Thomas S. Kuhn, post-modernism and materialist dialectics

William Whitlow
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William Whitlow replies to a reader's inquiry about sociologist Thomas S. Kuhn, author of The Structure of Scientific Revolutions*.*

Dear William Whitlow,

As a regular reader of the WSWS, I read your article on the NASA experiment GP-B (See "Einstein's theory of gravity confirmed by NASA probe"), which was published a few months ago with great interest. I think, however, that you are making an error at the end of the article. In the third to last paragraph you identify the naive conception that progress in science is attributable solely to the work of some great men with the one Thomas Kuhn developed in his work. You write, "There is widespread belief that science develops purely on the basis of individual genius. This distorted conception was reinforced by the work of sociologist Thomas Kuhn who argued that science underwent periodic paradigmatic shifts as a result of the work of outstanding individuals who happen to develop new theories."

First of all, I think it is not correct to dismiss Kuhn's conceptions in just one sentence. After all, Kuhn is still quite popular among serious scientists and this is certainly due to some insights he had into scientific praxis and the history of science. Second, it should be noted that this synopsis of Kuhn's conceptions is quite wrong. In his influential book *The Structure of Scientific Revolutions,* Kuhn devotes a significant part exclusively to what he calls "normal science" (three of thirteen chapters which comprise 35 of 190 pages in my edition expand on the character of "Normal Science"). This kind of scientific work, to put it briefly, is concerned with solving puzzles within a set of a more or less clearly formulated set of rules given by the currently acknowledged paradigm.

After what you wrote, it might surprise you that the details of the experiment which you explained in the first part of your article fit quite well Kuhn's description of normal scientific work: The scientists are working in the framework given by current paradigm (General Relativity) of their scientific specialization (Astrophysics). This framework gives rise to lots of puzzles. The team is working on the puzzle of measuring the structure of space-time near the earth and verifying some effects of General Relativity which were conjectured on the basis of theoretical calculations and they solve these problems by ingeniously applying a whole range of technical instruments like gyroscopes, telescopes, superconducting materials and so forth.

Kuhn was far from reducing scientific progress to the achievements of a few individuals. In addition, one of the main points of the mentioned book is to show that scientific revolutions are not coming out of the blue but are developed (and accepted by the scientific community) in response to a crisis which exposes the weaknesses of the current paradigm. It is well known (and one of the many examples treated in Kuhn's essay) that the discovery of General Relativity followed such a crisis which developed when it became more and more difficult to resolve the many contradictions arising in the area of overlap of the theories of electromagnetism and classical mechanics. I am sure that there are many weaknesses in Kuhn's conceptions. However, I think that a more differentiated assessment of his work is necessary.

Yours sincerely,

David L.

* * *

Dear David,

Thank you very much for your response to my article. The reference to Thomas Kuhn was all too brief, so please let me attempt to clarify the point I was making at the end of my article, and to explain more fully my understanding of Kuhn, especially his book *The Structure of Scientific Revolutions* [1].

First of all let me take issue with your claim that Kuhn is popular among "serious scientists." I don't know whether any poll has been carried out on the subject, but any scientist who made a serious study of Kuhn's writings would be appalled by his opposition to the possibility of objectivity.

Alan Sokal, whose spoof paper was famously accepted by the cultural studies journal *Social Text* in 1996, has done a good job of exposing the degeneration that has taken place in the humanities and social sciences. Sokal, a professor of mathematics at University College London and physics at the University of New York, has written strongly against Kuhn's idea "that our experience of the world is radically conditioned by our theories, which in turn depend on the paradigm" [2].

For scientists, who spend their time investigating an external world which is independent of their consciousness, Kuhn's relativism is unacceptable. I would contend that Kuhn's *The Structure of Scientific Revolutions* has had much more influence among non-scientists. It is no ordinary book on science history and philosophy.

As Thomas Nickles [3] notes, "By now the book has sold over a million copies in two dozen languages—numbers almost unheard of for an academic book about abstract philosophical topics. The wide reception of his work, which greatly surprised Kuhn himself, has elevated the terms 'paradigm,' 'paradigm change,' and 'paradigm shift' to household phrases and the stuff of advertising slogans, corporate boardrooms, and Washington bureaucratese."

