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EVALUATION OF SOME RECENT DEBATES ON SCIENTIFIC PROGRESS

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Abstract: At first glance, what scientific progress means seems to be a quickly answered question. It is not easy to think of the sciences without progress; sciences and the notion of progress seem identical in general. Describing the nature of scientific progress is an important task that will have practical and theoretical consequences. The approach, which argues that the background on which sciences are based does not have a historical or cultural character following the positivist interpretation, accepts sciences as testing the validity of observation and experiment data to a large extent. On the other hand, the tendency that emphasizes that the complex functioning of the history of science has an indelible mark on scientific theories prefers to build sciences on a historical and social basis. How both major approaches ground the idea of scientific progress profoundly affects both our understanding of the nature of scientific knowledge and the way we do science. This paper aims to evaluate scientific progress based on the views of prominent philosophers of science in the twentieth century.

Keywords: Knowledge, Carnap, Quine, Truth, Bloor, Kuhn, Bird

BİLİMSEL İLERLEME İLE İLGİLİ SON TARTIŞMALARIN DEĞERLENDİRİLMESİ

Öz: Bilimsel ilerlemenin ne demek olduğu ilk bakışta kolayca yanıtlanabilecek bir soru gibi görünmektedir. Bilimlerin ilerleme fikri olmaksızın düşünülmesi pek kolay değildir; neredeyse bilim ile ilerleme özdeş görülür. Bilimsel ilerlemenin doğasını betimlemek teorik olduğu kadar pratik sonuçlar doğuracak önemli bir görevdir. Bilimlerin yaslandığı arkaplanın pozitivist yoruma uygun olarak tarihsel, kültürel bir nitelik taşımadığını öne süren yaklaşım bilimleri büyük ölçüde gözlem ve deney verilerinin geçerliliğinin sınanması olarak kabul eder. Öte yandan bilim tarihinin karmaşık işleyişinin bilimsel kuramlar üzerinde silinmez bir damgası olduğunu vurgulayan eğilim ise bilimleri tarihsel, toplumsal bir zemin üzerine inşa etmeyi tercih eder. Her iki ana yaklaşımın bilimsel ilerleme fikrini temellendirme yolları, hem bilimsel bilginin doğasına

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ilişkin anlayışımızı hem de bilim yapma yöntemlerimizi derinden etkilemektedir. Bu yazıda özellikle yirminci yüzyılda öne çıkmış bilim felsefecilerinin görüşlerinden hareketle bilimsel ilerlemeye dair değerlendirme yapmak amaçlanmaktadır.

Anahtar Kelimeler: Bilgi, Carnap, Quine, Doğruluk, Bloor, Kuhn, Bird

1. Introduction

The manner in which humans interacted with our physical surroundings, as well as the ways in which we thought about it, changed dramatically from the Medieval and Renaissance eras to the age of the Scientific Revolution and the dawn of Modernity. But how should such change to be understood is the basic problem for all sorts of approaches to scientific enterprises. This question can be phrased in a variety of ways: What elements, such as social, historical, cultural, institutional, and other aspects, influence scientific progress? Why are some physical world perspectives accepted while others, which are equally plausible, are rejected? Is there a sense of continuity in the face of scientific change? Is it continuous with its past at some levels of practice and discontinuous at others, aside from evaluating scientific change as either continuous or discontinuous? Are ideas accepted because they can be proved, verified, or corroborated in some logically timeless way with objective evidence? Various responses have been offered to such questions, resulting in significant complications. In this paper two basic approaches to the scientific progress shall be discussed; one is positivist understanding of scientific progress, the other is sociologists's and social historians's account of scientific progress.

2. Scientific Progress through the Timeless Structure of Validation

The positivist interpretation of science ignores the historical and time-related aspects of scientific growth and change. It accepts the "received view" program in general. This first viewpoint on scientific development comprises logical positivism and logical empiricism, which are still widely regarded as the "received view" in the philosophy of science.

