Current problems in ball lightning science

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Y. H. Ohtsuki (ed.). Science of Ball Lightning (Fire Ball). World Scientific, Singapore, 1989 pp. 340.

This book is a collection of reports given by the attendees of the First International Symposium on Ball Lightning that took place on July 4–6, 1988, in Japan. The collection has been edited by Prof. Ohtsuki (Univ. of Tokyo), who was the organizer and the chairman of the symposium's organizing committee, as well as the president of the Japan Center of Ball Lightning Research. The symposium itself was largely a result of Prof. Ohtsuki's efforts.

Both the contents of the book under review and the symposium reflect the current state of ball lightning research. On the one hand, the very fact that the symposium took place indicates that ball lightning is a real scientific problem that should be investigated and discussed. On the other hand, the symposium demonstrated that this subject has attracted scientists of very different profiles that previously had little opportunity to communicate and exchange ideas. Consequently, unlike conventional international symposia and conferences, the ball lightning symposium was an inhomogeneous system and the book under review reflects this.

The first paper in the collection is authored by the American physicists Barry and Singer, both of whom had previously published monographs on ball lightning (Singer in 1971, Barry in 1980). These monographs played an important role in the evolution of the field. They reviewed the state of research in the field at the time of publication and laid the groundwork for further studies. In this collection the contribution of Singer and Barry also fulfils the function of an introduction. The views of these authors have changed only slightly in the intervening years and their paper is based largely on information culled from their monographs and reviews, with only a few more recent references chosen to illustrate their points.

Ball lightning research can be subdivided essentially into four directions: 1) collection and analysis of observational data; 2) analysis of phenomena related to ball lightning; 3) experimental modeling of ball lightning; 4) theoretical models. We shall follow this classification in analyzing the contents of the book under review.

This book contains four collections of observational data: Soviet (2058 sightings); Japanese (2060 sightings); Hungarian (over 300 sightings); and Austrian (150 sightings). The exhaustive paper by Grigor'ev, Grigor'eva, and Shiryaeva (USSR) summarizes the many years of research by the Yaroslavl' group. Their results cover a wide range of ball lightning parameters. The scientific style of this group recalls the work of I. P. Stakhanov, who made an important contribution to the analysis of observational data by developing convenient analytical schemes. It is unfortunate that the full scope of the Soviet group's research has been published only abroad. The paper by the Japanese researchers Ohtsuki and Ofuruton, who employed a statistical approach similar to that of the Yaroslavl' group, is still preliminary and addresses a limited number of parameters. The authors note that in Japan, contrary to the continental experience, ball lightning usually strikes on clear days, rather than during stormy weather. Nonetheless, the correlation between seasonal and geographical distributions of ordinary and ball lightning is approximately the same as in other collections of observational data.

Sightings of ball lightning collected over small regions furnish additional information on the possibilities of observing ball lightning and thereby shedding light on the phenomenon itself. Thus, according to Keul and Schwarzenbacher, ball lightning is practically never observed at high-altitude meteorological stations. The data of Egely make it possible to evaluate an upper bound on the probability of ball lightning sighting by a single individual, which comes out to $3 \cdot 10^{-5}$ per year or $2 \cdot 10^{-4}$ over the course of a lifetime. Furthermore, in a number of observations which involved the destruction of conductors, Egely estimates that the conductors were subjected to electrical discharges of several Coulombs. It therefore follows that this destruction is caused by electrical breakdown fueled by an external source of energy.

Among the studies devoted to the experimental modeling of ball lightning, the main contribution was due to Ohtsuki and Ofuruton, who extended Barry's experiments of some 20 years ago. The original experiments involved the generation of a spark in an air atmosphere containing a small admixture of propane and the subsequent formation of small fire balls that moved about the cell. Ohtsuki and Ofuruton improved the experimental technique and carried out experiments in mixtures of air with methane, ethane, and cotton fibers. They also observed the formation of fire balls, but noted the poor reproducibility of the results. At the symposium, Golka (U.S.) and Dijkhuis (Holland) discussed the formation of fire balls due to short-circuits in high-voltage equipment. Unfortunately, these reports were not included in the book under review.

