

MARXISM AND THE NEW PHYSICS*

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Although the ideological struggle between the East and the West has been carried into the natural sciences, the author contends that there is no connection between Marxism and physical theory, whether deterministic or indeterministic. Marxism, which concerns itself with social theory, deals with physical theory only in so far as it is used for specific class purposes instead of social needs. Marxism does not derive its social theory, as has been asserted, either from, or by analogy with, physical processes, nor does it read "social laws" of development into nature. The attempt to do so by way of "dialectical materialism" must be regarded as a Marxist aberration. The author deals with the history of this aberration and with the reasons for its persistency in Marxism-Leninism.

The conflict between the East and the West, although it involves different ideologies, has little to do with different concepts of physical reality. Ideologies differ because material and social interests differ; "physical reality," on the other hand, is quite the same for all the combatants. Nevertheless, in both camps, the ideological struggle is carried into the natural sciences—in the East, in the form of a rear-guard defense of dialectical materialism; in the West, in the assertion that dialectical materialism is "the real root of the conflict between East and West, because it is the basis of the fanatic belief of Marxists that the world is bound to fall to them spontaneously and inevitably."¹

Both sides insist, of course, that their scientific interpretations of the external world are free of all ideological encumbrances. While for the Eastern scientists and philosophers the whole of modern physics seems to verify dialectical materialism, for those of the West Marxism appears completely outdated because the idea of determinism has disappeared. The very term "materialism" is rejected as belonging to the last century. During Marx's lifetime, it is pointed out, "nothing was known of today's relativistic and atomistic physics; matter was at that time what our senses conveyed it to be; physical measurement dealt with sensually perceivable properties of things,"² which is no longer true.

Marx, of course, had only the natural science of his period to rely on; but the changes in science since then do not affect his theories. Marx did not coin the term *dialectical materialism* but used the word *material* to designate the basic and primary conditions of all human existence. Hegel's dialectic merely formed the point of departure for Marx's critique of capitalist society. It was important to Marx because of "the enormous historical sense upon which it was founded," and because "it dissolves all conceptions of final, absolute truth, and of a final, absolute state of humanity corresponding to it."³

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¹ Max Born, The Concept of Reality in Physics. *Bulletin of the Atomic Scientists, Chicago*, 1958. Vol. XIV, No. 8, p. 320.

² *Ibid.*, p. 319.

³ F. Engels, *Ludwig Feuerbach*, New York, 1945, p. 22.

The materialism which Marx encountered was not historical, and the dialectic then in vogue was not materialistic. By pitting Feuerbach against Hegel and Hegel against Feuerbach, Marx developed his own concept of social development, for which Friedrich Engels coined the term *historical materialism*. This materialistic conception of history did not stem from the "physical determinism derived from Newtonian mechanics."⁴ On the contrary, it developed, by way of dialectics, in direct opposition to the materialism based on Newtonian mechanics. It excluded the idea of human history being determined by overriding "natural laws," whether mechanical or dialectical. Although recognizing the interrelations between men, society and nature, it was, first of all, a theory of men and society.

Unfortunately, however, the persuasive power of historical or dialectical materialism—as it came to be known—was great enough to carry away even Engels, who spoke of its universal validity. While some tolerant critics found this merely amusing,⁵ the less well-disposed used this overzealousness as an excuse to reject the whole of Marxism as just an oddity of German mysticism. But while the notion of the "universality" of the dialectic process is not defensible, neither is it essential to Marxism, which loses none of its force by omitting it. Marx, at any rate, did not concern himself with the "dialectics of nature." It is not the ideas of Marx but "Marxism," as the ideology of the rising European labor movement and of the self-declared "socialist" states of the Eastern power bloc, that nourishes Western anti-Marxism. And it is for this reason that the struggle between the "Marxist" East and the anti-Marxist West, however real, tells us nothing about the validity or invalidity of Marxism for our time.

Marxism as Ideology. The pre-capitalist world was agitated by the question of the primacy of spirit or nature. "Those who asserted the primacy of spirit to nature comprised the camp of idealism. The others, who regarded nature as primary, belonged to the various schools of materialism."⁶ In opposing both the conditions and the religious ideologies of the feudal past, the revolutionary middle-class was materialistic. It considered nature as objectively-given reality and man as determined by natural laws. The natural sciences were to explain his life and actions and, with the function of his brain, his sensations and consciousness. Freed from religious superstitions, science devoted itself to the discovery of natural laws, and Newtonian mechanics served as the basis for a growing conviction that all natural phenomena follow definite causal rules.

