Einstein's repudiation of his own theory of relativity after 1920

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Einstein in his works from 1905 till 1907 discarded the ether from physics but his more than 5 papers from 1920 to 1934 deal with the ether as an unexceptionable physical reality. In these papers Einstein becomes more an enthusiastic advocate of the testification of the ether than supporters of the ether before the year 1905. It is regrettable that except of Einstein's widely cited less important paper presented at a conference in Leiden in 1920 other more important papers on ether in which Einstein comes with the definitive claim that without the ether it is not possible to explain the physical world around us are not known to wider physical community and even not known to dissident physicists community as well. In this paper we show that Einstein by his own declarations after 1920 about testified existence of the ether himself openly repudiated his Special and General theories of relativity. In amendment we bring the text of Einstein's 1924 paper "On the ether".

1. Introduction

The conviction of physicists to the end of the 19th-century of the full existence of ether can best be seen in the search work of H.A. Lorentz - Ether theories and eather models (1901-1902), examining the work of many distinguished physicists of the 19th-century on ether (Stokes, Planck, Fresnel, Maxwell, Kelvin, Neumann). In the beginning of the 20th century the properties of the ether was the prominent subjects of dissertations for a doctoral degree at the most Universities in Europe. In introduction to more excellent physical textbook from the beginning of the 20th century it can be repeatedly traced sentence like –The opinion on the existence of ether match certainty.

Proclamations of most outstanding physicists on the testificatopn of the ether:

R. Descartes (1596-1650), the father of modern western philosophy, who had the most influence on Newton, considered the space to be entirely filled with matter. The formation of visual matter, planets, by Descartes, happens from vortexes of ether. Descartes' vacuum of space is not empty but composed of huge swirling whirlpools of ethereal or fine matter, producing what would later be called gravitational effects [9].

Newton in Letter to Robert Boyle in 1678-9 "I suppose, that there is diffused through all places an etherial substance, capable of contraction and dilatation, strongly elastic, and, in a word, much like air in all respects, but far more subtle".

Newton's letter to Bentley 1692 : "Gravity so that one body may act upon another at a distance thro' a Vacuum, without the Mediation of anything else, by and through which their Action and Force may be conveyed from one to another, is to me so great an Absurdity that I be-lieve no Man who has in philosophical Matters a competent Faculty of thinking can ever fall into it. Gravity must be caused by an Agent acting constantly and according to certain laws"

Newton in 1708: "Perhaps the whole frame of nature may be nothing but various contextures of some certain ethereal spirits or vapors, condensed, as it were, by precipitation; and after condensation wrought into various forms, at first by the immediate hand of the Creator, and ever after by the power of nature" [9].

Newton claimed that ether's adapted aethereal spirits produce the phenomena of electricity, magnetism, and gravitation.

Newton's principia -gravity is "as a certain power or energy diffused from the center to all places around to move the bodies that are in them".

Maxwell in very last clause of his Treaties (1873):

"In fact, whenever energy is transmitted from one body to another, there must be a medium or substance in which the energy exists. . . . all theories lead to the conception of a medium in which that propagation takes place. . . and this has been my constant aim in this treatise".

Riemann asserts us that "space in itself is nothing more than a three-dimensional manifold devoid of all form ; it acquires a definite form only through the advent of the material content filling it and determining its metric relations"[9].

Tesla in his works claimed that Einstein's relativity, which discards the ether, is entirely wrong and he proved that no vacuum (void space) exists. He asserts that all attempts to explain the workings of the universe without recognizing the existence of ether and the indispensable function it plays in phenomena are futile. He asserts that there is no energy in matter other than that received from the environment.

Hubble for a more likely explanation than explaining the red shift spectra by mutual receding of galaxies, considered the explanation of this shift by the loss of light energy passing through the medium of interstellar space.

Hubble (1937): „The cautious observer naturally examines other possibilities before accepting the proposition, even as a working hypothesis. He (Hubble) recalls the alternative formulation of the law of red-shifts - light loses energy in proportion to the distance it travels through space. The law, in this form, sounds quite plausible. Interior nebular space, we believe, cannot be entirely empty" [9].

