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JUSTIFICATION, SKEPTICISM, IRREVERENCE: OR WHY SCIENCE IS DIFFERENT FROM FAITH AND RHETORIC

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Abstract. This essay is the text of a lecture the author was invited to give at the Department of Philosophy of Uppsala University in February, 2004. The main points of the essay are as follows. (1) There is no justification for the opinion that science too, like ideologies, religions, and mystical philosophies, is based on articles of faith. (2) The working logic of scientific justification is inescapable, in the sense that any deviation from its norms leads to a complete loss of one's ability to accept some propositions while rejecting others. (3) It is possible to demonstrate the difference between scientific justification and non-scientific justification by means of a quasi-Turing game in which a skeptical listener is allowed to pose questions to the originator of a position. The essence of the game is this: if *P* is a stated position, and *E* is a position designedly excluded by stating *P*; if furthermore justification *J* (anything ranging from logical derivation to divine inspiration) is being presented in support of *P*, then *J* cannot be valid if it can be used to justify *E* as well.

Keywords: science, faith, rhetoric, justification, skepticism, irreverence

1. Introduction

When I grew up, in the second half of the last century, the two sets of statements below would be considered common knowledge.

1. Scientists justify their claims by means of logic and systematic observation. They do not take anything on faith. They are skeptical towards their own claims and always ready to re-examine them. If a justification fails they abandon their claims, or clearly mark them as mere speculative possibilities. They avoid vagueness and abhor contradiction. They are irreverent to authoritative views. They define their terms and employ mathematics to achieve maximum clarity. Etc., etc.

2. Religious scholars, mystical philosophers, and ideologists of all kind take their claims on faith. They cannot and do not want to justify them either logically or empirically. To convince others, they use rhetorical eloquence, coercion, and brainwashing instead of justification. They are insensitive to contradiction and thrive in vagueness. They defer to authority. Etc., etc.

Now, the presently defunct country where I grew up had an official ideology variably called "Marxism-Leninism" and "dialectical and historical materialism". Even as a young boy I knew that of the two sets of statements above, this ideology conformed squarely to the second. But I also knew that it was using all those devices – rhetorical eloquence, coercion, and brainwashing – to convince people it fit within the first category, as "the only scientific ideology".

Later on, still young but no longer a boy, I had occasions to talk to some orthodox and not-so-orthodox Marxists, mostly professors at my university. I formed an impression that those of them who were sophisticated scholars and at the same time seriously believed in the "dialectical and historical materialism" (because many merely pretended they did to earn their bread and butter), clearly understood that it did not conform with the above-given Set of Statements 1.

One group of them believed, however, that Set of Statements 1 does not characterize science either, that these statements were but obsolete remnants of the Enlightenment era. Scientists too take a lot of things on faith, they would say. Just think of axioms in mathematics. They too defer to authoritative views. They too violate logic or disregard systematic evidence when it does not suit "prevailing paradigms" (a translation of Kuhn's book had just appeared and, as everywhere else in the world, was enthusiastically used to support all kinds of views disparaging science). In short, the "dialectical and historical materialism" had the right to be vague, self-contradictory, and empirically unfounded, because so was everything else – from physics to biology to psychology.

The second group did acknowledge the difference between science and "dialectical and historical materialism", but maintained that science represented merely a "limited perspective", just one of many ways of acquiring truth. Philosophy was supposed to overcome these limitations, propose alternatives to the "dogmatic confines" of logic and empiricism (dialectics being one such alternative).

I will label these two positions as the "you-too" position (nobody is perfect) and the "different but equal" position (you say pot[ai]to, I say pot[ah]to). As one can easily surmise, the nature of the two positions was such that their respective adherents did not consider them incompatible, and in fact readily borrowed each other's arguments (when, for example, asked how the "surplus value" could be a cornerstone of Marxist economic theory if the latter did not provide a common measure for the two quantities whose difference the "surplus value" was purported to be; or whether there was a principled way of distinguishing Newton's mechanics from the physical views of a toddler, or Darwin's theory from the Biblical account of biological creation). Both the you-too-ists and the different-but-equal-ists delighted in finding historical examples (which history indeed

provides in abundance) when scientists were grossly wrong, dogmatic, dishonest, or ideologically partisan. Both groups practiced respectful attitude (secretly, if they wanted to teach and publish; or openly, if they wanted to be admired by throngs of students) towards religious, mystical, and esoteric teachings of all kinds. And there was a strong if not universal tendency among these people to speak of knowledge in cultural terms: "Western scientism" versus various "non-Western" approaches to knowledge (different but equally, if not more, profound).