The positivist perspective is based on the core concepts of "received view," which state that opposing theories can always be formalized and compared with one another with the goal of accepting one and rejecting the other. The logical and empirical features of a theory are preserved when it is replaced by a newer theory. Scientific theories are logically tested through their observational consequences in the transition from one to another by means of confirmation, verification, or falsification. By its own nature and by virtue of its techniques, science is considered to be cumulative and progressive, objective and universal.

The majority of positivists were more concerned with laying a basis for knowing than with explaining how knowledge grew. However, more recently, logical explanations have been used to better understand scientific change.[1] In fact, Rudolf Carnap, like the other logical positivists and logical empiricists, shows a little interest throughout his career in scientific change. However, considering the nature of their logical, mathematical, philosophical, and linguistic interests, this is not surprising. Many of the themes of the positivist perspective may be found in the writings of Carnap (2003).

According to Carnap, eliminating metaphysics and pseudo-philosophical difficulties requires merely adopting this language as a science language built entirely on a physicalist foundation. To distinguish science from metaphysics, he favored verification. In truth, Carnap was never an outspoken participant in the debate over scientific change. Carnap's views on probability, confirmation, and induction, on the other hand, are pertinent to the difficulties of adducing criteria for theory of choice. As a result, he may define scientific change depending inductive evidence, as articulated by his probabilistic conception of degree of confirmation. In other words, a theory can be proved to be better than another if it has a higher degree of inductive probability than the other.

Karl Popper agrees with Carnap that natural sciences should be distinguished from non-science, metaphysics. But Popper, for such purpose, proposed to use falsification; he took falsifiability as the criterion of the scientific theories.[2] Popper argued that our knowledge has no foundations, so that it is fallible. In fact, Carnap and Popper disagreed about a lot of subjects, but only agreed on basics, (Hacking, 1983) i.e., the distinction between theory and observation, unity of science, the preciseness of scientific terminology, so on.

Popper (2002b) denounced the verificationist stress of the positivist program, as well as the attempt to cast the inferential structure of science in an inductive mold. The positivists maintained that science's descriptive language may be reduced to a stable, unchangeable empirical foundation based on experience. Science was viewed by positivists as a set of claims. The positivists, for example, wanted to acknowledge as scientific "only those statements which are reducible to elementary (or atomic) statements of experience– to 'judgements of perception' or 'atomic propositions' or 'protocol sentences' or what not" (Popper, 2002b, p. 12). The positivists maintained that those statements had their origins in experience, and that such atomic propositions had been established in a naturalistic manner. Such statements mirrored our underlying experiences and could not be changed. Popper (2002b) challenged and rejected such "dogmatic" acceptance of incorrigible truths in the area of knowledge.

The endeavor to reduce scientific claims to protocol statements, according to Popper, is the same as the need for inductive logic. Because he rejects the possibility of inductive logic, he cannot accept such a reduction. Popper believes that no such assertions can be clearly confirmed by any immediate experience, as the positivists claim, because the

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1 Recent adherents of logical approaches to scientific change include Gärdenfors (2008), Howson and Urbach (1999), and Levi (2009).

2 The development of this doctrine is the central theme of his *The Logic of Scientific Discovery* (2002b).

content of scientific statements is decided by the theory. Only other statements, not facts, can be used to make statements. As a result, the fundamental propositions of science have no ultimate validity that can be demonstrated naturalistically and justified by convictions. Approval or denial of a fundamental assertion, as well as the value that it professes to have, is a matter of norm, the outcome of a choice made by the scientific community.

Because induction is not a logical technique, Popper contends that it should be avoided when analyzing the essence of scientific progress through theory change. As a result, inductive generalization should be abandoned in favor of conjectural testing and refutations of hypotheses, irrespective of how they are discovered. In practice, this indicates that research must abandon its purpose of giving positive back up for any theory that differs from what has been known previously. He claims, theories "are *genuine conjectures* –highly informative guesses about the world which although not verifiable (i.e., capable of being shown true) can be submitted to severe critical tests. They are serious attempts to discover the truth … even though we do not know, and may perhaps never know, whether it is true or not" (Popper, 2002a, p. 154). From this perspective, he suggests (Popper, 2002a) that the manner in which scientists carry out their activity is more significant than the social and intellectual organization of science. Popper believes that the practice of critically testing hypotheses and rejecting the desire to make ad hoc alterations to keep hypotheses alive in the face of counter-evidence distinguishes science from non-science. As a result, he criticizes Kuhn's suggestion that periods of normal, stable, and unquestioning science are required for its progress; this, according to Popper, is just bad science (Popper, 2002a).