Einstein in 1924…" *we are not going to be able to dispense with the ether in theoretical physics , that is, with continuum furnished with physical properties; …every theory of contact action presupposes continuous fields, hence also the existence of an ether"* [9].

2. Einstein's development of opinion on the ether

The regular controversial procedure, when Einstein declared both two of the opposite mutually excluding claim was also the case in question of the existence of the ether.

Einstein discarded the existence of the ether in 1905 but yet in 1916 paper he regretted that he rejected existence of the ether and he speaks about introduction of medium filing the space and assume that electromagnetic fields are ether states "**metric facts can no longer be separated from true physical facts; the concepts of space and ether merge together. It would have been more correct if I had limited myself, in my earlier publications, to emphasizing only the non-existence of an ether velocity, instead of arguing the total non-existence of the ether**" [2].

Einstein after 1916 came in with his rediscovery of the ether and he subsequently becomes more an enthusiastic advocate of the proven existence of the ether than supporters of the ether before the year 1905. In his papers (e.g. 1916, 1920, 1924 discussed more below) Einstein claimed: ***"According to the general theory of relativity space without ether is unthinkable"." The mechanical ether, designated by Newton as 'absolute space', must therefore be considered by us as a physical reality. In Newton's theory of motion, space has physical reality- in contrast to the case of geometry and kinematics. We are not going to be able to dispense with the ether in theoretical physics. According to our present conceptions the elementary particles of matter are also, in their essence, nothing else than condensations of the electromagnetic field"***.

But this Einstein's final cognition is concealed to us and gravity as the mystery of nonmaterial space time curvature of GTR is daily forced upon public and wider physical community.

As is shown below in this paper all STR claims from 1905 resp. 1907 were recalled by Einstein in epoch from 1911 till 1934.

Einstein in his works from 1905 till 1907 discarded the ether from physics but his more than 5 papers from 1920 to 1934 deal with the ether as an unexceptionable physical reality. In his published lecture at a conference held in Leiden in 1920 [3], in his another paper published in his 1920 [1, V7, D31], and foremost especially in his work 'On the ether' from 1924 [Amendment] **Einstein comes with the opposite claim that without the ether it is not possible to explain the physical world around us**.

Einstein's concluded in his lecture in 1920 [3] –"**Thus we may also say, I think, that the ether of the general theory of relativity is the outcome of the Lorentzian ether, through relativation. According to our present conceptions the elementary particles of matter are also, in their essence, nothing else than condensations of the electromagnetic field. According to the general theory of relativity space without ether is unthinkable. ...ether has to serve as medium for the effects of inertia. Recapitulating, we may say that according to the general theory of relativity space is endowed with physical qualities; in this sense, therefore, there exists an ether**."

Einstein's in 36 pages 1920 paper 'Fundamental ideas and methods of the Theory of relativity, presented in their development'[1, V7, D31], containing no single one citation, declared his errant in rejecting ether in 1905 –" **My opinion in 1905 was that one should no longer talk about the ether in physics. But this judgment was too radical**. **Rather it is still permissible to assume a space-filling medium whose states may be imagined as electromagnetic fields. Therefore, one can say the ether has been resurrected in the theory of general relativity. ..space and ether flows into each other…The theory of space (geometry) and time no longer represent intrinsic physics propounded independently of mechanics and gravitation** ".

This declaration meant in fact cancelation of STR and GTR by Einstein himself.

In conclusions of Einstein's 1920 papers [1, V7, D31] Einstein rediscovered the ether. In conclusions of this 1920 paper he newly discovered the ether as the direct consequence of 'his' GTR field equations although full assurance of the ether by physicists and hundreds of papers in topics of ether from Aristotle ages till 1905 existed.

In 1924 paper [Amendment] (when continuous Millers experiments was keep confirming ether) Einstein becomes more an enthusiastic advocate of the existence of the ether than supporters of the ether before the year 1905. In his 1924 paper Einstein 'discovered':

– "**The mechanical ether, designated by Newton as 'absolute space', must therefore be considered by us as a physical reality**".