Radical middle-class materialism lost its ideological urgency with the establishment of the bourgeoisie as the ruling class. The emancipation of natural science from theology could not be extended to the emancipation of

⁴ M. Born, *The Concept of Reality in Physics*, p. 320.

⁵ B. Croce, *Lebendiges und Totes in Hegels Philosophie*, Heidelberg, 1909.

⁶ F. Engels, *Ludwig Feuerbach*, p. 31.

society from religion. As Napoleon expressed it: "As far as I am concerned, religion is not the mystery of creation but the mystery of society. Religion connects the idea of equality with heaven and thus prevents the butchery of the rich by the poor. Society depends on the inequality of incomes, and the inequality of incomes, on the existence of religion."⁷ The co-existence of science and religion in the uneasy bourgeois world found ideological support in idealistic interpretations of the further results of scientific development.

The early materialists, or natural philosophers, (Francis Bacon and Thomas Hobbes) were convinced that through sense experience and through intellectual activities derived therefrom, it would be possible to gain absolutely valid knowledge of the external world. This optimism vanished with John Locke, who saw this knowledge limited by the very intervention of ideas. He thought it valid only to the extent to which ideas were actually in conformity with things. Although sensations and ideas related to the external world, this world itself could not be really known. Immanuel Kant accepted the proposition that ultimates (the thing in itself) are not knowable and that empirical knowledge restricts itself to the subjective forms in which man becomes aware of the objective world. It was for this reason that he saw the need for *a priori* concepts which brought order into experience and made it intelligible. Concepts of time, space, and causality were inventions of the human mind and, though not empirically verifiable, were nevertheless necessary to science, philosophy and effective human activity. In its essential structure, the world was, then, a product of the idea. And just as the materialist theory of knowledge became for many materialists the materialist theory of reality, so for many idealists the idealist theory of knowledge became an idealist theory of reality.

In an attempt to carry the materialist representation of the objective world into the process of knowledge itself, Ernst Mach opposed both the new idealism and the old materialism. He insisted "that we cannot make up properties of nature with the help of self-evident suppositions, but that these suppositions must be taken from experience."⁸ But, since all knowledge derives from sensations and cannot go beyond sensations, it cannot make statements about objective reality; it can merely fill out the gaps in experience by the ideas that experience suggests. Although he opposed the Kantian point of view, he also rejected mechanical materialism and regarded its objective world of matter, space, time, and causality as artificial conceptions. Mach's critical empiricism supported, although unintentionally, a rising idealistic trend in the philosophy of science.

Marxist "revisionism," i.e., the successful development of labor organizations within the confines of capitalism and the hope, connected therewith, of a purely evolutionary transition from capitalism to socialism, led to the loss of an earlier militant atheism and to an ambiguous acceptance of the rising idealist trend in the form of neo-Kantianism. Radical socialists began to defend

⁷ Alphonse Aulard, *Histoire Politique de la Révolution Française; Origines et Développement de la Démocratie et de la République (1789-1804)*, Paris, 1901, p. 734.

⁸ E. Mach, *The Science of Mechanics*, London, 1942, p. 27.

the old materialism of the revolutionary bourgeoisie against the new idealism of the established capitalist class and its adherents in the labor movement. For Russian socialists this seemed of particular importance since the Russian revolutionary movement, still on the verge of the bourgeois revolution, waged its ideological struggles to a large extent with the arguments of the Western revolutionary bourgeoisie. The intelligentsia, largely from the middle-class, formed the spearhead of the movement and was quite naturally inclined to adopt Western middle-class materialism for their own purposes, that is, for the task of opposing the religious ideology that supported Czarist feudalism.

Because, for Ernst Mach, science had its origin in the needs of life, his ideas had a certain appeal to socialists. Some Russian revolutionaries, Bogdanov in particular, tried to combine them with Marxism. They gained some influence in Russia's Socialist Party and Lenin set out to destroy this influence with his book, *Materialism and Empiriocriticism*. The subjective element in Mach's theory of knowledge became, in Lenin's mind, an idealist aberration and a deliberate attempt to revive religious obscurantism. It was Mach's insistence upon the derived, abstract character of the concept of matter which disturbed Lenin particularly, because for him, as for the early materialists, knowledge was only what reflects objective truth; truth, that is, about matter. He thought that reducing objective reality to matter was necessary for the unconditional recognition of nature's material existence outside the mind.

