Truth and Science

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Preface

"What is truth?" is the core of nearly all philosophical, religious and scientific questions because, in any question we ask, it is the truth we seek.

Science is a particular means for seeking truth and therefore presents a particular definition of truth. However, before any meaningful discussion of whether a statement or conclusion is scientifically valid, we must first agree on a common logical framework and on conditions which distinguish science from non-science. Truth from mere assertion.

There may be other definitions of science, than what I propose here. The particular "brand" of science I propose is *rational* science. That means that the science and the truth we seek must be subject to the rational rules of logic.

The nature of science

The most fundamental assumption in Science is that the laws of Physics are true everywhere and always. For example, if a researcher in Chicago performs an experiment today and another researcher, in London, performs the same experiment, under identical conditions, but next Wednesday, the two experiments will still yield the same result. All science should always work in the same way everywhere, under the same conditions and within the bounds of the scientific theory being tested. In the language of logic, this is a *universal* statement.

A universal statement is true only if it is true for all members of the set to which it applies. Conversely, a universal statement is *false* if even one member of the set is contrary to the statement. If the set of applicability is large (like everywhere and always), it becomes very difficult or even impossible to prove that a universal statement is true, because we can't verify it for all possible cases. However, one needs only show one counter-example to prove that a universal statement is false. This asymmetry between the verification and falsification of a universal statement is the very foundation of science and the root of its strength and success. Essentially, we demand that science works everywhere, always and in the same way or we reject it as false.

Of course, in order to test whether a scientific theory works or not, the theory must be testable. This leads us to the principles on which Karl Popper's theory of demarcation is based. Popper claims that a theory must be *falsifiable.* That is, "statements or systems of statements...must be capable of conflicting with possible or conceivable observations." For example, a theory which claims that all red balls are red is not a scientific theory because there is no way to observe non-red balls within the context of the theory. It is not falsifiable and therefore not scientific.

During his lifetime, Popper had gone back and forth on the question of whether falsifiability is simply a *necessary* condition or is it a *sufficient* condition of demarcation. It is claimed that, at the time of his death, he considered it sufficient. Later, I will make the case that it is necessary but not sufficient.

Meanwhile, Popper also argued that *induction* has no place in science. Induction is when a

conclusion is based on supporting examples. His reasoning for this was that, in principle one could collect any amount of data supporting any hypothesis. Yet, because of the principle of falsification, only one counter-example is sufficient to disprove the hypothesis. Therefore, all the supporting examples are irrelevant and conclusions based on supporting examples (induction) are what Popper refers to as *pseudo-science*.

Consider, for example, two scientists performing exactly the same experiment, in exactly the same way and getting exactly the same results. The feature that distinguishes one as a scientist and the other as a pseudo-scientist is based on how they form their conclusions. The pseudo-scientist will gather evidence which supports the hypothesis and, based on the supporting evidence, conclude that the hypothesis is true. Dispite supporting evidence, however, the scientist will conclude from the *contradicting* evidence that the hypothesis is false. Essentially, the pseudo-scientist will base conclusions on induction while failing to apply the principle of falsification.

I agree with Popper that the principle of falsifiability is sufficient for the demarcation of a *hypothesis*. However, science is not limited to forming hypotheses. Science also includes the testing of the hypothesis. Vigorous attempts must be made to test the hypothesis and negative outcomes must be accepted (not ignored). Furthermore, all conclusions must follow rational rules of logic while premises, methods and data must be clearly stated or available so that results can be verified or repeated by others. Without any one of these additional features, the process is not science.

Although Popper has stated that induction has no place in science, I think he means that it has no place in the formation of a scientific conclusion. However, it is quite natural to form hypotheses based on induction. That is simply the forming of a hypothesis based on patterns in our observations. In fact, a hypothesis can be derived by any means and, as long as the hypothesis is testable and falsifiable, we can do science with it.

In summary, science requires *all* of the following features: A falsifiable hypothesis (formed by any means.) Vigorous attempts to test or falsify the hypothesis. Conclusions based only on rational rules of logic. Premises, methods and data clearly stated or available. This is our working definition of science for the purpose of the remaining discussion.