Popper examines the development of modern physics from the sixteenth century to the early twentieth century in his notable essay “The Aim of Science” (1957). He characterizes the evolution of physics as an increase in both the predicted scope and the level of detail. He believes that, despite the fact that Galilean physics enabled us to successfully forecast a wide range of occurrences over a length of time, Newtonian physics explained and superseded it. Within that area, Galilean physics laws can only accurately anticipate what happens in a small region, and they are less accurate than Newtonian laws. Then, in turn, Newtonian physics was superseded by Einsteinian physics, which corrects Newtonian physics in the domain of low-velocity objects and produces accurate predictions about objects traveling at very high velocities, a domain where Newtonian physics makes erroneous predictions.

As a result, according to Popper, there is a continuous evolution of knowledge, in which the predictive detail and scope of theories improves. Each theory explains and corrects its predecessor, according to Popper, because each theory makes some comparable but more accurate predictions in a certain domain and some quite different but roughly accurate predictions beyond that domain. Such an approach assumes several key assumptions: first, there exist objective standards by which we can assess the relative merits of theories, and we can use those standards to determine whether knowledge has grown. Second, the criteria are unaffected by the content of theories or the assumptions that underpin them. The Aristotelian and Galilean physics, for example, can be validly compared using the same standards, despite the fact that they are vastly different in many aspects. Third, the criteria we use to evaluate theories should be seen as rules that may be expressed coherently in the form of explicit general assertions. For instance, whether one of two scientific hypotheses has been falsified should be used to compare their respective strengths.

Popper characterizes science both by its method and by its products, although he prefers to emphasize the method over the products. He, like Carnap, believes in the unity of science. This means that the sciences should employ the same methods, so that the human sciences have the same methodology as physics. In fact Popper come to think that at least part of psychology and the social world could not strictly be reduced to the physical world, but Carnap has no such qualms. The traditional view on the stark separation between observation and theory underpins their trust in natural science as our best model of rational reasoning. Such a distinction that is crucial to the positivist enterprise is the central point of attacks of the later philosophers. One of them was Willard van Orman Quine (1963) who tried to show the weakness of such a distinction by rejection the extra-empirical criteria based on empirical or rational foundations.

Quine argues that scientific theories are never logically established by data, and that there are always in principle alternatives that more or less well fit the data.[3] He goes on to argue that any theory can be saved from falsification by apparently contradictory data, and conversely that any theory can be held to be falsified, provided sufficient adjustments are made in the extra-empirical criteria for what counts as a good theory. Even if it is reasonable to speak about facts of the matter outside of the scope of any theoretical conceptual framework, no theory can fully capture the reality of the situation. Moreover, since Quine holds that there is no separate category of a priori truth, it follows that these extra-empirical criteria are based neither on empirical nor rational foundations. Thus, it is merely a short leap from this philosophy of science to the conclusion that the adjustment of such criteria, which may be thought of as spanning multiple periods, should be clarified by social considerations rather than logical ones.

Thomas Kuhn, like Quine, emphasizes social elements as critical dimensions for comprehending the nature of move from one theory to the next. Three key concepts in Kuhn's model for understanding scientific developments are the paradigm change, the perseverance of remaining challenges in the presence of a paradigm's decaying capacity to address issues, and incommensurability between the old and new paradigms during a period of scientific crisis. The basic themes in Kuhn's method in his own words are:

> Like the choice between competing political institutions, that between competing paradigms proves to be a choice between incompatible modes of community life. … When paradigms enter, as they must, into a debate about paradigm choice, their role

[3] See Quine, "Two Dogmas of Empiricism", p. 20, and *World and Object*, chs 1 and 2.