The independent existence of the external world was not denied by Mach. He merely pointed out that our knowledge in this respect is limited because it is limited to sense experience. But Lenin found it "unconditionally true that to every scientific theory there corresponds an objective truth, something absolutely so in nature."⁹ For him dialectical materialism had already discovered what nature is and does, if not as yet completely, at any rate approximately. "From the standpoint of modern materialism, or Marxism," he wrote, "the relative limits of our approximation to the cognition of the objective absolute truth are historically conditioned; but the existence of this truth is unconditioned, as well as the fact that we are continually approaching it."¹⁰ With the discovery of the substance and motion of the universe, all that was left to do was to proceed in every separate field of knowledge in accordance with the principles established for nature as a whole. One could then not fail to have scientific practice conform with objective reality, just as the latter was bound to show up in every true scientific endeavor. The difficulty with this is, of course, that it is impossible to apply the criterion of practice to a theory of the universe, not to speak of the fact that nobody knows what nature as a whole is.

It was in this way that Lenin extended historical materialism into dialectical materialism. Nature has had a history and its dialectical pattern of development has been progressive in the sense that it has developed from the inorganic

⁹ *Materialism and Empiriocriticism*, New York, 1927, p. 107.

¹⁰ *Ibid.*, p. 107.

through the organic to mind and consciousness. "Matter is not a product of mind," Lenin wrote, "but mind itself is only the highest product of matter."¹¹ The world was an "eternally moving and developing material mass which reflects a progressive human consciousness."¹² Human history is a product of universal history. In a certain sense, this is true and follows from the admission of the existence of the external world independent of human existence. And it is clear that consciousness presupposes the existence of the brain.

But it is also true, as Marx pointed out, "that the question whether objective truth can be attributed to human thinking is not a question of theory but is a practical question. In practice men must prove the truth, i.e., the reality and power, the 'this-sidedness' of their thinking. The dispute over the reality or non-reality of thinking which is isolated from practice is a purely scholastic question."¹³ The atomic theories of the ancient Greeks, for instance, were based not on experimental facts but were part of a speculative cosmic philosophy and were opposed and defeated by other philosophical schools on purely philosophical grounds. This can no longer be repeated, for today's atomic theory is based on experiment and mathematical treatment, on a scientific practice in brief, able to verify the theory's validity. Not mere speculation but the work of chemists and physicists led from the atomic to the nuclear theory, to the new physics and the new philosophy associated with it. All real knowledge of the external world is the product of men's theoretical and practical activity in the actual world. But this knowledge produced by men can never be more than knowledge produced by men; it is not absolute truth. It is only truth about that part of the universe currently accessible to men, on which they can work and verify their theories. And as their knowledge accumulates with historical development, it leads to the continuous modification of knowledge by way of additional knowledge and sometimes to the discarding of theories made superfluous by theories referring to new discoveries.

The decline of the radical Western labor movement and the success of Russian bolshevism brought with it an almost complete identification of a specific Leninist version of Marxism with Marxism proper. Because the Russian Revolution was simultaneously a "bourgeois" and a "proletarian" revolution—in the sense that the preconditions for socialism were nonexistent while *laissez-faire* capitalism was no longer possible—it led to a form of state-capitalism which could be designated as "socialism" only because it was something other than private-property capitalism. But the functions assigned to private enterprise and competition were now the functions of the bolshevik state. By appropriating part of the social product and allocating productive resources for the construction of a larger productive apparatus and a higher productivity, the bolshevik rulers turned into controllers of labor and capital.

¹¹ *Ibid.*, p. 63.

¹² *Ibid.*, p. 109.

¹³ Marx's Theses on Feuerbach in F. Engels, *Ludwig Feuerbach*, p. 73.

While the capitalist's "peace of mind" and the necessary acquiescence of the workers require some form of general agreement on the indispensability of capital and private initiative, the new Russian situation needed a different ideology that could make the interests of the controllers and the controlled appear identical. Marxism could somehow satisfy this need because it was formulated during capitalism's *laissez-faire* stage. For there were no longer in Russia any capitalists in the traditional sense; and as to the government, it characterized itself as the executive of the ruling working class.

But since only the miserable are inclined to believe in an equal sharing of a miserable situation, the bolshevik "elite" soon found that income differentiations, by serving as incentives for greater individual effort, could turn into a blessing for all. In order to improve the life of all in the long run, it was necessary to improve that of some immediately. Thus a new class came into being based on control of the state apparatus and nationalized means of production. To hasten productive development, both the "positive" incentives of power and income, as well as the "negative" incentives of forced labor and terrorism were repeatedly advanced. Yet, the more the interests of the controllers and the controlled diverged, the more insistently did ideology proclaim their identity.