The nature of controversy

My own personal theory for why things become controversial is because two sides can present seemingly rational arguments which are based on the same facts, yet arrive at completely opposite or incompatable conclusions. How does this happen? Most commonly, this happens when one or both sides of an issue introduce logical fallacies into their respective arguments. The presence of these logical fallacies will often lead to invalid or contradicting conclusions. Therefore, it is important to at least be familiar with the most common logical errors. A brief list is presented below.

Common logical fallacies

converse error has the form $p \rightarrow q$; $q \ \therefore \ p$. For example, if Joe drops the glass, the glass will break. The glass is broken, therefore Joe dropped the glass. (The glass may have broken by other means.)

inverse error has the form $p \to q$; $\sim p \ \therefore \sim q$. For example, if Joe drops the glass, the glass will break. Joe didn't drop the glass, therefore the glass is not broken. (The glass may have broken by other means.)

improper induction Form a general conclusion based on a few cases.

begging the question Circular reasoning. Verification of conclusion is based on an assumption that conclusion is true. (Red must be Joe's favorite color since he drives a red car.)

appeal to authority To argue something is true because some authority says so.

appeal to ignorance Assert that theory is true if no alternate theory is proven.

straw man Replace original argument with misrepresentation. Prove or disprove misrepresentation and project result on original argument.

composition/division bias Assertion that, if part of an argument is true (or false,) then the entire argument is true (or false.)

ad-hoc Construct a series of unverified possibilities then draw conclusion based on the assumption that all the unverified possibilities are true.

post-hoc Assume that chronological order implies causation. (The rooster crows imediately before sunrise. Therefore, the crowing causes the sun to rise.)

Common procedural fallacies

confirmation/observational bias A tendency to see what one expects or wants to see.

ad-hominem This is also called attacking the messenger, but the truth of the message does not depend on who is giving it.

intimidation Use of threats and hostility to silence opposition.

censorship Disallow or purge opposing arguments.

Bad Science (B.S.)

For the remainder of this discussion, we will consider some real-life examples of bad science (BS) and why they are bad. For this purpose, we define BS as any scienctific endevor in which conclusions are based on logical fallacies or are inconsistent with the rational rules of logic. We will also consider any science-like endevor which is based on a non-falsifiable hypothesis to be *non-science*. However, non-science will also include pseudo-science, which *may* be falsifiable, except that efforts to falsify the hypothesis are supressed and/or conclusions are based only on supporting data.

It turns out that the science of anthropogenic global warming (AGW) features many, many examples with which to illustrate the nature of Bad Science, so that is where we will look.

First of all, many people who might otherwise be good scientists, often present evidence of warming as evidence of human-caused warming. This is a logical fallacy however, and

therefore is bad science. The fallacy is called the ***Converse Error*** or ***Affirming the Consequent***. The logical form is $p \rightarrow q;\ q\ \ \therefore p$. As we saw earlier, a simple example of the converse error is, if Joe drops the glass, the glass will break. The glass is broken. Therefore Joe dropped the glass. Although it may be true that Joe dropped the glass, we cannot conclude that it is true because there are any number of other reasons why the glass might be broken. This is why evidence of warming is not evidence that warming is caused by humans. In fact, *all* evidence of warming is irrelevant with respect to the cause of the warming. For example, suppose we form a theory that aliens on another planet are projecting an energy beam toward the Earth and the energy beam is the cause of warming. If the theory is true, the Earth will warm. Oh look! The Earth is warming. Therefore, it must be those pesky aliens. As ridiculous as that sounds, it is exactly the same logic as the claim that evidence of warming is evidence of human caused warming. Evidence of warming is ***not*** evidence of cause.

Another commonly given argument is that there is consensus among scientists and that the question is settled. However, even if that claim were true (which it, arguably, is not), it is totally irrelevant and contrary to the principles of science for two reasons: First, we demand that all scientific conclusions must be logical. **Appeal to a authority** is a logical fallacy and is not acceptable as science. Secondly, there is only *one way to test a hypothesis*, and it is not by popularity. A hypothesis is tested by whether or not observable predictions made by the hypothesis are true. If any of the predicted observables are false, then the hypothesis is false. This is brutally simple, but it is the very foundation and strength of science.