According to a more critical book by Steve Fuller [4] there has also been a "tendency for humanists and social scientists to adopt his [Kuhn's] account of science wholesale without closely analysing or developing its constituent ideas." Fuller is surely correct in referring to *Structure* as "the consummate postmodernist work."

The postmodernist trend in modern academia, with its so-called "death of grand narratives" and its opposition to the possibility of objective science, is usually considered as deriving from Jean-Francois Lyotard and other French thinkers. Fuller explains that Kuhn's achievement has been to ease Anglo-Saxon academia into "a postmodern mind-set" without any reference to French traditions.

Further, I would dispute your suggestion that the GP-B experiment that I was reporting fits into Kuhn's conception of "normal science." The scientists are not, as you put it, just "working on the puzzle of measuring the structure of space-time near the earth and verifying some effects of General Relativity." (Even this is not an accurate representation of Kuhn's ideas because Kuhn did not think verifying a theory was part of "normal science": he writes "the individual engaged on a normal research problem is almost never doing one of these things" where among "things" he includes "test long-accepted belief")[5].

I quoted from GP-B physicist John Mester who explained the well-known discrepancy between General Relativity, our current theory of gravitation and the "Standard Model" that accounts for the other forces of nature operating on sub-atomic scales: "Testing theories to high precision will help define their range of validity or reveal where these theories break down." In other words the NASA scientists are perfectly aware that Einstein's theory will break down outside certain "tolerances" that must be determined. There is no blind acceptance of a paradigm in the way that Kuhn suggests.

Looking back over the conflicts, doubts and disputes surrounding Einstein's theory during the last century we do not see Kuhn's neat picture of "mopping-up operations" as he somewhat contemptuously describes "normal science". Rather we see a protracted struggle over fundamental issues. Einstein originally added a "cosmological constant" to his theory, believing it was necessary to predict a universe that was static and would not collapse in on itself under gravitational attraction. During the 1920s, Alexander Friedmann and Georges Lemaître showed that solutions of Einstein's equations without the constant could represent an expanding universe. Their results went unnoticed until 1930 when Edwin Hubble, using his famous "red shift" observations of distant galaxies, established clearly that the universe was actually expanding. Einstein dropped the cosmological constant part of his theory, later referring to it as "the biggest blunder of his life" [6]. The expanding universe cosmology has led to the currently accepted "Big Bang" theory.

I could go through the subsequent developments: these included the "Steady State" cosmological theory of Fred Hoyle and others who challenged the Big Bang theory; the realisation that Einstein's theory predicted the existence of black holes with all the subsequent astronomical investigations; the controversy surrounding Einstein's unsuccessful attempts to extend General Relativity to a Unified Field Theory, opposing the accepted theory of Quantum Mechanics which he regarded as unsatisfactory; and so on. Even now the theory is being reshaped. In the recent period the cosmological constant has been reinstated, being associated with "dark energy" which is thought to make up three quarters of the mass of the universe. Only by a gross misuse of language could such a rich history be described as a "paradigm" established by Einstein followed by "normal" science throughout the next century.

One of the central contentions of Kuhn's theory is that apart from the "normal" period there is no historical development taking place in science. In one sense, I can agree with you that he is not "reducing scientific progress to the achievements of a few individuals," because if you seriously study Kuhn you see that he does not think progress takes place at all in the "paradigm shifts." Science is "non-cumulative" as he puts it. "The transition from a paradigm in crisis to a new one from which a new tradition of normal science can emerge is far from a cumulative process . . ." [7].

The main point I would make about individuals, and Kuhn does weave much of his "revolutionary" conception around a few individuals—Copernicus, Galilieo, Newton, Lavoisier and Einstein—even if he does also refer to smaller scale "revolutions" involving a number of scientists, is on the subjective nature of his philosophy. In a "revolution," Kuhn's view is that a complete change of world view takes place, and that the paradigms before and after a revolution are "incommensurable." They cannot be measured against the same standards and will use different vocabularies. Kuhn compares such paradigm shifts to the switches in perception put forward by Gestalt psychology (like the popular example of a picture that is seen as a duck suddenly being seen as a rabbit). I would claim that this is an irrational view that attacks the whole approach of the natural sciences and opens the way for extreme subjectivity—any individual's interpretation prevails as long as it convinces enough members of the scientific community.