-"**In Newton's theory of motion, space has physical reality- in contrast to the case of geometry and kinematics".**

-"GTR adds characteristics to the ether that are variable from point to point and determine the metric and the dynamic behavior of material points"

-"The ether of the GTR, consequently, differs from the one of classical mechanics, i.e. the special theory of relativity, in that it is not 'absolute'; its local variable properties are rather determined by the ponderable matter".

- " we are not going to be able to dispense with the ether in theoretical physics , that is, with continuum furnished with physical properties; because GTR excludes any unmediated action-at-a-distance. However, every theory of contact action presupposes continuous fields, hence also the existence of an ether".

But after these Einstein's declaration in his 1924 paper and according Einstein's own affirmation in 1925 his STR and GTR become invalid. "My opinion about Miller's experiments is the following. Should the positive result (ether) be confirmed, then the special theory of relativity and with it the general theory of relativity, in its current form, would be invalid".

In Einstein's 1913 paper [1, V4, D13, p.153] 'Outline of the generalized theory' we can read - "**I have shown in previous papers that the equivalence hypotheses leads to the consequence that in a static gravitational field the velocity of light c depends on the gravitational potential. This led me to the view that special theory of relativity provides only an approximation to reality; it should apply only in the limit case where differences in the gravitational potential in the space-time region under consideration are not too great**".

As the gravitational potential is changing in space from a star to a star, from a galaxy to a galaxy so according to the 1913 paper velocity of light in vacuum is no longer the constant and is changing (standard supposition of physicist before 1905). **This means in fact an abolition of the first principle of STR** which is based on firm proclamation that the velocity of light is the ultimate and constant velocity in the vacuum of the void space, that no carrying substance of the light propagation exists and that nothing can influence on the ultimate velocity of the light in the vacuum.

It is necessary to stressed that Michelson-Morley's experiment in 1887 (and all others later) never provided zero results but results which was by Michelson and Morley considered as negligibly small in light of their early physical assumption of their experiment.

This mean that STR never become valid because its validity requires zero results. This is clear also according affirmation of the Einstein himself detailed in chapter "Should the positive result be confirmed, then the special theory of relativity and with it the general theory of relativity, would be invalid". Negligibly small results of M-M experiment Einstein enunciated as the zero result and on this never measured zero result he based his STR.

As the zero result is M-M experiment presented in all textbook of physics till today. The fact that the result obtained by Michelson and Morley in 1887 was not negligibly small was very fully set forth by Professor Hicks of University College Sheffield, yet in 1902, in his important theoretical examination of the original experiment [12].

3. Conclusions

As was shown above, Einstein by his own declaration in 1920 or 1924 papers about existence of the ether as an unexceptionable physical reality himself openly canceled his Special and General theories of relativity.

In spite of this fact, up to day, during next 90 years to students and general public it was claimed by ideological power structures, academics and main stream physics that STR proved non-existence of ether and that GTR in new understanding of space and time discovered the biggest achievement in history of mankind.

In these claims just the M-M experiment from1887 is referred to although in next forty years continuing M-M experiments confirmed the ether end motion of the earth determined by the ether-drift (detailed below).

In these claims just the Einstein's STR paper form 1905 is referred to although Einstein himself, as is documented in this paper, later canceled basic principles of STR from 1905.

In these claims just the Einstein's GTR paper form 1915 is referred to although Einstein soon concluded that his Field equations resulted in rapid gravitationally collapsing universe and was not utilizable to Universe.

In these claims of discovery of new understanding of space and time just the Einstein's GTR paper form 1915 is referred to although Einstein after 1920 fully rejected his space-time concept and fully returned to ether concept.

Although Dayton Miller after 30 years of conducting Michelson-Morley interferometric experiments at least in 1933 fully determined the absolute motion and the speed of earth in surrounding ether [12] and although Einstein in 1913 came to the declaration that "special theory of relativity is only approximation to reality of changing light velocity" this facts are concealed next 100 years and validity of STR is forced upon public and students referring just to Einstein's 1905 paper and just to purported null result of Michelson-Morley's experiment from 1887.

