Tricky cases and Teller's programme

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Paul Teller [Tel04] has argued that scientific representations should not be thought of as true or false. It makes perfect sense to talk of one theory being more accurate than another and so "closer to the truth," he suggests, but none of our theories are flat-footedly true. He argues (a) that proximity to the truth admits of degrees and (b) that theories can be closer or further from the truth in different respects. Because of these two facts, truth-likeness does not impose a definite order on theories. There may be cases of two theories, such that the first is closer to the truth in one respect but further from the truth in another; call these *tricky cases.* Some tricky cases may be resolved by later refinement of the two theories in question, but Teller does not think that this will generally be the case. In general we are forced to live with incompatible; all of our representations are *informative fictions* or, as he puts it, *fallible veracities* [Tel04, p. 445–446].[1] In what follows, I try to make clear what this epistemologico-ontological programme requires.

Let the triadic predicate $Rxyr$ mean that x is more accurate than y in respect r; x is, in that respect, more truth-like than y. For any specific respect r, the relation R is at least a partial order on theories. Teller's claim that there are tricky cases can be represented as the claim that there are two viable theories x and y such that

$$\exists r_1 \exists r_2 (Rxyr_1 \ \& \ Ryxr_2) \tag{1}$$

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[*] This paper grew out of a seminar on causation and determinism at the University at Albany in Fall 2005.

[1] He also calls them *veridical fictions.* This terminology is paradoxical enough that one may be tempted to dismiss Teller's programme as a great muddle. I think that would be a mistake.

It is tempting to think that there is a "royal road to truth" and that tricky cases will be resolved when a third theory is found that is superior to both theories in both respects. Teller admits this temptation and attempts to explain it away. He writes:

> We have found, in a wide range of cases that, for each description, we can find refinements. From which we might reasonably conclude that, for each description and each relevant characteristic, there is a further description that refines the first with respect to the characteristic. But it is a fallacy... to infer from the last conclusion that there is *one* description that, for all characteristics,covers all refinements. [Tel04, p. 438]

Although Teller avoids the words 'accurate' or 'closer to the truth' in this passage, "x is a refinement of y in respect r" clearly means the same thing as the predicate R defined above. Formalized, Teller's story goes like this: We observe that for many theories we can find other theories that improve upon them. So we conclude

$$\forall x \forall r \exists y Ryxr. \tag{2}$$

We are tempted by the further conclusion:

$$\exists y \forall r \forall x Ryxr \tag{3}$$

As Teller notes, it would be fallacious to infer (3) from (2).[2]

I will grant, for the sake of argument, that accuracy is always a comparative matter relative to some respects, that there are tricky cases, and that there could never be an absolutely 'most accurate' representation. There is no maximal element in R, and so (3) must be false. Nevertheless, all of these are concessions are insufficient for Teller's broader conclusion.

The denial of (3) is compatible with ordinary scientific realism. As Paul Churchland suggests: "Just as there is no largest positive integer, it may be that there is no best theory. It may be that, for any theory whatsoever, there is always an even better theory, and so *ad infinitum*" [Chu85, p. 46]. It is enough for the realist if there will be some theory that refines both of the problematic theories in a tricky case. It need not be most accurate of all; it need only be more accurate than either. Suppose the realist says that for any two theories, there is some third theory superior to them in all respects. We can write this

$$\forall x \forall y \exists z \forall r (Rzxr \ \& \ Rzyr). \tag{4}$$

In order to maintain that some tricky cases are unresolvable, Teller must deny (4). The negation of (4) is logically equivalent to $\exists x \exists y \forall z \exists r (\neg Rzxr \vee \neg Rzyr)$, so Teller must say that there are two theories x and y such that

$$\forall z \exists r (\neg Rzxr \vee \neg Rzyr). \tag{5}$$

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[2] Teller dubs this "the UEEU fallacy — from $\forall\exists$ inferring $\exists\forall$" [Tel04, p. 438].

The x and y that satisfy (5) must also satisfy (1), since R is antisymmetric for any specific respect r. That is, the two theories in (5) comprise a tricky case, with the further restriction that no theory is superior to both of them in both of the relevant respects. Call this a *strong tricky case*. Teller is committed to the claim that at least some tricky cases are strong tricky cases.

There are many cases in the history of science which were tricky cases, but which proved not to be strong tricky cases. There were two rival theories, each more successful than the other relative to some legitimate scientific standards. Scientists at the time were unable to decide univocally in favor of either theory. Subsequently, scientists developed theories that were superior to both theories according to all of the legitimate scientific standards.