> is necessarily circular. Each group uses its own paradigm to argue in that paradigm's defence (Kuhn, 1970, p. 94).
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> …. As in political revolutions, so in paradigm choice– there is no standard higher than the assent of the relevant community. To discover how scientific revolutions are affected, we shall therefore have to examine not only the impact of nature and logic, but also the techniques of persuasive argumentation within the quite special groups that constitute the community of scientists (Kuhn, 1970, p. 94).
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> … [T]he proponents of competing paradigms practice their trades in different worlds… Practicing in different worlds, the two groups of scientists see different things when they look from the same point in the same direction (Kuhn, 1970, p. 150).
>
> … In these matters neither proof nor error is at issue. Transfer of allegiance from paradigm to paradigm is a conversion experience that cannot be forced (Kuhn, 1970, p. 151).
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> … Before they can hope to communicate fully, one group or the other must experience the conversion that we have been calling a paradigm shift. Just because it is a shift between incommensurables, the transition between competing paradigms cannot be made a step at a time, forced by logic and neutral experience. Like a gestalt switch, it must occur all at once (though not necessarily at an instant) or not at all (Kuhn, 1970, p. 150).

According to Kuhn, a paradigm is the entire set of shared ideas, attitudes, behaviors, and so on among members of a certain community. In this view, science must be seen as a social construct that expresses the scientific research community's affiliations, procedures, and organization in sociological and institutional terms. A paradigm, on the other hand, refers to models that demonstrate the clear principles and criteria that drive normal science's puzzle-solving efforts. Rather than pursuing novelties, normal science, according to Kuhn, tries to realize the potential of a paradigm by improving the scope of the paradigm's prediction. In this aspect, he opposes the notion that science advances through the application of ideas and norms to new practical and theoretical situations that may be confirmed or disproven; rather, he believes that science advances by utilizing the paradigm's puzzle-solving powers. And a new paradigm creates new puzzles and rules for solving them, as well as successfully addressing new unsolved problems that aren't necessarily those of the old paradigm.

According to Kuhn, there are a multitude of competing paradigms throughout the revolutionary period, but no agreed-upon logical or methodological structures by which consent to one of these paradigms over another can be enforced. The transition from one paradigm to another, which defines revolution, according to Kuhn's theory, cannot be stated or judged in merely logical terms. Rather, such a transition is at least in part a matter of personal or group commitment. The comparisons in Kuhnian thinking must be drawn from Gestalt psychology or even religious conversion language, that is, from situations where one way of seeing is abruptly displaced by another.

Kuhn's account of scientific revolutions is based on a historical analysis of what actually happens in science, as well as the criteria that appear to govern the most major conceptual modifications in constructing the science we know today. He believes that philosophy of science can no longer be pursued without taking into account the history of science and the sociology of scientists. As a result, he questioned the positivist view of scientific validity as founded on timeless logical structures. As a result, according to Kuhn, the adaption of a new paradigm is a reconstruction of collective commitments, which cannot be understood without reference to the sociological, psychological, and logical variables involved.

3. Scientific Progress as Social Phenomenon

Scientific change is viewed as a historical and social phenomenon in sociological accounts of science. This viewpoint begins with a study of human beings who have been historicalized and socialized in vastly different circumstances. In this form of contextual understanding, our norms and standards are based on context. As a result, every contextual reality has its own internal logic, values and standards, ways of dividing up experience, and internal changing dynamics. As a corollary, these contextual distinctions should be taken into account while judging each reality. On this account, it appears that there is no timeless truth that is the same in all domains of human activity and that there is no one true technique, founded on reason, that is applicable in all disciplines of systematic study. In other words, according to these assumptions, scientific change cannot be attributed to a single perspective on the physical environment, but rather to a single scientific culture that has been subjected to historical, sociological approaches.

The strong program is founded on the belief that the dichotomy of nature vs sociality is deceptive. The concept of physical nature existing outside can be fully understood in terms of society existing outside. Ultimately, society and social theory, which determine the limits of research, dominate over the philosophy of science and nature. Both the production and the products of science are effectively described by social theory. The strong program considers social theory to be the most accurate account of human action in science-making and human achievement in science-making. Although Kuhn's work seems appropriate to the strong program version of the scientific understanding, he avoids reducing the factuality of scientific reasoning to a kind of social construction. For Kuhn, the main subject of science still concerns an objective world without theory; therefore, science should be "concerned to solve problems about the behaviour of nature" (Kuhn, 1970, p. 168). As a result, he does not distinguish between 'justification' and 'rationality;' in other words, these are terms that are interchangeable. For Kuhn, the problem of scientific justification is unsolvable without the attribution of rationality to science. Unlike the proponents of the strong program, Kuhn recognizes that explaining scientific change must include explanations of both actions and beliefs, which are inextricably linked despite major differences in form.