You write that Einstein's development of General Relativity theory can be understood in Kuhn's terms. But reread what Kuhn actually says in *Structure*. He claims that a derivation of Newton's Laws as a limiting case of Einstein's theory is "spurious." In the limiting process, using mathematics and formal logic "we have had to alter the fundamental structural elements of which the universe to which they apply is composed." (Note the ambiguity here. Is the universe changed or just the theory? We will return to this issue). There is, says Kuhn, a "displacement of the conceptual network", from Newtonian mechanics to Einsteinian. The differences between successive "paradigms are both necessary and irreconcilable." He writes, "The normal-scientific tradition that emerges from a scientific revolution is not only incompatible but often actually incommensurable with that which has gone before" [8].

What Kuhn argues is that a development of concepts explained solely in terms of formal logic and mathematics is not possible. It leads to "incommensurable" theories and concepts and hence destroys the possibility of reason in the history of science and thought. Kuhn wrote on the philosophy of history and science largely ignorant of the fact that philosophers had faced this issue before. At the beginning of the 19th century, the philosopher G.W.F. Hegel developed dialectics. Formal thinking had presented Immanuel Kant, the foremost thinker of the German Enlightenment, with insuperable philosophical problems, and had led him in a subjectivist direction. In the tradition of German Idealism Hegel developed his dialectical logic in the realm of ideas; Marx took Hegel's method in a radically different, materialist direction and began to examine nature, economics and history in a dialectical way.

For a 20th century exposition one can turn to Leon Trotsky's "ABC of Materialist Dialectics" [9]:

"Our scientific thinking is only a part of our general practice including techniques. For concepts there also exists 'tolerance' which is established not by formal logic issuing from the axiom 'A' is equal to 'A', but by the dialectical logic issuing from the axiom that everything is always changing... Dialectical thinking analyses all things and phenomena in their continuous change, while determining in the material conditions of those changes that critical limit beyond which 'A' ceases to be 'A' ... Hegel in his Logic established a series of laws: change of quantity into quality, development through contradictions, conflict of content and form, interruption of continuity, change of possibility into inevitability, etc., which are just as important for theoretical thought as is the simple syllogism for more elementary tasks."

There is nothing "incommensurable" about Newton's theory being an approximation to Einstein's that is superseded but preserved at a higher level, if we examine the question dialectically. There is a dialectical progression from the one to the other. Einstein himself, like all serious natural scientists, worked as an unconscious dialectician. In his book *The Meaning of Relativity* [10], Einstein has no problem in writing that his theory "contains" Newton's theory, that Newton's theory is an "approximation" to his, precisely in the sense that Kuhn denounces as "positivist" or part of the "old historiography." Einstein writes, "we see that even in the first approximation the structure of the gravitational field differs fundamentally from that which is consistent with the Newtonian theory." Einstein is saying his theory both contains Newton's and differs fundamentally from it. There is no suggestion of incommensurability—he has no philosophical difficulty with this dialectical progression.

Hegel and Marx both understood that concepts and ideas develop socially through a struggle between opposing viewpoints and tendencies. Marx, of course, was the first to stress the fundamental importance of technology, in the development of society. Note the first sentence in the above quote from Trotsky. This was the point I made in my article: "What the GP-B project demonstrates is that science is a social endeavour and develops in close relationship with technological advances. The work of individual geniuses like Einstein, and their contribution is undoubtedly essential, depends on an entire scientific culture with which they are trained and against which they test their ideas. The creation of scientific culture is the work of generations and not brilliant but isolated insights or solitary experimental results."

I quoted from Trotsky's article "Culture and Socialism" [11] on this question of technology:

"'Does culture drive technology, or technology culture?' asks one of the notes lying before me. This is the wrong way to pose the question. Technology cannot be counter-posed to culture, for it is culture's mainspring. Without technology there is no culture. The growth of technology drives culture forward. But the science and general culture which rise up on the basis of technology give a powerful impulse to the growth of technology. Here there is a dialectical interaction."