Although Einstein after 1916 becomes more an enthusiastic advocate of the proven existence of the ether than supporters of the ether before the year 1905 and although he proclaimed in 1924 that "The mechanical ether, designated by Newton as 'absolute space', must therefore be considered by us as a physical reality" this fact is concealed by ideological power structures of the world next 100 years. Contrary alleged Einstein's mystery of nonmaterial space time is daily forced upon public and wider physical community referring just to Einstein's paper from 1915 in which no physical reasoning of Field equations was given.

Einstein after 1920 fully rejected his void space-time conception in General relativity, rejected his STR, fully accepted that the mechanical ether must be considered by us as a physical reality and explicitly declared inability to dispense with the ether in theoretical physics. But next 90 years just the space time conception from 1905 and 1915 are presented to general public as allegedly the Einstein's conception which he later rejected.

So the situation with Einstein is the same as in Hubble's case. Although Hubble remained cautiously against the Big bang theory [9] until the end of his life Hubble is by ideological power structures declared as the discoverer who proved the Big Bang theory. Einstein after 1920 admitted his fault from 1905 till 1915 and declared that his "theory of space and time no longer represents intrinsic physics". So although Einstein's himself after 1920 rejected space time conceptions from 1905 and 1915 next 90 years up today these rejected conception from 1905 and 1915 are lastly forced by mass suggestion of ideological power structures on general public as Einstein's ingenious new understanding of space - time and gravity as his ingenious conception of space - time curvature.

Of the hundreds of documentary films about the physical image of the universe produced in last thirty years not a single one mentions the biggest experimental discovery of our civilization about the creation and the annihilation of particles from and into the electromagnetic radiation so from and into the ether.

In his work from 1920 [4] Einstein's declared:

"**If we had based our considerations on the Galilei transformation we should not have obtained a contraction of the rod as a consequence of its motion. The theory of space (geometry) and time no longer represent intrinsic physics propounded independently of mechanics and gravitation. In Newton's theory of motion, space has physical reality- in contrast to the case of geometry and kinematics**"

This in closer context means also refusal of his energy momentum system.

After 1920 Einstein openly admits his youngster thoughtlessness in his 25 to his 35 epoch from 1905 till 1916 when he formulated his relativity - "My opinion in 1905 was that one should no longer talk about the ether in physics. But this judgment was too radical".

As was shown above he fully rejected his physically incompetent approach based on kinematics of Galilei transformation so linear ratios of space and time. This means Einstein's confession of his non perception of basic physical principles of Dynamics of Nature so non-linear ratios of space and time (expressing change in densities of mater in space described by gradients of fields or by changes of the pressures or by accelerations or by changes of velocities).

Although Einstein after 1920 in his 40 fully understood the absurdity of his theories he had produced in previous 15 years, for the next 35 years of his life he as well did not produced no meaningful theory.

The reason for this professional disaster was that Einstein until the end of his life never understood the largest physical mistake of his scientific career which resides in his understanding of the unit of time as the independent physical quantity instead of a proper understanding of the unit of time in mechanics as the identical quantity with the quantity of the unit of velocity [12].

But power ideological structures quickly seized new opportunities to return the physical picture of the world with the help of these Einstein's incompetent mysterious theories of relativity from 1905 and 1915 back into line with their ideologies.

In 20th century continues the state of the destruction of physics during previous 2000 years. This destruction was caused by installation of the Ptolemy geocentric image of universe consistent with the idea of the principles of creation as the only tolerable image of the universe for 1500 years till 16th century. This destruction was caused during 17th, 18th and 19th century by the ban of the books of the most outstanding physicists as heretical (including Newton, Galilleo, Tycho Brahe, Kepler and Copernicus) on Index Librorum Prohibitorum (along with the restrictions on printing in Europe) [12]. But this ban becomes less and less effective from the second half of the 19th century especially after democratic revolutions in Europe in 1848 since civil rights became more and more a reality.

