

## On concepts of law and truth

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ABSTRACT. This essay is dedicated to my learned colleague, Olivier Costa de Beauregard, on the occasion of the 60<sup>th</sup> anniversary of his doctoral thesis: “Contribution to the Study of Dirac’s Theory of the Electron”, and to his dedication to knowledge.

### 1 Introduction

Since the earliest periods of Western Civilization, a primary focus in science and natural philosophy has been on the *law of nature*. But in spite of maintaining this focus in the scientific enterprise, the meaning of the concept of *law* has changed many times throughout the different periods of the history of ideas.

Intimately related to the varied meanings of the concept of *law* are different definitions of the concept of *truth*. The first order of business, then, in resolving outstanding conflicts in science and philosophy in regard to their mutual goals is to agree on the meanings of the words that pertain to these goals, before discussing the most effective paths toward them.

The differences between the concepts of truth are well known and have been discussed by philosophers for centuries. An example is the distinction made between ‘analytic truth’ – pertaining to a convention whereby the truth or falsity of an assertion is predetermined by a (humanly devised) system of axioms and logical rules – versus a ‘contingent truth’ – pertaining to the interpretation of a fact of nature, whereby the truth or falsity of an assertion is contingent with respect to the natural world, *objectively*, irrespective of whatever sorts of logical conventions human beings may invent to describe nature. In recent times, there has been discussion by philosophers,

such as Quine [1], as to whether or not the alleged difference between ‘analytic truth’ and ‘contingent truth’ may not be illusory.

Then, there is a third sort of truth that may be termed ‘religious truth’. This entails a truth-value assigned to an assertion that is not verifiable in accordance with logical rules or the comparison of the predictions of science and the empirical facts of nature. This is rather based on the notion of *faith*. This may be any assertion based on faith - not only an assertion of an organized religion. For example, one may rightfully say that it is true that a man loves a woman – but he has no way of defining precisely or proving this statement with logical or scientific methods. Still, it is a statement of truth based on a deep feeling of faith in this relationship. To this person, the assertion of love is a ‘religious truth’

Thus, when we say that a particular law of nature is *true*, we must keep in mind a mutually agreed upon set of definitions of the words, *law* and *truth*.

In this essay, I wish to expand upon the concepts of *law* and *truth*, particularly to clarify their meanings from the perspective of their usage in theoretical science. We will see how different meanings of these words can become mixed up in debates on the concepts of *law* and *truth* in science, with opponents and proponents using the same words but having different meanings of the words in mind. An example is when one may be referring to science but in fact it is in regard to the concept of religion, as in ‘religious law’ and ‘religious truth’.

## 2 What is a Law in Science?

One meaning of the word ‘law’ is that it is a rule of behavior, such as the laws of jurisprudence imposed by society for the preservation and protection of human beings and their possessions. Examples are: Do not kill another human being, Do not drive through a red light, Pay your income tax before April 15, ... etc.

But a ‘scientific law’ does not have the same purpose as the laws of jurisprudence. In the present usage of the word *law* in the context of science, it has two distinct meanings that in turn are related to two epistemological approaches to knowledge. One of these meanings refers to a regularity of the empirical data of scientific experimentation, with respect to particular sorts of phenomena. An example would be the phenomenological approach of modern day elementary particle physics. In this field of study, one searches for categories under which groups of ‘particles’ may fit, regarding the data that pertain to them, or in classifying data in accordance with some curve or graph. The scientist may discover some empty (i.e. yet unobserved) compartments in the categories of the data, and then make a *prediction* that new

experimentation should reveal new data that would fit these places on a graph. Then, if such observations are vindicated, the scientist could claim that his law is obeyed and therefore it is a truth of nature.

But the second view of law in science is that it refers to *underlying* concepts that in turn give rise to the observed data regarding particular phenomena. That is to say, one views the categories and curves on graphs that provide phenomenological fits for the data as *particulars* that should follow in a deductive fashion from some underlying *universals*. It is the set of *universals* that is to be taken as the *laws of nature*.

The former phenomenological interpretation of *law* is close to the epistemological stands of logical positivism, empiricism, operationalism and instrumentalism. *Its logic is inductive*. The latter underlying view of *law* is closer to the epistemological stand of realism. *Its logic is deductive*. The latter approach to knowledge is ‘abstract realism’ in the sense that the underlying realities of the physical world – the universals – are abstract, that is, they are not all directly observable with human senses or instruments, though they are comprehensible and approachable, at least in part, by means of reason.

It is interesting to note that in contemporary physics, these two contrasting epistemological approaches separately dominate the philosophies of the two main rival theories in fundamental physics – the quantum theory and the theory of relativity [2]. In accordance with the interpretation of the Copenhagen school, the quantum theory takes the stand that all that one may refer to in science, regarding elementary particles of matter, are the measurements made on them by macro-observers. It contends, further, that the laws of error that necessarily appear in the interpretation of measurements, i.e. the mathematical expression of a particular sort of probability calculus, are the fundamental laws of matter themselves, rather than only an aid to interpret the laws of matter from the measurements.

