The New Electrodynamics

In this Issue of *Apeiron* dedicated to electrodynamics several points of view are presented in order to synthesize and measure progress. Classical and quantum electrodynamics are still considered by the majority of physicists to be the most accurate and complete theories in physics. Considerable development of the subject has occurred however, especially in the past decade, and this Issue seeks to briefly overview this progress, in the form of papers and scientific debate. The early stages of a paradigm shift are characterized by the sudden emergence of one or more new ideas, followed by considerable debate. This is especially true of theoretical physics, and especially true when the empirical testing of ideas is difficult or lags behind the theory. One of the ideas behind the paradigm shift currently taking place is that electrodynamics is determined ultimately by the topology of the structured vacuum of contemporary physical thought. The topology is developed in terms of gauge theory and group theory. The received view is recovered by assuming that the internal gauge space has U(1) symmetry. The new paradigm that has emerged over the past decade replaces the U(1) group by the O(3) group. The reaction to this idea is typical of the second stage of a paradigm shift and is exemplified in the debate between Hunter and Evans in this Issue, one of many such debates in the literature of the past decade, essentially a discussion between two schools of thought, one based on U(1), the other on O(3). The other papers in this issue reflect new developments within U(1), and are equally important as a sign that the received view is changing slowly within the U(1) *ansatz* itself. Dr. Phipps, for example, has contributed an interesting article in which his eqns. (3) have the same overall structure as the equations of O(3) electrodynamics in the vacuum, i.e. there is a vacuum charge and current present, whose structure in O(3) electrodynamics is derived from the topology of the vacuum.

The change over to O(3), however, represents a true quantum leap of thought that is entirely typical of the first stage of a new paradigm. This is like an earthquake with intermittent after shocks in the form of disagreement. Sometimes the old and new co-exist for many years, sometimes the new is accepted quickly. Often the new is incomprehensible to the old, as can be seen in the Hunter/Evans debate and the precedents cited in the reply by Evans. Another famous example is special relativity, which was dismissed by Soddy, for example, as a "fraud;" and by Rutherford as a "joke." It is now seen that all three were great scientists, Einstein, Rutherford and Soddy. *Tempus fugit*. Within the pages of *Apeiron* we have seen more reasoned challenges to special relativity. It is therefore hoped that this special Issue devoted to the new electrodynamics will make its mark on the Millennium.

The Lorenz condition was devised by Ludwig Lorenz of Copenhagen in 1867, not by Henrik Anton Lorentz of Leiden. Therefore it is referred to throughout this collection as the Lorenz condition. It is an arbitrary construct devised for mathematical convenience, and loses considerable information. It is the biggest blunder in classical electrodynamics, and makes canonical quantization based on the Lorenz gauge an arbitrary and meaningless procedure, invalidating for example the Gupta Bleuler procedure. The Lorenz gauge prohibits the existence of time-like and longitudinal photons, and there is no physical reason for this. Time like photons can easily be constructed from a structured scalar potential, and spin accorded to the photon through Wigner's method of 1939. Discarding the Lorenz gauge, and the idea of

gauge freedom, leads to a considerable amount of new physics. A tiny fraction of what is possible is outlined in this collection.

Myron Evans, Guest Editor, Ithaca, New York, Dec. 1999

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Fundamental Problems of Natural Sciences and Engineering

July 3-8, 2000 St.-Petersburg, Russia

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