# V.I. Lenin

## MATERIALISM and EMPIRIO-CRITICISM

### Critical Comments on a Reactionary Philosophy

---

#### Chapter Five: The Recent Revolution in Natural Science and Philosophical Idealism

A year ago, in *Die Neue Zeit* (1906–07, No. 52), there appeared an article by Joseph Diner-Dénes entitled "Marxism and the Recent Revolution in the Natural Sciences." The defect of this article is that it ignores the epistemological conclusions which are being drawn from the "new" physics and in which we are especially interested at present. But it is precisely this defect which renders the point of view and the conclusions of the author particularly interesting for us. Joseph Diner-Dénes, like the present writer, holds the view of the "rank-and-file Marxist," of whom our Machians speak with such haughty contempt. For instance, Mr. Yushkevich writes that "ordinarily, the average rank-and-file Marxist calls himself a dialectical materialist" (p. 1 of his book). And now this rank-and-file Marxist, in the person of J. Diner-Dénes, has *directly* compared the recent discoveries in science, and especially in physics (X-rays, Becquerel rays, radium, etc.[1]), with Engels' *Anti-Dühring*. To what conclusion has this comparison led him? "In the most varied fields of natural science," writes Diner-Dénes, "new knowledge has been acquired, all of which tends towards that single point which Engels desired to make clear, namely, that in nature 'there are no irreconcilable contradictions, no forcibly fixed boundary lines and distinctions,' and that if contradictions and distinctions are met with in nature, it is because we alone have introduced their rigidity and absoluteness into nature." It was discovered, for instance, that light and electricity are only manifestations of one and the same force of nature.[2] Each day it becomes more probable that chemical affinity may be reduced to electrical processes. The indestructible and non-disintegrable elements of chemistry, whose number continues to grow as though in derision of the unity of the world, now prove to be destructible and disintegrable. The element radium has been converted into the element helium.[3] "Just as all the forces of nature have been reduced to one force, so all substances in nature have been reduced to *one substance*" (Diner-Dénes' italics). Quoting the opinion of one of the writers who regard the atom as only a condensation of the ether,[4] the author exclaims: "How brilliantly does this confirm the statement made by Engels thirty years ago that motion is the mode of existence of matter." "All phenomena of nature are motion, and the differences between them lie only in the fact that we human beings perceive this motion in

different forms. . . . It is as Engels said. Nature, like history, is subject to the dialectical law of motion."

On the other hand, you cannot take up any of the writings of the Machians or about Machism without encountering pretentious references to the new physics, which is said to have refuted materialism, and so on and so forth. Whether these assertions are well-founded is another question, but the connection between the new physics, or rather a definite school of the new physics, and Machism and other varieties of modern idealist philosophy is beyond doubt. To analyse Machism and at the same time to ignore this connection—as Plekhanov does[5]—is to scoff at the spirit of dialectical materialism, *i.e.*, to sacrifice the method of Engels to the letter of Engels. Engels says explicitly 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" *(Ludwig Feuerbach,* Germ. ed., p. 19).[6] Hence, a revision of the "form" of Engels' materialism, a revision of his natural-philosophical propositions is not only not "revisionism," in the accepted meaning of the term, but, on the contrary, is demanded by Marxism. We criticise the Machians not for making such a revision, but for their *purely revisionist* trick of betraying the *essence* of materialism under the guise of criticising its *form* and of adopting the fundamental precepts of reactionary bourgeois philosophy without making the slightest attempt to deal directly, frankly and definitely with assertions of Engels' which are unquestionably extremely important to the given question, as, for example, his assertion that ". . . motion without matter is unthinkable" *(Anti-Dühring,* p. 50).[7]

It goes without saying that in examining the connection between one of the schools of modern physicists and the rebirth of philosophical idealism, it is far from being our intention to deal with specific physical theories. What interests us exclusively is the epistemological conclusions that follow from certain definite propositions and generally known discoveries. These epistemological conclusions are of themselves so insistent that many physicists are already reaching for them. What is more, there are already various trends among the physicists, and definite schools are beginning to be formed on this basis. Our object, therefore, will be confined to explaining clearly the essence of the difference between these various trends and the relation in which they stand to the fundamental lines of philosophy.