Under relatively stable social conditions ideological control may suffice to secure the social status quo. Under such conditions, designated as a "free" or "democratic" society, a struggle for ideas accompanies the social conflicts, and its class structure is simultaneously denied and admitted. Both the existence and non-existence of class relations, for instance, are incorporated in such concepts as "social mobility" and "equal opportunities." Socialism would eliminate these ambiguities, for if there are no classes there is no way of moving from one class to another, and if there are no privileges there are no equal opportunities to partake of. Russian society, while supporting a privileged minority, necessarily adheres to the concept of "equal opportunities," but it cannot admit the existence of class relations without destroying its socialist label.

Even if, out of fear of utopianism, Marxian socialism never became explicit, one thing was clear nevertheless: socialism implies a class-less, non-exploitative society, and not merely a modified class relationship in a modified capitalism. In Russia, ideology only can claim the absence of class relations. Yet, the ruled cannot help being aware of existing conditions and of their unrelatedness to the state-prescribed ideology. This ideology cannot serve as a substitute for, but is an aspect of, direct physical control—an instrument of police power. The enforced absence of social conflicts finds not support, but merely expression, in the apparent unanimity of ideas.

It was in the name of Marxism and socialism that the bolsheviks came into power, and in their name they destroyed all their enemies. Even their internal struggles for positions and influence within the controlling hierarchy must be expressed in Marxian terms—either as adherence to, or as an alleged deviation from, a once-established "orthodoxy." The total unrelatedness of Marxian

socialism to Russian conditions makes impossible any questioning or serious discussion of Marxian theory. Lenin's dogmatized "Marxism" must be accepted as an article of faith. Only in this way can it be fitted into Russian conditions. And it is not only Lenin's use of middle-class materialism in defense of "Marxism" which indicates the half-bourgeois, half-proletarian character of bolshevism and of the Russian Revolution itself. There is also the bolshevik state-capitalist concept of "socialism," the authoritarian attitude toward organization and spontaneity, the outdated and unrealizable principle of national self-determination and, finally, Lenin's conviction that only the middle-class intelligentsia is able to develop a revolutionary consciousness and is thus destined to lead the masses. The combination of bourgeois materialism and revolutionary Marxism which characterized early bolshevik philosophy reappears with victorious bolshevism as a combination of neo-capitalist practice and socialist ideology.¹⁴

Science and Society. "In social production," Marx wrote, summing up his materialism, "men enter into definite relations that are indispensable and independent of their will; these relations of production correspond to a definite stage of development of their material powers of production. The sum total of these relations of production constitutes the economic structure of society—the real foundation, on which rise legal and political superstructures and to which correspond definite forms of social consciousness. The mode of production in material life determines the general character of the social, political and spiritual processes of life. It is not the consciousness of men that determines their existence, but, on the contrary, their social existence determines their consciousness."¹⁵

Marx did not concern himself with the dialectic or any other absolute law of nature because for him "nature fixed in isolation from men—is *nothing* for men."¹⁶ He dealt with society as an "aggregate of the relations in which the producers live with regard to nature and to themselves."¹⁷ Although nature exists independently of men, it exists actually for men only in so far as it can be sensed and comprehended. The laboring process in its various forms, including scientific labor, is the interaction and metabolism between men and nature; it dominates, exploits, and alters nature, including the nature of man and society. "Laws of nature" relate not to "ultimate reality" but are descriptions of the behavior and regularities of nature as perceived by men. Perceptions change with the change of knowledge and with social development which affects the state of knowledge. *Concepts* of physical reality relate then not only

¹⁴ A more extensive criticism of Lenin's scientific and philosophical ideas is to be found in *Marxism and Philosophy*, by Karl Korsch, Leipzig, 1930, and *Lenin as Philosopher*, by Anton Pannekoek, New York, 1948.

¹⁵ *Critique of Political Economy*, Chicago, 1904, p. 11.

¹⁶ *Economic and Philosophical Manuscripts of 1844*, Moscow, p. 169.

¹⁷ *Capital*, Chicago, Vol. III, p. 952.

to nature and men but also indirectly to the structure of society and to social change and are therefore historical.

Although specific social relationships, bound to specific forms of social production, may find ideological reflection in science and affect its activities in some measure; science, like the production process itself, is the result of all previous social development and in this respect is independent of any particular social structure. Concepts of physical reality may be shared by structurally different societies. And just as different technologies may evolve within a particular social structure as, for instance, the current so-called Second Industrial Revolution, so one concept of physical reality may be replaced by another without affecting existing social relationships. Yet, these new concepts are still historical in comparison with earlier concepts of physical reality associated with previous and different modes of production and previous and different social relationships.