So power ideological structures come up with the proven procedure at Ptolemy model and violently installed Einstein's incompetent mysterious theories of relativity from 1905 and 1915 as the only one tolerable imagine of the universe to return the physical picture of the world back into line with their ideologies. On top of it (as the revenge to banned misbelievers) all previously banned most outstanding physicists including Maxwell as a bonus were in these theories of relativity refuted in substantial part. All previous physics was thus in fact impeached without looking for solutions in the physical reality instead of provided solutions in a mystery of the relativity and quantum mechanics.

During next hundred years after 1915 generations of students of physics are brainwashed with relativity and quantum mechanics although this theories are not understandable to nobody including academics who lecture them [12]. The mass-media suggestion on general public is performed with proclamation about Einstein's super geniality and with proclamation about his theories of space and time form 1905 and 1915 as the greatest achievement of human spirt in all history of mankind. This all despite the fact that Einstein himself after 1920 rejected these his own theories – "**The theory of space (geometry) and time no longer represent intrinsic physics**". The same mass-media suggestion is performed in proclamation Schrodinger's equations (in fact Einstein's bases) [12] of the quantum mechanics as the second greatest achievement of human spirt in all history of mankind despite Feynman, the Nobel Prize laureate for quantum physics in 1966 proclaimed "**I think I can safely say that nobody understands quantum mechanics. We have always had a great deal of difficulty understanding the world view that quantum mechanics represents**" [12].

Question is - what is the sense to teach such a theories at universities moreover as the most important and most time consuming part of the physical education which even creators of these theories themselves, most genial physicists and lecturers do not understand? Answer is – the sense is destruction of physics (in which no consonant picture of the physical world exists and everybody can have its own true) in order to install and sustain predetermined dogmas of ideological political power structures.

But the larger sense are power and money. Political parties on religious bases are still the most powerful and ruling political parties in the countries of the world. Voters of these political parties vote them also for the reason that ideology of these parties provided to voters is allegedly confirmed as valid, because it is consonant with science. This consonance of religion with science (Big bang, mystery of space time, god's particles) is frequently and massively instilled to the mind of these voters at every occasion by every possible manner. Vice versa these ruling ideological political parties of countries support such scientific projects which offer the consonant order of the universe with their ideology.

It was documented in this work that Einstein's theories need not to be uprooted or refuted because by his declaration in his

papers after 1920 Einstein refuted them himself. Just a familiarization of general public about this fact is necessary.

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Amendment:

"On the Ether" Einstein 1924

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When the topic being discussed is the ether, one naturally doesn't address the material ether of the wave theory, which is subject to the laws of Newtonian mechanics and in which individual points are assigned a velocity. It is my conviction that this theoretical construct has finally played itself out since the creation of the special theory of relativity. Rather, the topic more generally concerns those things, conceived to be physically real, that play a role in the causal nexus of physics, alongside ponderable matter, composed of charged elementary particles. Instead of speaking of the "ether," one could just as well be speaking of the "physical qualities of space." One could assume, however, that all subjects in physics are included in this concept because, according to the consistent theory of fields, ponderable matter, that is the constitutive elementary particles, are conceivable as "fields" of a special kind, or as special "states of space." Nevertheless, one will have to concede that such an interpretation would be premature in the present state of physics; for, all efforts by theoretical physicists directed at this goal have failed up to now. Thus, given the present state of things, we are in fact forced to distinguish between "matter" and "fields," although we may also hope that later generations will supersede this dualistic conception and will replace it with a unified one, as field theory in our day has been attempting in vain.

It is usually accepted that Newton's physics did not conceive of any ether, and that the wave theory of light was the first to introduce an omnipresent medium that co-determines physical phenomena. This is not the case, however. Newtonian mechanics has its "ether" in the indicated sense; albeit, it is described as "absolute space." In order to recognize this clearly and at the same time elaborate the ether concept somewhat more precisely, we must go back a bit.