Still later on, in other parts of the world and under very different circumstances, I continued to encounter the same two positions. Not being a philosopher I can only refer to occasional glimpses of literature and numerous "coffee-table talks" I have had with philosophers, religious scholars, and "ordinary scientists". My evidence therefore is far from being systematic. A philosopher of the social constructionist persuasion told me that science was essentially a rhetorical enterprise, like politics. Another philosopher advised me that scientific psychology should abandon its "artificial" explanatory schemes in favor of freely used colloquial "explanations", such as "I did this because I wanted to". In psychology itself, which is a huge agglomeration of very different disciplines (some of which fall within my professional domain), voices are heard from time to time calling for freedom from the excessive rigors of logic and systematic experimentation. To the extent I can generalize such evidence, the two positions in question seem quite prominent. The main difference from the poor dialecticians of my student years seems to be that the present day you-too-ists and the different-but-equal-ists do not have reasons for concealing their sympathy towards religious, mystical, esoteric, and culture-specific "alternatives" to the "Western scientism". In American universities some of these sympathies do in fact form an integral part of the political correctness culture and are therefore socially encouraged.

What I am going to do here is to argue that the claims commonly used by the proponents of the you-too position (that science is based on articles of faith) and by the proponents of the different-but-equal position (that there are viable alternatives to logic and empirical observation in establishing truths) are not tenable. By commonly used arguments I mean those I heard or saw in the literature repeatedly. Almost certainly I have missed some, but I assume (being ready to revise this assumption if new kinds of arguments are pointed out to me) that the arguments I missed can be dealt with analogously. If I am right, then Set of Statements 1, in spite of its apparent simple-mindedness, is a reasonable and meaningful characterization of science (in which term I include all empirical studies, mathematics, and certain forms of philosophy).

I freely and willingly admit that my analysis is superficial. I do not use this adjective in a self-disparaging way, but rather to indicate that I do not embark on a construction of a comprehensive or systematic scientific theory of science (some other time perhaps). The reason I feel I can say something useful without such a comprehensive construction is that the you-too and different-but-equal claims I am examining are superficial claims themselves, in the sense of not being (by their very nature) parts of a scientific theory.

2. On axioms

Perhaps the most frequently invoked example of something that scientists are supposed to take on faith are axioms of mathematics. A few years ago a Muslim scholar, when asked how he could accept the divine origin of Koran on the strength of a single man's testimony without accepting the Book of Mormon whose divinity is established in precisely the same way, said to me: "Are not the Euclidean and non-Euclidean geometries incompatible? And should not therefore the mathematicians who believe in one of them reject the other?" This scholar did not realize that the example he invoked was in fact a showcase illustration for the fact that science does not have anything that parallels the situation of the Koran versus the Book of Mormon.

In the (planar) Euclidean geometry one can draw one and only one parallel to a line through a point outside this line; in the classical non-Euclidean geometries (Lobachevsky and Riemann), there are, respectively, an infinity of such parallels and no such parallels, the other axioms being the same. As is widely known, for centuries mathematicians suspected that the Euclidean version of the axiom of parallels may be derivable from the other axioms. In other words, they suspected that a geometry like Lobachevsky's, if constructed, would be internally inconsistent. Even at that time, however, one could not say that mathematicians were taking the Euclidean version of the axiom on faith. They did precisely the opposite: they tried to prove it (and failed). It has been shown since that any of these three geometries is consistent if and only if the other two are consistent (and if and only if arithmetic is consistent). In what sense then could a modern mathematician believe that one of them is more true than the others? Within the language of mathematics such a belief would not even be expressible.

But could it be, one might ask, that mathematicians still believe that one of these geometries is more true than the others "in reality"? If the reality means an empirical domain, the answer is again no. When a geometry arises within a mathematical description of an empirical domain (physical space, perceived space, space of colors, etc.), a scientist may very well propose that one of the possible geometries describes this domain adequately, under certain rules of correspondence between the primitives of the geometry (say, points, planes, and straight lines) and certain phenomena or procedures in the empirical domain. Again, nothing here has to be taken as an article of faith. The imposition of a geometry on an empirical domain is like any other theoretical construct: depending on circumstances, the geometry being imposed either forms part of the theory's descriptive language (providing means for formulating the theory's propositions), or it is an empirically testable assumption (formulated in the theory's descriptive language). One does not "believe" in the truth of one's theoretical language: one simply proposes it, and retains or abandons it depending on whether it proves conducive to the development of one's research (a form of "quasi-empirical" testing, if you will). Nor does one "believe" in one's testable

assumptions: one simply tests them and abandons or modifies them if they are not true.[1]