On the other hand, a full exploitation of the theory of relativity in interpreting the laws of elementary matter – in accordance with the philosophical stand that Einstein took after he reached the stage of general relativity theory – concludes that there is a real world to talk about, quite apart from the particular measurements that human beings may or may not carry out on any sort of matter, whether it is micro-matter or macro-matter. With this approach, the laws of error in the measurement process are not fundamental laws of matter, as they are in the quantum theory. They are, rather, a set of rules that help the experimenter to interpret the data regarding what it is that *underlies* these data – in terms of the *laws of nature*.

### 3 What is Truth in Science?

Just as there are different contextual meanings for the word *law* in science, there are quite different meanings for the word *truth*, chosen from different contexts.

As I see it, there are three sorts of truth that should be distinguished for the purpose of this essay: scientific truth, analytic truth and religious truth.

*Religious truth* is based on faith. A religious person *knows* that God exists, because he or she has faith in the truth of this assertion. Similarly, the religious person *knows* that God created the universe (some believe that it was at the precise time of the ‘big bang’) because they have faith in this belief. Or, an atheist *knows* that God does not exist, similarly having faith in the belief of this negative assertion. In both cases, there is no way of proving these assertions with a scientific or an analytic argument – they are based on faith. The opposite of the foregoing ‘religious truth’ is the ‘knowledge’ of the agnostic – who does not know if God exists. This is because the agnostic does not have faith in any assertion about the existence or lack of existence of God. Of course, there is a whole body of other assertions in the domain of theological knowledge, in addition to the one about the existence of God, that would be considered as true or false *in the context of theological logic – that they are in regard to a judgment based on faith.*

*Analytical truth* is a logical conclusion following from a set of axioms that are in accordance with a given set of invented rules of one sort of logic or another, be it Aristotelian logic, Socratic logic, or the modal logics of contemporary thinking. For example, in accordance with the rules of the logic of arithmetic – the definition of numbers and the meaning of the operations ‘plus’ and ‘equal’ – it follows that it is *necessarily true* that 2 plus 3 = 5. The conclusion cannot be anything other than 5. The point here is that this is the sort of truth that does not have to relate in any way with religious truth (faith) or with the alleged truths of a real, observable world (science).

*Scientific truth* relates to the *objective world* – all of nature. Since our powers of comprehension are finite, the way that we explain phenomena of the natural world must be *contingent* on the way that nature *is*, rather than hypotheses that we guess at according to our own individual intuitions. That is to say, while the basis of an *analytic truth* is inside of us (in our minds), the basis of a *scientific truth* is not only in us, but also outside of us in all of nature. Thus, we proceed in the history of science by continually refuting and verifying alleged scientific truths. Thus, if, based on intuition, the scientist wishes to guess at some underlying hypotheses, as axioms for some natural phenomena, and she uses the rules of deductive logic to predict some of the empirical consequences, then if experimentation yields results that

agree with the theoretical prediction, it may be said that *thus far* the original hypotheses are scientifically true.

But this is clearly a *provisional truth*, subject to refutation - as soon as a single instance of nature is not in accord with any prediction of the theory, or if any logical error is found in the theoretical formulation. Thus, *scientific truth* is only meant in the context of being provisional regarding our understanding of the natural world, in any of its manifestations. It is not a necessary truth! It should be mentioned here, parenthetically, that the scientist must initially have a certain amount of faith in the possible existence of an underlying order that is not totally understandable, before he or she probes into consequences of this order in scientific terms. *Thus, there must be 'religious truth' involved in the investigations of the scientist.* This view is corroborated in the writings of such scientists as Michael Faraday and Albert Einstein.

The truth of an analytic assertion is based on the testing of the consistency of a given set of axioms and their logical consequences. The proof of a scientific truth is based on the analytical method *and* demonstrating the correspondence of an alleged truth and the empirical facts of nature. But one cannot prove the truth of a religious assertion the way that a scientific or an analytic truth are proven, because it is not defined in their respective contexts. Thus if one does not (or does) have faith in the truth of a religious assertion, he or she would deny (or affirm) that there is such a thing as 'religious truth' and 'religious knowledge'. But they cannot prove this denial (or affirmation) with any scientific method, since the different types of knowledge are out of context. That is to say, to make a religious claim from a scientific assertion would be a *non sequitur*. For example, it is often claimed by astrophysicists that the 'big bang' (the initiation of the currently observed expansion of the universe) must verify the existence of God, since it must be the outcome of His creation of the universe! This is a logically false statement! For it is a theological answer to this scientific question: how did the matter of the universe get into the state of maximum density and instability in the first place, to give rise to the 'big bang' and the ensuing expansion of the universe?

