

## HISTORICAL DOCUMENT

## On Comrade Timiryazev's attitude towards contemporary science<sup>1</sup>

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[188] Our note, signed H.E., on the fifth Congress of Russian Physicists appeared in No. 1 [of this journal] (Gessen & Egorshin 1927a, 134–141 [TN]).

Cde. A. Timiryazev<sup>3</sup> was displeased with the note, especially with our brief report on the debate over his own report.

We do not consider the pages of our journal to be a suitable place for conducting polemics on special issues in physics. The journal *Under the Banner of Marxism*<sup>4</sup> has set other tasks for itself. Therefore, we will not enter into a discussion of the purely physical, experimental and technical aspects of the Dayton Miller<sup>5</sup> and Kennedy experiments.<sup>6</sup> Discussion on these matters should be conducted in special physics journals. That part of Cde. Timiryazev's article devoted to the controversy and to Prof. S.I. Vavilov's<sup>7</sup> objections, would be most appropriate in the journal where S.I. Vavilov's article was published.

<sup>1</sup>The following is a translation of Gessen & Egorshin 1927b: 188–199. Hessen & Egorshin's original references have been replaced by English where possible. References to texts not cited by Hessen & Egorshin have been provided by the translator. This translation was completed with the aid of translation software [Translator's Note; hereafter, "TN"].

<sup>2</sup>Vasilii P. Egorshin (1898–1985) was a Soviet physicist and historian and philosopher of science. He worked as a professor of physics at Moscow State University, and specialized in the history of astronomy from a dialectical materialist point of view. A co-author with Hessen on several articles in the late 1920s, by the 1930s, Egorshin became one of Hessen's major opponents, accusing him of "anti-Marxism," "idealism" and "Menshevism" (Josephson 1991, 208; Korsakov, et al. 2015, 90–91) [TN].

<sup>3</sup>Arkady K. Timiryazev (1880–1955) was the son of celebrated Russian biologist, Kliment A. Timiryazev and a professor of physics at Moscow State University. Often mocked by his colleagues as "the monument's son," he adamantly opposed contemporary developments in the sciences, such as quantum mechanics and relativity theory, in favor of Newtonianism. In the "mechanist" and "Deborinite/dialectician" debate of the 1920s, he was a defender of the mechanist persuasion. Timiryazev gained Joseph Stalin's favor for his tendency to cite the latter in his writings on physics (Ings 2016, 246–247) [TN].

<sup>4</sup>*Under the Banner of Marxism* was a Soviet journal, published from January 1922 to June 1944. A major platform for popular debates over dialectical materialist philosophy, it was also one of the sites of the debate between the "mechanists" and "Deborinites/dialecticians" in the 1920s. In March 1922, Lenin published an article in the journal, "On the Significance of Militant Materialism," in which he argued that the journal should be a space for philosophical debates as well as matters in twentieth-century physics, with the particular aim of winning over engineers and natural scientists to Marxist ideology (Ermichëv 2012, 184–86; Lenin 1977, 227–236) [TN].

<sup>5</sup>Dayton C. Miller (1866–1941) was an American astronomer and physicist, who worked as a professor and head of the physics department at the Case School of Applied Science. He is best known for his follow-up experiments to the Michelson-Morley experiment of 1904 - generally considered to have disproven ether theory and to have been an important catalyst in Einstein's development of special relativity theory - which he insisted in fact proved the existence of ether and disproved relativity theory. He is also known for his contributions to the study of acoustics and X-rays (Fletcher 1945, 59–74) [TN].

<sup>6</sup>Roy J. Kennedy (1897–1986) was an American physicist, who worked as a professor at the California Institute of Technology as well as Princeton University. He is best known for his experiments with Edwin M. Thorndike, also an American physicist, which culminated in the famous "Kennedy-Thorndike experiment" of 1932. Along with the Michelson-Morley experiment of 1904, it provided crucial experimental support for special relativity theory (Giulini 2005, 122–127) [TN].

<sup>7</sup>Sergei I. Vavilov (1891–1951) was a Soviet physicist, who was a member, and at one point president, of the USSR Academy of Sciences. He was a translator and proponent of the works of Einstein, and managed to largely avoid Marxist debates over relativity theory. He was also the brother of renowned geneticist, Nikolai I. Vavilov (Graham 1993, 140; Joravsky 2009, 287) [TN].

Therefore, we will focus instead on the fundamental issues raised in Cde. Timiryazev's article.