Based on experimental evidence provided by T. Indow, for example, visual perception of spatial relations within a frontal-parallel plane is assumed to be described by the Euclidean geometry (which might be the main reason for Euclid's famous characterization of his axioms as "self-evident truths"). The geometry of three-dimensional vision is more complex, and some theories approximate it by Riemann's (elliptic) alternative to Euclidean geometry. The geometry of physical space in general relativity is Riemannian (not to be confused with Riemann's elliptic geometry). The geometry of color space, since E. Schrödinger's research (much less known than Schrödinger's role in the creation of quantum mechanics), is also assumed to be Riemannian. My own study of subjective dissimilarities among stimuli "from the point of view" of a perceiving system led me to propose for these dissimilarities a generalized version of Finsler geometry (which itself is a generalization of the Riemannian one). In my older research of spatiotemporal geometry of visual objects in motion experimental evidence led me to a generalized version of Minkowski's geometry of special relativity. These facts (in which I admit I am somewhat overindulging due to my professional interests) make abundantly clear the naivety of assuming that a scientist could believe in one true geometry on empirical grounds. And we have seen that it cannot be done on mathematical grounds either. We may rest assured therefore that we will not live to see gangs of Lobachevskians clashing with gangs of Riemannians, or Euclidean restaurants with signs saying "Let no non-Euclidean enter".

Generalizing, I see no reasons, or even possibility, for claiming that any axiom in any area of mathematics is ever taken as an article of faith, whether or not mathematicians actively study formal systems in which this axiom is replaced by an incompatible statement (as it is done in the case of the axiom of parallels). Consider, for example, Peano's axioms of natural numbers. In what reasonable sense could one have faith in the statements like "0 is a number", "if n is a number, then n+1 is a number", "if n is a number, then n+1 is not 0", etc.? Clearly, these axioms merely construct an object (natural numbers) which one wishes to work with. A mathematician either constructs her object of research or does not construct it, and there is nothing to believe in before it has been constructed. After it has been constructed there is nothing to believe in either: one investigates the construct to find out whether it has certain desirable properties (such as internal consistency) or applications (such as counting of beans), and retains, abandons, or modifies it accordingly. With some caution (because mathematics is vast and

[1] Elsewhere (in the context of my analysis of various ways of modeling response times) I wrote about the usefulness of distinguishing theoretical languages from falsifiable models formulated in these languages, and about comparing different languages in terms of their "transparency" and "heuristic power". It seems to me that considerations like that could be useful when evaluating various positions on the Popperian falsification criterion and Kuhn's notion of a "scientific paradigm" resisting contradicting facts.

heterogeneous), one could say that all axioms of mathematics are but constructions and definitions of objects one wishes to deal with.[2]

The process of constructing new conceptual schemes (defining new notions) is not well understood psychologically. Some would say, it is not understood at all. And as is usually the case when something is not understood scientifically, the you-too-ists prominently capitalize on this fact, descrying in it evidence for inherent irrationality of science. The issue, however, is not how one comes up with one's ideas, but how one justifies them, or (in the case of axioms) how one justifies what one does with them. A proof by mathematical induction, for example, involves a guess that some property holds for all natural numbers. It is irrelevant whether one can explain how the guess was formed as far as one provides a valid inductive proof that the guess was correct. No irrationality is involved in the justification process, and no faith is involved in the formulation of the guess (because it is being tested by the induction procedure).

But is not the principle of mathematical induction, the you-too-ists are likely to say, a prima facie example of something that a mathematician simply believes to be true, and cannot imagine not to be true? Is not this uncritical belief the reason for including mathematical induction in the list of Peano's axioms? There is no justification for answering yes to any of these questions. Again, we do not understand well how people form their idea of a natural number, and how the set of natural numbers is represented in their intuitions.

> *"If something is true about 0, and if from this I can derive logically that it also holds for 1, and from that I can derive that it holds for 2, and so on, well, then it must hold for all numbers. It cannot be otherwise."*

It is tempting indeed to think that mathematicians simply take the validity of this piece of reasoning on faith. But a critical examination shows otherwise. The first question to ask is what features of natural numbers the principle of induction is based on. Can it be the property that the set begins with 0 and is followed by 1 which is followed by 2 and so on? The answer is no, because otherwise the principle of induction could be derived as a theorem from the first four Peano's axioms (the ones that formalize this intuitive property of a chain starting at 0). The next question to ask is whether it is possible to think of objects that form a chain starting at zero but do not obey the principle of induction. On reflection, one can find such objects (e.g., a transfinite sequence 0, 1, …, ω; ω + 1, …; or even simpler, 0, 1 – 1/2, 1 – 1/3, …, 1, 2, 2 – 1/2, 2 – 1/3, …). So including the principle of induction as the fifth Peano's axiom merely delineates the type of numbers a mathematician wishes to work with: those starting at zero, forming a chain, and (where the induction comes into play) such that any two of them are connected by a finite sub-chain. The induction principle *by itself* is not either true

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[2] To prevent confusion, by saying this I am not subscribing to Hilbert's formalism, or any specific metamathematical theory (constructivism, quasi-empiricism, realism). Differences among these theories, as I see them, are primarily in the issues of what determines the mathematicians' choice of the objects they construct, and what are legitimate methods of proofs.

or false: it is tautologically true for some objects (whose definition includes its applicability to them) and false for others. Hence it cannot be an article of faith, and should instead be viewed as part of a construction, on a par with statements like "if n is a number, then $n + 1$ is a number". Epistemically, the situation is no different from that with the Euclidean and Lobachevskian geometries.

