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Relativity in Perspective: Science, Faith and Common Sense

Kevin G. Long

The difficulties of reconciling scientific theories with faith, and the abstract theories of physics with ordinary human experience, are legitimate concerns of Catholics, whose metaphysical understandings are based on the realistic perception of the created order-that things are basically what they appear to be. In the following analysis, Kevin Long takes up the particular problem of the theory of relativity. First providing a general background for the understanding of the place of the theory within legitimate science itself, Long suggests how Einstein's work squares with both Catholicism and common sense.

MAJOR SCIENTIFIC THEORIES, PERHAPS BECAUSE OF THEIR UNIVERSALITY, HAVE CUrious effects on the public imagination. They are widely venerated, yet seldom understood. Thus on March 14, 1979, the world marked the centenary of the author of the Theory of Relativity-a theory which, according to the popular belief, "only three people understand." On that occasion, the following appeared in Time magazine: "In the dazzling world of relativity, ordinary time and space are replaced by baffling effects at odds with common sense."(1)

In the face of such statements, the educated layman is understandably perplexed. Is modern science indeed asking him to surrender his common sense? The plight of the modern Catholic is even more acute. Einstein once said: "I believe in Spinoza's God, who reveals Himself in the orderly harmony of all that exists, not in the God who concerns Himself with the fates and actions of human beings." Could such a man's theories explain a universe designed and maintained by a personal and provident Creator?

A Catholic's view of the universe is necessarily more complex than that of his non-Catholic brethren. On the one hand, he acknowledges the value of genuine advance in the human sciences, but on the other, he realizes that they must finally be judged in the light of Revelation. Seeing an apparent contradiction between faith and reason, he cannot, like the fundamentalist, reject the worth of human knowledge because the latest findings appear to contradict some particular scriptural passage, nor, like the positivist, reject the possibility of a spiritual order because it cannot be measured by the most sophisticated techniques.

It seems appropriate to ask, without delving into detail, whether the Relativity Theory can be a complete account of the physical universe and whether its conclusions are consonant with the theological and philosophical traditions of the Church as typified in St. Thomas Aquinas.(2)

POPULAR SCIENCE, NATURAL SCIENCE, PHYSICS

It is annoying to read accounts of scientific discoveries written by devotees of the cult of Progress. "Scientific

Advance" is one of their lesser deities and they are more interested in proselytizing than in explaining the point in question. Paul Shorey, writing many years ago, called such the "literature of popular science":

We do not read [this literature] to learn science.... We read it sometimes as an escape and a fairy tale-which is harmless enough. But we read it perhaps more often as a form of modernist and sometimes immoralist propaganda. We read it to be told how much wiser and better we are than our forefathers; how inept were all our ideas before the discoveries of Darwin and Karl Marx and Freud and Westermarck; what imperfect and prejudiced instruments of truth are all minds except the author of the book and his assenting hearers; how obsolete are all the traditional moralities; how dark were the souls, how imperfect the digestions, how befogged the consciousness of all authors who wrote before electric lights, canned food, and psychoanalysis.(3)

Unfortunately, such tiresome rhetoric, replete with allusions to darkness, fog, chains, and shackles, fills many volumes of the literature on the sciences. But we should keep in mind that these are not the writings of the great scientists, but their mindless votaries and clever popularizers. Our attempt should be to judge the theories in the scientific spirit in which they are proposed.

"Nature," as Heraclitus so correctly observed, "loves to hide. "(4) It has been only after great labor that we have discovered the precious few secrets which she has divulged. Although the general methods of investigating nature have been known at least since the time of Aristotle, (5) the tools of science had to be developed and improved slowly over the centuries. Since there are actually two distinct approaches to the study of nature, we must see how they are the same and how they differ.

All knowledge begins with experience: either the vague and general experience which all men share, or the more refined but limited experience obtained by detailed inspection of isolated objects. In either case, knowledge arises by discerning the causes of that which falls within our experience.

