

Errata

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PIERRE DUHEM

ESSAYS IN THE HISTORY AND
PHILOSOPHY OF SCIENCE

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Copernican hypotheses had their foundation in the nature of things. But the truth they were introducing little by little into science was that a single dynamics must represent the motion of the stars, the oscillations of the sea, and the fall of heavy bodies, by means of a single set of mathematical formulas. They thought they were renovating Aristotle; they were preparing for Newton.

Despite Kepler and Galileo, we believe today, with Osiander and Belarmine, that the hypotheses of physics are only mathematical artifacts devised for *saving the phenomena*. But thanks to Kepler and Galileo, we now require that they *save at the same time all the phenomena* of the inanimate universe.

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Letter to Father Bulliot, on Science and Religion¹

Duhem's outspokenness on issues that mattered to him, regardless of his target, can be seen clearly in a letter to his mother about his participation at the Third International Congress of Catholics, held in Brussels in 1894: "Thus, yesterday, I decided to strike a great blow. It was in the session on philosophy. The room was full, especially with clerics. A brave churchman just treated an objection taken from mechanics. My opinion was solicited concerning the scientific aspects of the lecture. Then, I said frankly to all these good Catholic philosophers that, as long as they continued to talk about science without knowing a single word of it, the freethinkers would have fun at their expense, that, in order to talk about questions relating to science and Catholic philosophy, one needs to have ten or fifteen years of pure science, and that, as long as they have not trained people with deep scientific knowledge, they must keep silent. . . . The idea was launched; it made its way. The whole afternoon nothing else was spoken of during the congress. I do not regret having come. I believe that the seed I have sowed will germinate. It is the first time these brave people heard the truth spoken. It surprises them a bit, but I am also surprised to see that they, or at least several of them, go about it with good will."² At the same congress, Duhem met the future head of the Department of Philosophy of the Institut Catholique in Paris, the Père J. Bulliot. Some years later, in 1911, Duhem wrote to Bulliot on the relations of science and religion. The letter allowed

1. [Hélène Pierre-Duhem, *Un Savant français, Pierre Duhem* (Paris: Plon, 1936), pp. 158–169.]

2. [Hélène Pierre-Duhem, *Un Savant français, Pierre Duhem*, p. 157.]

Duhem to synthesize his thoughts on the philosophy of science and the history of science in ways that he had not previously accomplished.

Bordeaux, 21 May, 1911

My Father,

I have heard that the Catholic Institute of Paris is preparing to organize a coordinated set of philosophical classes. This news caused me great joy, and I think it will cause great joy for all enlightened Catholics. It is time, in fact, that we oppose the numerous and learned teachings of indifferent or opposed philosophies with a whole college of chairs in which traditional Catholic philosophy is taught in all its power and in its full development.

I have some thoughts on the subject of the composition of the future Institute of Philosophy; I ask your permission to relate them to you. They are not advice. Coming from me, that would be impertinent. They are, rather, simple information. Living among those who profess doctrines contrary to ours, I am well placed to understand their plan of attack against us and to see where our defenses must be reinforced, above all.

The field on which the battle has been waged and where, without any doubt it will become more violent, is the incompatibility of the scientific mind and the religious mind.

I do not say: the incompatibility of a given scientific discovery with a given religious doctrine. The polemics of the nineteenth century were constituted of these particular antagonisms. For example, some used their ingenuity to oppose a given geological theory with a given verse of the Bible. But these were isolated sorties that prepared for the great fight. The latter is much more extensive; the result toward which it leads threatens to be much more radical. It concerns denying all religion the right to subsist, and that in the name of the whole of science. It is claimed, as established, that no sensible person could accept the validity of science and believe in the dogmas of religion at the same time. And since the validity of science is further affirmed every day by a thousand marvelously useful inventions, which only a blind soul could put into doubt, religious faith is done for.

Science, it is said, takes as foundation either axioms that reason cannot doubt or facts that have all the certainty of the testimony of the senses. Everything it erects on these foundations is constructed with the help of rigorous reasoning. And with an overabundance of precautions, experience controls each of the conclusions at which it arrives. The whole edifice therefore maintains the unshakable solidity of the first foundations.

Religious dogmas, on the other hand, issue from vague aspirations and intuitions arising from sentiment and not from reason. They are not subject to any rule of logic and cannot sustain the examination of any critique, however rigorous, even for an instant.

Hence, everything that had made up the object of religious dogmas will be declared absurd and devoid of sense, and we will be content with a strict and absolute positivism, a relative of that crass materialism, which comes like a forced conclusion. Or else, we will regard an object that escapes the demonstrations of science as incapable of being known with even the least certainty. We will profess an agnosticism according to which religion is only a more or less poetic and consoling dream. But how can people who have experienced the firm realities of science allow themselves to be lulled by such a dream?

They are not satisfied with placing into evidence, with the help of logic, this antagonism between the scientific mind and the religious mind. They also want the history of the development of human knowledge to make this evident for less enlightened people. They allegedly show that all sciences are born from the fertile Hellenic philosophy, whose most brilliant members abandoned the ridiculous task of believing in religious dogmas to the common people. They then depict this terrifying night of the Middle Ages during which the schools, enslaved to the conduct of Christianity and uniquely solicitous of theological discussions, were not able to glean even the least part of the Greek scientific heritage. They display the brilliance of the Renaissance in which minds finally liberated from the yoke of the Church rediscovered the thread of scientific tradition at the same time as the secret of artistic and literary beauty. They are happy to oppose the always ascendant progress of science and the always deeper decline of religion, beginning with the sixteenth century. They then believe we are allowed to predict the approaching death of religion at the same time as the universal and incontestable triumph of science.