It may be worth noting that the intuition of a scientist coming up with a construction (definition) is not always enigmatic, and as a rule is not entirely enigmatic. Usually, it is a network of facts, special cases, and desiderata, all of which will eventually be demonstrated (hence, explicated) as applications, specializations, and outcomes of the evolving construction. When H. Lebesgue constructed the integral bearing his name, he knew of the Riemann integral which he wanted to be a special case of the new construction, and he knew a variety of functions that were not Riemann-integrable but whose integrals were "intuitively" calculable. Speaking of axioms again, many axioms are constructed by hypothetically extending to a broader class of objects propositions that can be demonstrated on a limited class of objects. Thus, it is rigorously demonstrable that the Cartesian product of any collection of sets each of which has an identifiable element is non-empty. To generalize this proposition to any collections of arbitrary sets amounts to proposing the Axiom of Choice. The point to emphasize here, again, is that no such generalization can be taken as an article of faith. The introduction of the choice axiom leads to certain "paradoxical" propositions, and is therefore used by mathematicians cautiously. And it would definitely be abandoned or weakened if it was shown to lead to true antinomies (as it happened with axioms of the naïve set theory and with Frege's construction).

3. On empirical "beliefs"

The practice of generalizing from special cases is sometimes called the "method" of induction, and it is another issue that is being brought up by the you-too-ists as an example of something taken by scientists on faith. The argument is not serious, as all "beliefs" in the reproducibility of a phenomenon are merely hypotheses subject to empirical refutation. A negation of the hypothesis that a phenomenon is reproducible, if made in the what-if-it-does-not-work-next-time form, is valid but not interesting. It expresses a doubt that is universally applicable and does not indicate what, if anything, can or should be done differently. Any specific doubt (what if the acceleration of free fall changes in time? what if the location of Mars influences the outcome? etc.) is perfectly legitimate and can be tested in principle.

Do scientists then believe that any change in an outcome should have a cause? Is not this a manifestation of the metaphysical principle of causality that can only be taken on faith? Not serious again. A scientist tries to establish regularities to be able to form predictions, but when regularities are not there they cannot be established. In quantum mechanics (especially after J. S. Bell's remarkable theorem) we have a prominent example of a scientific theory explicitly denying the possibility of

predicting certain outcomes, however precisely the initial conditions be controlled. The same theory, of course, asserts the possibility of predicting probabilities of certain sets of outcomes, which is a form of causal regularity. Unless one can show that the idea of detectable random fluctuations in probabilities is mathematically flawed (under certain assumptions it is, but this is a subtle topic), one cannot exclude the possibility that the probabilistic determinism will be eventually abandoned too. In psychology, probabilistic determinism is a common working assumption.

Speaking of regularities being or not being "there", is not science critically based on certain metaphysical beliefs about the world? That the world is "out there", for example? The same Muslim scholar whom I quoted on the issue of non-Euclidean geometries, also said to me: "Unless you can prove that solipsism is wrong, my faith in the Koran is no more arbitrary than yours in the external world". I do not, of course, have to prove solipsism wrong because it is a simple exercise in conceptual analysis to prove that (consistent) solipsism cannot have any consequences that would make it different from "realism". It is a sad testimony to people's inability to differentiate meanings from emotional connotations that solipsism is still presented as an idea rather than a childish play with words.[3]

Summarizing what I have said so far, there is no reason (justification) for maintaining that either mathematics or empirical science involve, let alone are based on, uncritically accepted articles of faith. Science is the very opposite of religion in this respect. A philosophical theory has ample room between these two poles to place itself.

To be on the safe side, I will add the trivial caveat that these conclusions have nothing to do with private beliefs of individual scientists or even shared beliefs of groups or generations of scientists. Any such belief, if explicated as a statement within the body of a theory (like Newton's "general scholium"[4]), can be removed (and, as seems to be evident from history, is always removed eventually) with no detrimental consequences for the theory.[5]

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[3] I hesitated to include this paragraph, due to the triviality of the issue. Certainly, I thought, no modern philosopher would consider "the world is real" and "the world is imagined" as distinguishable statements. But having taken a pause in my writing to search for "solipsism, realism" on the Internet, I discovered I was wrong to hesitate. "Solipsism is logically coherent, but not falsifiable, so it cannot be established (or disproved) by current modes of the scientific method" (Wikipedia). To be fair, I found out that D. Deutsch, a physicist, has recently written something on the indistinguishability of the two "positions" (unfortunately, with the use of unnecessary psychological terms, such as "subconscious mind").