For some time now, it has become fashionable to accuse Marxist dialecticians of a disrespectful attitude towards science, of seeking to adapt science to dialectical "schemas," etc. Such accusations come from the mechanist camp, to which Cde. A.K. Timiryazev belongs. But without special clarifications, it should be clear that this accusation, coming from the mouth of the mechanists, contains a clear contradiction. Dialectical materialism is, in fact, a much broader worldview than mechanistic materialism. While numerous scientific discoveries of the last decades, as Lenin emphasized, have shown all the inadequacy of the narrowly-mechanical worldview, these same discoveries confirm dialectical materialism perfectly. Lenin also showed that ignorance of dialectics causes many natural scientists to fall into the fold of idealism, Machism and other such "schools and sub-schools." From this, it follows that it would be completely wrong, in criticizing and refuting the many idealistic perversions of science, to return to the views that prevailed fifty years ago. The new dialectical natural science should be a synthesis of the materialistic worldview and the new *facts* that appeared in modern science.

[189] The mechanists hold to a different point of view. Without adopting dialectics (adopting the name only is not enough!), they might as well simply ignore and indiscriminately deny everything that does not fit into the Procrustean framework of the mechanical worldview. It is clear to everyone that this framework is incomparably narrower and more one-sided than the teachings of dialectics. Lenin expressed this magnificently in his fragment on dialectics: "Dialectics, as *living*, many-sided knowledge (with the number of sides eternally increasing), with an infinite number of shades of every approach and approximation to reality . . . —here we have an immeasurably rich content as compared with 'metaphysical' materialism" (Lenin 1976, 360). Even the "philosophical idealism is *only* nonsense from the standpoint of crude, simple, metaphysical materialism. From the standpoint of dialectical materialism, on the other hand, philosophical idealism is a *one-sided*, exaggerated, *überschwengliches* (Dietzgen) development (inflation, distention) of one of the features, aspects, facets of knowledge into an absolute" (Lenin 1976, 361). Furthermore, "idealism is clerical obscurantism. True. But philosophical idealism is ('*more correctly*' and '*in addition*') a *road* to clerical obscurantism *through one of the shades* of the infinitely complex *knowledge* (dialectical) of man (Lenin's emphases)" (Lenin 1976, 360, 361).

So, if anyone can be blamed for trying to ignore science and adjusting it to narrow and rigid schemas, then it is the mechanists alone, not the dialecticians.

The best evidence of this is Cde. A.K. Timiryazev's article. He maintains that relativity theory and quantum theory are inconsistent with materialism: both are 100% Machist.

"For a significant number of modern theorists," Cde. Timiryazev writes, "and especially those that are Russian, the 'philosophy of pure description' is still the only philosophy of science" (Timiryazev 1927a, 187 [TN]).

If one looks closely at all of A.K. Timiryazev's literary activities, we will see that apart from the "philosophy of pure description," he does not see any other enemy of materialism. For example, Kantianism in particular does not even seem to exist for him. All the while, since Helmholtz (who A.K. Timiryazev so respects and always cites as an example of the materialist dialectic), the Kantian trend among natural scientists should not at all be disregarded.

But let us set this aside. Let us suppose that we have only the Machist philosophy of "pure description" before us and nothing else. What does relativity theory have to do with it? A.K. Timiryazev's answer to this question is very clear and unequivocal.

"Relativity theory and quantum theory," he says, "have led to a new outbreak of Machism" (Timiryazev 1927a, 187 [TN]). There is no reason to argue against this. But this does not in any way imply that relativity theory and quantum theory must be approached from a dismissive point of view and wholesale indiscriminately rejected. In this regard, A.K. Timiryazev does not follow Lenin at all, who in *Materialism and Empirio-Criticism*, in the chapter titled "The Essence

and [190] the Significance of ‘Physical’ Idealism,” provided a remarkable analysis of the waverings of Mach, Duhem,<sup>8</sup> Stallo,<sup>9</sup> as well as Rey.<sup>10</sup>

Even Lenin, the most merciless enemy of Machism, did not indiscriminately reject some of the progressive aspects of physicists such as Duhem, Stallo, etc., who, as Lenin says, waver “in reality . . . between idealism and dialectical *materialism* (our emphasis here and below)” (Lenin 1977, 310). According to Lenin, they “most energetically combat the atomistic-*mechanical* conception of nature. They show the narrowness of this conception, the impossibility of accepting it as the limit of our knowledge, the *rigidity* of many of the ideas of writers who hold this conception. And it is indeed undeniable that the *old* (Lenin’s emphasis) materialism did suffer from such a defect” (Lenin 1977, 310). The matter seems clear.

