

Jan C.A. Boeyens

# The Chemistry of Matter Waves



Springer

Jan C.A. Boeyens  
Centre for Advancement of Scholarship  
University of Pretoria  
Pretoria, South Africa

ISBN 978-94-007-7577-0  
DOI 10.1007/978-94-007-7578-7  
Springer Dordrecht Heidelberg New York London

ISBN 978-94-007-7578-7 (eBook)

Library of Congress Control Number: 2013947190

© Springer Science+Business Media Dordrecht 2013

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed. Exempted from this legal reservation are brief excerpts in connection with reviews or scholarly analysis or material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work. Duplication of this publication or parts thereof is permitted only under the provisions of the Copyright Law of the Publisher's location, in its current version, and permission for use must always be obtained from Springer. Permissions for use may be obtained through RightsLink at the Copyright Clearance Center. Violations are liable to prosecution under the respective Copyright Law.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

While the advice and information in this book are believed to be true and accurate at the date of publication, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Printed on acid-free paper

Springer is part of Springer Science+Business Media ([www.springer.com](http://www.springer.com))

# Contents

<b>1</b>	<b>Of Electrons and Molecules</b>	1
1.1	Introduction	1
1.2	Electrons in Chemistry	1
1.2.1	Wave-Particle Duality	3
1.2.2	The Schrödinger Approximation	3
1.2.3	Four-Dimensional Waves	4
1.2.4	Nonlinear Schrödinger Equation	5
1.3	Molecular Structure	5
1.3.1	Molecular Modelling	6
1.3.2	Atomic and Molecular Structure	8
	References	9
<b>2</b>	<b>The Classical Background</b>	11
2.1	Introduction	11
2.1.1	The Copernican Revolution	13
2.2	Newtonian Physics	14
2.3	Daltonian Chemistry	15
2.4	The Aftermath	18
2.4.1	Dalton's Legacy	18
2.4.2	Classical Mechanics	20
	References	23
<b>3</b>	<b>Great Discoveries</b>	25
3.1	Introduction	25
3.2	Periodic Table of the Elements	26
3.2.1	Static Model of Chemical Affinity	29
3.2.2	The Planetary Quantum Model	33
3.2.3	The New Periodic Table	36
3.3	The Electromagnetic Field	37
3.3.1	Wave Theory of Light	37
3.3.2	Magnetism	39
3.3.3	Electrostatics	40

3.3.4 Electromagnetism . . . . .	43
3.3.5 Maxwell's Theory . . . . .	46
3.4 Electromagnetic Radiation . . . . .	47
3.4.1 General Theory of Wave Motion . . . . .	48
3.5 Conclusion . . . . .	51
References . . . . .	52
<b>4 Theoretical Response . . . . .</b>	<b>55</b>
4.1 Introduction . . . . .	55
4.1.1 The Electromagnetic Field . . . . .	55
4.1.2 Periodicity of Atomic Matter . . . . .	56
4.1.3 Theories in Conflict . . . . .	57
4.2 The Theory of Relativity . . . . .	57
4.2.1 Special Relativity . . . . .	58
4.2.2 General Relativity . . . . .	63
4.3 Quantum Theory . . . . .	66
4.3.1 Global Gauge Invariance . . . . .	67
4.3.2 Wave Mechanics . . . . .	69
4.3.3 Local Gauge Invariance . . . . .	74
4.3.4 Space-Time Manifold and Tangent Space . . . . .	76
4.3.5 The Periodic Function . . . . .	77
References . . . . .	78
<b>5 State of the Art . . . . .</b>	<b>79</b>
5.1 Introduction . . . . .	79
5.2 Chemistry at the Crossroads . . . . .	81
5.2.1 The Bonding Model . . . . .	82
5.2.2 Molecular Structure . . . . .	84
5.2.3 Stereochemistry . . . . .	86
5.2.4 The Particle Problem . . . . .	86
5.2.5 Reaction Mechanisms . . . . .	87
5.2.6 Atomic Periodicity . . . . .	88
5.3 Conclusion . . . . .	89
References . . . . .	89
<b>6 The Forgotten Dimension . . . . .</b>	<b>91</b>
6.1 Introduction . . . . .	91
6.2 The Classical World . . . . .	93
6.3 Non-classical World . . . . .	93
6.3.1 Potential Theory . . . . .	94
6.4 The Spin Function . . . . .	95
6.4.1 Four-Dimensional Action . . . . .	97
6.4.2 Spin Correlation . . . . .	98
6.5 The Time Enigma . . . . .	99
6.5.1 Quantum Potential . . . . .	100
6.5.2 Time Flow . . . . .	101