Generally stated, the first method of understanding nature is to proceed from effect to cause. This method alone, however, is not always fruitful; too often the causes of things are too far removed to be immediately perceptible. In many cases we must work the other way around, proceeding from cause to effect. This second method (often erroneously called "the scientific method") proposes possible causes of the observed facts hypothetically. Although the true causes can never be known this way with certitude, the hypothesis can be shown to be plausible by its correspondence with the observed facts, and even very likely by its ability to predict other facts not yet discovered.

A marvelous analogy to explain these two methods is suggested by Immanuel Kant in his Preface to the Critique of Pure Reason. In the first case, we ask questions of nature the way that a bright pupil might ask questions of his teacher. The questions are often quite simple (like What is time?), but the answers, unless they are vague and general, are usually long and complicated. The scientist may proceed in this way as long as he is content with an abstract but very certain knowledge about nature.

In the hypothetical method, we inquire into nature more like the lawyer questions his witness. In court, the questions are usually long and detailed (*Were you not, on the night of June 3rd, at the home of Mr. Jones for such-and-such a purpose?*), but they require a simple yes-or-no answer. So the scientific hypothesis is like a detailed question asked of nature, to which she responds by revealing a fact either consistent with, or inconsistent with, the original assumptions. But in adopting this second method over the first, we sacrifice in certitude what we gain in clarity.

Mathematics has been at once the greatest and most controversial tool in the history of the natural sciences. The utility of constructing "mathematical models" to represent and explain physical phenomena by analogy has rarely been questioned. But no two individuals seem to agree on just how far the analogy extends.

A simple case is the following, borrowed from elementary mechanics: "Let point A be an elephant moving in a straight line at 10 miles per hour." Now obviously an elephant cannot actually be a point since points have no extension and elephants generally have a good deal of it. But we can simplify the physical problem into a mathematical one because, as far as we are concerned, the elephant's extension is irrelevant.

The first systematic application of mathematics to a physical problem was in astronomy. The regular and circular motion of the stars across the night sky and their apparently spherical configuration easily lend themselves to a geometrical interpretation. In the second century A.D., Claudius Ptolemy, in his Almagest, starting from a few simple hypotheses, developed an exact mathematical account of the motions of all the heavenly bodies (even the erratic "orbits" of the planets, the moon and the sun) around the center of the celestial sphere, i.e., the Earth.

By this means, Ptolemy could predict with uncanny accuracy the exact location of any heavenly body in the sky at any given hour in the future. Because of its relative simplicity and its incredible powers of prediction, the Ptolemaic theory remained virtually unchallenged for 1300 years.(6) The fact that the theory was finally replaced by the superior system of Copernicus(7) should be a powerful lesson to future generations. The ability of a scientific theory to explain appearances and make predictions shows the *likelihood*, not the certainty, that the hypotheses are correct.

The case of Galileo brings to light the controversial character of tnathematical physics. Following Pythagoras and Plato, Galileo took the extreme position that nature is intelligible only through mathematics. The Book of Nature, for Galileo, was written in numbers:

> Philosophy is written in this grand book, the universe, which stands continually open to our gaze. But the book cannot be understood unless one first learns to comprehend the language and read the letters in which it is composed. It is written in the language of mathematics, and its characters are triangles, circles, and other geometric figures without which it is humanly impossible to understand a single word of it; without these, one wanders about in a dark labyrinth.(8)

Some of Galileo's opponents took the other extreme that mathematics was merely an abstraction in the mind and was in no way applicable to an understanding of nature.(9) St. Thomas had taken a more balanced view: Although mathematics cannot account for every aspect of nature, such as purpose, it can certainly study natural things under a certain formal aspect, namely, insofar as they are quantified. (10)

THE CHARACTER OF RELATIVITY

From the writings of Einstein himself, it is clear that Relativity is hypothetical and mathematical in the way we have been describing:

> The theory of relativity is a fine example of the fundamental character of the modern development of theoretical science. The hypotheses with which it starts become steadily more abstract and remote from experience. On the other hand, it gets nearer to the grand aim of all science, which is to cover the greatest possible number of empirical facts by logical deduction from the smallest number of hypotheses or axioms. Meanwhile the train of thought leading from the axioms to the empirical facts or verifiable consequences gets steadily longer and more subtle. The theoretical scientist is compelled in an increasing degree to be guided by purely mathematical, formal considerations in his search for a theory.(11)

It is interesting to note that Einstein characterizes scientific theorizing not only as mathematical, but also, in line with St. Thomas, formal. Thus Einstein implies that there is also a material aspect to nature, although it is not clear how much he thinks we can know about it.