Science in the modern sense developed simultaneously with modern industry and capitalism. The rapidity of scientific development parallels the relentless revolutionizing of the production process by way of competitive capital accumulation. There is an obvious connection between science, its technological application and the prevailing social relationships. Although modern science is not only quantitatively but also qualitatively different from the rudimentary science of the past, it is a continuation of it nonetheless. Likewise, the science and technology of the hypothetical socialist future—no matter how altered—can only be based on all previous scientific and social development. There is no “bourgeois science” to be replaced by “proletarian science.” What a Marxist critique of science is directed against is the class-determined ideological interpretation and class-determined practical utilization of science wherever and whenever it violates the needs and well-being of humanity.

Although science strives toward some hypothetical ideal objectivity, the application of science is guided by other considerations. Like the utilization of other productive and human resources, it is subordinated to the requirements of class relations which turn the social production process into capital formation. The utilization of science for prevailing profit and power principles may not affect internal scientific objectivity, but it affects the direction of scientific development. Because there is no “end” to science and because its fields of exploration are unlimited, science can choose to concentrate upon one or another. The emphasis upon a specific field and a particular direction depends upon the needs, structure, and superstructure of a particular society. There was, in the sixteenth and seventeenth centuries, an obvious connection between the concentration on astronomy and the development of world trade. There is an obvious connection between the present emphasis on atomic physics and the current imperialist military struggles.

In Marxist values, man is the measure of all things and science should be science *for* men. As socialism implies the further growth of the social forces of production, it also implies that of science. It intends to add to the principle of scientific objectivity that of social responsibility. And just as it rejects

fetishistic capital accumulation, so it rejects “science for the sake of science.” This fetishistic attitude towards science, supposedly based on an innate human need to search for ultimate reality, is actually only another expression of the lack of sociality in class society and the fierce competition among scientists themselves. The irresponsible, irrational, and self-defeating disregard for humanity on the part of many scientists today, who defend their work in the name of science even though it has often no other but destructive purposes, is possible only in a society that is able to subordinate science to the specific needs of a ruling class. The humanization of science presupposes, however, the humanization of society. Science and its development is thus a social problem.

Materialism and Determinism. Marxism, not being a theory of physical materialism and not bound to Newtonian determinism, is not affected by the new physics and microphysics. To be sure, Marx had no way of rejecting and no desire to reject the physics of the nineteenth century. What distinguished his historical materialism from middle-class materialism was his rejection of the latter’s direct confrontation of individual man and external reality and its inability to see society and social labor as an indivisible aspect of the whole of reality. What united Marxism with middle-class materialism was the conviction that there is an external world independent of men and that science contributes to the knowledge of this objective reality.

While Marxists accept the positivist emphasis on experience, they reject the notion that sensations are the sole source of experience—a notion which led some people into the self-contradictory sterility of solipsism and others to idealism and the indirect justification of religious beliefs. Although sense perceptions are individuals’ perceptions, men extended the range and amplified the powers of their senses in quality as well as quantity. Moreover the “knowledge of an orderly external world on which we can act rationally is derived almost entirely from society. The scraps disclosed in sense perceptions by themselves would make no pattern but fit into the pattern whose outlines society has taught us. Indeed what we perceive with our sense organs is conditioned very largely by our education—by what our elders and fellows have taught us to notice.”¹⁸

The concept of matter now implies something different from what it did a hundred years ago. While for Lenin, and middle-class materialism before him, matter, composed of atoms, was the very stuff of nature, and for Mach atoms were a mental artifice not susceptible to sense experience, matter is now regarded as something “in-between” because “matter as given by our senses appears as a secondary phenomenon, created by the interaction of our sense organs with processes whose nature can be discovered only indirectly, through theoretical interpretations of experimentally observed relationships; in other words, through a mental effort.”¹⁹

¹⁸ V. G. Childe, *Society and Knowledge*, New York, 1956, p. 97.

¹⁹ M. Born, *The Concept of Reality in Physics*, p. 319.

Matter was once conceived as consisting of indivisible atoms. This concept lost its validity by newly discovered properties of matter such as radio-activity. It was found that "material particles are capable of disappearing while giving rise to radiation, whilst radiation is capable of condensing into matter and of creating particles."²⁰ Einstein formulated the transformation of mass into energy and now the term, *matter*, when it is used, includes all the physical phenomena of which men are aware. Experimental methods were devised which recorded the effects of atoms and of the elemental particles of which they are composed. These elemental particles may be considered the ultimate units of matter—"precisely those units into which matter decomposes under the impact of external forces. This state of affairs can be summed up thus: All elemental particles are made of the same stuff—namely, energy . . . Matter exists because energy assumes the form of the elemental particles."²¹

These discoveries do not deny the objective existence of physical reality, nor its manifestation in things considered to constitute matter. Whatever science may reveal as properties of nature, and whether or not matter is considered "real" or "unreal," as a "primary" or as "secondary" phenomena, it exists in its own right and without it no immaterialist would be there to deny its existence. The material world is the world of men, quite independent of the fact—scientifically or philosophically speaking—that the *old concept* of matter is insufficient to account for physical reality.