The strong program takes science as entirely socially made, and so tries to explain the scientific change by taking account only scientific actions. It also claims that our understanding of facts and our findings on the structure of facts are driven by public interests. For example, David Bloor starts with the claim that "science is a social phenomenon so we should turn to the sociologist of knowledge". (Bloor, 1976, p. ix) He also sees himself as a rival to Kuhn. Only sociology, not philosophy, according to Bloor, can provide a meaningful description of the origin and structure of scientific knowledge. As he puts:

> Can the sociology of knowledge investigate and explain the very content and nature of scientific knowledge? Many sociologists believe that it cannot. They say that knowledge as such, as distinct from the circumstances surrounding its production, is beyond their grasp. They voluntarily limit the scope of their own enquiries. I shall argue that this is a betrayal of their disciplinary stand point (Bloor, 1976, p. 1).

Like Bloor, the most of the sociologists of knowledge who, committed to a special reductionistic approach, try to show that reasoning processes are nearly arbitrarily formable even in similar social situations. He recognizes as knowledge whatever groups of educated persons believe it to be, as well as information that a cognitive community agrees on through the pragmatics of social consensus (Bloor, 1976, p. 3). As a result, the only way to provide a meaningful description of the origin and structure of scientific knowledge is to apply it to a social account.

Bloor claims that four prerequisites must be met in order to provide a sociological account of scientific knowledge. The prerequisites should be causal, unbiased, symmetrical, and reflexive in character (Bloor, 1976, pp. 4-5). To achieve the first criterion, a causal description of the conditions that lead to scientific knowledge must be provided, but not just any causal description, but one that incorporates social characteristics. The sources of thoughts and the characteristics of levels of knowing can only be explored in this way, and these can only be defined by a theory based exclusively on social theory principles. The second and third criteria advocate abandoning a causal description of both what is assumed to be true and rational, as well as what is assumed to be incorrect and irrational. The fourth criterion requires that any sociological account of knowledge be reflective; if a sociological theory is a piece of knowledge in and of itself, it must explain itself to avoid being refuted.

Therefore, Bloor, like most of the sociologists of knowledge, wishes to explore the social structure of scientific knowledge taking his model up-to-date sociology in order to give a descriptive account of the issue, but not explanative account. As a result, the strong program overlooks the necessity to produce an explanatory account of what distinguishes one hypothesis from another that the scientific community has uncovered.

The strong program overlooks the fact that what distinguishes modern science from previous generations is not just change, but also progress. The following paragraphs from Barnes demonstrate this argument:

> Progressive realism is one of the ideal accounts of scientific knowledge which has it moving towards something, in this case a description of the real existing mechanisms in the world. There are now several independent strands of work which imply that such theories are misconceived, and that all knowledge generation and cultural growth should be regarded as endlessly dynamic and susceptible to alteration just as is human activity itself, with every actual change or advance a matter of agreement and not necessity.
>
> The upshot of all this is that our current scientific models and mechanisms are likely to be seen at some future time as part of what is an endlessly unfolding chain of such mechanisms, constructed and eventually abandoned (or stripped of their ontological standing) as the activity of knowledge generation proceeds. Clearly then our present theories should stand symmetrically with earlier scientific theories, and for that matter with any other (Barnes, 2015, p. 24).

As a result, the strong program is as essentialist as the positivist or other rationalist approaches, because they prioritize one perspective over others. On the one hand, by the positivist programs we abandon the human origin of knowledge, and we are forced to build society with nature. On the other hand, by the strong program we abandon the non-human origin of knowledge, and we are led to build nature with society. As a corollary, all explanations offered by positivist and social programs begin at one of two extremes, nature or society, and go to the other. As Bruno Latour puts it:

> Most of philosophies of science and all of the social sciences were, on the contrary, considering either stabilized sets of natures facing stabilized sets of societies, or letting only one of them be unstable at once. The misunderstanding was complete since what is the rule for us was the exception for them (Latour, 1992, p. 287).