[4] "... This Being governs all things, not as the soul of the world, but as Lord over all: And on account of his dominion he is wont to be called Lord God Pantokrator ..."

[5] In response to protestations that private and shared beliefs can influence one's work I will say that one should distinguish between "being able to influence" and "being a necessary part of" (a fortiori, "being a basis for"). Errors of reasoning, of computation, or of observation influence science significantly. Political ideologies, like Christianity or Communism, can influence and have influenced science significantly. But in no reasonable sense are these things a necessary part of a scientific theory: any theory can (and, with some luck, eventually will) be developed without errors and political pressure.

4. On working logic

Scientific justifications are logical, and this fact leads to what is arguably the strongest point of the you-too position. Is not all science based on logic? And is not logic unjustifiable? For if it were justifiable by *logical* means we would have had a circularity, and if by *extra-logical* means, then why would not we use such means in other scientific endeavors? This argument has its validity, and it cannot be brushed aside as easily as most of the other arguments of the you-too-ists (the present discussion, however, is even more relevant for the different-but-equal position).

That science does not take its logic as an article of faith could be seen in the fact that all forms of logical justifications can be (and de facto are) subjected to scientific analysis. What we get are various formal logical systems, in which the norms and practices of the working logic of science are made into axioms, schemas, and derivation rules. Moreover, once formalized, the working logic can be (and de facto is) generalized or modified in a variety of ways. Thus we get restricted logics of the constructivist variety, multivalent logics, "fuzzy logics", etc. There are even logics (non-adjunctive, strict implication, internal negation, etc.) admitting the possibility of $A\& \sim A$ (or at least of both A and $\sim A$ as separate statements) but restricting something else so that this does not lead to admitting any arbitrarily chosen statement B. (All these logics and several others are collectively called *paraconsistent*.) In principle, there is no limit to what one can modify in the "standard logic" and still call the resulting system a logic.

A problem arises, however, once one realizes that any examination of a logic can only be conducted by logical means; and that these logical means are of a special variety. I use the term working logic for this variety, to avoid saying "informal" (for this term is sometimes used to designate formal models of "everyday thinking") or "metalogic" (for working logic is universal, and is not only used to study formal logics). The working logic of science seems to be a network of derivation and interpretation rules that more or less resemble those of the standard first-order logic intermixed with modal logic and a variety of "guiding" instructions, such as "consider now", "for a moment assume that", "I will now switch to", etc., etc. Now, with some discipline one can probably minimize and standardize most of these components. With some discipline one can even confine one's working logic within additional constraints, such as not using reductio ad absurdum in mathematical proofs. It seems clear to me, however, that this does not work in the opposite direction, that the working logic can never relax any of its informal rules without degenerating into "poor reasoning".

I call this the *"inescapability of logic":* one cannot escape adhering to certain logical norms without completely losing one's ability to accept some propositions while rejecting other. This thesis seems to me trivially demonstrable, even though I painfully realize that my preceding characterization of working logic is far from being clear. Consider, for example, a mathematician who studies a multi-valued logic. She can hardly allow herself to state something like "Propositions in my

calculus can have *3* truth values: *T,U,F*. Now, with the value *U* I claim that ...". A student of the non-adjunctive logic can hardly allow himself to say "In my calculus I can derive *X* from *Y* . Separately, in my calculus *X* cannot be derived from *Y*. Note that I said these things separately. They cannot be adjoined because I follow rules of my calculus." And (in reference to Lewis Carroll's charming story with the Tortoise debating Achilles) it would be weird to hear a scientist saying "According to my theorem, if *A* is observed, then *B* should be accepted as true. I did observe *A*. But I do not accept *B*:" The fallacy of such statements would not be in their deviation from the norms of working logic per se, but rather in the fact that by deviating from them they create a paralyzing chaos in one's ability to accept some statements and reject others. The situation is very different from that on the level of formal, object logics, where the formal counterparts of the statements just given would form consistent (or at least not proven to be inconsistent) alternatives to the "standard" formal logic.

So do the you-too-ists have a point after all? Do scientists take a certain form of logic on faith? I think the "inescapability of logic" does not warrant this conclusion. Being inescapable and being believed in are not just different things, they are, in a sense, mutually exclusive, for believing in something implies having a choice between believing and not believing in it. To use analogies, some form of signaling is unavoidable if one wishes to communicate, but this does not mean that communicating involves "believing in" signaling. One cannot escape using some form of spatial and temporal coordinates in describing a physical motion, but one does not "believe in" coordinates. The inescapability here is of a purely tauto-logical nature: the essence of the notion of communicating is in signaling, the essence of motion is in changing spatial locations in time. One can also come up with numerous examples of "physical" inescapability (e.g., most of us need to have brains to think), and those do not involve any faith either.