The equivalence of mass and energy, of light and matter, extended the wave-corpuscule duality—at first discovered for light—to all matter. Like light, material particles can be pictured as either corpuscles or waves, and both pictures are necessary to explain their properties. According to Max Planck's quantum theory radiation is not continuous but, like matter, can be dealt with only in individual units. Emission and absorption of these units involves the principle of probability. The application of quantum mechanics to the problems of atomic structure by Niels Bohr and Werner Heisenberg led to the principle of uncertainty, or indeterminism, and to the concept of complementarity. According to the latter the description of micro-objects, such as electrons, requires both wave and corpuscule models; although mutually exclusive, they also complement one another. The uncertainty principle relates to the impossibility of ascertaining with accuracy both the position and the momentum of a particle simultaneously.

Because in their totality the elementary processes constitute physical reality, the indeterminist, statistical, probabilistic character of quantum physics led to a denial of causality. Not all scientists, however, are willing to recognize acausality as a fundamental aspect of nature. For Einstein, quantum theory in all its implications seemed only a temporary makeshift—an expression of our ignorance. Max Planck held that the quantum hypothesis will eventually find its exact expression in certain equations which will be a more exact formula of

²⁰ L. d. Broglie, *Physics and Microphysics*, New York, 1960, p. 68.

²¹ W. Heisenberg, From Plato to Max Planck. *Atlantic Monthly*, Boston, November, 1959, p. 113.

the law of causality. And Heisenberg speculates whether acausality is only a consequence of the separation of observer and observed and is not applicable to the universe as a whole.

However this may be, the problem can only be resolved, if at all, by further scientific work. While some scientists hold that behind the statistical laws of quantum physics there are hidden, but discernable, parameters obeying the laws of classical physics, others think that causality in macroscopic phenomena is itself based on probability laws. While for some, causality once ruled absolutely, now chance rules absolutely for others. Marxism, which does not think in absolutes, accepts the state of physics for what it is, convinced that like any other state previously it, too, is transitory and is not the final end of physical knowledge.

Newtonian mechanics worked well on the macroscopic and human scale of phenomena. The knowledge gained about objective reality through our sense organs and scientific instruments did not perceptibly affect external reality itself. In microphysics, however, the interaction between the observed and the observer affects the observed phenomenon. Sense impressions and instruments imply the transfer of energy (photons) which forms an integral part of the behavior of the atomic objects under observation. This inescapable situation, deplored by some as the definite borderline to all understanding of objective reality, induced others to state "that science stands between man and nature," and though events in the world of nature do not depend on our observations of them, nevertheless, "in science we are not dealing with nature itself but with the science of nature—that is, with nature which has been thought through and described by man."²²

While this aspect of quantum physics is used, more often than not, as an argument against philosophical materialism and as evidence in favor of idealism, in a way, and differently expressed, it rather suits Marxism quite well. What stands *between* men and nature also *connects* men and nature. Marxism, for which knowledge of objective reality implies the indivisible interrelationship between man, society and nature, does not bother with an "objective reality" apart from that recognizable by men. If there should be no way towards "absolute" objectivity, that degree of objectivity attainable is the objective reality for men. The recognition that nature and the nature revealed through science may not be the same merely compels us to the largest possible degree of objectivity, quite apart from the question as to whether or not it will lead to an understanding of "ultimate reality."

Microphysics is one of many human endeavors and though it led to new concepts of physical reality, it did not alter the human situation in the macroscopic world. The duality "between statistical and dynamic laws is ultimately associated with the duality between macrocosm and microcosm, and this we must regard as a fact substantiated by experiment. Whether satisfactory or not, facts cannot be created by theories, and there is no alternative but to

²² W. Heisenberg, *From Plato to Planck*, p. 112.

concede their appointed places to dynamical as well as to statistical laws in the whole system of physical theories."²³ Space, time, causality, derived from experience, remain dependable guides to most human activities, quite independently of the over-riding or under-lying relativistic and atomistic theories of reality. It is quite certain that classical mechanics will "remain the instrument best fitted to solve certain questions, questions which for us are of the highest importance, since they relate to our scale of magnitude."²⁴