6.6	Space-Time Curvature . . . . .	102
6.6.1	Space-Time Topology . . . . .	103
6.7	Quantum Effects . . . . .	105
6.7.1	Exclusion Principle . . . . .	105
6.7.2	Wave-Particle Duality . . . . .	106
6.7.3	Quantum Probability . . . . .	107
6.7.4	Measurement Problem . . . . .	110
6.7.5	Uncertainty Principle . . . . .	112
6.7.6	Fine-Structure Constant . . . . .	113
	References . . . . .	113
7	<b>Nonlinear Chemistry</b> . . . . .	117
7.1	Introduction . . . . .	117
7.2	Wave Model of the Electron . . . . .	118
7.2.1	Wave Mechanics . . . . .	119
7.2.2	Matter Waves . . . . .	122
7.2.3	Two-Wave Models . . . . .	127
7.2.4	Fine-Structure Parameter . . . . .	128
7.3	Nonlinear Systems . . . . .	131
7.3.1	Hydrodynamic Analogy . . . . .	132
7.3.2	Schrödinger Oscillator . . . . .	132
7.3.3	Korteweg–de Vries Equation . . . . .	134
7.3.4	Solitons . . . . .	135
7.3.5	Soliton Eigenvalues . . . . .	136
7.3.6	Soliton Models . . . . .	137
7.3.7	Electronic Solitons . . . . .	140
7.4	Chemical Aspects . . . . .	146
7.4.1	Solving the Equation . . . . .	148
7.4.2	Chemical Interaction . . . . .	148
	References . . . . .	149
8	<b>Matter-Wave Mechanics</b> . . . . .	153
8.1	Introduction . . . . .	153
8.2	The Aether and Matter . . . . .	155
8.2.1	Alarming Phenomena . . . . .	156
8.2.2	Generation of Mass . . . . .	157
8.2.3	Space-Time Topology . . . . .	157
8.2.4	The Vacuum . . . . .	164
8.3	The Wave Model . . . . .	165
8.3.1	Projective Solution . . . . .	166
8.4	Matter in Space-Time . . . . .	169
8.4.1	Fibonacci Numbers . . . . .	170
	References . . . . .	178
9	<b>Chemical Wave Structures</b> . . . . .	181
9.1	Introduction . . . . .	181
9.2	Electronic Structures . . . . .	182

9.2.1	Numbers and Waves . . . . .	183
9.3	Atomic Structure . . . . .	185
9.4	Chemical Concepts . . . . .	186
9.4.1	Atomic Size . . . . .	186
9.4.2	The Bohr-de Broglie Model . . . . .	188
9.4.3	Ionization Radii . . . . .	190
9.4.4	Electronegativity . . . . .	191
9.4.5	Covalent Interaction . . . . .	192
9.4.6	Bond Order . . . . .	193
9.4.7	General Covalence . . . . .	194
9.4.8	Atomic Polarizability . . . . .	196
9.4.9	Atomic Radii . . . . .	198
9.4.10	Final Results . . . . .	202
9.5	Molecular Structure . . . . .	202
9.5.1	Molecular Modelling . . . . .	203
9.6	Reaction Mechanism . . . . .	204
	References . . . . .	205
<b>10</b>	<b>A Fresh Start . . . . .</b>	<b>207</b>
10.1	Introduction . . . . .	207
10.2	The Copenhagen Interpretation . . . . .	208
10.2.1	Quantum Mechanics . . . . .	209
10.2.2	The Quantum Postulate . . . . .	210
10.2.3	Atomic Model . . . . .	213
10.2.4	Quantum Chemistry . . . . .	216
10.3	Two New Models . . . . .	216
10.3.1	Superconductivity . . . . .	216
10.3.2	Cold Fusion . . . . .	218
10.4	The Common Wave Model . . . . .	222
10.4.1	The Periodic Function . . . . .	223
10.5	New Horizons . . . . .	224
10.5.1	Nanostructures . . . . .	224
10.5.2	Quasicrystals . . . . .	229
10.6	Future Prospects . . . . .	231
10.6.1	The Space-Time Vacuum . . . . .	231
10.6.2	Perceptions in Linear Tangent Space . . . . .	232
10.6.3	Four-Dimensional Reality . . . . .	232
	References . . . . .	233
<b>Index</b>		<b>235</b>