Frontiers of Fundamental Physics

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Preface

The Olympia conference **Frontiers of Fundamental Physics** was a gathering of about hundred scientists who carry on their research in conceptually important areas of physical science (they do "fundamental physics"). Most of them were physicists, but also historians and philosophers of science were well represented. An important fraction of the participants could be considered "heretical" because they disagreed with the validity of one or several fundamental assumptions of modern physics. Common to all participants was an excellent scientific level coupled with a remarkable intellectual honesty: we are proud to present to the readers this certainly unique book.

Alternative ways of considering fundamental matters should of course be vitally important for the progress of science, unless one wanted to admit that physics at the end of the XXth century has already obtained the final truth, a very unlikely possibility even if one accepted the doubtful idea of the existence of a "final" truth. The merits of the Olympia conference should therefore not be judged a priori in a positive or in a negative way depending on one's refusal or acceptance, respectively, of basic principles of contemporary science, but considered after reading the actual new proposals and evidences there presented. They seem very important to us.

The confrontation between different lines of research has accompanied science from its birth. Galileo's scientific ideas were heretical, not only with respect to the dominant religious and political powers of his times, but with respect to the academic establishments of the universities as well: Well known is the example of the astronomy professor who refused to look in the telescope, but many were the centers where the heliocentric ideas were rejected. The great results obtained by Kepler, Newton, and many others, slowly transformed Galileo's heresy into the orthodoxy of modern physical science.

Atomism had existed as an idea cultivated by few isolated people for about 2300 years when, at the end of the XIXth century, Ludwig Boltzmann presented his conception of an objectively existing atomic structure of matter. Almost all scientists surrounding him seemed to reject atomism, and the bitter struggle that went around this question probably contributed to the dramatic ending of his life (1906). In the same years, however, Albert Einstein and Jean Perrin obtained an atomistic description of Brownian motion and shortly afterwards atomism was fully accepted in physics, owing also to the discoveries made by Ernst Rutherford and Niels Bohr. In this way the isolated ideas of Boltzmann became the new orthodoxy.

The geophysicist Alfred Wegener was much laughed at for his 1912 proposal that the continents had shifted relatively thousands of km, that the Atlantic Ocean had opened as the Americas split from Africa and Europe, and that all the continents had once been united as a single supercontinent, Pangaea. Only after the confirmations found by Warren Carey in 1954 Wegener's discovery started to be accepted in the scientific community. Today there are so many independent proofs that continents have been united in the past that it seems impossible to doubt it. Here the new frontier has become the conjecture that the Earth radius has considerably increased in the past.

In spite of these well known examples science is of course not reducible to an endless confrontation between opposite ideas, since it deals with the material reality surrounding us and uses powerful methods that allow sometimes the scientists to understand true properties of the real world. Therefore part of the orthodoxy can also be considered as valid knowledge. Such are for example the following statements: the Sun is just a star; the Milky Way is our galaxy seen from inside; in outer space there are hundreds of millions of other galaxies; there is a molecular and atomic structure of matter, and a nuclear structure of atoms; there exist subatomic entities called electron, proton, pion, etc. Many other examples of valid knowledge could easily be given. It is a fact however that today's physics seems to contain more than just valid knowledge.

In books dealing with astrophysics and cosmology one often finds statements like: "the astronomer Edwin Hubble established beyond all reasonable doubt that the Universe is expanding", but Hubble himself wrote in several different occasions statements like the following one of 1939: "... the results do not establish the expansion as the only possible interpretation of redshifts". Moreover quasars are the objects with the largest observed redshifts, and should therefore be considered at the margins of the visible universe, but many independent pieces of observational evidence indicate that some of them are actually associated with nearby galaxies and that their redshifts cannot therefore be due to recessional motion. A recent amazing discovery is the so called "redshift quantization" phenomenon for spiral galaxies, and this is so difficult to explain within the standard cosmology that most people prefer to forget about it - a predictable reaction of modern scientific thinking confronted with radically new evidence. Important astrophysicists and cosmologists (Hannes Alfven, Halton Arp, Geoffrey Burbidge, Fred Hoyle, Jayant Narlikar, ...) have repeatedly argued that the observed redshifts of quasars and galaxies could well have an explanation radically different from the standard one based on *big bang*. In spite of all this the dominant view remains the idea that the only possible explanation of galaxy and quasar redshifts is based on the universal expansion

