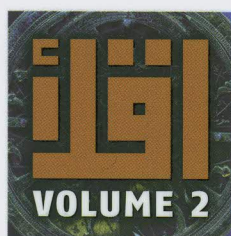
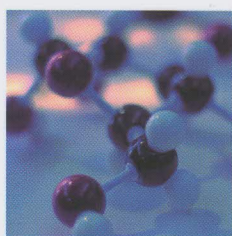
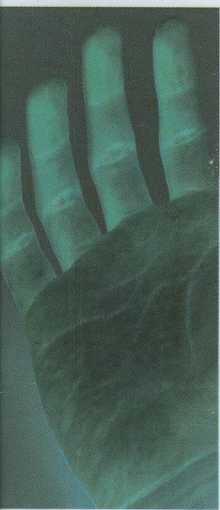


NATURAL
SCIENCE *from the*
WORLDVIEW *of the* **QUR'AN**
AN INTRODUCTION



Chief Editor **M. KAMAL HASSAN**

NATURAL
SCIENCE *from the*
WORLDVIEW *of the* **QUR'AN**
AN INTRODUCTION



Chief Editor

M. KAMAL HASSAN



Institut Terjemahan & Buku Malaysia
Malaysian Institute of Translation & Books



Kuala Lumpur
2018

This book **NATURAL SCIENCE FROM THE WORLDVIEW OF THE QUR'AN: An Introduction – Volume 2** is published by Institut Terjemahan & Buku Malaysia Berhad.

Published by:

INSTITUT TERJEMAHAN & BUKU MALAYSIA BERHAD

(Company's No.: 276206-D)

Wisma ITBM, No. 2, Jalan 2/27E

Section 10, Wangsa Maju

53300 Kuala Lumpur

Malaysia

Tel.: 603-4145 1800

Fax: 603-4142 0753

Email: publishing@itbm.com.my

Website: www.itbm.com.my

First Published in 2018

Publication © Institut Terjemahan & Buku Malaysia Berhad

Text © Mohd Kamal Hassan

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, except brief extracts for the purpose of review, without the prior permission in writing of the publisher and copyright owner from Malaysian Institute of Translation & Books, Wisma ITBM, No. 2, Jalan 2/27E, Section 10, Wangsa Maju, 53300 Kuala Lumpur, Malaysia. It is advisable also to consult the publisher if in any doubt as to the legality of any copying which is to be undertaken.

National Library of Malaysia

Cataloguing-in-Publication Data

Natural Science from the Worldview of the Qur'an: An Introduction. Volume 2 / Chief Editor

M. Kamal Hassan

Includes index

Bibliography: page 499

ISBN 978-967-430-462-1 (set)

ISBN 978-967-430-460-7

1. Qur'an and science. 2. Nature in the Qur'an. 3. Science. I. M. Kamal Hassan, 1942-.

297.1228

Printed in Malaysia by:

Attin Press Sdn. Bhd.

No. 8, Jalan Perindustrian PP4

Taman Perindustrian Putra Permai

Bandar Putra Permai

43300 Seri Kembangan, Selangor

This is to inform that in the course of producing this work, all authors and contributors to the work have adhered to the ethical and legal standards required in producing an original work. All efforts have been exercised with vigilance and care to ensure the academic integrity of the work.

CONTENTS

<i>Preface</i>	<i>vii</i>
<i>Notes to Readers</i>	<i>xv</i>
<i>Notes to Teachers</i>	<i>xvii</i>
<i>List of Abbreviations</i>	<i>xxiii</i>
<i>Symbols for Parameters and Unit of Measurement</i>	<i>xxv</i>
<i>Authors and Team Members</i>	<i>xxvii</i>
<i>Islamic Legacy: Timeline of Significant Scientific and Related Events</i>	<i>xxxi</i>

VOLUME 2

Introduction	1
<i>0.1 Part 1</i>	<i>5</i>
The Necessity of Studying and Mastering Natural Science	
<i>0.2 Part 2</i>	<i>17</i>
The Fundamental Rationales for Advocating the Study of Natural Science from the Worldview of the Qur'an	
<i>0.3 Part 3</i>	<i>49</i>
Supplementary Rationales, Challenges of the 21 st Century, Science and Scientific Knowledge, Conclusion	

Chapter 1	99
Energy, Dynamics and Motion	
1.0 Energy – The Origin	103
1.1 The Sources and Forms of Energy	104