Kuhn rejects this dialectical relationship between culture and technology and deliberately concentrates on what is now called the "internal" development of science, avoiding any discussion of technology, society or broader ideological issues. This underlines the subjective character of his approach. In so far as he discusses the clashes and contradictions between opposing tendencies and schools of scientific thought—without which there can be no criticism and elaboration of objective concepts and theories—he forces the whole process into a rigid "paradigm switch" whose source he cannot explain and which has no relation to previous scientific ideas.

Compare Kuhn's paradigm switch theory to the Marxist conception as set out by Trotsky in his discussion of the great Russian chemist Dmitri Mendeleyev [12]:

"Science as a whole has been directed toward acquiring knowledge of reality, research into the laws of evolution, and discovery of the properties and qualities of matter, in order to gain greater mastery over it. But knowledge did not develop within the four walls of a laboratory or a lecture hall. No, it remained a function of human society and reflected the structure of human society. For its needs, society requires knowledge of nature. But at the same time, society demands an affirmation of its right to be what it is; a justification of its particular institutions; first and foremost, the institutions of class domination, just as in the past it demanded the justification of serfdom, class privileges, monarchical prerogatives, national exceptionalism, etc."

There is no doubt that Trotsky here offers an analysis of the scientific process and the relationship of the scientist to society that is far superior to Kuhn's simplistic offering. Trotsky insists that natural science, in practice, often over generations, tests out and confirms its theories. Trotsky goes on to compare the natural sciences to the academic social sciences such as economics and sociology drawing a significant distinction between them.

"The need to know nature is imposed upon men by their need to subordinate nature to themselves. Any digressions in this sphere from objective relationships, which are determined by the properties of matter itself, are corrected by practical experience. This alone seriously guarantees natural sciences, chemical research, in particular, from intentional, unintentional, semi-deliberate distortions, misinterpretations and falsifications. Social research primarily devoted its efforts toward justifying historically-arisen society, so as to preserve it against the attacks of 'destructive theories,' etc. Herein is rooted the apologetic role of the official social sciences of bourgeois society; and this is the reason why their accomplishments are of little value."

Kuhn does not analyse the relationship between science and society, or science and nature. We are left with the scientist isolated within the four walls of the laboratory cooking up whatever theory takes his fancy, which, if he can convince enough of his colleagues to accept it will become the new paradigm.

The impact of class prejudices on the social sciences can also be extended to philosophy. We have already noted Kuhn's ignorance of dialectics, reflecting the widespread bias against Hegel and Marx in academia. Also we noted Kuhn's ambiguity in relation to the philosophical question of the existence of a material universe, independent of human consciousness. Here is another example:

"Though the world does not change with a change of paradigm, the scientist afterward works in a different world... I am convinced that we must learn to make sense of statements that at least resemble these." [13]

Such ambiguous and sloppy formulations perhaps help to explain the popularity of Kuhn's work. The reader can find a quote to show "science" is in accord with all sorts of mysticism.

Fortunately, the German philosopher Paul Hoyningen-Huene worked for a year at MIT with Kuhn and studied all his writings, "reconstructing" and making sense of Kuhn's writings such as those above as far as he was able [14]. He points out that Kuhn uses the term "world" in two senses. The world that "does not change" is the unknowable world of Kant, even indirect access to this world is impossible according to Kuhn. It is parallel to the "thing-in-itself" of Kant, explains Hoyningen-Huene [15], though Kuhn attempts to do without this concept. Kuhn wishes to reject the "naive realist interpretation of science." He also "wished to reject the more refined realist philosophy of science which sees the scientific process as a progressive 'drawing closer to the truth'. . ."

Thus Kuhn is firmly in the tradition of opposing materialism as well as dialectics. He does not accept the "more refined realist philosophy," which despite his ignorance of Marxism, means essentially the Marxist tradition. Science does progress, it does draw closer to the truth, but not in a simple straight line. "The line of progress is curved, broken, zig-zagging," [16]. Trotsky expressed this in his characteristically brilliant fashion:

"The human brain is a product of the development of matter, and at the same time is an instrument for the cognition of this matter; gradually it adjusts itself to its function, tries to overcome its limitations, creates ever new scientific methods, imagines ever more complex and exact instruments, checks its work again and yet again, step by step penetrates into previously unknown depths, changes our conception of matter, without, though, ever breaking away from this basis of all that exists."