Let us first look at a branch of physics that makes do without the ether, namely, Euclid's geometry, conceived as the doctrine of the possible ways to bring practically rigid bodies into contact with one another. (Here we disregard rays of light, which may likewise be involved in the development of the concepts and laws of geometry.) The configuration laws governing rigid bodies, excluding relative motions, temperature, and deformation Influences as are ideally laid down in Euclid's geometry, employ the concept of the rigid body; Euclidean geometry does not conceive of any surrounding influences as existing independently of the bodies or acting on the bodies and influencing their configuration laws. The same is true of non- Euclidean geometries of constant curvature, when these influences are interpreted as (permissible) laws of nature about the stacking of bodies. This would be different were we to be forced to assume a geometry of variable curvature; that would mean that the possible contact configurations of practically rigid bodies were determined differently for different cases by environmental influences. In this instance one would have to say, in the light of our con-

sideration, that such a theory would be making use of an ether hypothesis. Its ether would be something physically real, as good as matter. If the configuration laws did not depend on physical factors, such as the clustering and state of motion of bodies' "in their vicinity, etc., then one would denote this ether as "absolute" (i.e., independent of influences by some other objects).

A (physically interpreted) Euclidean geometry needs an ether no more than does the kinematics or phoronomics of classical mechanics; its theorems make clear, physical sense if one only assumes that the influences of motion on measuring rods and clocks assumed in the special theory of relativity do not exist.

It is different in Galilean and Newtonian dynamics. The law of motion "mass x acceleration = force" does not just make a statement about material systems, not even when, as in Newton's astronomical fundamental law, force is expressed by intervals, hence by dimensions, whose real definition can be based on measurements with rigid measuring bodies. This is so because the real definition of acceleration cannot be based wholly on observations of rigid bodies and clocks. It cannot be attributed to measurable intervals between the points constituting the mechanical system. For its definition, a coordinate system is also needed, that is, a reference body in a suitable state of motion. If the state of motion of the coordinate system is chosen differently, then the Newtonian equations do not apply with reference to it. In those equations, the environment in which the bodies are moving also figures implicitly as a real factor in the laws of motion alongside the real bodies and their mutual distances definable by measuring bodies. In Newton's theory of motion, "space" has physical reality—in contrast to the case of geometry and kinematics. Let us denote this physical reality, which is incorporated within the observable ponderable bodies in Newton's law of motion, as the "ether of mechanics." The occurrence of centrifugal effects in a (rotating) body, whose material points do not alter their distances from one another, shows that this ether should not merely be understood as an imaginary form in Newtonian theory; rather, something real in nature corresponds to it.

We see that, for Newton, "space" was something physically real, despite the strangely indirect way in which this realness makes itself known to us. Ernst Mach, who was the first after Newton to subject the foundation of mechanics to profound analysis, recognized this clearly. He sought to elude the hypothesis of the "ether of mechanics" by trying to attribute inertia to an unmediated interaction between the considered mass and all the rest of the masses of the universe. This conception is logically possible; however, as action-at-a-distance, it no longer comes seriously under consideration for us today. The mechanical ether, designated by Newton as "absolute space," must therefore be considered by us as a physical reality. Yet, the expression "ether" must not lead us to think of something analogous to the 19th century's physics concept of ponderable matter.

When Newton denotes the space of physics as "absolute," he is still thinking of another property of what we here call the "ether" Every physical object influences others and conversely is generally influenced by others. This latter point does not, however, apply to the ether of Newtonian mechanics. The latter's property of expending inertia, according to classical mechanics, cannot be influenced by anything, neither by the configuration of matter nor by anything else; to that extent it can be described as "absolute."

It became clear to physicists only in the past few years that a real thing must be presupposed as the cause for the preference of inertial frames over non-inertial frames. Historically, the ether hypothesis in its present form emerged by sublimation out of the mechanical ether hypothesis in optics. After long, fruitless efforts, the conviction was reached that light should not be comprehended as the motion of an inert, elastic medium; that the electromagnetic fields of Maxwell's theory could not be interpreted mechanically at all. Thus, under the pressure of these failures, the electromagnetic fields were gradually regarded as the last, irreducible physical realities, as still inexplicable states of the ether. What initially remained of the ether of the mechanical theory was its definite state of motion; it embodied to some extent an "absolute rest." Whereas in Newtonian mechanics all inertial frames were at least equivalent, in the Maxwell-Lorentz theory it seemed that the state of motion of the legitimate coordinate system (rest against the ether) was fully determined. It was silently assumed that this preferred system was an inertial frame at the same time, i.e., that the principle of inertia was valid relative to the electromagnetic ether.