All of this, however, is not entirely satisfactory (not to me at least) insofar as the "inescapability of logic" remains a mere phenomenon, not even clearly described. Unfortunately, I cannot offer much more. I will only submit, as a tentative hypothesis, that working logic may be inescapable because (unlike in any form of formal logic) it lacks the distinction between logical relations and the derivation rules applied to these relations, so that the very meaning of logical relations in play compels or suggests corresponding derivations. Let me use again Lewis Carroll's modus ponens story. Several times I heard people interpreting this story as indicating the unjustifiability, if not irrationality, of standard logic. I do not see why. Note that the "paradox" only arises in working (informal) logic. It cannot be formulated in an object (formal) logic, where all one has to do is to simply invoke the rule $A \rightarrow B, A \vdash B$ and point out the difference between the symbols $\rightarrow$ and $\vdash$. The "paradox" can be formulated in working logic because "if ... then" in this logic is both a logical relation and a derivation rule. "If *A* then *B*" means two things: accepting the statement $A \rightarrow B$ and committing oneself to accepting *B* as soon as *A* is accepted. Precisely for the same reason the "paradox" is immediately resolved: to accept statement $A \rightarrow B$ means that if *A* is accepted

(separately) then *B* will have to be accepted (separately). To give another example: to accept *A&B* means to accept *A* and (separately) to accept *B* (which is why the non-adjunctive logic cannot be incorporated in working logic). The list of examples can be easily extended to other propositional relations and to quantifiers (thus, the specialization rule is merely part of the meaning of the generality quantifier). If one adopts this approach, Lewis Carroll's story appears no deeper than an imaginary story in which the Tortoise would say: "I have accepted *A*: But why should I then have accepted *A*?"

If my hypothesis could be upheld (presumably by means of critical examination of real samples of working logic), then the role of logic in science (including mathematics) would be characterizable not so much in terms of a set of rules guiding one from one set of propositions to another, but rather in terms of the rules determining normative meanings of logical relations that one uses in the formulation of these propositions. It seems to me that this may link in a nontrivial way the issue of working logic with that of semantic clarity (which I regrettably have to leave out of this essay).

5. Different but equal

The difficulty of dealing with the you-too position is in the fact that when challenging science as wanting in this or that respect it capitalizes on aspects of science that are not well understood scientifically. The situation is not dissimilar to that of creationists capitalizing on incompleteness of certain fossil records or disagreements about carbon dating of certain geological formations in order to justify their "alternative" to evolutionary biology. It is easier to demonstrate that creationist accounts of biological and geological phenomena are ridiculous than to explain the irrelevance of various difficulties in evolutionary biology for the validity of the creationist claims. In this respect the different-but-equal position is easier to deal with.

To compensate for this, however, the different-but-equal position presents another difficulty. To avoid circularity one must not criticize a construction presented by an adherent of this position on scientific grounds. Thus, if a radical dialectician asserts that every statement is true and false simultaneously and in the same respect, one must not counter this by saying "But this is a logical contradiction", because the dialectician is more than likely to eschew logic. A statement like "I know this by divine inspiration" cannot be challenged by asking for empirical evidence or definition of a divine inspiration, because the author of the statement is likely to maintain that divine inspiration is above empirical evidence, definitions, and all other devices of mere mortals. The question arises then: is there any way of arguing with these people? I would like to propose one possible way, and it is based on the extension of my characterization of working logic, which was: one cannot escape adhering to certain logical norms without completely losing one's ability to accept some propositions while rejecting other.

Note that this characterization does not speak of distinguishing truths from *falsities*, because in the eyes of the different-but-equal-ists "there is always your truth and my truth". So using the notion of truth would lead to a circularity, which our opponents, however contemptuous of logic otherwise, would point out to us as a logical contradiction. It seems, however, that I can safely assume one commonality among all people who write and talk instead of doing useful things: whether we are dealing with science or with what I claim to be counter-science (religion, mysticism, dialectics, etc.), we are always dealing with some expressed views that the author of these views *wants us to accept* (i.e., true statements in the eyes of this author) and which *exclude* certain assertions that the author *would not want us to accept* (i.e., false statements in the eyes of this author). Even if an assertion made is that any assertion is true, it tells us that it would not be correct to assert that some assertions are not true, or that no assertion is true. If a radical dialectician tells us that any statement is both true and not true in the same respect, he would disagree with us if we say that some statements cannot (or no statements can) be both true and not true in the same respect. In both these examples the assertions being made are self-contradictory from a logical point of view, but mindful of the circularity, we should let it be. What should be observed here is not the logical inconsistency of certain stated positions, but the mere fact that any such a position *designedly excludes* some other positions as untrue.

