2. Application of the method of relative dimensionless characteristic of developmental duration for forecasting values of $\tau_n$ at varying temperature.....	90
3. Temporal patterns of development in poikilothermic animals.....	91
4. Heterochrony.....	93
5. Age of embryos and its significance for differentiation.....	93
<b>Chapter 3. Mathematics</b> .....	99
<b>Mathematical Temporal Constructions</b> .....	99
<i>R. I. Pimenov</i>	
1. Introductory remarks.....	99
1.1. The place of the present work among others.....	99
1.2. Mathematical preliminaries.....	100
1.3. The concept of a set and our levels of consideration.....	101
2. Linear structures.....	103
2.1. Order type relations.....	103
2.2. Temporal interpretation of the examples.....	105
2.3. A self-contained temporal flow.....	107
2.4. Time in a universal.....	109
2.5. Event dating.....	111
2.6. Numerical dating: clocks.....	112
2.7. Point observers and frames of reference.....	114
2.8. Time transformations for a specific object.....	116
2.9. Constants with the dimensionality of time.....	118

3. Structures irreducible to linear ones .....	118
3.1. The simultaneity relation.....	118
3.2. Two examples for the simultaneity relation .....	120
3.3. A metric as a proper time interval .....	123
3.4. Time reversibility and irreversibility .....	127
3.5. The indicator space problem .....	128
3.6. A scheme of concept (object) derivation for the Einsteinian ordering .....	130
4. Causality and determinism.....	130
4.1. The differential equation ideology.....	130
4.2. The Cauchy dependence domain.....	131
4.3. Smoothness in space-time theory.....	132
4.4. Groundlessness of the determinism.....	134
<b>Chapter 4. Earth Sciences.....</b>	<b>137</b>
<b>Time in The Earth Sciences.....</b>	<b>137</b>
<i>A.D.Armand</i>	
1. Geographic time.....	137
2. Matching the characteristic times.....	142
3. The conditional nature of time.....	145
<b>Chapter 5. System Theory.....</b>	<b>149</b>
<b>Time As Variability of Natural Systems: Ways of Quantitative Description of Changes and Creation of Changes by Substantial Flows.....</b>	<b>149</b>
<i>A. P. Levich</i>	
1. Time-metabolē .....	149
1.1. The substitutional construction of time.....	149
1.2. Properties of substitutional time.....	155
1.3. Substitutional motion.....	160
1.4. Difficulties of the substitutional approach.....	165
2. The entropy parametrization of time and the extremum principle for motion.....	166
2.1. Numbers of elements in structured sets.....	166
2.2. A category description of systems.....	171
2.3. The extremum principle as a law of variability.....	174
2.4. Example: a formula of species structure in ecology of communities.....	177
2.5. The substitutional, entropy and category time.....	180
3. The hypothesis of generating flows.....	182
3.1. The nature of the time flow.....	182
3.2. Elements of the picture of the world.....	184
3.3. Getting rid of the bugaboo of thermal death.....	187
<b>Time Structure of the World.....</b>	<b>193</b>
<i>V. M. Sarychev</i>	