It is true that some elements of science do require consensus. For example, we have consensus of how to define a meter or kilogram, or on the names and masses of atoms in the periodic table. We have consensus regarding a huge amount of technical data (as we might find, say, at NIST.) This is data which we accept as accurate (within the limits of carefully described methods with which the data was measured.) So we have agreement upon many things in science according to their carefully defined definitions. However, it is also by consensus that consensus is *never* an acceptable test or verification of a hypothesis. If it's science, it isn't consensus. If it's consensus, it isn't science.

Ironically, many people who call themselves scientists, refer to skeptics as being anti-science or "science deniers" The irony is that science ***is*** skepticism and it is those who reject skepticism who are anti-science and science-deniers. In rational science, hypotheses are *never* crowned as true. Even after a hundred years of success, we are still testing general relativity because science is never settled and skepticism is always welcome.

The **straw man** fallacy is when we substitute the real question with a misrepresentation of that question and then proceed to prove or disprove the misrepresentation. In this regard, it is important to realize that computer models are not reality. Computer models only do what they are programmed to do and we can only program them to do what we already understand. When we make a model, it is standard procedure to make sure that it does what we expect it to do. That process often gives us false confidence that the model is an accurate reflection of reality. Of course it will do what we expect it to do. We programmed it that way! However, it is *not* reality.

Furthermore, a common feature of non-linear systems, like climate, is that even small changes

can have large effects. In regard to climate models, they contain many parameters of uncertain value. For some, even the sign (+/-) is unknown. To deal with these unknowns, modellers often adjust them until they get results they want or expect. In this manner, warming, cooling, wet, dry, stormy, calm, all can be achieved by tuning the unknown parameters. When they assume that the parameters are correct when the expected results are achieved, modelers become pseudo-scientists in the strongest possible sense because they seek expected results which support their hypothesis and reject those that don't.

Another straw man argument is to present the production rate of CO_2 by human activity and make future projections based directly on that rate. This argument misrepresnets the atmosphere as a simple, static system in which the CO_2 simply accumulates. It does not, for example, account for powerful feedbacks such as more CO_2 promotes more plant growth which, in turn, consumes more CO_2.

When examples of collapsing ice shelves or receding glaciers are used to conclude that all glaciers are melting, it is an example of **improper induction**. By drawing a general conclusion from a few examples it overlooks the hundreds, if not thousands of glaciers around the world that are growing. Those examples of growing glaciers could, similarly, be evidence that all glaciers are growing. But that would also be improper induction.

Confirmation or observational bias occurs when the researcher has strong expectations and is inclined to 'see' data which supports those expectations and may miss or ignore contrary data. Sometimes this is accidental, sometimes it is deliberate. This is a procedural fallacy. For example, a research group at the CRU in East Anglia, loaded historical temperature data into a program which processed the data by subtracting temperature from early data and added the subtracted temperatures to recent temperature data, forcing the data to show a temperature increase while keeping the total temp $\times$ time constant. That is outright and deliberate alteration of data.

A more subtle example, also from the CRU, occured when a researcher had collected proxy-temperature data from tree-rings. However, the data showed the temperature to be *decreasing* in modern times (post 1960). So they discarded the post 1960 proxy-data and replaced it with other data from an entirely different source but happened to feature higher temperatures. So they joined two different and incompatible data sets by selecting portions of each set to create a pre-determined result.

In yet another example of data manipulation and bias, it was shown that the historical temperature data at many weather stations throughout the U.S. were unreliable. This is because of urbanization which causes the temperatures to read artificially higher compared to the more reliable rural data. Stations that were once rural are now on black-topped parking lots, below air-conditioner exaust vents, subject to jet exausts at airports... To solve the inconsistency, reliable stations were recalibrated to agree with the unreliable stations, guaranteeing that the data would show expected warming.

