EDITORIAL INTRODUCTION

Commemoration of the Yang and Mills paper on Non-Abelian Theories

THIS SPECIAL ISSUE *is dedicated to the celebrated paper of Yang and Mills of 1954, ref. [1]. It is the continuation of the special issue on Contemporary Electrodynamics (Ann. Fond. Broglie* **27***, Nos. 2-3 (2002), edited by V. Dvoeglazov and G. Lochak).*

The Daviau paper opens the issue. It presents various generalizations of the Dirac formalism with the purpose to apply them to the explanation of the lepton generations. It also tries to find out origins of the gauge theories, such as $U(1) \times SU(2) \times SU(3)$*, thus unifying interactions. The author begins with the idea of the real Dirac algebra, which follows back to the Majorana works [2] and Hestenes works [3] (the latter is within the Clifford algebras formalism). In fact, he separates the real and imaginary parts of the field functions and comes to the 8-component formalism. Actually, the 8-component Dirac equation was first introduced by Markov [4] (see also [5]). Then, the author extends the number of components even further, to 16. It should be noted that the various symmetries of the Dirac equation have been studied by Fushchich and Nikitin [6]. Perhaps, it would also be worth to study the relations with various Poincaré-gauge theories [7]. Stumpf develops the old de Broglie idea of photons as composite particles. He works on the level of quantum-field theoretical formalism with non-Abelian theories. He claims that "electrodynamics is not an elementary but an effective theory". The presentation is rather sketchy, so the readers frequently should refer to his work [8]. The next paper is the paper of E. Mielke and A. A. R. Maggiolo. It presents a brief review of their previous works on the Yang theory of gravity, the gravitational gauge theories. The particular interest presents the Mills letter, see [9]. The latter reminds that* *"the whole trust [in 1954] was to extend the electromagnetic case, with the non-linear terms as an exciting complication". However, Mills warns about "the awkwardness of quantizing gauge fields", and he suggests that "perhaps we don't really understand quantum theory". Finally, he also says that "if gravity is a gauge field, then the symmetry group has to be the Poincaré group, which means torsion has to be included", cf. ref. [7]. The Quznetsov paper is the continuation of his LANL arxiv paper [10]. The author constructs a sort of non-Abelian gauge theories with fields "deduced from probabilities of physical events". In fact, he works with six Clifford pentads in the 4-dimensional space and generalizes the mass matrix in a way, which is similar to ref. [11]. Finally, he concludes with a bit encripted statement:"if the other methods of the information receiving and processing can exist somewhere then the physical laws of the other shape must operate there". Santilli presents a brief summary of his previous research, the so-called isotopies. First of all, we would not say that the Poincaré symmetry is "absent in contemporary gravitation". However, his introduction of a new mathematical unit can find relations to modern physics. In fact, he confirms that saying:"the projection of the treatment into the conventional spacetime recovers [the Einstein-Hilbert equations] in their totality". In our viewpoint, his reformulation of the Dirac equation presents particular interest (because it is connected with the research of one of us [12]). Finally, his idea that "gravitation has always been present in unified gauge theories" should not remain unnoticied. The next paper is that of Varlamov. It is rather too mathematical (mainly, based on the Clifford formalism,* **Pin** *and* **Spin** *groups), but we decided to include it in the volume due to his relation with the old ideas of Gelfand and Tsetlin [13], and Wigner [14] (see also ref. [15]). He considers CPT symmetry of the Dirac field "without handling to analysis of relativistic wave equations", precisely what had been stressed in the recent articles. "A situation with the discrete symmetries remain unclear for the fields of higher spin* $j > 1/2$*."*

Then, we come back to the papers, which are more connected with the modern phenomenology. R. Ingraham proposes to use the conformal group instead of the Poincaré group in order to approach the mass generation problem. Remember, the former is "augmented by a 5-parameter set of transformations which preserve space-time angle but not length". His theory, while using additional dimensions, "has nothing to do with the Kaluza or Kaluza-Klein theories". "It gives point particles a structure or extension", so non-local in a certain sense. (This is precisely *that our group invoked in the recent years.) The Dirac equation generalization is proposed too. He claims that "the whole electroweak theory can be reproduced" within his approach. However, he frequently refers to his previous papers, so the reader should also study them. The solution of the mass generation problem has not been elaborated in detail. S. Kruglov continues the research of the second-order generalized Dirac equation. We agree with him that "the mass generation mechanism is needed to understand physics beyond the Standard Model", see also ref. [16]. The 5-dimensional "business" has been considered in two subsequent papers. It is well known that the ideas of Kaluza and Klein have been developed by Yu. Rumer [17]. "In the spaces of higher dimensions a trajectory of the massive particle can be considered as a light trajectory in the corresponding medium". The Yamaleev paper is certainly related to the Vankov paper of this issue and to the earlier Horwitz et al consideration. The main idea is the variation of mass parameter and construction of a "new" relativistic mechanics on this basis. We agree with the main conclusion of the Yamaleev paper: "the relativistic condition of maslessness does not oblige one to set the inertial mass of the particle to zero", cf. ref. [18]. Vankov continues the consideration of the 5-dimensional theories. He connects his thoughts to the divergence problems in the modern field theories. The proper mass is not the constant, but it is field dependent – that is the point of his alternative relativistic theory. The idea of Vankov is also to include the gravitational forces into SRT domain, cf. [19]: "...the general relativistic equations of point particle motion in a conservative field were derived". However, this idea goes back in some sense to the Logunov business during last decades [20]. The important advantages of his paper are in his consideration of the well-known test problems, such as 1) a particle in the static spherical symmetric gravitational field; 2) a charged particle in the Coulomb field; 3) the problem of the gravitational and electromagnetic radius, and, finally, 4) the gravitational refraction concept. There are some too strong statements in the article. For instance, the author said that "there is no quantum uncertainty in a complete ideal experiment when the 4-momentum and 4-coordinate vectors are measured". But, the value of the paper is not in these statements.*

The Shi and Ni paper concludes the special issue. It is based on the treatment of the polarized muons behaviour, being considered in the helicity basis [21]. The conclusion is quite unexpected. It deserves the attention of both theorists and experimentalists. "The [theoretical] re-

sult shows that the lifetime of right-handed polarized muons is always greater than that of left-handed polarized muons with the same speed in flight in any inertial frame". So, in fact, this is the only paper in the issue which proposes a well-testable (in experiments) predictions, which can be checked in these days. There were a lot of discussions during the referee process. Some referees expressed their opinions that this result has already been ruled out by experiments, but, finally, everybody agreed that the experimental accuracy was not sufficient to say that. Our opinions are: we should agree that "a spin state is helicity degenerate, the polarization of muons must be described by helicity states", and this fact should provide a basis for proposed experiments.

In conclusion, we should again refer to the de Broglie words given in the Editorial Introduction of the first special issue on the Contemporary Electrodynamics. However, during last years we had a chance to see that new holes have arisen (have been done?) in the fortress of modern physics. While the present-day education system prepares new and new defenders, it is inevitable that a new beauty building of Physics will be constructed. Everybody will win from that.

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