1.2 Heat and Transfer of Heat	128
1.3 Nuclear Energy	145
1.4 Dynamics	174
1.5 Support and Movement	190
1.6 Motion	216
<i>List of Suggested Readings</i>	<i>249</i>

Chapter 2 251

Electricity and Magnetism

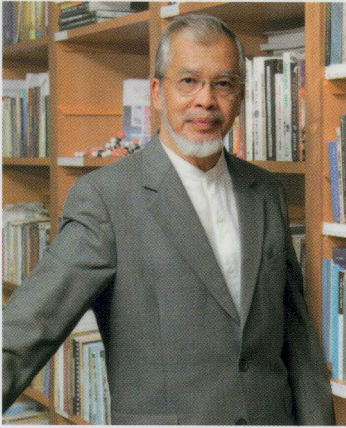
2.0 Electricity, Magnetism and Light as Forms of Energy	255
2.1 Electricity	255
2.2 Magnetism and Electromagnetism	287
2.3 The Generation and Supply of Electricity	306
2.4 Light, Colour and Sight	323
<i>List of Suggested Readings</i>	<i>359</i>

Chapter 3 361

Chemical Thermodynamics, Kinetics and Equilibria

3.0 Introduction	365
3.1 Energy and Chemical Changes	365
3.2 Rates of Reactions	394
3.3 Chemical Equilibria	417
3.4 Entropy	447
<i>List of Suggested Readings</i>	<i>457</i>

Conclusion	459
Glossary	469
Bibiliography	499
Index	521
Photo and Illustration Credits	533



Distinguished Prof. Dr. M. Kamal Hassan

Prof. M. Kamal Hassan (b. 1942 in Malaysia) was the third Rector (Vice-Chancellor) of the International Islamic University Malaysia (IIUM). He obtained his B.A. (First Class Honours) in Islamic Studies (1966) from the University of Malaya in Kuala Lumpur; and M.A. (1970), M.Phil. (1973) and Ph.D. (1976) from Columbia University, New York, specialising in contemporary Islamic thought. He was Head of the Department of Islamic Theology and Philosophy at the National University Malaysia in 1980; and then served the International Islamic University Malaysia since 1983, as the founding Dean of the new Faculty of Islamic Revealed Knowledge and Human Sciences. He was appointed as the Deputy Rector for Academic Affairs at IIUM and held the post for 7 years, before being appointed as the first Malaysian Rector of IIUM from 1999 to 2006.

He was appointed as the first Malaysian Chair of Islam in Southeast Asia as well as Visiting Professor at the Centre for Muslim-Christian Understanding, Georgetown University, Washington D.C. from 1997–1999. One of his major intellectual missions is the reintegration of human reason with Divine Revelation and Wisdom. The award of Distinguished Professor was conferred upon him by the Ministry of Higher Education, Malaysia, in December 2010. He is currently teaching at IIUM as a professor and assumed the leadership of the Distinguished Professor's project (which is now known as the *N.S.W.V.Q.* Project) in 2011.

AUTHORS AND TEAM MEMBERS

ABOUT THE AUTHORS AND OTHER MEMBERS OF THE TEAM

BIOLOGY

Nazira Zubir (b. 1971) is the lead author for Biology. She holds a B.Sc. (Pharmacology and Physiology) from Adelaide University, Australia, and M.Eng. (Biomed.) from *Universiti Malaya*. Her many years of diverse working experience include broadcasting, editorship and education. Nazira is involved in the vetting, moderating and setting of examinations questions, and in the marking of Biology scripts for the Pre-university Matriculation Programme under the Ministry of Education Malaysia (2006–present). This award winning teacher of IIUM’s Centre for Foundation Studies (CFS) has held a number of administrative positions at the CFS. She led the team of authors towards the publishing of *Discovering Your Body System* (Kuala Lumpur: Pearson, 2012), apart from compiling a customised derivative Biology book for students of CFS, IIUM, where she teaches Biology since 2005.

Co-authoring are two Biology teachers from MARA Junior Science College, Malaysia. They are **Zolkofli Awang** (b. 1960) [B.Sc. (Edu.) Hon. Bio. *Universiti Sains Malaysia*], who is a senior teacher with “Excellent Teacher” standing and **Siti Marziah Mohd. Dani** (b. 1984) [B.Sc. (Industrial Bio.) *Universiti Teknologi Malaysia* and (Post-Graduate) Dip. Ed. (Bio.), IIUM.].