My point now is this: if P is a stated position, and E is a position designedly excluded by stating P; if furthermore a justification J (rhetorical argument, divine inspiration, Plato's anamnesis, a Sufic interpretation of a text, or simply the author's desire to assert P) is being presented in support of P, then J cannot be valid if it can be used to justify E as well.

To make it more interesting, the situation can be presented in the form of a quasi-Turing game, in which the originator of position P (let us call him Originator) relates it to a Skeptical Listener who is allowed to put to Originator all kinds of questions, and whose aim is to ascertain whether the justification means for P used by Originator can also be used to justify a position E designedly excluded by P.

A simple example. Originator states P (excluding E) and in response to all questions asked by Skeptical Listener says "Mu". Once Skeptical Listener understands that this is Originator's justification method, she states E on the strength of the same justification, Mu. We conclude from this brief quasi-Turing test that "Mu-ism" is not a valid alternative to science.

Another example.

Originator. The sum of the interior angles of a triangle is π:
Skeptical Listener. Why?
Originator. (provides the Euclidean proof based on Hilbert's axioms)
Skeptical Listener. And how do you justify Hilbert's axioms?
Originator. I don't. These are axioms. They are self-evident.
Skeptical Listener. So your method is to adopt some axioms, without justification, and then derive from them something and claim it to be true?

Originator. Yes. But the axioms are self-evident.
Skeptical Listener. Can you justify their self-evidence to me?
Originator. No.
Skeptical Listener. Then I claim that the sum of the interior angles of a triangle is a variable quantity less than π: I use Hilbert's axioms with Lobachevsky's modification, I claim them to be self-evident to me (though they may not be so to you), and I derive my claim as a theorem.

This example shows that stating one's axioms as unconditional truths is not a valid alternative to science. Note that the dialogue would not have led to this conclusion if the original claim was conditional: "If we accept Hilbert's axioms, then the sum of the interior angles of a triangle is π". By the quasi-Turing test, this statement is tenable, and may even belong to science. (Passing the test, at best, is only a necessary condition for belonging to science.)

Our game is, of course, less precisely defined than its celebrated prototype. It assumes that Skeptical Listener is able to distinguish the proposition being advanced (*P*) from the justification methods (*J*) for this proposition. This is by no means certain when dealing with "alternatives to scientific thinking". A real-life mystical philosopher, if asked to justify this or that, will respond with a progressively growing set of propositions each of which begs the same question. If it were possible to designate this progressively growing set of unfounded propositions as this philosopher's *method* of justification ("just keep saying things until your listener nods or leaves"), then of course Skeptical Listener would be able to play her trick. But the philosopher is not likely to ever admit this was his method. Or take a hypothetical philosopher who claims that all people are inherently evil and justifies this by citing numerous examples of heinous acts people do every day. Skeptical Listener, having detected this method of justification, should be able to advance the counter-claim that all people are inherently good, by giving numerous examples of kind and nice things people do every day. It is unlikely, however, that in real life the philosopher would agree that the series of trivial examples was his true method of justification.

With this in mind, let me switch to examples when the propositions being advanced are in fact about the methods purported to be valid alternatives to science. Simplistic as they are, they seem to me to reflect the essence of the different-but-equal views.

A dialogue.

Originator. One does not have to follow the rigid laws of logic in one's studies to come to valid conclusions.
Skeptical Listener. I agree.
Originator (elated). Really? That is very nice, very nice indeed. I thought at first you were one of those ...
Skeptical Listener. And I conclude that one always has to follow the rigid laws of logic in one's studies to come to valid conclusions.

Originator. What are you talking about? Haven't you just said you agreed with my thesis?

Skeptical Listener. Yes, I have.

Originator. But this is absurd!

Skeptical Listener. Logically, yes. But I have agreed, remember, that one does not have to follow the rigid laws of logic.

Again, a real-life counterpart of our Originator is unlikely to be convinced, and will probably continue the conversation by explaining that he did not mean just any violations of logic, but some and made at the right time in the right place under right circumstances, but that it would be silly to ask him to define what the right times and places and circumstances might be, etc., etc. Skeptical Listener would probably be correct to suspect that what the philosopher would really want to establish is the right for him, the philosopher, to violate logic when this suits him and to adhere to it when it does not.

Another dialogue.

Originator. One cannot define everything. When I say that mind is a property of highly organized matter I am unable to define what I mean by mind, or property, or highly organized, or (for that matter) matter, but I still think that what I say is true.

Skeptical Listener. I completely agree with your first thesis. But I disagree with your statement about mind, because it is apparent to me that induction is evanescent in the emergent power of life.