A number of contributors analyzed processes in other systems that could be relevant to ball lightning research. Nickel (West Germany) researched the application of Hill's vortices and hydrodynamic flows to ball lightning. Smirnov (USSR) presented two radiative models of ball lightning: the first described the luminescence as analogous to the flame of a candle, while the second compared it to the explosive burning of pyrotechnical mixtures. As these two models are mutually exclusive, the future will tell which of the processes really describes the phenomenon. Gladyshev (USSR) discussed chemical processes in hot air involving ions and oxides of nitrogen, making use of current knowledge of reaction rate constants. Kikuchi (Japan) summarized the infor-

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mation acquired in the course of studying the passage of rockets through the atmosphere, including electrodynamical processes and the reconnection of electric field lines. Handel (U.S.A.) studied maser effects that can occur in atmospheric water vapor and analyzed the possibility of analogous effects in ball lightning. Koloc (U.S.) discussed an original magnetohydrodynamic model of luminescent ball formation. Together these studies enable us to cull information useful in ball lightning research from the existing body of scientific concepts and ideas.

A number of attendees presented specific models of ball lightning. Yamamoto (Japan) presented a plasma model, whereas Dijkhuis and Pijpelink (Netherlands) proposed a mechanism in which plasma electrons are paired as bosons, as in the theory of superconductivity. Neda, Ofuruton, and Ohtsuki (Japan) computed the electric field intensity in ball lightning within the framework of the aerosol model. Zou (China) explained the UFO phenomenon reported in China as a plasma soliton.

In all, this book reflects the current state of ball lightning research and will be of interest to scientists pursuing this problem.

What we can learn from "The Myths of Relativity Theory"

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A. A. Denisov. The Myths of Relativity Theory. Lit. NII NTI, Vil'nyus, 1989 pp. 52.

Are the special theory of relativity (STR), modern relativistic theory of gravitation, or classical electrodynamics of relativistic particles really valid? It would appear that these questions, however reasonable early in this century, have been rendered obsolete by the many decades of experimental and theoretical research that have demonstrated convincingly the validity of the fundamental postulates of modern physics. And yet, although by now these postulates have become well-nigh classical, certain recent developments are compelling us to return to this ostensibly outdated issue.

Although the explosive current growth of social self-awareness in our country has been enormously beneficial, certain excesses were bound to occur. Thus, in recent times, astrologers and extrasensory perception practitioners have commanded more radio and television exposure than real scientists addressing real scientific matters. We have also witnessed ever more frequent attempts by insufficiently literate people to supplant the scientific worldview with crude "common sense", as well as heightened interest towards such "scientific sensations" as "unidentified flying objects" and "otherworldly phenomena". Among such recent developments we must, unfortunately, include the ignorant critique of relativity theory by A. A. Denisov in his booklet entitled "The Myths of Relativity Theory", published in a printing of 50 000 copies by the Lithuanian Scientific-Research Institute of Scientific and Technical Information in 1989.

Every individual has the inalienable right to hold personal opinions on scientific and other matters, even if these opinions contradict established facts. Clearly, scientific matters also require a certain competence in the subject. Unfortunately, the author's argumentation clearly indicates his superficial, to put it kindly, familiarity with the postulates of the theory he chooses to criticize. Not all individual opinions deserve discussion in a scientific journal, especially opinions that are both incompetent and irresponsible. In this case, however, the author of the piece of sensational "debunking" is a professor at an institution of higher learning[1] whose word could carry weight with students. Furthermore, A. A. Denisov attacks a theory that is of fundamental significance to modern physics and of great practical and philosophical import. The theory of relativity underpins the modern physics of elementary particles, atomic and nuclear spectroscopy, nuclear engineering, and many other fields of physics and technology. The design of all modern particle accelerators is based on the results of STR. Because of the theory's fundamental importance, the basic ideas of STR have been incorporated into the physics programs not only of institutions of higher learning, but even of secondary schools. For all the above reasons, it is worth the effort to determine whether A. A. Denisov's "theory" is a revolutionary physical contribution or a misinterpretation of fundamental physical facts and concepts.

For the benefit of the reader unfamiliar with the booklet by A. A. Denisov, let us cite some of the author's basic precepts, which also provide a fair idea of his expository style and self-confident judgement:

"...The Lorentz–Einstein transformations of Cartesian coordinates underlying the Special Theory of Relativity do not satisfy the relativity principle despite the universal conviction to the contrary" (p. 4).

"...The canonization of the absurd postulate of the constant speed of light...was too hurried and unjustified" (p. 10).

"...In constructing his theory Einstein did everything to make these absurdities (*Reviewers' note*: relativistic mass increase, time dilation, length contraction) cancel each other and become an organic part of the theory. Moreover, if Lorentz still attempted to relate these effects to the influence of ether on moving objects, Einstein made them a consequence