

Preface

This book commemorates the lifelong dedication of physicist Francis Michael Russell to science, for a large part of which he has been fascinated with the dark tracks in mica muscovite. Some of these lines he was able to explain as the fossil record of charged elementary particles in a series of amazing papers which starts with *Tracks in mica caused by electron showers* published in Nature in 1967. However, many of the tracks were produced by other causes and as they were along the primary lattice directions he suggested that they were the record of some kind of quasi one-dimensional excitations of the lattice, to which he gave the name *quodons*. The theory was improved by his collaboration with nonlinear physicist Prof. Chris Eilbeck, which after many years had a high point in 2007 with the experimental verification of the transmission of localized energy and momentum in mica along the lattice directions. Thereafter Russell, or Mike as we all know him, has continued doing research in mainly two directions: What many other things are recorded in mica? What is the exact nature of quodons among the many *nonlinear localized travelling excitations in crystals*?

At present, Mike has just turned 83 and he is still extremely active. Evidence of this is apparent in the chapters he has written for this book, his nomination in 2013 as honorary professor of the University of Pretoria, South Africa, his trek to the Himalayas in 2014 and last but not least the recent theory of charged quodons. For a long time he has been worried that his ideas, dispersed in publications in many journals over many years may be forgotten. To prevent it he decided to write his lifelong research in such a way that it would be accessible to a wider audience. The result of his labour is in Chap. 20 of this book.

With the same objective, we conceived the idea of organizing a conference where Mike could explain in detail his ideas to an interested audience of scientists and they would contribute with the latest advances of science in this field. Finally, the conference took place in Altea in 2013. At the end of the conference it was proposed that a book be written in a year's time so that work could be finalized and

ideas clarified. The objective of the book was to describe the phenomena in mica, the past and present research of Mike Russell and to show that phenomena similar to quodons appear in theory and experiments in many different systems, hence, the title *Quodons in Mica* and the subtitle *Nonlinear Localized Travelling Excitations in Crystals*.

The conference had to be in a very special place, where the atmosphere would inspire the participants and leave them with lasting memories of what they have thought and felt. The region of Valencia was in preference to Sevilla because of its many seaside locations. Soon, the enchanting village of Altea, overlooking a wonderful bay and surrounded by impressive mountains was selected. The conference took place in September 2013 with participants from all over the world.

The book is the present volume. It is organized into several parts, although the classification is somehow arbitrary and many chapters could also be included in other parts:

Part I *Mica and Mica-Related Systems*

- Tracks in mica, 50 years later. Review of evidence for recording the tracks of charged particles and mobile lattice excitations in muscovite mica by F.M. Russell.
- Numerical simulations of nonlinear modes in mica: past, present and future by J. Bajars, J.C. Eilbeck and B. Leimkuhler.
- A supersonic crowdion in mica: Ultradiscrete kinks with energy between ^{40}K recoil and transmission sputtering by J.F.R. Archilla, Yu.A. Kosevich, N. Jiménez, V.J. Sánchez-Morcillo and L.M. Garca-Raffi.

Part II *Two-dimensional Lattices*

- Pattern formation by traveling localized modes in two-dimensional dissipative media with lattice potentials by V. Besse, H. Leblond D. Mihalache and B. Malomed .
- A numerical study of weak lateral dispersion in discrete and continuum models by L.A. Cisneros-Ake and A.A. Minzoni
- Breather mobility and the Peierls-Nabarro potential by M. Johansson and P. Jason.
- Asymptotic approximation of discrete breather modes in two-dimensional lattices by J.A.D. Wattis.

Part III *Molecular Dynamics in Three Dimensions*

- Moving discrete breathers in 2D and 3D crystals by S.V. Dmitriev, A.A. Kistanov and V.I. Dubinko.
- Standing and moving discrete breathers with frequencies above the phonon spectrum by V. Hizhnyakov, M. Haas, A. Shelkan and M. Klopov.
- Phonon interference and energy transport in nonlinear lattices with resonance defects by Yu.A. Kosevich, H. Han, L.G. Potyomina, A.N. Darinskii and S. Volz.

Part IV *Electrons and Lattice Vibrations*

- Electron transfer and tunneling from donor to acceptor in anharmonic crystal lattices by A.P. Chetverikov, L. Cruzeiro, W. Ebeling and M.G. Velarde.
- Bound states of electrons in harmonic and anharmonic crystal lattices by L.S. Brizhik, A.P. Chetverikov, W. Ebeling, G. Röpke and M.G. Velarde.
- Solitons and charge transport in triangular and quadratic crystal lattices by A. P. Chetverikov, W. Ebeling and M.G. Velarde.

Part V *Semiconductors*

- Experimental observation of intrinsic localized modes in germanium by J.F.R. Archilla, S.M.M. Coelho, F.D. Aurret, C. Nyamhere, V.I. Dubinko and V. Hizhnyakov.
- The origin of defects induced in ultra-pure germanium by Electron Beam Deposition by S.M.M. Coelho, J.F.R. Archilla, F.D. Aurret and J.M. Nel.
- Rate theory of acceleration of defect annealing driven by discrete breathers by V.I. Dubinko, J.F.R. Archilla, S.V. Dmitriev and V. Hizhnyakov.

Part VI *Other Systems*

- The amide I band of crystalline acetanilide: old data under new light by L. Cruzeiro.
- Extreme waves and branching flows in optical media by M. Mattheakis and G. P. Tsironis.
- Discrete bright solitons in Bose-Einstein condensates and dimensional reduction in quantum field theory by L. Salasnich.

Part VII *A Historical Perspective*

- I saw a crystal: A historical account of the deciphering of the markings in mica by F.M. Russell.

The last part is not only interesting in this particular field, but also for showing how the mind of a scientist works, how science is mixed with life, sometimes personal events being an obstacle, but often science and life fertilizing each other.

I think it will also be useful for young students to show them that science needs not be boring and how determination and persistence can lead to success.

Success in science is not money or social approval but the satisfaction of discovery. I think that will be the lasting legacy of Mike Russell.

Sevilla
Valencia

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Mike Russell in his laboratory in 2011 when he celebrated his 80th birthday

Quodons in Mica

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