Originator. I am not sure I get your objection. You are saying ...

Skeptical Listener. That induction is evanescent in the emergent power of life.

Originator. Well, I know all these words, of course ... But can you at least tell me whether by induction you mean logical induction or mathematical induction?

Skeptical Listener. One cannot define everything, we agreed on that. Just try to understand what I am saying: Induction is ... (etc.)

This dialogue involves more levity than the previous one. Seriously taken it touches upon the issue of semantic clarity that I tried to avoid due to its difficulty. I think nevertheless that the dialogue is a useful demonstration for why the "one cannot define everything" attitude does not belong to science and cannot form a viable alternative to it. Unless understanding among one's skeptical listeners is implicit, one should aspire to define one's special terms: in relation to each other (as in mathematics), in relation to empirical observations and procedures, or at least by citing examples or instances in which a term occurs. Logical positivism and pragmatism in philosophy have played an exceedingly useful role in pointing out to us how easy it is to mistake vague emotional connotations for true meanings. All of us could readily provide numerous examples of such empty statements that are used over and over in philosophical presentations ("the whole is greater than sum of its parts" being the one that may be holding the longevity record).

6. Intellectual irreverence

This is a relatively trivial aspect of the justification issue: no tenable claim (by the criterion of our quasi-Turing game, hence also by scientific criteria) can be justified by its source, be it a person, holy book, God, cultural tradition of a Siberian tribe, prevailing views in an underprivileged group, or a moral tenet. I call this intellectual irreverence. This is but a variant (or generalization) of the untenability of stating a mathematical axiom as truth. If Originator uses a reverential justification for a claim, Skeptical Listener can always create an artificial source of authority (say, a piece of her own letter) based upon which she would state something designedly excluded by Originator's claim. I do not see a reason for pursuing this issue further, but it may be of some interest to touch upon the special case of intellectual irreverence, related to moral claims.

Clearly, stating that something is good or bad without specifying what it is good or bad for and precisely in what respect, puts this statement outside science and makes it subject to dismissal by means of our quasi-Turing game. One can come up with examples of conditional moral statements, however, that are perfectly tenable and can even be viewed as scientifically justifiable. To give an example, the original Buddhism is based on the following piece of reasoning resulting in a conditional prescription for action:

1. suffering is widespread (empirical observation, with suffering plausibly defined as feeling of suffering, which is easily operationalizable);[6]
2. the primary cause of suffering is in not getting or losing something one wants, or in acquiring something one does not want (empirical generalization testable, e.g., by survey and case studies);
3. ergo, if one could diminish one's desires and avoidances, one would diminish one's suffering (plausible conclusion from the premises, based on several explicable assumptions);
4. methods for diminishing one's desires and avoidances do exist, and here they are (an empirically testable claim).

The non-scientific part of Buddhism would be (I am not sure it was actually present in Buddha's original sermon) in asserting that diminishment of suffering is something one must wish to achieve (as opposed to "if you want to achieve it, then do this and that"). It is by no means obvious that everybody would want to get rid of a feeling of suffering, in any situation (thus, a mother may not want to diminish her anguish by forgetting her dead son).

This is a good opportunity for me to apply what I am saying to my saying this. It is inevitable that the views presented in this essay will be criticized on moral grounds, as promulgating and promoting a form of intellectual intolerance. This may be an effective rhetorical tool, but will not be justifiable. While one is free to impose any system of values on what I have written, it is a statement of fact that it

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[6] In its original form, Buddhism would not maintain that one can be suffering in a metaphysical sense, even if one feels happy. It would only make a plausible prediction that one's happiness is always temporary, and will inevitably turn into suffering.

does not present any specific moral position and makes no normative prescriptions. I have tried to establish that insofar as one is concerned with justification of one's positions to a skeptical listener, science (i.e., a network of positions justified by logic and empirical observation) has no tenable alternatives. I have no way (precisely because I wish to remain within the confines of science) of justifying the desirability of justifying anything to anyone, skeptical or otherwise. If I did touch in this essay on the vast issue of technology (which I did not do), I would be able to claim that in order to provide people with physical comforts and leisure time (both being necessary conditions for writing philosophy books) one has to rely on science, and that no "alternatives" to logic or systematic observation would provide people with the same. One could very well agree with me and then reject science because it is leading people to the evils of physical comfort, leisure time, and philosophy books. There are no unconditional goods and bads I can assign to logic, observation, technology, writing books, talking to other people, brainwashing, coercing, lying, or anything else I may have mentioned. One can very well agree with me that science is clearly distinguishable from religion, dialectics, mysticism, social constructionism, and other teachings that use "alternative" means of justification, and having agreed with me, decide that science is bad and one of these alternative things is good.

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