Science and Religion: Notes on a Lecture by Professor David Kazhdan

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Over twenty years ago, when I was working on my doctorate at the Weizmann Institute, my teacher and friend, Professor David Kazhdan, delivered in Rehovot a lecture on the topic "Science and Religion." Since then many things around us have changed (for example, this year David was awarded the prestigious Israel Prize), but the "eternal questions" discussed in that lecture remain as relevant as ever. Based on David's notes for that lecture, I would like to start a new round of discussion on this fascinating subject. The following text is an expansion of those lecture notes, translated from Russian. I have added footnotes to provide references, as well as further explanations and clarifications.

Usually at the heart of discussions such as the topic of this lecture lies the premise that the distinction between science and religion can be easily formulated.[1] Let us try to understand how people perceive this difference.

We can point out three main features of science:

a) The goal of science is to pursue knowledge of the objective world;

b) Science uncovers the patterns that underlie the beauty and orderliness of the cosmos;

c) SInformation provided by science equips us with a roadmap with which we can set precise goals and select the appropriate means for exploring nature.

In other words, the object of scientific inquiry is nature, which exists independently of us, and only with great effort do we succeed to discover new information about it. By contrast, religion has no meaning outside of the human domain, precisely because it deals with the role of Man, standing before the Almighty in the world created by Him. The purpose of religion is not so much the exploration of the outside world, as the transformation of the inner world of individuals to enable them to come closer to God and obey His will better.

Therefore, we maintain that science and religion belong to different spheres. Laplace very clearly expressed this position in his famous response to a question posed by Napoleon (regarding the role of God in Laplace's structure of the Universe): "I did not need this hypothesis." For Laplace, the role of science was to explore the laws of nature, and religion cannot contribute in any way to this endeavor.

The difference between science and religion can be viewed also from another angle. Science deals with the knowable; it does not consider the irrational, and therefore does not tolerate contradictions. Any contradiction must be a sign of error, misunderstanding, or inaccurate definition. Religion, on the other hand, proclaims the inscrutability of God. God's incomprehensibility to man is not limited to any particular situation or timeframe in which man finds himself. Nor does it result from any deficiency in the development of the human mind or theology. God is simply not part of nature. Only nature can be explored and conquered by man.

God's inscrutability is the source of the perceived contradictions between divine omniscience and human freedom of choice, between God's goodness and the existence of evil and suffering, and between man as the image of God and the prohibition of eating from the Tree of Knowledge[2].

1 Prof. Eliahu Rips has drawn my attention to the fact that the idea of a clear-cut separation between science and religion is extensively discussed in various forums. See, for example, http://en.wikipedia.org/wiki/Non-overlapping_magisteria. A clear distinction between the objective world of science and the subjective world of religion is not so obvious, even for the sake of argument. This thesis is questioned towards the end of this lecture. See also C.H. Townes, "The Convergence of Science and Religion" in Think Magazine, IBM, NY, v32, 2, 1966, pp1-7 for a similar discussion.

2 I understand the last contradiction as follows: on the one hand, man was created in the image of God and thus man has the freedom of choice. On the other hand, man's freedom of choice was limited by God's prohibition to eat from the Tree of Knowledge because eating from it would make him similar to God.

There are other features that distinguish science from religion. All of them, however, can be related to the fact that science deals with the objective world and religion with the inner world of man.

Everything would be simple if we could stop here and conclude that science and religion have nothing in common. Further examination will show, however, that in fact there are similarities in the way we think about these two areas. The opposition between the objective and the subjective, which indeed seemed obvious to thinkers in the 17th -18th and even in the 19th centuries[3], has not been fully upheld by the subsequent development of science. Here are a few examples.

For Euclid, the axiomatic structure of geometry[4] was a wonderful reflection of the beauty and perfection of the cosmos. Almost all the Euclidean axioms are "self-evident:" between any two points, one and only one line can be drawn; two lines intersect at only one point or do not intersect at all, etc. All of these axioms can be formulated even if we restrict ourselves to a finite region of space. The only exception is the axiom of parallel lines, which makes sense only when we consider infinite space. This anomaly motivated numerous attempts to reduce the parallel lines axiom to be self-evident, like the rest of them.

At the end of the 18th century it became clear that these attempts were hopeless. Why did the acknowledgement of this fact take so long? Already in his youth, Gauss had developed a geometry without the parallel postulate (non-Euclidean geometry). Yet why did he not dare publish this discovery even in his mature years? Most likely, the very possibility of the existence of different geometries was frightening, as it implies (as explicitly formulated by Riemann) the possibility of the existence of other worlds described by different geometries. Perhaps our world is not absolute? Gauss' fear was not unfounded. Recognition of the possible existence of variant geometries required a dramatic, shattering change in perception.