Cde. Timiryazev likes to cite Lenin, but a citation like the above is nowhere to be found in his writings. Hiding behind Lenin’s broad back, Cde. Timiryazev shoots from the hip at the greatest modern scientists and their theories, by labeling them with monotonously dull epithets like “scientific fashion,” “fashionable theory,” “fanatical followers,” etc. The whole Marxist overcoming of modern natural science, according to Cde. Timiryazev, should consist in going from the “Machist”-Einsteinians - Planck, Sommerfeld, Bohr, etc. - and certainly Einstein himself, *back* to Helmholtz, Maxwell, Thomson and Boltzmann. In Cde. Timiryazev’s opinion, if you follow these scholars, you will not deviate a single step from consistent (i.e., dialectical) materialism. It is from them that he invites all Marxists to learn both materialism and dialectics.

Cde. Timiryazev forgets a “small” detail, namely, that even though the old teachers could be materialists, they were not dialectical, but metaphysical, materialists (with traces of dialectics, which is possible, of course, for anyone, even “Black Hundred”<sup>11</sup> Einstein). As Lenin wrote in the same chapter the following lines to which Cde. Timiryazev devotes none of his attention: “The basic materialist spirit of physics, as of all modern science, will overcome each and every crisis,” (Lenin is speaking of Machism – H.E.), “*but only by the indispensable replacement of metaphysical materialism by dialectical materialism* (our emphases)” (Lenin 1977, 306). We shall let the reader decide whether Cde. Timiryazev’s *blatant nihilism* and old-school beliefs satisfy this passage.

Apparently, Heisenberg’s theory (quantum mechanics) enjoyed considerable fame last year simply because it was “new” and in “fashion” at the time, whereas now, the same popularity befalls the even newer Schrödinger’s theory, and for the very same reason.<sup>12</sup>

[191] It seems that all physicists resemble flirtatious Parisian women and change their views and physical theories as often as ladies update their fashionable wardrobes. And the more Machist a theory is, the more rapaciously physicists rush to adopt it.

In fact, this is not completely the case, or rather, completely not the case. If Heisenberg’s theory has become popular among physicists, this is not because physicists are susceptible to every new,

<sup>8</sup>Pierre Duhem (1861–1916) was a French theoretical physicist, and historian and philosopher of science. He is best known as a major proponent of “energetics” in physics, exemplified in his *Traité d’énergétique*, as well as for his belief that natural scientific research could be reconciled with Catholic religious doctrine (Jaki 1991, 7–25; Maugin 2014, 149–185) [TN].

<sup>9</sup>John B. Stallo (1823–1900) was a German-American judge, lawyer, philosopher and politician. He is known for being one of the first proponents of Hegelian philosophy in the United States, as found in his *The General Principles of the Philosophy of Nature*, which was highly influential on subsequent schools of American philosophy. Later distancing himself from Hegelianism, he wrote his masterwork, *The Concepts of Modern Physics*, in which he provided a critique of atomic theory and mechanistic physics, as well as criteria for how to properly formulate scientific concepts (Calore 2016, 928–930) [TN].

<sup>10</sup>Abel Rey (1873–1940) was a French historian and philosopher of science, who worked as a professor at the Sorbonne. He is best known for his contributions to the development of positivism, as exemplified in his *La Théorie de la physique chez les physiciens contemporaines*, and his influence on the logical positivism of the Vienna Circle (Brenner 2018, 77–95) [TN].

<sup>11</sup>The Black Hundred were a tsarist gang in Russia which formed in the 1890s. Often characterized as proto-fascist, they were known for their intimidation, assault and murder of intellectuals, liberals and revolutionaries as well as for organizing pogroms against Jews and ethnic minorities (Laqueur 1996, 179; Sheehan 1985, 141) [TN].

<sup>12</sup>Coincidentally, Cde. Timiryazev writes that Schrödinger’s theory appeared in Autumn of 1926, when in fact, his first works appeared in February 1926.

Machist sensation (even though individual followers of such a sensationalism can, of course, be found), but because, despite its abstract character, Heisenberg's theory represents a step forward in the field of atomic mechanics, as a whole series of experimental data fit within the framework of this theory that were inexplicable from the standpoint of classical quantum theory.

But Heisenberg's theory is a formal description! It wants to deal only with "fundamentally observable quantities." It refuses to build any models! What good can such a theory provide, apart from the fact that it pours water on the mill of the "philosophy of pure description"! This is Cde. Timiryazev's argument.

A few words concerning description: is every description always identical with Machism? We think that the issue here is not so simple. One thing is the "economical description"<sup>13</sup> as a general, methodological and *gnoseological* principle, but it is quite another thing for description to be a step in the process of physical research.

It is known that Mach considered Kirchhoff<sup>14</sup> to be his ally and an adherent of "economical description." In his lectures on mechanics, Kirchhoff identifies the problem of mechanics as follows: "I define the task of mechanics to be the *description* (Kirchhoff's emphasis) of the movements occurring in nature; namely the complete and simplest possible description" (Kirchhoff 1897, v [TN]).