Einstein and St. Thomas seem to agree on the place of mathematics in natural science. But Einstein's invocation of non-Euclidean geometry has been a real source of confusion since, at this point, Relativity seems "at odds with common sense". According to the theory, just as any point in space can be located by three coordinates of length, breadth and depth, any "event" in "space-time" can be located by adding a fourth dimension of time. As it turns out, the shortest distance between two "events", when measured by a ray of light, is not a straight line, but a curved one.

Would St. Thomas condone a "geometry" whose premises are patently false? Or would he concede the modern view that geometry cannot be true or false but only logically consistent, its "truth" being determined by applicaton to various physical problems? It is a tribute to St. Thomas' wisdom that he has already answered the question.

Aristotle, in his *Metaphysics*,(12) lists length, breadth and depth as species of magnitude, but paradoxically adds time to the list in the *Categories*.(13) Commenting on these passages, St. Thomas observes that magnitude is considered in the latter insofar as it is a measurement; in the former, insofar as it is a quantity, strictly speaking:

> There [in the *Categories*] he distinguished between the species of quantity from the point of view of the different kinds of measure... whereas here [in the *Metaphysics*] he considers the species of quantity from the being of quantity.(14)

Thus, St. Thomas is able to distinguish between geometry as the science of the quantified, and geometry as the art of measurement, which he calls "sterometry",(15) and which Einstein would call a "metric". The science of (Euclidean) geometry, therefore, still speaks truly about the universe, so long as we are considering its magnitude as it exists in itself.

The simplest example of a non-Euclidean geometry applied to the physical world is the spherical geometry used in navigation. Because the Earth's surface is curved, the interior angles of "triangles" marked out by "straight" lines add up to more than 180 degrees. Only a fool would insist that sailors navigate as if the surface of the Earth were a Euclidean plane, or that spherical geometry has refuted and replaced plane geometry.

Just as the curvature of the Earth gives bizarre properties to the "triangles" traced on its surface, so the curious properties of light distort the measurements of "events in space-time". But since light is the best tool available for measuring the universe, scientists needed a new "metric" in order to use it. And the world owes a tremendous debt of gratitude to Einstein for having discovered that "metric".

SCIENCE AND FAITH

In recent years, several Thomistic scholars have labored to show the fundamental harmony between Einstein and St. Thomas. Dr. John F. Kiley goes even further:

> Not only can [St. Thomas' metaphysics] account for the epistemological procedures of Albert Einstein.. .but it *alone* of all known philosophies may be able to do so.(16) (emphasis his)

But a rapprochment at the level of theology may not be as easy.

Einstein's view of God has been cited above. Elsewhere he expresses even more clearly the paradox that confronts him:

> When one views the matter historically, one is inclined to look upon science and religion as irreconcilable antagonists, and for a very obvious reason. The man who is thoroughly convinced of the universal operation of the law of causation cannot for a moment entertain the idea of a Being who interferes in the course of events-that is, if he takes the hypothesis of causality really seriously.(17)

Our difficulty with this position is similar to that of St. Thomas with Aristotle's. While Aristotle, unlike Einstein, admits the possibility and even the likelihood of divine providence,(18) he argues that the universe is co-eternal with its Cause and thus not created. Both he and Einstein, as Dr. Kiley suggests, are attempting to explain a created universe by doctrines formulated to explain an eternal one.

For St. Thomas, all human knowledge is not only valuable in itself, but also as an instrument in the service of Christian truth. And to the extent that truth is found outside the context of Revelation, it must, like Egypt's gold, be seized as wrongfully possessed, but not without gratitude to its discoverers.(19) All knowledge, if it is to become wisdom, must submit to the authority of Wisdom Itself.