How did mathematicians react to the shock they experienced at the realization that the *a priori*-specified object of their research had apparently lost its absoluteness?

The first and natural reaction was an attempt to artificially create a foothold, to find a reliable foundation for mathematical constructions. To borrow from biblical imagery, this can be compared to the building of the Tower of Babel.[5] Such an effort is reflected in Hilbert's program, which attempted to clarify the foundations of mathematics. Its objective was to develop a finite set of

3 Laplace's (1749-1827) response to Napoleon, cited by David earlier, clarifies this position. Laplace also believed that if he knew the position and velocity of every particle in the universe, and could calculate sufficiently well, he would be able to predict the future. Another example is Pasteur (1822-1895), who, when asked how he as a scientist could be religious, simply replied that his laboratory was one realm, and that his home and religion were a different one.

4 David does not discuss the question whether one can evaluate the natural sciences using the example of mathematics. A widespread opinion exists that mathematics is a special case and is not at all comparable to the other sciences. The relation between mathematics and other sciences is discussed, for example, in the classic work of E. Wigner, "The Unreasonable Effectiveness of Mathematics in the Natural Sciences," Richard Courant Lecture in Mathematical Sciences delivered at New York University, May 11, 1959. *Communications on Pure and Applied Mathematics* 13: 1–14. Further exploration of this topic is beyond the scope of our article.

5 According to Midrash Raba, 38:6 the intention of the builders of the Tower was to strengthen their independence from God's presence in this world. This can explain the severity of the punishment they received.

definitions, axioms, and inference rules which would be complete enough to serve as a basis for the deduction of all the theorems of geometry, but at the same time would not lead to contradictions. In other words, this set of axioms must be *consistent* (so that it would be impossible to arrive at conflicting conclusions based on it), and *complete*, i.e. any meaningful statement formulated with these definitions can be either proven (that is, it can be derived from the axioms by means of stated rules of inference), or refuted (the falseness of the statement can be proven).

The implementation of Hilbert's program was supposed to lead mathematics into a "safe harbor" and to bring about a situation where the verification of any proposition, at least in principle, could be reduced to a finite sequence of tests.

Hilbert achieved partial success in the implementation of his program by demonstrating the applicability of its statements to the calculation of propositions. It seemed that only one more step was required to expand the program into more substantial areas of mathematics, and the bottomless abyss would be closed. But Gödel showed that Hilbert's program in fact could not be realized. According to Gödel's theorem, any set of consistent axioms that is rich enough to serve as the basis for deduction of all the theorems of geometry cannot be complete, because there will always remain questions to which a definite answer cannot be given.

What does Gödel's theorem mean for us? In the dry language of mathematical logic it proclaims an astonishing discovery: there is no natural mathematics independent of man.[6] Man is not the discoverer of mathematical truth; he is the *creator* of it.

We can find another example in the field of linguistics. In the 19th century it was accepted that language emerged from the primitive sounds by which prehistoric people communicated, similar to those observed among animals. According to this view, in the course of evolution these sounds combined and became more complex, to the point at which they developed into sufficiently advanced systems to be considered language.

If this were true, however, the grammatical structures of languages spoken by primitive tribes should be much simpler than those of developed languages such as English, Russian, or Greek. But in fact, to no small embarrassment of the evolutionists, the languages of seemingly "primitive" African and Australian tribes are no simpler than the languages of the civilized world.

Thus, the hypothesis that man developed speech at a certain stage of evolution is not supported by facts. Rather, it can be said that man without language is as unthinkable as language without man. With reference to the first chapters of the Bible, we can say that Adam was created already endowed with the ability to give names to animals and objects.

We see from these examples that the world that we encounter cannot be regarded either as given *a priori* or as a result of the application of some objective idea. We live in a world whose very

6 For example, a system that includes the "Axiom of Choice" (see Wikipedia, http://en.wikipedia.org/wiki/Axiom_of_choice, for explanation) in its set of axioms is a different kind of mathematical system than one that does not include this axiom.

existence rests on our shoulders. This view had been expressed many centuries ago in the Talmud. In tractate Avodah Zarah, 3a, a question is asked regarding why a definite article is not used before the numerals in the account of the first five days of creation (יום אחד, שני, שלישי, רביעי, חמישי - first day ... second ... third ...), whereas the sixth day is mentioned with a definite article: יום השישי (the sixth day).[7] The Talmud explains that this is an allusion to the Sinai revelation, which will occur on the sixth day of the month of Sivan. In effect, the Talmud asserts that all of creation that emerged in the six days existed only on condition that on the sixth of Sivan the People of Israel would receive the Torah at Sinai.

