PREFACE

This volume collects together the invited contributions to the NATO Advanced Research Workshop on Modality, Probability, and Bell's theorems, held in the Kolegium Polonijne in Cracow, Poland, from August 19 to 23, 2001. Forty researchers participated in this meeting; and twenty-one main lectures, not counting informal seminars and evening discussions, were given. The excellent organization of the conference, the friendly local hospitality of the staff at the conference center, and its beautiful location, all contributed to the delightful atmosphere and scientific success of the workshop. The organization of the meeting was made possible by generous support from the NATO Scientific Affairs Division, and from the Jagiellonian University in Cracow.

Quantum non-locality has been an active research area in physics, philosophy of science and logic for several decades. Indeed, the revival of the entire field of foundational studies of quantum physics from the mid-1960s is due, in good measure, to Bell's epoch-making theorems about non-locality, together with related work—such the Kochen-Specker theorem, and the growing appreciation of the significance of the pilot-wave theory.

But during the last ten years, new developments have changed the field considerably. Here we would pick out for special mention, three examples, spanning both physics and philosophy—and which are all represented in this volume. First, the last decade has seen the rise of quantum information theory, providing many new perspectives on non-locality and entanglement. Second, unsharp quantum theory, with its more general notion of observable, has in similar fashion changed the field. Third, there have been deeper and more precise studies of the relations between quantum non-locality and philosophical theories of causation, probability and modality. These various developments of course overlap with each other; and with yet others such as the recently renewed examination of the orthodox Copenhagen interpretation and further studies of heterodox interpretations, like the pilot-wave theory—again represented in this volume.

Accordingly, we have divided the contributions to this volume into several groups, though the boundaries are of course vague. We begin with three papers that give a philosophical re-examination of the views, especially as regards non-locality, of two giants of quantum theory, Bohr and von Neumann. There follows a group of papers about interpretations of quantum theory, including heterodox interpretations; and then a group focusing on entanglement and non-locality, by and large without commitment to an interpretation. The next group of papers applies unsharp quantum theory to the Bell and Kochen-Specker theorems. Finally, there are two groups of papers about more philosophical aspects. They study how various philosophical doctrines bear on quantum theory's non-local correlations: the first group focuses on philosophical doctrines about causation (including probabilistic causation), the second group on doctrines about modality.

In our opinion, the workshop was fortunate to have, not only lively and stimulating discussions, but also many truly first-rate research papers. So it is a pleasure for us to make these proceedings available to the foundations of physics community.

Finally, a note of sadness: after the workshop, the philosophical community was saddened to hear of the death on 14 October 2001, in Princeton, of David Lewis. He was a systematic philosopher of genius, and a superb craftsman in all his work: work which has had immense influence in most branches of analytic philosophy, including the philosophy of physics. He was also unfailingly conscientious and helpful to others in all his professional dealings: he will be greatly missed. We dedicate this volume to his memory.

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