CHEMISTRY

Leading the Chemistry authorship is **Nur Jannah Hassan** (b. 1964), who holds a B.Sc. (Hon. Sc.) in Chemistry from University of Waterloo, Canada, and a (Post-Grad.) Dip. Ed. (Math.-Eng.), an M.Ed. and Ph.D. (Philosophy, Ethics and Contemporary Issues) from IIUM. She is an alumnus of *Sekolah Tun Fatimah*,

Malaysia and holder of a Canadian Ontario High-School Diploma (Hon.) (Welland Centennial). Her teaching experiences include volunteering with the Heritage Programme of Waterloo County Board of Education (1989–1993); teaching Mathematics (Cambridge I.G.C.S.E.) and Chemistry (Cambridge I.G.C.S.E. and A-Levels) at the International Islamic School, Malaysia (I.I.S.M.) (1998–2010); Mathematics and English at James Thompson Elementary and Science at British Columbia Muslim School, Canada (2001–2002). She held various academic and administrative positions in I.I.S.M. (Secondary), and was the school's Head and Principal from 2009 to 2011.

Her passion on issues of Islamic ethics and education brought her to work with Distinguished Professor Dr. M. Kamal Hassan, who entrusted her with the onus of coordinating the *N.S.W.V.Q.* Project from its initiation (October 2011) to its completion. She did her Ph.D. dissertation under the supervision of the same professor. **Sabrina Sabri** (b. 1956) [B.Sc. (Hon.) Chem. University of Wales, U.K.; Dip. Islamic Studies, U.K.M. and M.Ed. (Sc. Educ.) U.K.M.], a senior lecturer of Chemistry at the CFS, IIUM is her co-author.

PHYSICS

The Physics lead author, **Mohd. Isa Mohd. Yusof** (b. 1962) is a graduate of Victoria Institution, Kuala Lumpur. He earned his B.Sc. and M.Ed. in Physics at the University of Minnesota, Duluth, USA. Mohd. Isa started his career as a Physics teacher at a *MARA* Junior Science College in 1989. He has been a lecturer of Physics at the Faculty of Applied Sciences, *Universiti Teknologi MARA* (UiTM), Malaysia since 1999. A senior lecturer at the university, Mohd. Isa is a member of a research team at the Faculty of Applied Sciences, exploring the superconducting, ultrasonic and magneto-resistivity properties of ceramic oxides.

Co-authoring is **Abu Hassan Husin** (b. 1961). Coming from the FELDA (Federal Land Development Authority) scheme in Malacca, he is an alumnus of *Sekolah Dato' Abdul Razak*, and holds a B.Sc. and M.Sc. in Physics from Ohio University, USA, and a Ph.D. in Physics Education from UiTM, Malaysia. Since 1986, he has taught various levels of mechanics, electricity and magnetism, and modern and thermal physics at UiTM. He is in the process of incorporating innovations such as Physics Education Technology (PhET) (of University of Colorado) and Technology Enabled Active Learning (TEAL) (of M.I.T.) into Introductory Physics courses, apart from looking into connecting the laws of physics to God as the Creator of these laws. Currently an Associate Professor, he heads the School of Physics and Materials, Faculty of Applied Sciences, UiTM.

OTHER MEMBERS OF PROJECT N.S.W.V.Q.

Research Team

Headed by the **Distinguished Professor Dr. M. Kamal Hassan** as the Principal Researcher, Chairman, and the Chief Editor; the members of the Research Team are **Professor Dr. Hamzah Mohd. Salleh** (Faculty of Engineering, IIUM); **Professor Dr. Ahmad Yousif** (Director, International Institute of *Wasatiyyah*, IIUM); **Dr. Agus Purwanto** (*Institut Teknologi Sepuluh Nopember*, Surabaya, Indonesia); **Mohd. Isa Mohd. Yusof** (Senior lecturer, UiTM) and **Dr. Nur Jannah Hassan** (International Institute of Islamic Thought and Civilisation, IIUM).

Team of Illustrators

Assisting the authors is the Team of Illustrators, comprising of **Maryam Hamzah** [B.Sc. (Arch. Studies) Hon. and B.Arch (Hon.), IIUM] as the Graphic Designer; **M. Haneef Hamzah** (a student of B.Mech.Engin., IIUM) as the Photographer; and **Noorafifah Salihah Mohd. Noor** [B.Biomed.Sc. (Hon.), IIUM] and **Wan Safiyyah Nurnajah Wan A. Tajuddin** [B.Med. & B.Surgery, CUCMS] as the Illustrators.

