PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A MATHEMATICAL, PHYSICAL & ENGINEERING SCIENCES

Preface to The metal–non–metal transition in macroscopic and microscopic systems

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Preface

The fascinating and rich subject of the metal to non-metal transition continues to thrive and develop, so that it has re-emerged as one of the major intellectual challenges in condensed matter science.

These proceedings are dedicated to the memory of Sir Nevill Mott, CH, FRS, who initiated, inspired and led the subject of the metal–non-metal transition for over half a century.

In a series of seminal papers beginning in 1949, Sir Nevill posed the fundamental question as to whether non-metallic materials would, under appropriate conditions, become metals. His conclusion, that they would, was perhaps not surprising; what was remarkable, however, was his demonstration that at the transition from non-metal to metal, *all* the valence electrons would become free (itinerant) at once, not just a few of them. This led to the prediction of a discontinuous transition from a non-metal (having zero conductivity at $T = 0$ K) to a metal (having finite conductivity at $T = 0$ K). The words of John Dryden penned over two centuries earlier—'. . . Either be wholly slaves or wholly free'—capture the very essence of the metal–non-metal transition beautifully.

This kind of discontinuous phase transition from non-metallic to metallic behaviour has long been called the 'Mott transition'. This is just one example of Sir Nevill's monumental contributions to condensed matter science. His enduring intellectual legacy lies in the ineffable traces that he has left on the history of our subject, and indeed, on our time. The everyday parlance of condensed matter science will always include such expressive terms as 'Mott transition', 'Mott insulators', 'Mott variable-range hopping', 'Mott minimum metallic conductivity', and many more.

Sir Nevill was a scientist of awesome intellect and acute physical intuition and insight. As a friend and colleague he displayed great kindness, generosity and support, a mischievous sense of humour, and an immense love of life. In his later years, the enormous intellectual challenge of the metal–non-metal transition still remained central to Sir Nevill's science. In his very last letter to Peter Edwards on 9 May 1996, he provided surely the *unequivocal* answer to the perennial question, What is a metal?: 'I think one can only answer the question at $T = 0$ K. Thus a metal conducts and a non-metal doesn't.'

In this Discussion Meeting, therefore, we celebrate the life and work of Sir Nevill Mott, doyen of condensed matter science. The papers to be found in these proceedings cover a multitude of topics in the subject of the metal–non-metal transition, but the seminal work of Sir Nevill continues to provide the unifying theme.

We thank our colleagues, Ian Gameson, Neil Hyatt, Martin Jones, Lesley Lloyd, Graeme Peacock and Nick Wilson, for their invaluable assistance during the Discussion Meeting. We are also indebted to the staff and officers of the Royal Society for their professionalism, and patience! Last, but certainly not least, we thank Ms Janet Taylor for her unstinting efforts during all stages of this endeavour.

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