In order to overcome the difficulties streaming from the one-sided explanations of scientific progress we may need a new understanding of rationality, as Joseph Agassi puts:

> Let me conclude that with an outline of the new rationalism which is neither radical nor romantic but gradualist, which neither rejects nor endorses tradition but critically takes it as a point of departure, which makes truth neither the universal and easily attainable goal of all science nor the local relative accepted view of our own part of society, but as the long term goal to which all inquiry strives; which recommends reform rather than either the blind conservatism of the total revoking of tradition (Agassi, 1981, p. 14).

4. Epistemic Approach to Scientific Progress

In his paper Alexander Bird (2007, p. 64) argues that "(t)he epistemic approach takes knowledge to be the concept we need in order to understand what progress is." According to him, without knowledge we cannot understand the meaning of scientific progress. Epistemic approach takes the accumulation of knowledge essential for the progress in sciences. Bird argues that if one knows that her knowledge is an outcome of true belief, then she knows it:

> On the epistemic account, progress is even harder to achieve. For S to have made progress, it is not enough that T be true, S must know that T is true. Correspondingly, for S to know that she has made progress, S must know that she knows that T is true. S may well be in such a position, but since one does not necessarily know that one knows, it will also be possible to be in the position of having made progress but not knowing that one has done so. This is plausibly the case when T is as the cutting edge of a field and when new methods and techniques are used in confirming T. Far from being internally accessible, like many of the best things in life, the most exciting contributions to progress are often recognizable as such only with the benefit of hindsight (Bird, 2007, p. 87).

In Bird's view "three principal approaches to scientific progress relate to three views of the aim of science, in accordance with the simple view of progress" (Bird, 2016, p. 547). Science aiming problem-solving progresses when it solves problems. Science aiming truth progresses when it "gets closer truth". Science aiming knowledge progresses when the "stock of knowledge" increases in size. Bird adopts the third approach that is epistemic approach. He simply argues that "scientific progress is the accumulation of scientific knowledge" (Bird, 2016, p. 555). But, according to Finnur Dellsén, the proliferation of scientific knowledge does not automatically lead to scientific progress. For him, there are situations where scientific knowledge does not multiply, but scientific progress takes place. In addition, there are cases where scientific knowledge has increased, but progress has not been observed (Dellsén, 2016, p. 73).

5. Conclusion

While a positivist understanding of science dominated the first half of the twentieth century, the second half was dominated by another understanding of science, culminating in Kuhn's book *The Structure of Scientific Revolutions*. The positivists' approach is based on the verification principle, whose results are obtained by observing the facts and considering the historical and social background unscientific. Scientific progress will be achieved through more sensitive research techniques; human knowledge would thus increase. Starting from the 1960s, the studies in the history of science have revealed findings that point to a kind of sociology of knowledge of scientific progress. These two outstanding accounts differ in the formation of scientific knowledge. As Dellsén argues:

> In the recent literature on scientific progress, two new views have emerged. Alexander Bird has defended an epistemic account according to which science makes progress precisely when knowledge is accumulated. In some ways, this represents a return to the naïve view, since Bird's view requires that each progressive step adds a fully true proposition to science's knowledge corpus. However, the epistemic account is also more demanding than the naïve view, since knowledge is taken to amount to more than truth (Dellsén, 2018, p. e12525).

Bird's epistemic account seeks scientific progress in accumulating knowledge, though the growth in scientific knowledge is not merely a data collection. As he emphasized, "the most exciting contributions to progress are often recognizable as such only with the benefit of hindsight" (Bird, 2007, p. 87). Seeing science as a separate and distinct field from knowledge would allow illogical and unscientific views. Understanding the world better than in the past or getting closer to the truth will not contradict the epistemic approach. Science without knowledge will leave it unclear how we will understand the world; moreover, it will make the search for truth mysterious.

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