And despite this, Lenin defends Kirchhoff from Mach! When Mach says in *Knowledge and Error* that his principle of economic description and "the 'complete and simplest description' (Kirchhoff 1874) ... with a slight variation, express one and the same idea," Lenin ardently defends Kirchhoff: "Is this not a model of confusion? 'Economy of thought,' from which Mach in 1872 inferred that sensations *alone* exist ... is declared to be *equivalent* ... to the simplest description (of an *objective reality*, the existence of which it never occurred to Kirchhoff to doubt!" (Lenin 1977, 171, Lenin's emphases). One kind of description, therefore, is different from the other one!

The point is that for Mach, "economical description" is an epistemological principle; that is, a principle that serves as "the basis for the theory of knowledge," while for Kirchhoff, "a complete and simplest description is a tool for eliminating from mechanics those concepts whose physical meanings were obscure, first and foremost, the concept of force" (Kirchhoff 1897, v).

In his matrix method, Heisenberg tries to overcome a number of basic, fundamental difficulties in the construction of mechanics of the atom. These difficulties stem from the imperfections of our [192] models and our ideas about atomic processes. Heisenberg's theory overcomes some of these difficulties, albeit formally.

Therefore, in our report, while pointing out the possibility of drawing Machist conclusions from the principles of Heisenberg's theory (and Heisenberg himself does draw such conclusions), we still thought that on this ground alone, one should not reject its *physical* content. We think this is the only correct approach, from the perspective of Marxism, to the evaluation of various physical theories. Description will never be a bogeyman for us. We need to figure out exactly what kind of description. At one time, Balmer's formula<sup>15</sup> was also just a description, but was it not also a

<sup>13</sup>"Economical description" refers to Ernst Mach's principle that human thought tends toward practical and theoretical parsimony. Found throughout Mach's writings, this principle is perhaps most clearly stated in his "The Economical Nature of Physical Inquiry," where he claims that "physics is experience, arranged in economical order. By this order not only is a broad and comprehensive view of what we have rendered possible, but also the defects and the needful alterations are made manifest, exactly as in a well-kept household. Physics shares with mathematics the advantages of succinct description and of brief, compendious definition, which precludes confusion" (Mach 1898, 197) [TN].

<sup>14</sup>Gustav R. Kirchhoff (1824–1887) was a German physicist, who spent the majority of his career as a professor of theoretical physics at Heidelberg University and was a foreign member of the Royal Netherlands Academy of Arts and Sciences. He is best known for his contributions to spectral analysis and radiation theory (Stepanov 1977, 1099–1104) [TN].

<sup>15</sup>Balmer's Formula ( $\lambda = h (m^2/m^2 - n^2)$ ) is a mathematical formula, originally designed for calculating the spectral lines of hydrogen atoms. The formula was discovered by Swiss mathematician Johann J. Balmer in 1885, and became the basis for the analysis of spectral series, broadly speaking (Magie 1963, 360–365) [TN].

step forward? Bohr came along after Balmer and explained the physical significance of the formula and the meaning of its constants (i.e., the Rydberg Constant<sup>16</sup>). So, why do we have to reject Heisenberg's theory in advance? After all, it is possible that it, too, will receive its physical interpretation.

"Machism," Comrade Timiryazev writes, "in fact, thrives where we still know little, where we have to temporarily confine ourselves to formal description. Machism also considers this arrangement to be the final answer" (Timiryazev 1927a, 187 [TN]). There is no doubt that formal description is most common in those areas where we cannot yet explain molar patterns from molecular patterns. But what if such an explanation is not yet possible in the current stage of science?

Should we just abandon the formulation of a general (mathematical) law altogether, the molecular mechanism of which is unknown, because it is a formal, pure description and Machism?

Let us listen to the opinion of one physicist, who Cde. Timiryazev is unlikely to suspect of Machism. In some cases, he says, we know all the details of all changes:

Thus the motion of the moon may be described by stating the changes in her position relative to the earth in the order in which they follow one another. In other cases we may find that some change of arrangement has taken place, but we may not be able to ascertain what that change is. Thus when water freezes we know that the molecules or smallest parts of the substance must be arranged differently in ice and in water. We also know that this arrangement in ice must have a certain kind of symmetry, because the ice is in the form of symmetrical crystals, but we have as yet no precise knowledge of the actual arrangement of the molecules in ice. But whenever we can completely describe the change of arrangement we have a knowledge, perfect so far as it extends, of what has taken place, though we may still have to learn the necessary conditions under which a similar event will always take place. (Maxwell 1925: 1–2)

This is the articulation of the tasks of physics in those areas where the molecular mechanism is unknown to us, by James Clerk Maxwell.

