

*INSTANTANEOUS ACTION AT A DISTANCE**IN MODERN PHYSICS : PRO AND CONTRA*

Instantaneous Action at a Distance in Modern Physics : Pro and Contra – edited by ANDREW E. CHUBYKALO, VIV POPE and ROMAN SMIRNOV-RUEDA. Nova Science Publishers, Inc., 1999.

To begin with, I would like to explain why the reviewed book “Instantaneous Action at a Distance in Modern Physics : Pro and Contra” is interesting enough at the turn of the millennium :

In the last century, the understanding of the nature of electromagnetic phenomena was proceeding with a constant rivalry between two concepts of interaction : namely, Newton instantaneous action at a distance (IAAAD) and Faraday-Maxwell short-range interaction. Finally, the discovery of Faraday’s law of induction (explicit time dependence of electromagnetic phenomena) and the experimental observation of electromagnetic waves seemed to confirm the short-range interaction. Nevertheless, the idea of IAAAD still has many supporters. Among the physicists who have developed some theories based, in any case, on this concept, we can find names such as Tetrode and Fokker, Frenkel and Dirac, Wheeler and Feynman, and Hoyle and Narlikar. This interest in the concept of IAAAD is explained by the fact that classical theory of electromagnetism is an unsatisfactory theory all by itself, and so there have been many attempts to modify either the Maxwell equations or the principal ideas of electromagnetism.

On the other hand, the famous article “Can Quantum-Mechanical Description of Physical Reality Be Considered Complete ?” by Einstein, Rosen and Podolsky published in *Physical Review* in 1935 revived this discussion in a new panorama. In this article Einstein made public his position against the Copenhagen interpretation of the quantum mechanics. The controversy unleashed since then made this article a very popular one for its implications in our physical and philosophical understanding of the physical reality.

The main objective of this article was to demonstrate that the quantum mechanics, the same way the Newtonian mechanics was for the relativistic mechanics, is an incomplete theory, and therefore, transitory of reality. For that reason Einstein made evident what is now known as the EPR paradox. According to EPR quantum mechanics is no local theory, that is to say, it permits action at a distance and, that is forbidden by the relativity theory, instantaneous action at a distance. Unfortunately for Einstein, and for common

sense the experiment performed by Aspect seems to indicate that the IAAAD following from quantum mechanics exists.

As a consequence of this confusion, physicists are divided in two big groups according their position about IAAAD. These disputants are the quantum physicists and the relativists, who, almost after a century, have not been able to answer the old question whether the subject of their studies is a complete and integrated Universe – a physical Universe in its own right – or simply a assemblage of locally interacting parts. This argument is not banal due to our understanding of the fundamental concepts of space and time depends drastically on which of these two positions is correct.

To this controversy are addressed the articles brought together in the book “Instantaneous Action at a Distance in Modern Physics : Pro and Contra” edited by Andrew E. Chubykalo, Viv Pope and Roman Smirnov-Rueda. This important compilation of articles (23 pro and 14 contra) written by well-known specialists represents a formidable synthesis of the present situation of this problem.

There are physicists who believe that their predecessors have done all the important conceptual work to interpret the natural phenomena and there is no need of any radical revision in this direction. What remains, in their opinion, is a restricted science that accommodates all the observational and experimental evidences so that they fit in the accepted conceptions almost as dogmas in this tremendous edifice which is modern physics.

This belief strengthens due to the opinion that “the present science has demonstrated through its influence in the modern technology development that man is ever closer to the absolute control of the world” as if this was a unquestionable statement. Nevertheless, notwithstanding the apparent triumphalism the human spirit rebels against this scientific positivism due mostly to the internal contradictions of science as it is in the case of the EPR paradox. This pragmatism derives partly on the loss of the romantic character of physics with the obvious consequence of the loss of interest by the generations of young people to study pure sciences.

After so many years of dwelling on this problem, without having obtained an accepted solution by the scientific community, it is logical to expect that the discussion has arrived to a conceptual deadlock and for that reason, partly, hopelessness has settled in the minds of young people who want to study this field of human knowledge. For young people wanting to understand the world, this particular field of science seems to provide only philosophically disorganized bits of knowledge, that constitute in its majority means of destroying ourselves entangled in the web of intellectual confusion. Because of this, what began as a Natural Philosophy has been losing its essence and has slowly transformed into a practical science against what was initially expected of it.