In relativity most people believe that the "luminiferous ether" of the XIXth century has been ruled out by Michelson-type experiments and by the development of the theory of special relativity. The situation is very different however, since

Poincaré and Lorentz were both defenders of the existence of ether, and Einstein himself after 1916 radically modified his previously negative attitude. For example in 1924 he wrote: "According to special relativity, the ether remains still absolute because its influence on the inertia of bodies ... is independent of every kind of physical influence." The minority group of people working today in the foundations of special relativity seems to be almost completely ether-oriented, and there are many proposing a reformulation of the theory along the lines dear to Lorentz: Simon Prokhovnik and the late John Bell are two examples. It has also become clear how such a reformulation should be carried out, after the 1977 realization that the conventional nature of the clock synchronization procedures opens the door to theories which are different from, but physically equivalent to special relativity.

Also general relativity has problems of fundamental nature, in particular those connected with the right-hand side of Einstein's field equations, where only the matter stress-energy tensor, but not the field stress-energy tensor, contributes to space-time curvature. This goes against the very fundamental conclusion of special relativity that all forms of energy are completely equivalent, and gives rise to a curious conservation law of rest mass, but not of energy-momentum. A very large number of theoretical physicists seem to be happy with calculations performed strictly within the standard formulation, in spite of the fact that it has been shown that Einstein's field equations do not lead to interactive N-body solutions, if $N > 1$. General relativity can be considered as a test-particle theory, and as such it explains the three classical tests, but in other respects seems sometimes not to be quite satisfactory. More about this can be found in these proceedings.

In our century the interplay between science and ideology has become more important than ever and the hystorians of physics have produced detailed reconstructions of the true scientific/cultural processes leading to the development of what we call "modern physics". From this work evidence has emerged for the existence of common cultural roots with philosophers such as S. Kierkegaard, M. Heidegger, A. Schopenhauer, and W. James. It is therefore not surprising that these philosophers developed ideas similar to some now prevailing in modern physics, in particular concerning the negative attitude toward the possibility of a correct understanding of the objective reality. In fact in quantum physics the standard teaching (after 1927) is that one cannot understand the atomic world in "classical" terms, that is by employing causal space-time descriptions. People active in the foundations of quantum physics believe instead that no good reason for such a pessimistic conclusion has ever been presented, and recall that Einstein, Planck, Schrödinger and de Broglie could not accept it. A group of participants in Olympia try accordingly to find new space-time models of elementary particles and/or to develop new mathematical tools useful for this task.

Bell's theorem states that any theory of the physical world based on the rather natural point of view of local realism must disagree at the empirical level with the predictions of quantum mechanics by as much as 42%. Experiments performed in the seventies and early eighties have produced results compatible with the existing quantum theory, but Bell's theorem has actually not been checked due to the introduction in the reasoning of arbitrary (but unavoidable, given the efficiency of the used apparata) additional assumptions. In this way a confusion has been produced between Bell's original inequality and the much stronger inequality violated in those experiments, forgetting that the latter owes the very possibility of being violated by the quantum theoretical predictions to the mentioned additional assumptions. In spite of the fact that Bell's theorem could allow in principle to decide who was right in the Einstein/Bohr debate, we still do not know the answer thirty years after the formulation of the theorem.

The confrontation between different points of view goes on, but a strange mutation seems to reduce its effects, since new ideas in fundamental physics find invariably difficulties in being accepted by the majority, no matter how well formulated and important they could be. While the ruling of the majorities is a fundamental feature of every democracy, it certainly does not apply to science where the great steps forward have always been made by isolated individuals. This dogmatic hardening risks today to make the scientific majorities impenetrable to a critical understanding of the foundations of contemporary scientific theories.