In the words of St. Thomas:

> Divine authority prevails over human reason much more than the authority of a philosopher prevails over some feeble argument which is offered by a small boy.(20)

Notes

1 *Time*, February 19, 1979

2 Precisely such inquiries are enjoined by the Second Vatican Council: "[The Church] seeks in a systematic way to have individual branches of knowledge studied according to their own proper principles and methodss and with due freedom of scientific investigation. She intends.., as a result of extremely precise evaluation of modern problems and inquiries, to have it seen more profoundly how faith and reason give harmonious witness to the unity of all truth. The Church pursues such a goal after the manner of her most illustrious teachers, especially St. Thomas Aquinas." *Declaration on Christian Education*, n. 10

3 "A Lay Sermon" in *Atlantic Monthly*, Vol. 153, No. 6 (June, 1934) p. 723

4 Freeman, Kathleen, *Ancilla to the Pre-Socratic Philosophers* (Basil Blackwell, Oxford, 1971) p. 33

5 Aristotle is best known for his more abstract study of nature in the Physics. Yet he insists that such studies be balanced by direct observation of natural things: "The greater nearness and affinity to us [of terrestial things] balances somewhat the loftier interest.. .of the higher philosophy. Having already treated of the celestial world as far as our conjectures could reach, we proceed to treat of animals, without omitting, to the best of our ability, any member of the kingdom, however ignoble." *Parts of Animals*, Bk. 1, Chap. 5 (645a 2-7)

6 Although the theory was not seriously challenged, it was still regarded as hypothetical, at least by St. Thomas: "We must not say that they [the Ptolemaic hypotheses] are thereby proved to be facts, because perhaps it would be possible to explain the apparent movement of the stars by some other method which men have not yet thought out. " In II *De Caelo*, Lect. 17, n. 2

7 It is noteworthy that Copernicus advanced his theory before the invention of the telescope made possible observations which would have made Ptolemy's method of calculation hopelessly complex. Copernicus' argument was based solely on mathematical grounds. In this context, Jeffrey Marsh remarks, "It is amusing to speculate that had the computer been invented before Copernicus, Ptolemaic calculations would have been immeasurably simplified, thereby removing one of the most important attractions of the heliocentric theory." "Creation according to Cosmology" in *Commentary*, October, 1977, p. 66

8 "The Assayer" (1623) in *Discoveries and Opinions of Galileo,* Stillman Drake, trans., (Doubleday, New York, 1957) pp. 237-8

9 Notably the Dominican Tommaso Cassini; cf. my "Galileo on Trial" *Faith & Reason*, Vol. VI, No. 3(Fall, 1980) p. 234

10 On the role of mathematics in the study of nature according to St. Thomas, see Bernard Mullahy, 'Subalternation and Mathematical Physics" in *Laval Theologique et Philosophique*, Vol. II, No. 2 (1946)

11 "Problems of Space, Ether and the Field in Physics" in *Essays in Science*, (Philosophical Library, New York, no date) p. 69

12 *Metaphysics*, Bk. V, Chap. 13 (1020a 29-33)

13 *Categories*, Chap. 6 (5a 6-14)

14 In V Meta., Lect. 15, n. 986 Of course, St. Thomas does not mean "measure" in the specifically empirical sense, but the distinction remains relevant for our purposes.

15 In I *Post. Anal.*, Lect. 25, n. 208

16 Kiley, John F., *Einstein and Aquinas: A Rapprochment*, (Martinus Nijhoff, The Hague, 1969) pp. 105-6

17 "Religion and Science" in *Ideas and Opinions*, (Crown Pub., New York, 1954) p. 39

18 "The question is asked whether happiness.. .comes in virtue of some divine providence.... Now if there is any gift of the gods to men, it is reasonable that happiness should be god-given." *Nicomachean Ethics*, Bk. 1, Chap. 9 (1099b 8-12)

19 Cf. Kiley, p. 86

20 In VIII *Physicorum*, Lect. 3, n. 991