In modern physics, we have, on one hand, a kinetic theory of matter, where the molecular mechanism is more or less known to us, and from which we can explain molar [193] laws and, on the other hand, the area of electromagnetic phenomena, where such explanation is not yet possible.

How nice would it be - and most physicists would have had nothing against it - had it been possible, having accepted the ether with some strictly-defined properties, to build, on this basis, a complete picture of all electromagnetic phenomena. Unfortunately, physics ran into extreme difficulties in following this path, and it was precisely these difficulties that led to a second path pointed out by Maxwell.

Let us provide just one historical example, which shows how great the difficulties are with respect to constructing a theory of electromagnetic phenomena, based on a particular model of the ether.

One of the greatest physicists of the nineteenth century, William Thomson, devoted his whole life to the question of building a theory of electromagnetic phenomena from the ether. And in his speech at the celebration of the fiftieth anniversary of his scientific career, this great physicist - a contemporary of Faraday, Helmholtz and Maxwell - literally said the following:

It is possible to characterize my persistent efforts to move science forward for fifty years in one word, and this word is - failure. I now know no more about electrical and magnetic forces and about the relationship between ether, electricity and material (ponderable matter) bodies than what I knew and tried to teach my students fifty years ago, at the start of my days as a professor. (Thompson 1910, 1073)

<sup>16</sup>The Rydberg Constant ( $R_{\infty}$ ) refers to a constant between formulae for atomic spectra, and expresses the binding energy between the electrons and the nucleus of an atom. The constant is named after Swedish physicist, Johannes R. Rydberg. (Daintith, ed. 2008, 468–469) [TN].

When we talk about the need for a “description,” we do not at all want to say “*ignorabimus* [we do not know and never will know]” with respect to the ether, but we want to emphasize that the problem is not as simple as Cde. Timiryazev depicts. It is necessary to take into account and analyze these difficulties. Instead, if we consider Machism and the unwillingness to engage with the works of J.J. Thomson to be the sole cause of the formal trend, this point of view cannot move us forward in solving physical problems.

This is the criterion with which we approach the evaluation of Heisenberg’s and Schrödinger’s theories.

Let us now turn to the question of relativity theory. Here, Cde. Timiryazev has such an extremely one-sided point of view that he had to spend considerable currency to justify it and therefore, we understand his persistence and firmness.

Cde. Timiryazev continues to hold the view that relativity theory is completely incompatible with materialism. In this case, it is permissible to ask: imagine that the *physical* side of relativity theory is justified by experiment (Lenin has already said everything about the absurdities of philosophical, idealistic relativism), if Einstein, the *physicist*, turns out to be right - what then? Would the whole materialistic worldview collapse? Should idealism and clericalism take its place? If we adopt *this* understanding, if materialism is inseparable from Newtonian mechanics, it would mean valuing materialism too little. It would mean changing an entire worldview (materialism into idealism) depending on some new, and in turn, transient, scientific theories.

[194] But, this is exactly how Cde. Timiryazev sees materialism. In the article printed here, we read:

Cdes. H.E. wonder why the speaker did not include questions about the philosophy of relativity theory in his report. Mainly, because now *the whole question* is whether the conclusions drawn by Dayton-Miller are proven or not? Whether we will return to healthy *materialism* and to the discovery of new forms of matter and new forms of motion of the matter in this area of physics *depends on this*, — or we will continue to flounder in the Machian sea of “pure mathematical description.” (Timiryazev 1927a, 187, our emphases [TN])

*Either* materialism, and then relativity theory is excluded, —, *or* relativity theory triumphs, and with it, also Machism. Such is the dilemma put before the mass of readers.

By contrast, we think, following Lenin and Engels, that “with each epoch-making discovery even in the sphere of natural science [‘not to speak of the history of mankind’], materialism has to change its form” (Lenin 1977, 251; Engels 2010, 369–370 [TN]). If, at present, Einstein’s theory is not yet rigorously, experimentally proven, then Marxist methodology must await the resolution of the physical question by physical methods and cut off any hand that attempts to use this question (both before and after experimental confirmation) for the benefit of Machist, fictional or any other idealistic philosophy. If it is confirmed that matter does not move according to the laws of Newton, but according to the laws of Einstein, the matter will not cease to be an objective reality, despite Cde. Timiryazev’s totally fabricated claim that in this case, inevitably, “matter disappears and only equations remain” (Timiryazev 1927a, 187 [TN]).

