

Newtonian theory, interpreted in terms of readings on scales and clocks, and the like, will turn out to be correct within the limits of experimental accuracy. When interpreted in this way, the truth content of Newton's and other false theories will not be zero, and it may well be possible to apply Popper's conception of approximation to the truth to some series of theories within physics. However, this interpretation of Popper's theory of verisimilitude introduces an instrumentalist element that clashes with Popper's realist intentions as expressed elsewhere. It clashes, for instance, with the claim that "what we attempt in science is to describe and (as far as possible) explain reality".¹ In the next chapter I will give a strong argument to the effect that this instrumentalist retreat from realism is inadequate.²

1. K.R.Poper, *Obejective Knowledge*, Oxford: Oxford University Press, 1972, p.40.

2. A.F.Chalmers, *What is this thing Called Science*, pp. 157-159.

اسکولوں اور دینی مدارس کے طلباء و طالبات کے لئے!

مختصر نصابِ فقہ سوالاً جواباً

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☆.....نیفی کہ چون گر بہ عاجز شود ☆☆☆ برآر وہ چنگال چشم بلیک ☆.....

world that it does not possess. For instance, Newton's theory attributes a property "mass" to all systems or parts of systems in the world, whereas, from the point of view of Einstein's theory there is no such property. Einsteinian mass is a relation between a physical system and a reference frame. As we have seen, both Kuhn and Feyerabend have stressed the extent to which the mechanical world as described by Newton's theory is very different from the world as described by Einstein's theory. The outmoded and inadequate conceptions of mass, force, space and time, that are utilized in the formulation of Newtonian theory, are transmitted to all its deductive consequences. Therefore, strictly speaking, if we are talking in terms of truth and falsity, all of those deductive consequences are false. The truth content of Newton's theory is zero, as is the truth content of all mechanical theories prior to Einstein. The truth content of Einstein's theory itself may prove to be zero after some future scientific revolution. Viewed in this way, Pepper's attempt to compare "false" theories by comparing their truth and falsity contents, and thereby to construe science as approaching the truth, breaks down.

There is a way in which Popper's conception of approach to the truth can be rendered immune to this kind of criticism. This involves interpreting theories instrumentally. If, for example, we add to the claims of Newton's theory certain practical procedures for putting it to the test, definite procedures for measuring mass, length and time, we can say that a large class of the predictions of

truth-content, and the class of all false consequences of a theory its content, then we can say, quoting Popper,

assuming that the truth-content and the falsity content of two theories t_1 and t_2 are comparable, we can say that t_2 is more closely similar to the truth, or corresponds better to the facts, than t_1 if and only if either (a) the truth-content but not the falsity-content of t_2 exceeds that of t_1 . (b) the falsity-content of t_1 but not its truth-content, exceeds that of t_2 .¹

We can say that the verisimilitude of a theory is something like the measure of its truth-content minus the measure of its falsity-content. The claim that a science approaches the truth can now be restated, "as a science progresses, the verisimilitude of its theories steadily increases".²

I do not think this move of Popper's enables him to overcome the objections to the application of the correspondence theory to physics discussed in the previous section. Further, I think it can be shown that Popper's view of progress as successive approximation to the truth has an instrumentalist character out of keeping with his realist aspirations.

If we consider revolutionary changes in the development of physics, then not only is the theory that is replaced as a result of the , revolution inadequate in the light of the theory that replaces it, but it attributes features to the

1.K.R.Popper, *Conjectures and Refutations*, p.233.

conceived, would abruptly change from being a human, social product to being something that, in one strong sense, is not a human product at all. I, for one find this implausible to say the least.

An Important contribution of Popper's to the project of construing science as a search for truth was his recognition of the importance of the idea of approximation. An important contribution of Popper's to the project of construing science as a search for truth was his recognition to the truth. For Popper, the fallibilist, past theories that have; been replaced, such as the mechanics of Galileo or Newton, are false in the light of our current theories, whilst as far as modern Einsteinian or quantum physics is concerned, we cannot know that they are true. Indeed, they are most likely false and liable to be replaced by superior theories in the future. In spite of this falsity or likely falsity of our theories, falsificationists such as Popper wish to say that science has progressed ever closer to the truth; For example, they need to be able to say that Newton's theory is closer to the truth than Galileo's, even though both are false. Popper realized that it was important for him to make sense of the idea of approximation to the truth, so that, for instance, it makes sense to say that Newton's theory is a better approximation to the truth than Galileo's.