#### **4 Relations Between Time and Law in Science and Theology**

The concept of *time* in physics has several meanings and it is intimately related to the concept of scientific law. *Time* has a still different meaning in the context of theology.

The concept of time in Einstein's theory, applied to relativistic mechanics of particles of matter, serves the role of the parameterization of the trajecto-

ries of moving matter. It is a *subjective* parameter that expresses a relative measure of the evolution of a bit of matter that moves along a trajectory – from the view of any particular observer’s frame of reference. In Newtonian mechanics, *time* is an *objective* parameter describing the trajectory of a singular particle of matter.

The time concept in the second law of thermodynamics does not at all refer to a singular particle of matter. Rather, it refers to a parametric measure of the process of restoring disorder from order, for an entire ensemble of material particles, as it proceeds from some non-equilibrium state to its final equilibrium state. Explicitly, this is described in terms of the increase of ‘entropy’ (a measure of the disorder of the system) *in time*. But this sort of *time* has nothing to do with the dynamical time of Einstein’s special relativity theory or that of Newtonian dynamics. Thus, statements about thermodynamic time, the time of Einstein’s special relativity theory and the time of Newtonian dynamics are in different contexts – *since they all refer to a parameterization of mutually exclusive sorts of laws of matter*.

In theology, the time of the laws pronounced in the Biblical Scriptures have still a different meaning. Consider the Christian theologian St. Augustine’s comment in his *The Confessions* (Book 11) [3]:

“It is in you, O my mind, that I measure time. I do not measure the things themselves whose passage produced the impress; it is the impress that I measure when I measure time. Thus either that is what time is, or I am not measuring time at all”.

St. Augustine then argued that “before” the matter of the universe existed, there was no time to talk about – just as the wetness of a liquid is a meaningless concept apart from the existence of a liquid. He then saw *time* as one of the created things, yet apart from matter.

Several centuries after St. Augustine, the Middle Ages Hebrew theologian and philosopher, Moses Maimonides (his Greek name for Rambam) gave an explicit interpretation of the creation, *ex nihilo*, in the sense of interpreting time as *a quality of matter*. In his treatise, *The Guide of the Perplexed*, he said [4]:

In the case of everything produced in time, which is generated after not having existed,.. the nature of that particular thing after it has been produced in time, has attained its final state, and achieved stability, is different from its nature when it is being generated and is beginning to pass from potentiality to actuality. God’s bringing the world into existence does not have a temporal beginning.

In Maimonides' view, then, *time* is a quality, or manifestation of matter, whereas in St. Augustine's view, time is a separately created thing, in addition to matter – a thing in which matter evolves.

The meanings of *time*, according to St. Augustine's or Maimonides' views of Biblical law, does not imply that there is a logical fallacy in the Scriptures. In their view, there could not have been a 'First Cause' *preceding* the creation of the universe (effect), because 'cause' must precede 'effect' (*in time*) and there was no time preceding the effect of the creation. It is not a fallacy because 'First Cause', in the theological view, is not defined temporally. This is because time *per se* is defined in the context of the science of matter (physics) while 'First Cause' is meant only in the theological context.

In terms of its inherent qualities, 'First Cause' is timeless – there is no past, present or future with respect to it – even though the word 'First' appears in the name. One of the Hebrew names for God is: 'HAYA-HOVEH-YEEHEEYEH' (*was-is-will be*). Thus, the name 'First Cause' is not meant to imply a temporal sequence; it is only meant in the sense of being *fundamental* and *underlying*, in a theological sense.

Summing up, *law* and *truth* are multivalued concepts, having different meanings in different contexts. Thus, to understand and to pursue further the bases of scientific laws, laws of mathematics and logic and religious laws, it is essential to state at the outset the meanings of *law* and *truth* that are appropriate to the contexts to which they are applied in the ensuing discourse, if meaningful conclusions are to be reached.

I wish to thank Dr. Robert R. Sachs for his insights in discussing the ideas of this essay with me.

## References

- [1] W. V. Quine, *From a Logical Point of View* (Harvard University Press, 1961), Second edition; *The Ways of Paradox and Other Essays* (Harvard University Press, 1966).
- [2] I have compared the philosophies of the quantum and relativity theories in: M. Sachs, *Einstein Versus Bohr* (Open Court Publishing Co., 1988).
- [3] H. Chadwick, *translator, Saint Augustine Confessions* (Oxford University Press, 1991).
- [4] S. Pines, *translator, M. Maimonides: The Guide of the Perplexed* (University of Chicago Press, 1963), p. 294. I have discussed these ideas further, in the context of physics, in: M. Sachs: "Maimonides, Spinoza and the Field Concept in Physics", *Jour. Hist. Ideas* **37**, 125 (1976).

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