What about the other "world" referred to by Kuhn, the world that does change with a change of paradigm. This is a "perceived world" of the scientist, which Kuhn claims radically changes before and after a scientific revolution. Whereas Kant attempted to solve the problems of philosophy with the unknowable "thing-in-itself" and the one world of appearances or phenomena, Kuhn, explains Hoyningen-Huene, is primarily concerned with multiple distinct and incommensurable phenomenal worlds. Despite multiplying the available "worlds," we end up even further away from objective reality than was the original Kant.

Where do Kuhn's ideas of history and philosophy come from? He is very light on references in his book and disarming when referring to his lack of philosophical education. Surprisingly little study has been made of the origin of Kuhn's ideas, though an article by Michael Friedman [17] does provide some information. Kuhn tells us in *Structure* how he switched from mathematical physics to the history of science, spending three years as a junior fellow at Harvard. As well as reading the historian of science Alexandre Koyré, Kuhn lists historians Emile Meyerson, Hélène Metzger, and Anneliese Maier. Whilst Friedman objects to all of these little-known scholars being called by Kuhn "neo-Kantian" and points to differences between them, he has to accept that this was the broad tradition to which they belong.

Kuhn saw this neo-Kantian school of history as the "new historiography." He saw it turning away from the "old" tradition that most scientists instinctively follow, studying contemporary scientific concepts in terms of their evolution, a cumulative history of progress. The "old" approach is usually presented in terms of a simplistic, gradualist evolutionism, rather than admitting development in the Marxist sense, with contradictions, leaps and reversals. It is what historians of science now call contemptuously "Whig history," and generally associate with other terms of opprobrium such as "scientism" and "positivism."

Kuhn claimed in true neo-Kantian fashion, that the historian's task is "to climb inside the head of the members of the group which practices some particular scientific speciality during some particular period …" [18]. Hence the stress on "reconstruction" of various branches of science in the past and the assumption that they cannot be understood by a "presentist" reader today who is not a historical expert. According to Hoyningen-Huene this new approach to science history and the "new historiography," which was in fact a longstanding feature of German neo-Kantian philosophy, became the dominant trend in the US by the 1970s.

The philosopher Georg Lukács writes on the development of neo-Kantianism after the 1848 revolution in Germany. Scholars were united in their view: "dialectics are nonsense and unscientific in principle; the course of German philosophy from Kant to Hegel is a major aberration, a cul-de-sac of learning;' back to Kant!' must be philosophy's catchphrase." [19] Lukács explains, "the neo-Kantians believed, in the age of 'security,' that they could remove the new enemy, socialism (dialectical and historical materialism), through hushing it up. They thought that Kantian agnosticism, as the sole 'scientific' philosophical method, when combined with the categorical moral imperative [20] to submit unconditionally to the Hohenzollern system [21], would suffice to remove all ideological dangers." Any idea of progress should be confined to a gradual evolution within Western capitalism, "from this standpoint any movement of history by way of contradictions and antitheses appeared a pure unscientific absurdity." [22] Lukács linked the development of irrationalist tendencies in Germany with the eventual rise of Nazism. In so far as some liberal neo-Kantians were opposed to the more aggressive forms of irrationalism their flawed philosophy was helpless to deal with it.

While Kant had been ambivalent about materialism, his 19th and 20th century disciples were not. As Lukács points out in relation to the neo-Kantian Dilthey – and this is reflected in Kuhn's writings – "as in all modern Kantians, the master's uncertainties regarding materialism were completely eliminated." [23]

Finally, an understanding of Kuhn's role is not complete without considering the political background to his work. As Fuller explains [24], Kuhn's patron was James Bryant Conant (1893-1978), president of Harvard University (1933-1953), director of the National Defense Research Committee during World War II, in which capacity he was responsible for supervising the construction of the first atomic bomb, and chairman of the Committee on the Present Danger in the 1950s, a Cold War anti-Communist lobby. Conant introduced Kuhn to studying the history of science—*Structure* is dedicated to Conant and, according to Fuller, Kuhn "took Conant's politics of science as uncontroversial—indeed, as a taken-for-granted worldview" [25]. Conant set up the course at Harvard around which *Structure* was developed and arranged for Kuhn's three-year Harvard fellowship to study science history.