The basic conception of physicists shifted in a second way as well under the influence of the Maxwell-Lorentz theory. After electromagnetic fields had been conceived as fundamental, irreducible entities, they seemed to be called upon to rob ponderable, inert mass of its fundamental importance in mechanics as well. Ii was concluded from Maxwell's equations that a moving electrically charged body is surrounded by a magnetic field whose energy in first approximation depends quadratically on the velocity. What would suggest itself more immediately than to conceive of all kinetic energy as electromagnetic energy? That way one could hope to trace mechanics back to electromagnetism, after the previous endeavor to trace electromagnetic processes back to mechanical ones had failed. This seemed the more hopeful, the more it was becoming probable that all ponderable matter was built out of charged elementary particles. Yet two difficulties could not be mastered. Namely, first, the Maxwell-Lorentz equations could not make comprehensible why the electric charge constituting a charged elementary particle can exist at equilibrium despite electrostatic forces of repulsion. Second, the electromagnetic theory was incapable of explaining gravitation in any somewhat natural and satisfactory manner. Despite this, the successes that the electromagnetic theory afforded physics were so significant that it came to be regarded as a completely secure part and parcel of physics, indeed, as its most well-founded achievement.

The Maxwell-Lorentz theory ultimately influenced our attitude toward the issues regarding the theoretical foundations by leading to the creation of the special theory of relativity. It was realized that the electromagnetic equations in truth do not prefer any definite state of motion; rather that, according to those equations, just as according to classical mechanics, an infinite manifold of mutually uniformly moving coordinate systems were equally legitimate, if only one applies suitable transformation formulas for the spatial coordinates and for time. It is well known that this insight bore in its train a profound modification of kinematics and dynamics. Henceforth a definite state of motion was no longer assigned to the ether of electrodynamics. Its effect now—like the ether of classical mechanics— was not the preference for a defined state of motion, but just the preference for a defined state of acceleration. Because simultaneous states could no longer be spoken of in an absolute sense, the ether became four-dimensional, so to speak, as there was no objective order to its states by time alone. Even according to the special theory of relativity, the ether was absolute since its influ-

enceli2j on inertia and the propagation of light was thought of as independent of any kind of physical influences. While in classical physics the geometry of bodies is presupposed to be independent of the state of motion, according to the special theory of relativity the laws of Euclidean geometry for the configuration of bodies at rest relative to one another are relevant only if these bodies are at rest relative to an inertial frame; this can be easily concluded out of the so-called Lorentz contraction. Consequently as in dynamics, the geometry of bodies is co-determined by the ether.

The general theory of relativity removes a trouble spot in classical dynamics: According to the latter, inertia and gravity appear as entirely different, mutually independent phenomena, despite both being defined by the same body-constant, the mass. Relativity theory overcomes this deficiency in that it establishes the dynamical behavior of the electrically neutral mass-point by the law governing the geodetic line, in which the inertial and gravitational effects are no longer kept apart. It thereby adds characteristics to the ether that are variable from point to point and determine the metric and the dynamic behavior of material points. They, for their part, are defined by physical factors, namely, by the distribution of mass or energy. The ether of the general theory of relativity, consequently, differs from the one of classical mechanics, i.e., the special theory of relativity, in that it is not "absolute"; its local variable properties are rather determined by the ponderable matter. This determination is complete if the world is spatially finite and closed. It is more characteristic of the mathematical form of this theory than of its physical content that, in the general theory of relativity, there are no preferred space-time coordinates uniquely linked with the metric.