Because man is not merely one of the elements of creation but its very essence and basis, without man the world would not exist.[8]

Maimonides[9] connects the apparent contradiction between divine omniscience and human freedom of choice with God's infinitude,[10] expressed by his assertion that God is identical with His knowledge (His will). A similar connection[11] can be seen in modern science. It is precisely the infinite nature of the discovered world that leads to contradictions, which have become an integral feature of many modern scientific concepts.

The following examples can be mentioned, among others: the paradoxes of mathematics, the problems of interpretation of quantum mechanics, the complexity of "primitive" languages, and the contradiction between the law of increasing entropy and data obtained from observations of distant galaxies.[12]

7 ואמר רבי שמעון בֶּן לָקִישׁ, מַאי דִּכְתִיב, (בראשית א) "וַיְהִי עֶרֶב וַיְהִי בֹּקֶר יוֹם הַשִּׁשִּׁי"? מְלַמֵּד שֶׁהִתְנָה הַקָּדוֹשׁ בָּרוּךְ הוּא עִם מַעֲשֵׂה בְרֵאשִׁית, וְאָמַר, (להם) אִם יִשְׂרָאֵל מְקַבְּלִים אֶת הַתּוֹרָה - מוּטָב, וְאִם לָאו - הֲרֵינִי מַחֲזִיר אֶתְכֶם לְתוֹהוּ וָבוֹהוּ.
R. Simeon b. Lakish further said: What is conveyed by the phrase (Bereshit, 1) "And there was evening and there was morning the sixth day?" It teaches us that God stipulated with the works of creation, saying: "If Israel accepts the Torah it will be well, but if not, I shall reduce you to a state of chaos".

8 In my opinion, this is the main conclusion from David's lecture: we are responsible for the world in which we live. While David arrives at this idea in the lecture as the result of a very general analysis and understanding of the foundation of mathematics, this position is familiar to us from the Jewish teaching (Mishna Sanhedrin 4:5): "Everyone is obliged to say: The world was created for me."
חייב כל אחד ואחד לומר בשבילי נברא העולם.
Another Talmudic saying (Bava Batra,11a) can also be referenced as the basis of man's responsibility for the world:
כל המקיים נפש אחת מישראל כאילו קיים עולם מלא.
– "Whoever saves the life of a member of Israel, it is as if he had saved the entire world."

9 Yad HaHazaka, Hilchot Teshuva, 5:12

10 As was correctly pointed out by Dr. Michael Shneider, Maimonides never states that God is infinite, as Maimonides believes that infinity is a negative quality, and thus cannot be attributed to God. David agreed that his intention here can be better formulated in the terms of the negative theology: one cannot say that God is finite, etc.

11 The common denominator of Maimonides' approach presented in this passage and the modern development of mathematics discussed earlier in this article is the fundamental limitation regarding the possible extent of human knowledge.

12 What David seems to be saying here is that according to the law of increasing entropy, the universe was more structured in its earlier stages and with the passage of time it becomes less and less orderly. However, the comparison of data from distant galaxies (whose light reflects an earlier stage) and proximate galaxies (whose light reflects a more recent stage) does not seem to confirm this. My problem with the use of this example is that the law of increasing entropy can be applied only to a finite and closed system, and the universe cannot be viewed as such a system.

These changes in the scientific representation of the world require from us to rethink our definition of the boundaries between science and religion.

The revolution in consciousness resulting from modern science can be summed up succinctly as follows: the science of the past presented our world as finite,[13] whereas today we face an infinite world. To better grasp this, we must understand the difference between the finite and infinite. For example, we can rely on Kantor's definition of infinity: a set is infinite if it is equipotent with at least one of its parts. In other words, the infinite neither can be exhausted by its parts, nor decomposed into its constituent elements. In this sense, the physical world of Laplace is finite – it can be described by a finite number of laws (which constitute what Laplace perceived to be the objective science). In a similar manner, Gilbert tried to prove the finiteness of mathematics. On the other hand, according to Maimonides, God is infinite[14] and therefore equivalent to His wisdom, His mercy, or His justice. Centuries later, modern science has realized at least in part the "terrible truth" about the infinite: that the world is not reducible to simple elements that can be studied independently of each other – or independently of ourselves – as a reliable *a priori* basis for the pursuit of knowledge.

We have seen[15] how this awareness developed in mathematics and linguistics. Similar examples can be found in many other fields of knowledge.

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13 This juxtaposition "finite-infinite" is not related to the space, but rather to the complex nature of the interaction of Man inside the world with the "outside" physical reality, as it is explained in the next sentences.

14 See footnote 10.

15 David's lecture ends on a rather optimistic note. The author joins Prof. Rips's disagreement with this optimism. The author leaves this topic as the starting point for future discussion, which is beyond the scope of this article.