At one time, idealism used an electron theory for its own purposes by claiming that it contradicts materialism. So, how worth it would it have been for a “materialist,” at the time when experiments were being made on electromagnetic mass, to have cried out at every crossroad: “Help! Materialism is dying! Materialism is hanging in the balance!” This would be genuine obscurantism, diametrically opposite to the materialist path taken by Lenin. He was not afraid to “revise” the *form* of materialism, as it was given by Engels, and clarify the definition of matter and, under these conditions, electron theory turned out to be, not at all a refutation, but, a brilliant confirmation of dialectical materialism.

If Lenin, the philosopher, had to grasp the essence of these discoveries to evaluate the latest scientific discoveries, then this is the primary duty of a Marxist naturalist. He must study the

physical aspect of a new theory and, only after such a test, accept or reject it. As for Cde. Timiryazev, his approach to relativity theory can be called nihilistic, as it has been for a long time, independently of the Dayton-Miller experiments.

We believe that it is too early for Marxists to cast their verdict on relativity theory, and in our note on the congress of physicists, we support neither A.I. Ioffe's<sup>17</sup> point of view nor [195] A.K. Timiryazev's point of view. We think that physics does not yet have any final answers, no *experimentum crucis* [definitive experiment]. But, we consider it beyond doubt that Newtonian mechanics is insufficient and will have to be updated one way or the other - on this, we disagree with Cde. Timiryazev. Whether this update comes from Einstein's theory or from some other theory, physics will decide, and neither of them can crush materialism.

We think that most of those materialistic physicists who *now* adopt the standpoint of relativity theory, and who Cde. Timiryazev assigns to the idealist camp with incredible ease only for relativity theory, agree with this view. Take, for instance, Planck. This famous physicist, who fought hard against Machism for many years, is now, according to Cde. Timiryazev, a Machist. Meanwhile, M. Planck recently wrote the following:

Of course, the last word on the question of admissibility and on the significance of the theory of relativity belongs to experiment, and the most important sign of the fruitfulness of a theory is the ability to test it by experiment. So far, no contradictions have been established with experiment, which I would particularly like to emphasize in contrast to some reports that have recently made their way into the general public. But even those who, for whatever reason, consider it possible or probable that contradictions with experiment will arise, from the point of view of their own interests, can do nothing better than to take part in the development of the theory of relativity and in the further development arising from its consequences. For this is the only way to disprove it, namely, with experiment. (Planck 1926, 192)

Every Marxist physicist cannot but agree with this approach. What does Cde. Timiryazev see here that is Machist? The same implication permeates an article in *Pravda* by the academician, A.F. Ioffe, from 1 January of this year, which A.K. Timiryazev already labeled idealistic and Machist.<sup>18</sup>

Of course, Cde. Timiryazev can reject even the physical aspect of relativity theory. It is even possible that relativity theory in its present form will be refuted.

[196] But in this case, Cde. Timiryazev should have defended his ideas first of all and above all, among physicists. But we have not seen any article by him in specialized physics journals to present this point of view. Cde. Timiryazev obviously thinks that with his articles in the journal *Under the Banner of Marxism* or in *Pravda* he will triumph over all "Machist"-physicists. In our opinion, this hope is unfounded.

It is true that Cde. Timiryazev's report at the Physics Congress represented such an attempt. But, first, this was his only attempt; and, secondly, it was poorly presented at the congress, if solely

<sup>17</sup>Abram F. Ioffe (1880–1960) was a Soviet physicist and founder of the Leningrad Physico-Technical Institute (later, the Ioffe Institute), which came to be known as the "cradle of Soviet physics." He is best known for his work in solid state physics and electromagnetism (Graham 1993, 209-10) [TN].

<sup>18</sup>A.F. Ioffe says: "Theory that describes material phenomena and physical processes in matter cannot contradict the materialistic worldview as long as it seeks to describe the properties of matter as best as possible. What is the specific content of a physical theory 'is a matter of expediency'." A.K. Timiryazev says the following about this position: "He (A.F. Ioffe) definitely identifies materialism with Mach's philosophy . . . only the word 'economical' is replaced by the word 'expedient'." A.K. Timiryazev is surprisingly generous with applying the label "Machism." A.F. Ioffe speaks about *matter* everywhere, but Cde. Timiryazev seems to see a "complex of sensations" in its place. A.F. Ioffe uses the unfortunate term "expediency." But, whether he means Machist "description" is clear from the broader context. A.F. Ioffe literally says the following in the next sentence: "The best of these ideas (of matter) is the one that comes closest to the properties of real matter." Hence A.F. Ioffe uses "expediency" in the sense of "conformity to reality." Consequently, there is an unwarranted charge of Machism here, in a hope that the reader will forget to check the content of A.F. Ioffe's article (Ioffe 1927; Timiryazev 1927b).

because the report was read only in a section (there were five sections in total at the congress, which met at the same time) and not at the plenary session.