## 1. The Crisis in Modern Physics

In his book *Valeur de la science [Value of Science],* the famous French physicist Henri Poincaré says that there are "symptoms of a serious crisis" in physics, and he devotes a special chapter to this crisis (Chap. VIII, *cf.* p. 171). The crisis is not confined to the fact that "radium, the great revolutionary," is undermining the principle of the conservation of energy. "All the other principles are equally

endangered" (p. 180). For instance, Lavoisier's principle, or the principle of the conservation of mass, has been undermined by the electron theory of matter. According to this theory atoms are composed of very minute particles called electrons, which are charged with positive or negative electricity and "are immersed in a medium which we call the ether." The experiments of physicists provide data for calculating the velocity of the electrons and their mass (or the relation of their mass to their electrical charge). The velocity proves to be comparable with the velocity of light (300,000 kilometres per second), attaining, for instance, one-third of the latter. Under such circumstances the twofold mass of the electron has to be taken into account, corresponding to the necessity of over coming the inertia, firstly, of the electron itself and, secondly, of the ether. The former mass will be the real or mechanical mass of the electron, the latter the "electrodynamic mass which represents the inertia of the ether." And it turns out that the former mass is equal to zero. The entire mass of the electrons, or, at least, of the negative electrons, proves to be totally and exclusively electrodynamic in its origin.[8] Mass disappears. The foundations of mechanics are undermined. Newton's principle, the equality of action and reaction, is undermined, and so on.

We are faced, says Poincaré, with the "ruins" of the old principles of physics, "a general debacle of principles." It is true, he remarks, that all the mentioned departures from principles refer to infinitesimal magnitudes; it is possible that we are still ignorant of other infinitesimals counteracting the undermining of the old principles. Moreover, radium is very rare. But at any rate we have reached a "*period of doubt*." We have already seen what epistemological deductions the author draws from this "period of doubt": "it is not nature which imposes on [or dictates to] us the concepts of space and time, but we who impose them on nature"; "whatever is not thought, is pure nothing." These deductions are idealist deductions. The breakdown of the most fundamental principles shows (such is Poincaré's trend of thought) that these principles are not copies, photographs of nature, not images of something external in relation to man's consciousness, but products of his consciousness. Poincaré does not develop these deductions consistently, nor is he essentially interested in the philosophical aspect of the question. It is dealt with in detail by the French writer on philosophical problems, Abel Rey, in his book *The Physical Theory of the Modern Physicists (La Théorie physique chez les physiciens contemporains,* Paris, F. Alcan, 1907). True, the author himself is a positivist, *i.e.,* a muddlehead and a semi-Machian, but in this case this is even a certain advantage, for he can not be suspected of a desire to "slander" our Machians' idol. Rey cannot be trusted when it comes to giving an exact philosophical definition of concepts and of materialism in particular, for Rey too is a professor, and as such is imbued with an utter contempt for the materialists (and distinguishes himself by utter ignorance of the epistemology of materialism). It goes without saying that a Marx or an Engels is absolutely non-existent for such "men of science." But Rey summarises carefully and in general conscientiously the extremely abundant literature on the subject, not only French, but English and German as well (Ostwald and Mach in

particular), so that we shall have frequent recourse to his work.

The attention of philosophers in general, says the author, and also of those who, for one reason or another, wish to criticise science generally, has now been particularly attracted towards physics. "In discussing the limits and value of physical knowledge, it is in effect the legitimacy of positive science, the possibility of knowing the object, that is criticised" (pp. i-ii). From the "crisis in modern physics" people hasten to draw sceptical conclusions (p. 14). Now, what is this crisis? During the first two-thirds of the nineteenth century the physicists agreed among themselves on everything essential. They believed in a purely mechanical explanation of nature: they assumed that physics is nothing but a more complicated mechanics, namely, a molecular mechanics. They differed only as to the methods used in reducing physics to mechanics and as to the details of the mechanism. . . . At present the spectacle presented by the physico-chemical sciences seems completely changed. Extreme disagreement has replaced general unanimity, and no longer does it concern details, but leading and fundamental ideas. While it would be an exaggeration to say that each scientist has his own peculiar tendencies, it must nevertheless be noted that science, and especially physics, has, like art, its numerous schools, the conclusions of which often differ from, and sometimes are directly opposed and hostile to each other. . . .