As an example, consider the Devonian controversy in 19th-century geology, the story of which is recounted by Martin Rudwick [Rud85]. Competing groups of scientists developed theories, each of which was able to account for some but not all of the evidence. One approach maintained that the rocks of Devonshire were an unbroken sequence and that they were all older than the so-called Coal Measures; the other maintained that the the rocks did not form a continuous sequence and that some of the strata were at the level of the Coal Measures. These two approaches (to use my terminology) made for a tricky case. The matter was resolved not by one winning out over the other, but by a synthesis of the two research programs and a theory that accommodated the vexing evidence: The rock strata were an unbroken sequence, and some were attributed to the Coal Measures— but a new period dubbed the 'Devonian' needed to be introduced. (This is nicely illustrated by Rudwick in his figures 15.2 and 15.4 [Rud85, pp. 404, 408].)

The Devonian controversy arose, was a great theoretical puzzle for a time, was resolved, and was then forgotten. Cases like these fit what Philip Kitcher [Kit93, ch. 6] calls the 'compromise model' of scientific change.[3] Rudwick [Rud85, p. xxi] maintains that this is the typical arc of a controversy; in my terminology, tricky cases arise and are resolved. It may well be objected that, although there are examples like the Devonian controversy, science is not always or even typically like that. Yet the existence of even this one example shows that some tricky cases are not strong tricky cases. Provided with some present pair of theories that makes for a tricky case, how could we know if it was a strong tricky case or not? Knowing the strength of a present tricky case would require knowing the limitations on as-yet-unformulated, future theories.[4] Knowing when such limitations are present would be difficult— perhaps impossible— and so there is little hope of showing that (5) holds for some particular specified theories.

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[3] Kitcher gives the Devonian controversy as an example [Kit93, pp. 211–218].

[4] The bet that a tricky case is a strong tricky case is a bet against the possibility of scientific progress. As C.S. Peirce writes, "The likelihood is that it will be solved long before you could have dreamed possible. Think of Auguste Comte who when asked to name any thing that could never be found out instanced the chemical composition of the fixed stars; and almost before his book became known to the world at large, the first steps had been taken in spectral analysis" [Pei03, p. 273]. See also [Mag05].

Teller might still argue that we have good reason to believe (5) as an existentially quantified statement; perhaps we have good reason to believe that there are some strong tricky cases, even if the historical record makes us dubious of our ability to say whether a particular tricky case is a strong tricky case or not. The argument might go something like this: Because of the diversity among respects in which things may be more or less truth-like, there are standards which will almost inevitably be in conflict. To borrow Kuhn's phrase, there is an essential tension between some scientific desiderata and others. If a third theory improves on two tricky-case theories in one of these respects, it will come out worse in the other respect. This would give us a reason to think that (5) is satisfied for some tricky case.

It seems that Teller does think that there is a tension of this kind between desiderata. This is clearest in his discussion of quantum-mechanical and hydrodynamic accounts of water. In my language, he thinks these are a tricky case. Suppose we are interested in the water running through the pipes in my apartment. Our foundational theory tells us that the water is a complicated quantum mechanical system made up of a great many entangled quarks and leptons. This is accurate in some respects, but provides no "humanly accessible understanding of the fluid properties and behavior of water" [Tel04, p. 439]. A fluid-dynamical model of water both allows us to make accurate predictions and grants humanly accessible understanding. So the quantum mechanical representation is closer to the truth than the hydrodynamic model in some respects but further from the truth in the other.

The puzzle here is discerning the respect in which the quantum mechanical representation is closer to the truth. The realist may be tempted to say that providing an intuitive picture of the world ("humanly accessible understanding") is not a mark of truth if the bits of the world in question are not intuitively graspable things. The mark of truth is correctly describing the world, even if it hurts our heads to think about it. Yet Teller insists that the description of the water as an aggregate of quarks and leptons does not get the ontology right. Quantum field theory only portrays quarks as particles in spacetime of constant curvature, but (according to another of our favorite theories) we do not live in a spacetime of constant curvature [Tel04, p. 433]. Since quantum field theory does not do a better job of cataloging the underlying reality, in what respect is it closer to the truth at all? Teller needs to say. Only then can he argue that the respects in which quantum field theory is better than hydrodynamic theory and the respects in which it is worse are both legitimately respects of *accuracy*— rather than mere expedience— and moreover that there is likely to be a tradeoff between these respects.[5]

I hope to have shown that Teller's programme requires a great deal. I have granted *arguendo* that truth-likeness or accuracy is always a matter of degree, that theories may be more or less accurate in a number of different respects, that there is no maximally accurate theory in any respect, and that there are

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[5] For reasons given above, I think Teller would still be best off not claiming that this case is itself a strong tricky case. Rather, he can use it to illustrate respects of accuracy that are in tension— and so to support the existential claim that there are *some* strong tricky cases.

some tricky cases. It does not follow from all of this that there are any strong tricky cases. I have suggested, moreover, that the historical record should make us suspicious of alleged strong tricky cases. Teller's programme requires either a historical argument that overturns the suggestions I have made or a general argument that shows that there are legitimate respects of accuracy which are bound to be in conflict.

References

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