In implementing the formal apparatus of the general theory of relativity, it was not possible to attribute all the mass inertia to electromagnetic fields or even to fields generally. Neither, in my view, have we until now gone beyond a superficial inclusion of electromagnetic forces into the scheme of the general theory of relativity. The metric tensor codetermining the effects of gravitation and inertia, on one hand, and the tensor of the electromagnetic field, on the other hand, seem now, as before, to be essentially different expressions for the ether's state, whose logical independence one would surely be far more readily inclined to attribute to the imperfection of our theoretical framework than to a complex structure of reality.

Although Weyl and Eddington did find by a generalization of Riemannian geometry a mathematical system that appears to unite both types of fields under a unified aspect, nevertheless, the simplest field laws that this theory yields seem to me not to lead to advances in physical knowledge. Overall, it seems today that we are much farther away from an understanding of the electromagnetic elementary laws than seemed to be the case at the beginning of this century. As a basis for this opinion, I would like to point out here briefly the problem of the magnetic, terrestrial, and solar fields^ as well as the problem of light quanta, problems which to some extent concern the coarse structure and (he fine structure of the electromagnetic field, respectively.

The Earth and the Sun possess magnetic fields whose orientation and sense are in approximate relation to the rotational axis of these celestial bodies. According to Maxwell's theory, those fields could originate from electrical currents flowing counter to the rotational motion around the rotational axis of these celestial bodies. Sun spots, too, which are interpreted as vortices for good reasons, possess analogous, very powerful magnetic fields. But it is hardly conceivable that in all these cases electrical conduction, or convection, currents of sufficient strengths are actually present. It much rather looks as if cyclical motions of neutral masses generated magnetic fields. Neither Maxwell's theory in its original version, nor Maxwell's theory expanded in the sense of the general theory of relativity, permit one to predict such a field creation. Here nature seems to be pointing us to a fundamental connection that has not yet been understood theoretically.

If the aforesaid involves a case seemingly incapable of standing up to the field theory in its present shape, the facts and ideas contained in the quantum theory threaten to burst apart the framework of field theory altogether. For the arguments are multiplying in favor of the interpretation of light quanta as real physical entities, and of the electromagnetic field as not being the ultimate reality to which the other physical things could be attributed. After the theory of Planck's formula already showed that the transfer of energy and momentum by radiation proceeds as if the latter were composed of atoms moving at the velocity of light c of energy hv and momentum hv/c , Compton demonstrated by experiments on the scattering of X-rays by matter that scattering acts occur in which light quanta collide with electrons and transfer to them part of their energy, whereupon the light quanta change their energy and direction. It is a fact, at least, that X-rays experience such changes of frequency upon being scattered (predicted by Debye and Compton) as is required by the quantum hypothesis.

Moreover, a short while ago, a paper appeared by the Indian Hose on the derivation of Planck's formula that is of special significance to our theoretical consideration for the following reason: Hitherto, all complete derivations of Planck's formula somehow made use of the hypothesis of the wave structure of radiation.

Thus, e.g., the factor …of this formula was obtained in the known Ehrenfest - Debye derivation by counting the number of natural oscillations in the cavity that belong to the frequency range dv. Bose replaces this counting based on the notions of the wave theory by a calculation in gas theory, which he relates to a light quantum imagined to be inside the cavity, similarly to a molecule. Thus, the question arises whether it wouldn't be possible one day, after all, to link the phenomena of diffraction and interference to quantum theory in such a way that the fieldlike concepts of the theory only represent expressions of the interactions between quanta, whereby separate physical reality is no longer attached to the field.

The important fact that, according to Bohr's theory, the frequency of emitted radiation is not determined by electrically charged masses undergoing periodic processes of the same frequency can only strengthen our doubt of the independent reality of the wave field.

But even if these possibilities mature into real theories, we are not going to be able to dispense with the ether in theoretical physics, that is, with the continuum furnished with physical properties; because the general theory of relativity, whose fundamental aspects physicists will probably always retain, excludes any unmediated action-at-a-distance. However, every theory of contact action presupposes continuous fields, hence also the existence of an "ether."