If Cde. Timiryazev sets himself the goal of seriously opposing relativity theory, under no circumstances should he neglect the task of upholding his views among physicists.

We now turn to another question that Cde. Timiryazev touched upon in his article against us - about the new quantum mechanics.

“Methodologically, Schrödinger’s theory is just as formal as Heisenberg’s theory. According to this theory, waves that do not have a material carrier form electrons - matter. This is a classic illustration of Lenin’s words ‘an attempt to think of motion without matter’” (Timiryazev 1927a, 187).

First and foremost, nowhere in our previous note did we claim that Schrödinger’s theory in its present form is unconditionally acceptable to dialectical materialism. Classical physics and the old quantum theory proved powerless before the task of explaining nature. And we see new theories emerging that are trying to avoid a dead end. Some of these theories, too, may be found unsuccessful, but this does not at all cancel the *collapse* of the old, mechanical physics.

Second, we did not deny the formal nature of Schrödinger’s theory. We ourselves pointed out that the derivation of Schrödinger’s equation requires further discussion (Gessen & Egorshin 1927a, 140). The most important thing that we emphasized was that Schrödinger’s theory is an attempt to provide a synthesis of molar and molecular mechanics. We pointed out the difference between Schrödinger and Heisenberg. We noted that some of Heisenberg’s *fundamental* assumptions, which led him to doubt the degree of the electron’s reality, are unacceptable. The methodological foundation of Schrödinger’s theory is of a quite different nature. His task, as we emphasized, is to “build . . . such a theory of matter and such a mechanics that would embrace both molecular and molar laws of motion, i.e. that would be a synthesis of Newtonian and quantum mechanics” (Gessen & Egorshin 1927a, 139).

Cde. Timiryazev himself acknowledged that Newtonian mechanics is insufficient and that such a synthesis is necessary, as he wrote the following in his article “‘Quantum’ Theory and Contemporary Physics”: “The task is to connect the new with the old. We need to find the limits of the applicability of classical mechanics and electrodynamics and find out those general laws that should unite and supplement them, since it is clear that “quanta” introduce something new” (Timiryazev 1925a, 138).

[197] Third, we already have attempts in the literature to provide a visual interpretation of Schrödinger’s equation by means of a material carrier and it turns out that this leads to an expansion of our idea of the electron and these ideas are very close to those defended by Cde. Timiryazev himself.

It is not so easy to answer the question about Schrödinger’s theory!

In classical quantum theory, there were many strange and incomprehensible positions, above all the expression of quantum conditions in integers.

In his article “Recent Attempts to Revive Teleology in Physics,” Cde. Timiryazev himself reproaches Bohr for only half-overcoming Mach, since his theory did not provide an account of the mechanism of electron hopping and the essence of quantum conditions. Schrödinger’s theory attempts to clarify a discrete set of integers in quantum conditions by using wave processes as the basis of mechanics (Timiryazev 1925b, 321). Only in this way is it possible to understand why there is a need for integer numbers in quantum theory.

This is how Comrade Timiryazev himself explains this fact, as can be read in his article “‘Quantum’ Theory and Contemporary Physics.” So in this respect, Schrödinger’s theory represents a step forward in *explaining* phenomena. This is how, for instance, W. Wien<sup>19</sup> evaluates it.

<sup>19</sup>Wilhelm Wien (1864–1928) was a German physicist who specialized in the studies of thermodynamics and electromagnetism. He is best known for the discovery of the proton and won the Nobel Prize in 1911 “for his discoveries regarding the laws governing the radiation of heat” (Rüchardt 1955, 57–62; Nobel Foundation 1998, 287–290) [TN].



Here is what he says in a speech delivered in 1926: “What was particularly strange about quantum theory was its complete break with old physical theories, irrational integers and the inability to have an idea of the processes occurring in reality. And now, Schrödinger has made an attempt to present the whole problem as a problem of the oscillatory process, making the theory more intuitive and closer to our understanding” (Wien 1926, 14). Yes, but it conceives motion without matter!

Such a conclusion is, perhaps, too hasty. Above, we indicated the difficulties encountered in physics on the question of the ether. Schrödinger’s equation is derived on the basis of formal analogies between geometric and physical optics. But why should one conclude that this theory, in principle, methodologically rules out a material carrier for oscillatory processes? One can see from the following facts that this is not the case: Madelung,<sup>20</sup> for example, is trying to provide a “visual interpretation of Schrödinger’s equation” (Madelung 1926, 1004; Madelung 1927, 322).