Popper attempted to make sense of approximation to the truth, or *verisimilitude* as he called it, in terms of the true consequences and false consequences of a theory. If we call the class of all true consequences of a theory its

language. To use technical terminology, taking the notion of primitive satisfaction as given, Tarski defined truth recursively.

Tarski's result was certainly of major technical importance for mathematical logic. It had a fundamental bearing on model theory and also had ramifications for proof theory. It also showed why it is that contradictions can occur when truth is discussed in natural languages and indicated how such contradictions can be avoided. Did Tarski achieve more than this? In particular, did he go any way towards explicating the notion of truth in a way that might help us to understand the claim that truth is the aim of science? Tarski himself did not think so. He regarded his account as "epistemologically neutral". Others have not shared Tarski's view. Popper, for example, writes, "Tarski . . . rehabilitated the cor-respondence theory of absolute or objective truth which had become suspect. He vindicated the free use of the intuitive idea of truth as correspondence to the facts". Let us look at Popper's use of Tarski to see if he [Popper] is able to sustain the claim that it is meaningful to talk of truth as the aim of science.¹

Apart from some minor aspects, such as the words used to denote the pre-existing features of the world, the end-point of a branch of science, the truth, will not be a social product at all. It is pre-ordained by the nature of the world before science is ever embarked on. Science, which is a social product, if it were ever to reach its end-point, so

1. Ibid., pp. 151-152.

talking is being done. If the sentences on both side of the card are taken to be in the object language then they cannot also be taken as referring to each other. If one follows the rule that each of the sentences must be in either the object language or the metalanguage but not in both, so that neither sentence can both refer to the other and be referred to by the other, then no paradoxes arise.

A key idea of Tarski's correspondence theory, then, is that if we are to talk about truth for the sentences of a particular language, then we need a more general language, the metalanguage in which we can refer both to the sentences of the object language and to the facts with which those object language sentences are intended to correspond. Tarski needed to be able to show how the correspondence notion of truth can be systematically developed for all sentences within the object language in a way that avoids paradoxes. The reason that this was a technically difficult task is that for any interesting language there is all infinite number of sentences. Tarski achieved his task for languages involving a finite number of single placed predicates, that is, predicates such as "is white" or "is a table". His technique involved taking as given what it means for a predicate to be satisfied by an object, x. Examples from everyday language sound trivial. For instance, the predicate "is white" is satisfied by object x, if and only if, x is white and the predicate "is a table" is satisfied by x, if and only if, x is a table Given this notion of satisfactioil for all the predicates of a language, Tarski showed how the notion of truth can be built up from this starting point for all the sentences of the

theory a sentence is true if it corresponds to the facts. Thus the sentence "the cat is on the mat" is true if it corresponds to the facts, that is, if there is indeed a cat on the mat, whilst the sentence is false if there is no cat on the mat. A sentence is true if things are as the sentence says they are and false otherwise.

One difficulty with the notion of truth is the ease with which use of it can lead to paradoxes. The so-called liar paradox provides an example. If I say "I never tell the truth" then if what I have said is true, then what I have said is false. Another well known example goes as follows: We imagine a card, on one side of which is written "The sentence written on the other side of this card is true", while on the other side of the card is written, "The sentence written on the other side of this card is false". It is not difficult to see how, given this situation, one can arrive at the paradoxical conclusion that either sentence on the card is both true and false.

The logician Alfred Tarski demonstrated how, for a particular language system, paradoxes can be avoided. The crucial step was his insistence that, when one is talking of the truth or falsity of the sentences in some language system, one must carefully and systematically distinguish sentences in the language system that is being talked about, the "object language", from sentences in the language system in which talk about the object language is carried out the "metalanguage". Referring to the paradox involving the card, if we adopt Tarski's theory then we must decide whether the sentences on the card are within the language system being talked about or within the language system in which the

provide a calculus consistent with the observations that alone is sufficient.¹

That is, the Copernican theory is not to be taken as a description of what the world is really like. It does not assert that the earth really moves around the sun. Rather, it is a calculating device enabling one set of observable planetary positions to be connected with other sets. The calculations become easier if the planetary system is treated as if the sun were at the centre.¹

3. The correspondence theory of truth

As indicated in section I, the typical realist position incorporates a notion of truth in such a way that true theories can be said to give a correct description of some aspect of the real world. In this section I will investigate attempts that have been made to make more precise the notion of truth operative in this connection. Although I will not argue it here, I take it that the so-called "correspondence theory of truth" is the, only viable contender for an account of truth able to fulfill the demands of the realist, and I will restrict myself to discussion and criticism of that theory.

