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Original Article

Critical Analysis of Field Theory

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ABSTRACT: *A detailed proof of the incorrectness of standard field theory (vector analysis) is proposed. The correct methodological basis for this proof is the unity of formal logic and rational dialectics. The unity of formal logic and rational dialectics is the only correct criterion of truth. The proof leads to the following irrefutable statement: standard field theory (vector analysis) is a gross error. Gross errors are as follows: (1) field theory is based on differential and integral calculus, which is an incorrect theory; (2) field theory is based on vector calculus, which is an incorrect theory; (3) field theory is formulated within the framework of a geometric coordinate system. But mathematical and physical quantities have no dimension "meter" and cannot be presented (be defined, exist) within the framework of a geometric coordinate system; (4) in the point of view of formal logic and dialectics, the concepts "field in abstracto" and "mathematical field" are identical and meaningless concepts. "Field in abstracto" and "mathematical field" have neither physical properties nor geometric properties; (5) the standard definition of a field is: "A field is a part of space, each point of which corresponds (conforms) to a certain value of some physical quantity". In the point of view of formal logic, the term "correspondence" is meaningless. The subject-predicate conjunction in a definition must be either "is" or "is not". Replacement of a dimensionless quantity in mathematical definitions and expressions by a dimensional quantity is an inadmissible operation; 6) a physical field has no points (i.e., values of a physical quantity) in a geometric coordinate system. A material point has coordinates, but a material point is not a point of a physical field. The error is in the assertion that the coordinates of a material point determine (define, identify) the value of a physical quantity; that the value of a physical quantity determines (defines, identifies) the coordinates of a material point; (7) the absurdity is that a dimensionless (i.e., mathematical) quantity is identical to a dimensional (i.e., physical) quantity.*

KEYWORDS: *Foundations of mathematics, Vector and tensor analysis, Field theory, Foundations of theoretical physics, Mathematical physics, Philosophy of mathematics.*
MSC: 00A05, 00A30, 00A35, 00A69, 35Q61, 53A45.

1. INTRODUCTION

As is well known, field theory (vector analysis) is an important branch of mathematics based on differential and integral calculus, vector calculus, and Euclidean geometry [1-4]. Field theory (vector analysis) also represents a mathematical formalism of theoretical physics [5-13]. The origination and development of field theory (vector analysis) were conditioned by the needs of mechanics and physics. The early 19th century was characterized by significant advances in the application of field theory in mechanics, optics, electrodynamics, magnetism, thermodynamics, hydrodynamics, and continuous medium mechanics. Famous scientists worked in these fields: D. Bernoulli, L. Euler, J. d'Alembert, J. Lagrange, K. Gauss, J. Fourier, S. Poisson, A. Cauchy, P. Dirichlet, J. Green, M. V. Ostrogradsky, and J. Stokes. These scientists introduced a number of new concepts: level lines and vector lines, vector tubes, the gradient of a scalar field, circulation, divergence, and rotor (curl) of a vector field. Application of the vector analysis is widely used in physics (André-Marie Ampère, Charles-Augustin de Coulomb, Michael Faraday, Lord Kelvin, James Clerk Maxwell, Paul Dirac, Pascual Jordan, Eugene Wigner, Werner Heisenberg, Wolfgang Pauli, John Wheeler and Richard Feynman (Wikipedia), [5-13]). But, in my opinion, this does not mean that field theory (vector analysis) is a substantiated theory. Really, this theory is a synthesis of erroneous, absurd theories: differential and integral calculus, vector and tensor calculus. The absurdity is, firstly, that differential and integral calculus operate with dimensionless (i.e., non-physical) quantities which do not take numerical values. Secondly, the absurdity is that vectors and tensors have no geometric representation in the Cartesian (metric) coordinate system. Moreover, field theory does not contain a correct definition of a field, because famous scientists did not find the correct methodological basis of science: the unity of formal logic and rational dialectics. The unity of formal logic and rational dialectics is also the only correct criterion of truth. My contribution to science is that I found the correct methodological basis of science and critically analyzed the foundations of theoretical physics and mathematics [14-175]. The purpose of this work is to propose a critical analysis of the foundations of standard field theory (vector analysis) within a correct methodological basis.

1.1. CONCEPTS AND RELATIONSHIPS OF STANDARD FIELD THEORY

"A field is a part of space; each point of which corresponds (conforms) to a certain value of some physical quantity. If the physical quantity is a scalar quantity, then the field is called a scalar field, and if the physical quantity is a vector quantity, then the field is called a vector field.

A scalar field is considered to be given if a scalar quantity $u(P)$ (is called a field function) is defined at each of the point P of the field. (The notation $u(P)$ means that the quantity u is a function of the point P). If the scalar field is related (belongs) to the coordinate system $XOYZ$, then assignment of the point P is equivalent to assignment its coordinates x, y, z: $u(x, y, z)$. The coordinates x, y, z have the dimension "meter". Thus, this is the physical interpretation of the dimensionless function $u(x, y, z)$ of three variables" [1-4].