In this way, the importance of this book lies in its editorial approach as it intends to break the current conceptual deadlock through discussion as it encourages the innovation through a multidisciplinary approach in the selection of the diverse published articles. In this sense the book is nearer

to the conception of what was called once Natural Philosophy which we call now as Physics. It is clear that in the selection of the papers the declared purpose by the editors has been to restore partly the original adventurous spirit of Nature Philosophy. Regarding the controversy of the fundamental issue of action at a distance, they have tried to consider not only the old academic arguments and their associated terminology, but also and principally new arguments. Its emphasis was thus on presenting informed and carefully considered descriptions of natural phenomena, avoiding as far as possible the interpretations in terms of entities that only result being speculative.

This is in accordance with what modern philosophers have discovered, that the final referee in matters of perception in all fields of knowledge including physics, is language. They have alerted us against the semantic entanglements that lead us to “problems” of Wittgenstein type called Scheinprobleme (Who knows if IAAAD and EPR are these “problems”?) which are, really, problems that we attribute to nature but we ourselves create due to the complicated ways to denominate and describe things.

This last thought is expressed in what, from a point of view of the common language, has become an in-group jargon which is unintelligible for the modern public, the same way the Latin of the priests was to the peasants of the Middle Ages. To be a physicist, therefore, one must converse with that jargon and must be able to quote all the recognized authorities on the subject. No kind of tentative of originality is allowed, of the type that would be required to break the professional EPR deadlock, but until one familiarizes himself completely with the stories that predecessors achieved in the interpretation of nature – even when an excessive indoctrination in that science could have well been the origin of the problem. However, this initiation in science is obligatory for the physics student. “Thinking”, he is taught, “starts from here”. Student is reminded the reason Newton once said, that his success in science had been gained by “standing on the shoulders of the giants”. That could have been correct in Newton times. Since then, however, nature has become, modern physics is also part of it, something barely visible over the heads of a great number of elevated intellects. Someone said “in modern times it is rather difficult to publish on some phenomenon without quoting some expert.”

It is important to point out that, to the greatest extent, the use of ordinary logical language has been observed in the book in the chosen contributions addressing the problem of how bodies can physically interrelate in a vacuum. But of course, in none of the stages in its evolutionary history ordinary language has been a “pre-established set.” It is a process of development of logical negotiation with nature involved and in which, as in politics, conservatism fights against radicalism in the formation of the new language. In physics, for example, exists “conservatives” who believe that the linguistic devices of the past, such as our habitual vocabulary of “fields”, “ether”, “wave-particles”, “photons”, . . . and so on, are indispensable for a new leap in physics in the future. The others, more radical, believe there is an excessive collection toward those old linguistic devices which make, in particular, the IAAAD problem seem unanswerable. These radicals insist that to reach some sort

of genuine progress the whole structure of the language of physics must be revised.

The conservative thinker, of course, does not accept that the physical interaction could happen in any other manner but the usual delayed one. They insist, as Maxwell and Einstein did, that in space there must exist mediating agents, analogous to air or water, that perform as conductors of the causal influences that cross the space that separates a piece of matter from the other. For radicals, such as Mach, on the other hand, there is no "space" without its relation with sensible matter, so that instantaneous configurations of bodies and the space, which is extrapolated between them, must go inseparably together.

The original spirit of Natural Philosophy comes back to life in this book through heated debates, which bring us closer once again to the romantic character of physics. The struggle for the truth is not only present in the authors belonging to the different positions but also among those of the same group. In particular, what calls our attention are the articles "Loopholes and Anomalies in Actual Bell Test" by Caroline H. Thompson and "Objective Local Models for Would-be 'Nonlocal' Physics" by A.F. Kracklauer. Both being contrary to action at a distance, they clash against one another when arguing about the need of complete re-investigation of the experiments.

We cannot omit mentioning the article "Arguments in Favour of Action at a Distance" by Andre Assis. Besides the article itself having an interesting and valuable content, the author narrates in the Introduction the evolution of his personal relation toward the concerning postures to action at a distance. His hesitation between these positions turns out to be illustrative for young people with inquisitive minds who wish to study the fascinating search for the truth.

The authors of the articles must be congratulated for their fine and imaginative contributions. The editorial work realized must also be congratulated for having been able to create the scenario of the meeting of the modern positions about IAAAD, and also for allowing us the hope that perhaps, at the turn of the millennium, science can successfully clarify to some extent the conceptual confusion and reach a clearer panorama of the old-age action-at-a-distance problem.

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