"From this one may judge the significance and scope of what has been called the crisis in modern physics.

"Down to the middle of the nineteenth century, traditional physics had assumed that it was sufficient merely to extend physics in order to arrive at a metaphysics of matter. This physics ascribed to its theories an ontological value. And its theories were all mechanistic. The traditional mechanism [Rey employs this word in the specific sense of a system of ideas which reduces physics to mechanics] thus claimed, over and above the results of experience, a *real* knowledge of the material universe. This was not a hypothetical account of experience; it was a dogma. . ." (p. 16).

We must here interrupt the worthy "positivist." It is clear that he is describing the materialist philosophy of traditional physics but does not want to call the devil (materialism) by name. Materialism to a Humean must appear to be metaphysics, dogma, a transgression of the bounds of experience, and so forth. Knowing nothing of materialism, the Humean Rey has no conception whatever of dialectics, of the difference between dialectical materialism and metaphysical materialism, in Engels' meaning of the term. Hence, the relation between absolute and relative truth, for example, is absolutely unclear to Rey.

". . . The criticism of traditional mechanism made during the whole of the second half of the nineteenth century weakened the premise of the ontological reality of mechanism. On the basis of these criticisms a philosophical conception of physics was founded which became almost traditional in 7philosophy at the end

of the nineteenth century. Science was nothing but a symbolic formula, a method of notation *(repérage,* the creation of signs, marks, symbols), and since the methods of notation varied according to the schools, the conclusion was soon reached that only that was denoted which had been previously designed (*fa&ctail;onné*) by man for notation (or symbolisation). Science became a work of art for dilettantes, a work of art for utilitarians: views which could with legitimacy be generally interpreted as the negation of the possibility of science. A science which is a pure artifice for acting upon nature, a mere utilitarian technique, has no right to call itself science, without perverting the meaning of words. To say that science can be nothing but such an artificial means of action is to disavow science in the proper meaning of the term.

"The collapse of traditional mechanism, or, more precisely, the criticism to which it was subjected, led to the proposition that science itself had also collapsed. From the impossibility of adhering purely and simply to traditional mechanism it was inferred that science was impossible" (pp. 16-17).

And the author asks: "Is the present crisis in physics a temporary and external incident in the evolution of science, or is science itself making an abrupt right-about-face and definitely abandoning the path it has hitherto pursued?. . ."

"If the [physical and chemical] sciences, which in history have been essentially emancipators, collapse in this crisis, which reduces them to the status of mere, technically useful recipes but deprives them of all significance from the stand point of knowledge of nature, the result must needs be a complete revolution both in the art of logic and the history of ideas. Physics then loses all educational value; the spirit of positive science it represents becomes false and dangerous." Science can offer only practical recipes but no real knowledge. "Knowledge of the real must be sought and given by other means. . . . One must take another road, one must return to subjective intuition, to a mystical sense of reality, in a word, to the mysterious, all that of which one thought it had been deprived" (p. 19).

As a positivist, the author considers such a view wrong and the crisis in physics only temporary. We shall presently see how Rey purifies Mach, Poincaré and Co. of these conclusions. At present we shall confine ourselves to noting the fact of the "crisis" and its significance. From the last words of Rey quoted by us it is quite clear what reactionary elements have taken advantage of and aggravated this crisis. Rey explicitly states in the preface to his work that "the fideist and anti-intellectualist movement of the last years of the nineteenth century" is seeking "to base itself on the general spirit of modern physics" (p. ii). In France, those who put faith above reason are called fideists (from the Latin *fides,* faith). Anti-intellectualism is a doctrine that denies the rights or claims of reason. Hence, in its philosophical aspect, the essence of the "crisis in modern physics" is that the old physics regarded its theories as "real knowledge of the material world," *i.e.,* a reflection of objective reality. The new trend in physics regards

theories only as symbols, signs, and marks for practice, *i.e.*, it denies the existence of an objective reality independent of our mind and reflected by it. If Rey had used correct philosophical terminology, he would have said: the materialist theory of knowledge, instinctively accepted by the earlier physics, has been replaced by an idealist and agnostic theory of knowledge, which, against the wishes of the idealists and agnostics, has been taken advantage of by fideism.