The general idea of the correspondence theory of truth seems straightforward enough and can be illustrated by examples from common discourse in a way that makes it appear almost trivial. According to the correspondence

1. E.Rosen, *The Copernican Treatises*, New York: Dover, 1962, p.125.

1. Ibid., p. 150.

defenders of the kinetic theory of gases should have been somewhat taken aback to observe the results of collisions of their theoretical fictions with smoke particles in the phenomenon of Brownian motion. Finally, Hertz himself reported that he had been able to produce the fields of Maxwell's electromagnetic theory in a "visible and almost tangible form". Episodes such as these undermine the naive instrumentalist claim that theoretical entities have a fictitious or unreal existence in way that observable entities do not. Further difficulties with instrumentalism will come to light in section 4.¹

Some contemporaries of Copernicus and Galileo took an instrumentalist attitude to the Copernican theory. Osiander, the author of the preface to Copernicus's main work, *The Revolutions of the Heavenly Spheres*, wrote:

...it is the duty of an astronomer to compose the history of the celestial motions through careful and skilful observation. Then turning to the causes of these motions or hypotheses about them, he must conceive and devise, since he cannot in any way attain to the true, causes, such hypotheses as, being assumed, enable the motions to be calculated correctly from the principles of geometry, for the future as well as the past. The present author [Copernicus] has performed both these duties excellently. For these hypotheses need not be true nor even probable; if they

1. Ibid., p. 149.

as Popper.

Later in this chapter I will argue that the notion of truth typically incorporated into realism is problematic. Before doing that I will take a more detailed look at instrumentalism and show how, on the face of it, realism seems to have distinct advantages over it.¹

سائنس کے نظریے پہلے وجدانی، خیالی، افسانوی اور نظری سطح پر بیان کیے جاتے ہیں کوئی تصور، خیال، وجدان اور احساس سائنس داں کو متحرک کر دیتا ہے۔ پھر بہت عرصے بعد یہ افسانہ حقیقت کے سانچے میں ڈھل جاتا ہے، جیسے کیکول کا وجدان، جیمز بین رنگ کے بارے میں، میکسویل کی الیکٹرو میگنیٹک تھیوری جسے آخر کار تجربے کی آنکھ سے مشاہدہ کیا گیا، کا پرنکس کا نظریہ جو بالکل درست تھا کہ زمین گردش کر رہی ہے لیکن وہ اسے مشاہدات کی بنیاد پر تجربات سے بیان نہ کر سکا اور انسانی آنکھ سے نہیں دکھا سکا اسے پایہ ثبوت تک پہنچنے کے لیے کئی سال صرف ہو گئے۔ مکسویل نے اس کے علم کی صداقت کو دور بین کی آنکھ سے دکھا دیا:

The fact that theories can lead to novel predictions is an embarrassment for instrumentalists. It must seem a strange kind of accident to them that theories, that are supported to but mere calculating devices, can lead to the discovery of new kinds of observable phenomena by way of concepts that are theoretical fictions. The development of theories concerning the molecular structure or organic chemical compounds provides a nice example. The idea that the molecular structure of some compounds, benzene for instance, should consist of closed rings of atoms was first proposed by Kekule. Kekule himself had a somewhat instrumentalist attitude towards his theory and regarded his ring structure as useful theoretical fictions. On this view, it must be regarded as a remarkable coincidence that these theoretical fictions can nowadays be seen almost "directly" through electron microscopes. Likewise, instrumentalist

1. Ibid., pp. 146-147.

فلسفہ سائنس کے مؤرخ اے۔ ایف چارمر کی تحقیقات کا خلاصہ ظفر اقبال

Realism typically involves the notion of truth. For the realist, science aims at true descriptions of what the world is really like. A theory that correctly describes some aspect of the world and its mode of behaviour is true, whilst a theory that incorrectly describes some aspect of the world and its mode of behaviour is false. According to realism, as typically construed, the world exists independently of us as knowers, and is the way it is independently of our theoretical knowledge of it. True theories correctly describe that reality. If a theory is true, it is true because the world is the way it is. Instrumentalism will also typically involve a notion of truth but in a more restricted way. Descriptions of the observable world will be true or false according to whether or not they correctly describe it. However, the theoretical constructs, that are designed to give us instrumental control of the observable world, will not be judged in terms of truth or falsity but rather in terms of their usefulness as instruments.

The idea that science aims at a true characterization of reality is often used as a counter to relativism. Popper, for example, uses truth in this way. According to that usage, a theory can be true even though nobody believes it and can be false even if everybody believes it. True theories, if they are indeed true, are not true relative to the beliefs of individuals or groups. Truth, understood as a correct characterization of reality, is objective truth for realists such