It is even written in the UN IPCC Policy Guide that their procedure is to write the Summary for Policy Makers first and then edit their reports *and data* so that they conform to the Summary. As a matter of official policy, they alter their own data in order to fit their pre-determined conclusions.

Another procedural fallacy is the **ad-hominem** or attack the messenger. Probably the most common attacks are, "He's gotten money from Big Oil" or "He's not a climate scientist." But these have nothing whatsoever to do with the truth of what the person is saying. Ad-hominems should be ignored.

Intimidation and censorship are often more difficult to ignore because they result in silencing the opposition so you might never even hear an opposing view. For example, Roger Pielke Jr at Colorado U had a long history of supporting the global warming hypothesis. But when he testified that certain storm damages couldn't be attributed to global warming, he came under investigation by Congress and his university also received a letter from congress threatening the university's funding. That same week, six other letters went out from other congressmen and senators threatening university funding because they had 'climate deniers' on their staff.

As if that's not bad enough, state prosecutors in two states are threatening to prosecute and jail climate deniers and Loretta Lynch, who was the US attorney general said that the Department of Justice was looking into the possibility of putting climate deniers in jail. So these aren't just idle threats. The force of law is being used to silence opposition.

As for **censorship**, at least one journal editor was fired from his editor job because he allowed an article critical of global warming to be published in the journal. The same group responsible for the editor's firing also applied pressure to editors of other journals as well. This is science today.

Is there any valid global warming science?

Up to this point, I have only given examples of unacceptable or invalid evidence. However, that doesn't prove that the global warming advocates are wrong. Even a stopped clock is right twice a day. So, what about *valid* scientific evidence? Happily, there is some valid evidence which we can consider.

The hypothesis that recent warming is primarily caused by greenhouse gases produced by human activity *is* a scientifically valid hypothesis. It is valid because it predicts certain observables which must be true if the hypothesis is true. In other words, the hypothesis is *falsifiable* and that is the most fundamental requirement of a scientific hypothesis.

One of the observables that the hypothesis predicts is that the temperature trend in the tropical troposphere increases at a rate of three to four times the rate at the surface. This makes sense because, if it is the atmosphere that is warming the surface, then the atmosphere must be warmer than the surface. This is a result of the 2nd law of thermodynamics and it is an observation we expect to see if warming is due to the greenhouse effect.

We have about seventy years of balloon and satellite data with which to test the prediction. It turns out that the observational data shows a trend in the tropical troposphere which increases at a rate of about half to a third of the trend at the surface. This is the exact opposite of what greenhouse gas theory predicts. To any reasonable scientist, this should cast grave doubts on the theory. But proponents of the theory simply refuse to accept the observational evidence.

Meanwhile, another observable is also predicted by the theory. This second prediction argues

that, as the oceans warm, they will release more water vapor into the atmosphere. Since water vapor is a more potent greenhouse gas than CO_2, it is argued that the increase of water vapor will result in a more effective insulating layer. As a result of this stronger layer, it is predicted that the rate at which heat is radiated into space will decrease as the ocean temperatures increase.

We have several decades of satellite data with which to test this prediction and we find that the rate at which heat energy is radiated into space *increases* at a rate about three times greater than what greenhouse gas theory predicts it should be *decreasing*. So again, the observations are the opposite of the predictions.

Even if we don't have a better theory or understanding of what causes global warming, these observations clearly and unmistakably show that, whatever it is that is driving temperature, it is *not* greenhouse gases.

Evidence of warming is not evidence of cause. Consensus is not proof. Computer models are not real and are not proofs (especially non-validated computer models). Observational tests of the predictions of a theory are the only legitimate scientific tests of a theory. Global warming via greenhouse gas theory has failed as a scientific theory since observations refute its predictions. We have seen that the theory is supported by invalid arguments such as, consensus, converse error and induction. Yet many scientific organizations and people who call themselves scientists continue to invoke un-scientific methods, logical fallacies and abandonment of the principle of falsification to prop-up and defend this failed theory. And then they have the gall to refer scientist that don't agree with them as being anti-science! Global warming is single-handedly destroying all of science.