Nothing is altered in this situation if the deterministic interpretation of classical mechanics is also regarded a fallacy.²⁵ For causality and determinism do not refer to nature in its totality but to our interrelationship with nature through which we discover rules and regularities that allow us to expect—and thus to predict—natural events with a degree of probability close to certainty. Although the early ideal of absolutely certain knowledge of the external world vanished in the very quest for scientific objectivity, "natural laws" which allow for predictability retain their "absolute" validity on the human scale of experience. And while the understanding of atomic processes implies probability and statistics, the utilization of this knowledge leads to predictable activities as if based on cause-and-effect relationships. Likewise, "the notions of classical physics provide an *a priori* foundation for the investigations of quantum physics, since we can carry out experiments in the atomic field only with the aid of concepts from classical physics."²⁶

Because indeterminism rules in quantum physics, and determination is out of the question "even in the simplest classical science, that of mechanics," Max Born finds it "simply fantastic to apply the idea of determinism to historical events."²⁷ However, historical materialism, in so far as it claims predictive powers, does not claim that these powers are derived from, or are analogous to, natural processes but that they are based on "social laws" of development fortified by the evidence of history. To reject "social determinism" it is necessary to demonstrate its impossibility in society and history, not by analogy with physical processes. By doing the latter, Born does exactly—only the other way around—what pseudo-Marxists were doing when they read "social laws" of development into nature. If one analogy is bad, so is the other.

Society does not develop and function by chance but through human responses to definite necessities. Man must eat in order to live, and if he must work in order to eat, the work itself leads to a regulated behavior on his own part and in connection with his obeying of, and his struggle against, natural phenomena and their regularities. When men work in groups and societies, new necessities and new regulations arise out of the social labor process. With the increase of productivity there develops social class relations and social

²³ M. Planck, *A Survey of Physical Theory*, New York, 1960, p. 64.

²⁴ E. Borel, *Space & Time*, New York, 1960, p. 182.

²⁵ See: M. Born, *Voraussagbarkeit in der klassischen Mechanik*. Physikalische Blätter, 1959, Heft 8.

²⁶ W. Heisenberg, *From Plato to Max Planck*, p. 112.

²⁷ *The Concept of Reality in Physics*, p. 320.

regulations based on them. With the further growth of the productive powers of society the determination of human behavior by external necessity diminishes while the determination by social arrangements increases. Determination is largely a social product; it is the social development itself which leads—with the recognition of the material and social requirements of production and reproduction—to predictability.

Because of the socially-produced character of social determination, Marx is neither a determinist nor an indeterminist in the usual sense of these terms. "In his opinion history is the product of human action, even while men are the products of history. Historical conditions determine the way man makes subsequent history, but these historical conditions are themselves the result of human actions . . . The basic point of departure is never history, but man, his situation, and his responses."²⁸

In known history stages of human and social existence are recognizable through changing tools, forms of production, and social relationships that alter the productivity of labor. Where social production stagnates, society stagnates; where the productivity of labor develops slowly, social change is also tardy. But all previous development is the result of progress made in the sphere of production and it is only reasonable to expect that the future will also depend on it.

This indicates little with regard to the actual transformation from capitalism to socialism anticipated by Marx. It merely predicts that socialism is the next step in the development of the social forces of production, which includes science and social consciousness. Every class structure, according to Marx, both fosters and retards the general development of social production. It fosters it in contrast to previously-existing social relations of production; it retards it by attempting to make existing social relations permanent. Definite social class relations are bound to definite levels of the expanding social forces of production—all the actual over-lapping of old and new forms of social relations and modes of production notwithstanding. In our time, it is the capital-labor relationship, the basis of all social antagonisms, which fetters further social development. But such development requires the abolition of social antagonisms. And since only those able to base their expectations on a class-less society are likely to strive towards its realization, Marx saw in the working class and its needs a force of human emancipation.

Although Marx was convinced of capitalism's inevitable end, he did not commit himself as to the time of its departure. This depended on the actual class struggle and was certain only on the assumption of a continuation of the previous course of social development. Future events can only be based on present knowledge and predictions are possible only on the assumption that the known pattern of past development will also hold for the future. It may not; yet, all knowledge justifies some expectations and allows for actions which themselves will decide whether the expectations were justified or not. When

²⁸ A. G. Meyer, *Marxism: The Unity of Theory and Practice*, Cambridge, 1954, p. 10.