This interpretation relies on the idea that the electron is taken to be a fluid that continuously fills the entire space with a certain density and flows at a certain speed. “Thus,” Madelung says, “the quantum theory of the stationary states of an atom is reduced to the hydrodynamics of continuously distributed electricity. In the case where there are several electrons in an atom, one must accept that they mutually penetrate each other, but do not merge” (Madelung 1926, 1004; Madelung 1927, 322 [TN]). One cannot, of course, accept this interpretation as final, but it shows that Schrödinger’s theory does not necessarily conceive motion without matter. Additionally, [198] this interpretation leads to a new conceptualization of the electron, which undoubtedly expands our ideas. And these ideas are reminiscent of those of . . . J.J. Thomson, an exemplary materialist according to Cde. Timiryazev. Here is what we read in the latter:

In fact, when we calculate the electromagnetic mass of an electron, which, according to Thomson, is otherwise “associated with the lines of force of the electron is the mass of the ether,” we have to take into account the entire ‘connected’ mass in the entirety of infinite space. True, most of this mass is in the immediate vicinity of the electron. However, it is necessary to summarize or “integrate” across all of space and it does not matter if we consider the ether to exist or only a “vacuum with electromagnetic properties” as supporters of “pure description” and enemies of ‘materialist metaphysics’ like to say. Thus, the carrier of the mass of an individual electron is strictly speaking - the whole world! It is clear that under these conditions, the old notion of impenetrability is quite relative. Furthermore, according to J.J. Thomson, we perceive the mass of the ether as weighty, only as long as it is “connected” with the lines of force of electrical charges. The rest of the mass is weightless for us - it neither affects us nor do we affect it. (Timiryazev 1924, 227)

Is this really so different from Madelung’s interpretation?

For this reason alone, Comrade Timiryazev should not dismiss Schrödinger’s theory simply as a “new fashion.”

Even more recently, we have had other interpretations of Schrödinger’s theory, for example, Darwin’s from his article in *Nature* from 22 November 1927 (Darwin 1927a, 282–284; Darwin 1927b, 227–253).

As for Schrödinger himself, his view on the material carrier of wave movements essentially coincides with Madelung’s views (Schrödinger 1927, §2 and §7).

We do not at all claim that Madelung’s and Schrödinger’s interpretations are the ultimate conceptions of material substance. It is possible that much will have to be fundamentally changed. But, the fact remains that Schrödinger’s theory does not exclude the material carrier of movement. If we note that Madelung published his interpretation in November 1926, then in March 1927, it is

<sup>20</sup>Erwin Madelung (1881–1972) was a German physicist who held the chair of theoretical physics at Goethe University Frankfurt for nearly three decades. Though initially specializing in the studies of crystal lattices and ion energy, he is best known for his contributions to the studies of atomic physics and quantum mechanics (Schröder 2008) [TN].

absolutely incorrect to speak about Schrödinger's theory as a "classical example of thinking of motion without matter."<sup>21</sup>

Finally, the last question.

"In his article," Cde. Timiryazev writes, "Cdes. H.E. praise Russian theorists for the fact that they follow Schrödinger and refuse to accept the formal Heisenberg theory" (Timiryazev 1927a, 187 [TN]). In our note on the congress, as any impartial reader can see, we "praised" Russian theorists not for the fact that they followed Schrödinger, but for the fact that the majority of speakers dissociated themselves from the Machist tendencies present [199] in Heisenberg. It seems that this is not the same thing. Cde. Timiryazev is reading something that is not written.

If he wants to raise the fundamental question about Marxists' attitude toward Russian physicists, there is one of two things here: either Cde. Timiryazev agrees with us in our assessment of Russian physicists as "being without a deliberately and consciously scientific 'reactionary character'" and that "generally speaking, Marxists would be able to work with most Russian scientists," then his ironic remarks about "praise" and so on are completely incomprehensible and unnecessary; or Cde. Timiryazev did not like our words that Marxists could work together with Russian physicists and that the latter have spontaneous, materialistic tendencies (Gessen & Egorshin 1927a, 140 [TN]). In this case, Cde. Timiryazev must clearly and unambiguously declare that he considers most Russian physicists to be reactionary, unconditionally foreign to us and incapable of accepting the ideas of modern materialism, not to mention the task of Soviet, socialist construction.

Here we come to such conclusions, where theory becomes intertwined with practical politics. We, together with the Party and Soviet power, adhere to the unshakable opinion that we need to work together with the representatives of modern science, that we can make them dialectical materialists only by collaborating with them, and we maintain that the nihilistic standpoint would bring irreparable harm to Marxism and to the revolution.

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<sup>21</sup>It is interesting to note that Cde. Timiryazev, who considers Heisenberg's and Schrödinger's theories unacceptable for materialistic physics, never spoke in the discussions about this issue at the congress of physicists.

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