Editorial Team

The Editorial Team consists of:

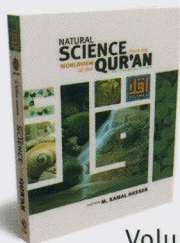
- (1) **Dr. Kausar Ahmad** [B.Sc. (Chem.) UNSW, Australia; Dip.Islamic Studies, IIUM and Ph.D. (Polymer Colloid & Processing) U. of Malaya] as the Biology editor;
- (2) **Professor Dr. Hamzah Mohd. Salleh** (Dept. of Biotechnology Engineering, Faculty of Engineering, IIUM) [B.Sc. (Hon.) Biochem., M.Sc., Chem. (Enzymology) and Ph.D., Chem. (Enzymology), U. of Waterloo, Canada] as the Chemistry editor;
- (3) **Assoc. Prof. Dr. Raihan Othman** (Head, Department of Science in Engineering, Faculty of Engineering, IIUM) [B.Sc. (Hon. Physics), M.Sc. (Physics) and Ph.D. (Electrochemical Power Sources) U. of Malaya] and **Professor Dato' Dr. Mohd Zambri Zainuddin** (ISTAC, IIUM, with specialisation in Astronomy, Astrophysics and Astronomy Education) as the Physics editors;
- (4) **Tuan Syed Salim Agha** (Former Chief Librarian, IIUM) [B.Sc. (Botany) U. of Madras; Associate of the Library Association, U.K.] as the English language editor;
- (5) **Dr. Esam Eltigani** (Dept. of Qur'an and Sunnah, Faculty of Islamic Revealed Knowledge and Human Sciences, IIUM) [B. Engin. Southern Illinois U., USA; M.A. and Ph.D. (Qur'an & *Sunnah*) IIUM] as the Editor for Islamic Input (Qur'an & *Turath*); and
- (6) **Dr. Nur Jannah Hassan** (IIUM) as the General Editor, assisted by a team of Copy Editors including Dr. Asma El-Muhammady (IRKHS, IIUM) and a wonderful and dedicated team of type-setters (Attin Press).

NATURAL SCIENCE *from the* **WORLDVIEW** *of the* **QUR'AN** VOLUME 2 AN INTRODUCTION

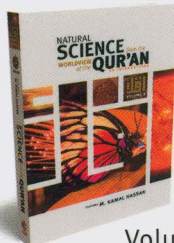
THIS book, the second of a three-volume work on natural science for secondary school students, consists of three chapters. Energy is that which stirs our world to life and is so much in demand today. “Energy, Dynamics and Motion” is thus the theme of CHAPTER 1, which explores the various forms and sources of energy created by Allah The Most Gracious, the different technologies available on how best to harness them and the problems associated with these. The vehemently debated nuclear energy is allotted a special focus keeping in view of all the implications, responsibilities and precautions. With energy, there is force, which in turn sets matter in motion with or without us realising it. The chapter elaborates on dynamics, support in the structures of organisms and the physiology of their movements, followed by an exploration of the physics of motion.

CHAPTER 2 looks into the details of “Electricity and Magnetism”, the interplay between the two, the generation of electricity and the various applications of electro-magnetism. This is followed by the subject of light, a form of energy in the family of electromagnetic radiation. Included in the discussions on light is colour, and sight – the God-given aperture that lets us perceive the beautiful world that He created.

The discussions on energy continues in CHAPTER 3 with the theme “Chemical Thermodynamics, Kinetics and Equilibria”, providing the foundation for understanding chemical thermodynamics and kinetics, with a thorough treatment on rates of reactions. The subject of equilibrium ensues, where the reader is brought to realise the dynamism and universality of equilibrium apparent in every level of cosmic existence as a Sign (*Ayah*) of the grandeur of the plan, order, and intelligence of Allah’s creativeness, artistry and impeccable design. The chapter concludes with a brief qualitative reflection on entropy.



Volume 1



Volume 3

SCIENCE	
ISBN 978-967-430-462-1 (set)	
ISBN 978-967-430-460-7	
	
9 789674 304607	West Malaysia Sabah/Sarawak RM50.00 RM55.00
www.itbm.com.my	



Institut Terjemahan & Buku Malaysia
 Malaysian Institute of Translation & Books



IIUM