"The gradient of a function $u(x, y, z)$ is a vector whose projections are the values of the partial derivatives of this function:

$$grad\, u \equiv \nabla u = \frac{\partial u}{\partial x}\vec{i} + \frac{\partial u}{\partial y}\vec{j} + \frac{\partial u}{\partial z}\vec{k}$$

Where the symbol ∇ is a nabla-vector (Hamilton operator); $\vec{i}$, $\vec{j}$, $\vec{k}$ are unit vectors that have no dimension.

The definition of the divergence of the gradient of a function $u(x, y, z)$ is as follows:

$$div\, grad\, u \equiv \nabla\cdot(\nabla u) \equiv \nabla^2 u \equiv \Delta u = \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}$$

Where the symbol Δ is the Laplacian (Laplace operator).

The definition of the curl of a vector function is the following: the curl of a vector function $\vec{A}(P)$ is the vector product of the nabla-vector ∇ and the vector function:

$$rot\,\vec{A}(P) = \Delta \times \vec{A}(P)$$ " [1-4].

2. OBJECTIONS TO STANDARD FIELD THEORY

Objection 1

1) A geometric coordinate system $XOYZ$ contains only the following geometric elements: a material point $M(x, y, z)$, a segment of a material line $L(x, y, z)$, and a material figure $F(x, y, z)$. The coordinates of the points of a segment of a material line and a material figure have the dimension "meter" and define (determine) the positions of these elements in the coordinate system.
2) If a function $u(x, y, z)$ has no dimension, then the function $u(x, y, z)$ is neither a physical quantity nor a geometric quantity.
3) If a function $u(x, y, z)$ has no dimension, then the definitions of gradient, divergence, and curl are meaningless.
4) If the unit vectors $\vec{i}$, $\vec{j}$, $\vec{k}$ have no the dimension "meter", then they cannot exist in the coordinate system $XOYZ$. (Unit vectors $\vec{i}$, $\vec{j}$, $\vec{k}$ cannot be on coordinate scales.)
5) If the quantities $\vec{i}$, $\vec{j}$, $\vec{k}$ are vectors, then they cannot exist in the coordinate system $XOYZ$. (Generally, vectors cannot be on coordinate scales that have the dimension "meter").
6) In the point of view of formal logic, a theory is a system of scientific concepts. All scientific concepts can be divided into separate types: general concepts, concrete concepts, individual concepts, and abstract concepts. The concept "physical field" is a general and concrete concept. The concepts "gravitational field" and "electromagnetic field" are individual concepts. Abstract concepts are concepts (of) about the properties of material objects (gravitational and electromagnetic fields) if these properties are considered as an independent objects of thought. These properties (as abstract concepts) represent the unity of qualitative and quantitative determinacy of material objects. The unity of qualitative and quantitative determinacy is expressed by the concepts of measure and physical quantity. The

qualitative determinacy of a physical quantity is the dimension of the quantity. If a quantity has no dimension, then this quantity is not a physical quantity. (For example, the quantity $\frac{\partial u}{\partial x}$ is meaningless because the dimension $\left[\frac{\partial u}{\partial x}\right] = \frac{no\ dimention}{meter}$ is meaningless).

7) The concept "field in abstracto" is meaningless because this concept has no essential feature (dimension).The standard definition of a field is as follows: "A field is a part of space, each point of which corresponds (conforms) to a certain value of some physical quantity". In the point of view of formal logic, the first error in this definition is that the concept "space" is undefined. The second formal-logical error is that the terms "correspondence", "to correspond", and the expression "physical interpretation of a dimensionless function" are meaningless. Really, the subject-predicate conjunction in the definition should be as follows: "is" or "is not". However, the standard definition of a field and the "physical interpretation of a dimensionless function" contain the following contradiction: a dimensionless (mathematical) quantity is a dimensional (physical) quantity. This contradiction violates the formal-logical law of lack (absence) of contradiction.

"A dimensionless (mathematical) quantity
is not
a dimensional (physical, geometric) quantity".

In other words, the replacement of a dimensionless quantity in mathematical expressions by a dimensional quantity is a gross formal-logical error.Thus, the violation of the laws of formal logic is the essence of field theory.

Objection 2

As is well known, the Universe is an ordered, stable, and unlimited material system. A emptiness does not exist. This fact leads to the following statements.