The existence of such attitudes within modern science has been observed by many physicists and also by the best epistemologists of our century. Thomas Kuhn, for example, wrote about the education of young physicists: "Of course, it is a narrow and rigid education, probably more so than any other except perhaps in orthodox theology." Karl Popper was worried about the poor standards of scientific confrontations and stated: "A very serious situation has arisen. The general anti-rationalist atmosphere which has become a major menace of our time, and which to combat is the duty of every thinker who cares for the traditions of our civilization, has led to a most serious deterioration of the standards of scientific discussion. ... But the greatest among contemporary physicists never adopted any such attitude. This holds for Einstein and Schrödinger, and also for Bohr. They never gloried in their formalism, but always remained seekers, only too conscious of the vastness of their ignorance." The understanding of the vastness of our ignorance was generally present in Olympia, but in all fairness we must add that one could also get glimpses of what our science could become in the future: in all cases these were very exciting moments.

The choice of Olympia for helding the conference was not casual: this is the place where the Olympic games of ancient times were held for something like 1,200 years. Wars were stopped when the games started and activities included reading of poems, and discussions about science and philosophy. Olympia is not only one of the most beautiful and interesting spots of the world, but also a positive symbol of the modern civilization.

The generous efforts of many people have made our conference possible. First of all we wish to thank Attanassios Kanellopoulos for his encouragment and for many useful suggestions. The elected member of the Parliament Crigno Kanellopoulos-Barone has generously helped us in establishing fundamental contacts in Olympia and elsewhere. The constant help of Georges Kanellopoulos has been of tremendous importance for the success of the meeting: we thank him warmly. We are also very grateful to the physics students Rossella Colmayer, Francesco Minerva and Gabriella Pugliese, who formed an efficient and charming secretariat.

Our thanks go also to the International Olympic Committee, and to its president Prof. X. Yzezezez, for allowing us to use, free of charge, the wonderful structures of the Olympic Academy where the conference was held. Mr. A. Bababab, representative of the Greek government, brought us welcome greetings and encouragment, and Prof. R. Rapetti, president of the Istituto Italiano di Cultura in Athens, stressed the European nature of the conference. The words of Mr. X. Kosmopoulos, major of Olympia, made the participants feel at home in his marvellous town.

Last but not least our gratefulness goes to the generous sponsors: the Greek Ministry of Culture, the General Secretary of Research and Technology of the Greek Ministry of Industry, the Università di Bari and, independently, the Physics Department of the Università di Bari, the National Tourist Organization of Greece, the Commercial Bank of Greece, the Ionian Bank of Greece, the Ellenic Industrial Development Bank S.A., and Glaxo A.E.B.E. Without their concrete help the Olympia conference would not have taken place.

M. Barone and F. Selleri

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EMPIRICAL EVIDENCE ON THE CREATION OF GALAXIES AND QUASARS

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Simply the arrangement on the sky of extragalactic objects has long shown that the youngest, smallest quasars and compact galaxies have been created recently in the vicinity of older progenitor galaxies. Now high energy observations in X-rays and γ-rays confirm these connections and require the creation of matter as an ongoing process marked by an initially high intrinsic redshift.

The nearest superclusters of galaxies show creation along lines in space originating from the central, ejecting galaxy. String theory may be pertinent. The existence of preferred values of redshift (periodicity) rule out, again, an expanding universe. They also imply quantum mechanical effects at the $m = 0$ creation points of particulate matter. No theory has been advanced, however, which numerically predicts the quantization values.

Introduction

The Big Bang theory of the universe precludes any scientific observation of creation because the event is so remote in time and space. But even if we could observe this singular event at a distance of 15 bilion light years this age zero universe would supposedly surround us in every direction. That leads to the rather bizarre conclusion that we are, at this moment, "inside" a point that is so small it is dimensionless (the point from which the universe is supposed to have suddenly expanded).

Perhaps the conclusion is illogical enough to send us back to what we should have been doing all along – looking at the actual observations. If we do, we find that they all point to the incorrectness of one key assumption in the current theory. That assumption is that extragalactic redshifts measure velocities of expansion. If redshifts are not due to recessional velocities the expansion of the universe and Big

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