But Rey does not present this replacement, which constitutes the crisis, as though all the modern physicists stand opposed to all the old physicists. No. He shows that in their epistemological trends the modern physicists are divided into three schools: the energeticist or conceptualist school; the mechanistic or neo-mechanistic school, to which the vast majority of physicists still adhere; and in between the two, the critical school. To the first belong Mach and Duhem; to the third, Henri Poincaré to the second, Kirchhoff, Helmholtz, Thomson (Lord Kelvin), Maxwell—among the older physicists—and Larmor and Lorentz among the modern physicists. What the essence of the *two* basic trends is (for the third is not independent, but intermediate) may be judged from the following words of Rey's:

"Traditional mechanism constructed a system of the material world." Its doctrine of the structure of matter was based on "elements qualitatively homogenous and identical"; and elements were to be regarded as "immutable, impenetrable," etc. Physics "constructed a *real* edifice out of *real* materials and *real* cement. The physicist possessed *material elements, the causes and modes* of their action, and the *real* laws of their action" (pp. 33-38). "The change in this view consists in the rejection of the ontological significance of the theories and in an exaggerated emphasis on the phenomenological significance of physics." The conceptualist view operates with "pure abstractions . . . and seeks a purely abstract theory which will as far as possible eliminate the hypothesis of matter. . . . The notion of energy thus becomes the substructure of the new physics. This is why conceptualist physics may most often be called *energeticist* physics," although this designation does not fit, for example, such a representative of conceptualist physics as Mach (p. 46).

Rey's identification of energetics with Machism is not altogether correct, of course; nor is his assurance that the neo-mechanistic school as well is approaching a phenomenalist view of physics (p. 48), despite the profundity of its disagreement with the conceptualists. Rey's "new" terminology does not clarify, but rather obscures matters; but we could not avoid it if we were to give the reader an idea of how a "positivist" regards the crisis in physics. Essentially, the opposition of the "new" school to the old views fully coincides, as the reader may have convinced himself, with Kleinpeter's criticism of Helmholtz quoted above. In his presentation of the views of the various physicists Rey reflects the indefiniteness and vacillation of their philosophical views. The *essence* of the crisis in modern physics consists in the breakdown of the old laws and basic principles, in the rejection of an objective reality existing outside the mind, that

is, in the replacement of materialism by idealism and agnosticism. “Matter has disappeared"—one may thus express the fundamental and characteristic difficulty in relation to many of the particular questions, which has created this crisis. Let us pause to discuss this difficulty.

---

## Notes

[1] *X-rays, Becquerel rays*,radium—discoveries which, laid the basis for the development of atomic physics.

X-rays (Rontgen rays) are extremely short-wave electromagnetic radiation ’which can pass through media impenetrable by visible light. They were discovered by the German physicist Wilhelm Konrad R6ntgen in December 1895 who described their main properties; later the nature of this radiation was discovered.

In 1896 the French physicist Antoine-Henri Becquerel, while studying the action of various fluorescent substances on photo graphic film, discovered that uranium salts affect such film in the dark even without previous exposure to light. By further experiments he showed that this action was due to a new form of radiation distinct from X-rays.

Investigating this new form of radiation, Pierre and Marie Curie established that it was due to a hitherto unknown property of matter, which they called radioactivity. As a result of their experiments two new radioactive elements were discovered: polonium and radium (1898). Later it was found that Becquerel’s rays consist of three components (alpha-, beta- and gamma-rays).

[2] This discovery was made by lames Clerk Maxwell. By generalising Michael Faraday’s experimental results in the study of electromagnetic phenomena he created the theory of the electromagnetic field, from which it followed that changes of the electromagnetic field are propagated with the speed of light. On the basis of his researches, Maxwell in 1805 concluded that light consists of electromagnetic vibrations. In 1886-89 his theory was confirmed experimentally by Heinrich Hertz, who proved the existence of electromagnetic waves.