1) The Universe is a controlled system.
2) The material elements (objects) of the system are finite (limited, bounded) objects.
3) The elements are macroscopic solids (bodies), macroscopic liquids, macroscopic gases, microscopic particles, microscopic and macroscopic fields.
4) The elements are connected (interact) with each other through material fields that are generated by the elements and connected with the elements.
5) A field is a finite (limited, bounded) material object that has physical properties; a field without properties does not exist.
6) The existence of physical properties of material fields is detected using sensors (detectors) created by people; the properties of fields are studied by people; the characteristics of fields are measured by people using instruments, devices.
7) The existence of fields can be proven if only they interact with particles, bodies, sensors, instruments, and devices. In this case, the coordinate system $XOYZ$ can be used to study the geometric positions of particles and bodies interacting with the fields. The results of this geometric study are essential for research of the physical properties of the fields.
8) Physical fields (for example, gravitational and electromagnetic fields) have no points (and coordinates) in the geometric system $XOYZ$, because physical fields are not geometric elements and have no the dimension "meter". In other words, physical fields do not exist in the geometric system $XOYZ$.
9) Geometric space does not exist without a material object. The space of a material object M is the set of positions (states) of the material object M in the geometric coordinate system $XOYZ$. A moving material object M as a material point in the metric system $XOYZ$ has values of coordinates $x_n^{(M)}, y_n^{(M)}, z_n^{(M)}$, $n = 0, 1, 2, \ldots$ at different points in time t (t is a parameter). In other words, the position of the material point M is described by unique functions $x^{(M)}(t), y^{(M)}(t), z^{(M)}(t)$.
10) The functions $x^{(M)}(t), y^{(M)}(t), z^{(M)}(t)$ can depend on a physical quantity as a parameter: .
11) The function $u(x, y, z)$ and mathematical operations $grad\, u$, $div\, grad\, u$ and $rot\, \vec{A}(P) = \Delta \times \vec{A}(P)$ are meaningless because the quantity u has no dimension. Furthermore, replacement of the function $u(x, y, z)$ in

mathematical relationships by a physical quantity ξ violates the formal-logical law of lack (absence) of contradiction.

12) The description of physical phenomena within the framework of the geometric coordinate system $XOYZ$ is insufficient, inadequate.

3. DISCUSSION

Thus, field theory represents a gross methodological error because field theory operates with dimensionless (non-metering, unmeasurable) quantities. The mathematical formalism of field theory was created by immature (young, unintelligent) scientists. Scientists can be divided into two classes: "early" scientists and "late" scientists. "Early" scientists are probably more capable (?) than "late" scientists. But "early" scientists are underdeveloped and limited scientists.The abilities (features) of "early" scientists are clearly evident in school age: they easily and quickly grasp the formalism of higher mathematics (for example, differential and integral calculus). However, they do not understand (do not comprehend) the essence (foundations) of higher mathematics. "Early" scientists remain infantile, underdeveloped scientists in mature age. They are unable to study formal logic and critically analyze the foundations of mathematics and theoretical physics. "Early" scientists become conservative (dullish, rather stupid) scientists in old age. Conservative scientists cannot think critically because they have a narrow (childish, underdeveloped) consciousness. Conservative scientists are not philosophers. The abilities (features) of "late" scientists are not fully and clearly evident in school age: "late" scientists cannot easily and quickly grasp the formalism of higher mathematics (for example, differential and integral calculus). "Late" scientists do not become conservative (dullish, rather stupid) scientists in old age because they have a broad (adult) consciousness and can think critically within the framework of formal logic. They are capable of analyzing the foundations of mathematics and theoretical physics. They are philosophers. As practice shows, cooperation of the "early" and the "late" scientists leads to that the "early" scientists create new theories, while the "late" scientists refute these theories. Truth is not granted to Humanity. This is the dialectics of cognition of the World.

4. CONCLUSION

Thus, field theory (vector analysis) contains serious (gross) mathematical, physical, and methodological errors. The errors are as follows:

1) field theory is based on differential and integral calculus, which is an incorrect theory;
2) field theory is based on vector calculus, which is an incorrect theory;
3) field theory is formulated within the framework of a geometric coordinate system. But mathematical and physical quantities have no dimension "meter" and cannot be presented (be defined, exist) within the framework of a geometric coordinate system;
4) in the point of view of formal logic and dialectics, the concepts "field in abstracto" and "mathematical field" are identical and meaningless concepts. "Field in abstracto" and "mathematical field" have neither physical properties nor geometric properties;
5) the standard definition of a field is: "A field is a part of space, each point of which corresponds (conforms) to a certain value of some physical quantity". In the point of view of formal logic, the term "correspondence" is meaningless. The subject-predicate conjunction in a definition must be either "is" or "is not". Replacement of a dimensionless quantity in mathematical definitions and expressions by a dimensional quantity is an inadmissible operation;
6) a physical field has no points (i.e., values of a physical quantity) in a geometric coordinate system. A material point has coordinates, but a material point is not a point of a physical field. The error is in the assertion that the coordinates of a material point determine (define, identify) the value of a physical quantity; that the value of a physical quantity determines (defines, identifies) the coordinates of a material point;
7) the absurdity is that a dimensionless (i.e., mathematical) quantity is identical to a dimensional (i.e., physical) quantity.

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