Marx spoke of the end of capitalism, he also thought of the elements of a new society already present and unfolding in the "womb of the old." Capitalism had no future because its transformation was already an observable phenomenon. As it developed, it enlarged all its contradictions so that its expansion was at the same time its decay when regarded from a revolutionary instead of from a conservative point of view.

The Ideological War. While there is no connection between Marxism and physical determinism or indeterminism, there is also no real connection between the cold war and the different concepts of physical reality in the East and the West. Indeed, what possible connection could there be between the indeterminacy of nuclear physics and all the social problems that beset the world and give rise to its political movements? These social struggles were disturbing the world before the rise of the new physics and they cannot be abated by either science or philosophy. Political relations between East and West will not improve simply because physicists abstain from ideological interpretations of their work. This work, and its practical application, is the same in the East and the West. Where there is disagreement, it does not matter, i.e., in speculations as to what the physical knowledge of the future may reveal. Some Eastern scientists do not bother to embroider their work with philosophical interpretations; others try to fit it into the scheme of dialectical materialism so as not to violate the state-prescribed ideology in which they may also actually believe, just as Western scientists accept almost generally the ruling ideologies of their own society.

At any rate, reality is always stronger than ideology, as is demonstrated by the recurrent need to incorporate the new findings of science and the advancements of technology into the prevailing ideologies. There was a time when Russian dialectical materialists denounced Einstein's relativity theory as bourgeois obscurantism, only, and rather quickly, to come to celebrate it as still another manifestation of dialectical materialism. Space-time, wave-mechanics, the structure of matter, in short, the whole of modern physics has been turned into so many revelations of the dialectics of nature and of its material substance. The principle of "complementarity," i.e., the abandonment of a conceptually unitary picture of atomic phenomena, has been interpreted as yet another example of dialectical development by way of contradiction and reconciliation, that is, as a struggle between thesis and anti-thesis, bringing forth the synthesis.

As yet, however, the "synthesis" is only philosophically anticipated by dialectical materialists to satisfy the Leninist criterion of absolute objective truth. Some Eastern physicists (not all) simply claim that the phenomena observed in microphysics with regard to both wave and particle are completely objective, whereas for some Western scientists (not all) they are in part subjective, because of the disturbing and altering interplay between observer and observed, and because wave has the character of a probability wave and is not regarded as an objective entity. Of course, the Russian physicists admit

that the sheer objectivity of micro-objects is only partly recognizable but they believe that, in principle, it will be possible to establish their full objectivity by finding ways and means to discount the influence of the observer and his instruments upon the observed micro-objects. The application of atomic energy appears to them as proof of the objective character of atomic phenomena.

For Western physicists, all that matters presently is quantum theory in its present state and the problems to which it gives rise. This, of course, is also true for Russian scientists. And it can at once be admitted that their search for absolute objectivity, whether realizable or not, seems a better working-hypothesis than the subjectivistic resignation to an assumed absolute limit to the understanding of objective reality on the part of some Western physicists. However, atomic energy has been applied on both sides of the "barricades"; the pragmatic truth of atomic theory has been revealed quite aside from dialectical materialism and bourgeois idealism.

Because Lenin insisted on the objectivity and universal validity of causality and because Leninism is the ruling ideology, it cannot very well be denied by Russian physicists. There is also no real need to do so, for according to dialectical materialism causality does not exclude but implies chance. The indeterminacy in quantum physics, though recognized, is explained as due to experimental techniques and not to a fundamental law of nature. The differences between the Eastern and Western physicists may then be summed up as differences relating not to their work but to additional expectations on the part of Eastern physicists that their work will come to verify the assumptions of dialectical materialism.

These assumptions, however, relate not to the victory of socialism over capitalism, but merely to the reestablishment of causality for the whole of nature and to the reacceptance of the concept of matter, in its present sense, as the sole basis of all existing phenomena including the human mind. Of course, in a certain sense, such expectations may be regarded as an expression of a general optimism associated with the rise, success and expected triumph of bolshevism and its ideological concomitant, Leninism. Still, it is difficult to see how dialectical materialism in physics could determine the political decisions of people one way or another or could be regarded an instrument of class struggle.

Ideologies are weapons, but in the age of the atom bomb they are no longer decisive or even very important weapons. As little as the Western nations trust in the "rationality" and the "naturalness" of their socio-economic relations, just as little do the Eastern "Marxists" put their trust in the dialectical course of history—not to speak of that in nature—as the means to final victory. Both sides rely, first of all, on their material might. It can only be to the good, of course, when material might finds ideological support, for which reason successful ideologists in both camps find themselves in comfortable income brackets. But their professional rating of the meaning and power of ideologies is only an over-rating of their own importance.