[3] The study of radioactivity revealed the existence of a special kind of radiation: alpha-, beta- and gamma-rays. In 1903, Ernest Rutherford and Frederick Soddy suggested that radioactivity was the spontaneous transformation of one chemical element into another. This was speedily confirmed by William Ramsay and Frederick Soddy, who discovered that helium was one of the products of radioactive disintegration of radon (1903). Shortly afterwards it was discovered that helium was formed by the disintegration of radium and other radioactiye elements showing alpha-radioactivity. This formation of helium was an important argument in favour of the theory of radioactive transformations,

and could only be explained by supposing that alpha-rays are the nuclei of helium atoms. This was confirmed in 1909 by the experiments of T. Rutherford and T. Royds.

[4] Lenin uses the concept of the ether, which was still generally accepted in physics at the beginning of the twentieth century. The idea of the ether as a special material medium filling all space and acting as the carrier of light, gravitational forces, etc., was put forward in the seventeenth century. Later, the notion of different forms of the ether, independent of one another (electromagnetic, magnetic, etc.) was introduced to explain various phenomena. Owing to the success of the wave theory of light, the concept of the luminiferous ether (Christian Huygens, Austin Frosnel and others) was especially developed; subsequently the hypothesis of a single ether arose. As science developed, however, the concept of the ether came into contradiction with new facts. The untenability of the hypothesis of the ether as a universal mechanical medium was proved by the theory of relativity; the rational elements contained in the hypothesis of the ether were reflected in the quantum field theory (tile vacuum concept).

[5] Lenin repeatedly pointed out the limited nature of Plekhanov's criticism of Machism. In 1905, in connection with his preface to the second Russian edition of Engels' *Ludwig Feuerbaeh and the End of Classical German Philosophy,* Lenin wrote: "How petty are his sallies and 'pinpricks against the Machists! For me this is the more to be regretted since Plekhanov's criticism of Mach seems to me essentially correct" *(Lenin Miscellany XXVI,* p. 21). In 1907-08, in the works *Fundamental Problems of Marxism, Materialismus militais* and others, Plekhnnov criticised Machism and its adherents in Russia (Bogdanov, Lunacharsky and others) and pointed out the fallacy of their attempts to combine Marxism with the subjective-idealist philosophy of Mach and Avenarius. In so doing, Plekhanov "was less concerned with refuting Mach than with dealing a factional blow at Bolshevism" (see p. 355 of this volume).

Plekhanov's opposition to Machism played a positive part in defending Marxist philosophy from the attacks of the revisionists, but he did not give a deep theoretical analysis of empirio-criticism, and did not reveal the direct dependence of Machism on the crisis in natural science, confining himself to a criticism of the idealist epistemological views of some of its adherents.

[6] See K. Marx and F. Engels, *Selected Works,* Vol. II, Moscow, 1958, p. 375. 94.

[7] See F. Engels, *Anti-Duhring,* Moscow, 1959, p. 86.

[8] The description of the concept of mass given by Henri Poincaré and quoted by Lenin was in accord with the level of development of physics at that time. The development of the electronic theory that followed the discovery of the electron made it possible to explain the nature of the mass of the electron. Joseph

John Thom son advanced the hypothesis that the actual mass of the electron is determined by the energy of the electromagnetic field (i.e., the inertia of the electron is due to the inertia of the field). The concept of the electromagnetic mass of the electron was introduced, and this mass was found to depend on the velocity of motion of the electron. The mechanical mass of the electron, however, like that of any other particle, was regarded as unchanging. The existence of the mechanical mass should have been revealed by experiments on the dependence of the electromagnetic mass of the electron on its velocity. However, these experiments, performed by Walter Kaufmann in 1901-02, unexpectedly showed that the electron behaved as if all its mass was of an electromagnetic nature. Hence the conclusion was drawn that, in the case of the electron, mechanical mass, which was formerly regarded as an inalienable property of matter, has disappeared. This circumstance gave rise to various kinds of philosophical speculations and statements about the "disappearance of matter', the fallacy of which was demonstrated by Lenin. The further development of physics (relativity theory) showed that mechanical mass also depends on velocity of motion and that the mass of the electron cannot be reduced wholly to electromagnetic mass.

8. How Could J. Dietzgen Have Found Favour with the Reactionary Philosophers? | 2. "Matter Has Disappeared"

Contents forward >
Works Index | Volume 14 | Collected Works | L.I.A. Index