The Harvard course was intended to train non-science specialists who would become the future political and corporate leaders in the US. What was intended? Conant, formerly a professor of chemistry, grasped that in the twentieth century science had undergone an exponential expansion. The development of physics during and after World War II required huge state expenditure, tied to constructing the atomic bomb and expanding US military hegemony. It was essential for the American ruling class to develop its own ideological approach to science and science policy. Many of the best scientists and intellectuals were becoming attracted to Marxism, both in terms of the outlook of dialectical materialism and the political conception that science could develop the technology of a future socialist society.

Conant himself began studying the history of science with the intention of creating an ideological approach that would protect science for the ruling class and keep scientists firmly away from Marxism. It was he that promoted the study of "case studies," primarily of pre-twentieth-century scientists. He did this in order to isolate what he thought were the characteristics intellectual features that were "internal" to science, and it was an approach that was to be followed by Kuhn.

Conant's efforts were limited. His books such as *Science and Common Sense* (1961) were hardly best-sellers. But by adapting various aspects of the century-old neo-Kantian approach to history, a far more sophisticated opposition to Marxism than Conant's homespun pragmatism, Kuhn would reach an incomparably larger audience. Kuhn's style is easy to read and, if one does not probe too deeply, his ideas seem simple to grasp. Neither Conant nor Kuhn could have predicted the widespread influence that *The Structure of Scientific Revolutions* would have in shaping official ideology for the last 50 years.

Notes:

[1] Thomas S. Kuhn, *The Structure of Scientific Revolutions*, University of Chicago Press, Chicago, 3rd edition, 1996.

[2] Alan Sokal, *Beyond the Hoax*, Oxford University Press, Oxford, 2008, p. 192.

[3] Thomas Nickles (ed), *Thomas Kuhn*, Cambridge University Press, Cambridge, England, 2003, p. 1.

[4] Steve Fuller, *Thomas Kuhn*, University of Chicago Press, Chicago and London, 2000, p. 31.

[5] Kuhn, op. cit., Chapter IV.

[6] See, for example, http://www.aip.org/history/cosmology/ideas/expanding.htm

[7] Kuhn, op. cit., Chapter VIII.

[8] Kuhn, op. cit., Chapter IX.

[9] http://www.marxists.org/archive/trotsky/1939/12/abc.htm

[10] A. Einstein, *The Meaning of Relativity*, (1st edition 1922), ElecBook, London, 1993 edition, p. 90.

[11] Leon Trotsky, "Culture and Socialism", http://www.wsws.org/articles/2008/oct2008/cult-o23.shtml

[12] Leon Trotsky, "Dialectical Materialism and Science," http://www.marxists.org/archive/trotsky/1925/09/science.htm

[13] Kuhn, op. cit., Chapter X.

[14] Paul Hoyningen-Huene, *Thomas Kuhn's Philosophy of Science*, University of Chicago Press, Chicago and London, 1993, Chapter Two.

[15] Hoyningen-Huene, p. 35.

[16] Leon Trotsky, "Radio, Science, Technique and Society", https://www.marxists.org/archive/trotsky/1926/03/science.htm

[17] M. Friedman, in Thomas Nickles (ed), op. cit.

[18] Hoyningen-Huene, op. cit. p. 20.

[19] Georg Lukács, *The Destruction of Reason*, Merlin Press, London, 1980 p. 409.

[20] Kantian agnosticism is the view that the material world is unknowable, outlined above. Kant's categorical moral imperative is the conception of a timeless human morality, as explained by Trotsky in "Their Morals and Ours", http://www.marxists.org/archive/trotsky/1938/morals/morals.htm

[21] The Hohenzollern system is the rule of the Emperor in Prussia.

[22] Lukács, p. 409.

[23] Lukács, p. 418.

[24] Fuller, especially Chapters III and IV.

[25] Fuller, p. 6.

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