That is what is taught from a mass of chairs and what is written in a multitude of books.

It is time that Catholic teaching address this teaching and that it respond to its adversaries with the following word: "lies!" These are lies in the domain of logic and lies in the domain of history. The teaching that claims to establish the irreducible antagonism between the scientific mind and the Christian mind is the most colossal, boldest lie that has ever attempted to dupe the human race.

In order to oppose the method that leads to scientific truths and the method that leads to religious dogmas, they falsify the description of both

these methods. They consider both of them in a superficial manner and, as it were, externally. They borrow some features from this quick examination and pretend that these features are the very essence of the processes they claim to have analyzed.

How different are these methods to a mind that has really penetrated to the heart of the matter and that has captured their living principles! That mind is able to recognize both what gives these processes their variety and what unifies them. It sees everywhere a single human reason utilize the same essential means in order to arrive at the truth. But in each domain, it sees reason adapt the use it makes of these means to the special object whose knowledge it wishes to acquire. Thus, with the help of common operations that properly constitute our intellect, it sees the pursuit of a method for mathematical sciences, a method for physics, a method for chemistry, one for biology, one for sociology, and one for history. For mathematics, physics, chemistry, biology, sociology, and history have different principles and different objects. In order to reach those objects, we must follow, in the same fashion, different routes from different points of departure. It then recognizes that in order to attain religious truths, human reason uses no other means than those it used to reach the other truths. But it uses them in a different manner, because the principles from which it departs and the conclusions toward which it tends are different. The antagonism announced between scientific demonstration and religious intuition disappears while it perceives the harmonious agreement of the multiple doctrines by which our human reason forces itself to express truths of different orders.

What can be said about the strange history which we claimed was almost confirmed by our insufficient logical analysis?

From its birth, Greek science was fully impregnated with theology, but with a Pagan theology. This theology teaches that the heavens and the stars are gods. It teaches that they have no other motion than circular and uniform motion, which is perfect motion. It damns the impiety that would dare to attribute a motion to the earth, the sacred hearth of divinity. Although these theological doctrines furnished natural science with some temporarily useful postulates, although they guided its first steps, they soon became for physics what apron strings become for a child—namely, fetters. If the human mind did not break out of these fetters, it could not have surpassed Aristotle in physics or Ptolemy in astronomy.

Now, how did it break these fetters? The answer is Christianity. Who first profited from this freedom just gained in order to rush toward the discovery of a new science? Scholasticism. Thus, who dared to declare, in the

middle of the fourteenth century, that the heavens were not moved by divine or angelic intelligences but by an indestructible impulse given by God at the moment of creation, in the manner of a ball thrown by a player? A Parisian Master of Arts, Jean Buridan. Who, in 1377, declared the diurnal motion of the earth simpler and more satisfying for the mind than the diurnal motion of the heaven? Who cleanly refuted all the objections raised against the first of these motions? Another Parisian Master, Nicole Oresme. Who founded dynamics, discovered the laws of falling bodies, postulated the foundations of geology? Parisian scholasticism, at a time when the Catholic orthodoxy of the Sorbonne was proverbial throughout the world. What role did the highly exalted freethinkers of the Renaissance play in the formation of modern science? In their superstitious and rote admiration of antiquity, they mistook and disdained all the fertile ideas put forth by fourteenth-century scholasticism, in order to take up again the least-sustainable theories of Platonic or peripatetic physics. What did this great intellectual movement amount to, which, at the end of the sixteenth century and the beginning of the seventeenth century, produced the doctrines accepted ever since? A pure and simple return to the teaching of Parisian scholasticism during the Middle Ages, so that Copernicus and Galileo are the heirs and, as it were, disciples of Nicole Oresme and Jean Buridan. Therefore, if this science of which we are justly proud has been able to see the light of day, it is because the Catholic Church has been its midwife.

Such are the denials we must issue against the false assertions found everywhere, in history as in logic. Do you not believe, my father, that this would be one of the most important roles, perhaps even the most important role that the future Institute of Philosophy will have to play? That is why I tend to think that two chairs would be particularly appropriate in this institute. The one devoted to the analysis of the logical methods by which the various sciences progress would show us that we could, without contradiction or incoherence, pursue the acquisition of positive knowledge and at the same time meditate on religious truths. The other, following the development of human science in its path, would lead us to recognize that when people cared most of all about the kingdom of God and his justice, God gave them in addition the deepest and most fruitful thoughts about the things here below.

Would you judge me very bold to have thus communicated my opinions to you? Surely not, for you know that the only thing that guides me in this affair is the desire to see God's rule reestablished among us. For such an aim, boldness is not only permitted, it is commanded.

Moreover, at this moment, when in face of the intellectual anarchy facing the human mind, I cry out to God: "Adveniat regnum tuum (Thy kingdom come)," I seem to hear your prayer echoing mine. May our prayers be granted! That is my wish in offering you my very humble respects.

Pierre Duhem

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History of Physics¹

This article attempts to give a complete picture of how the history of physics fits together. Readers who follow these issues into the contemporary history of science will find many qualifications to Duhem's various historical theses. On the crucial issue of the indebtedness of seventeenth-century physics to fourteenth-century physics, however, recent scholarship has tended to support Duhem's view. The article is also a good source of historical information for the other essays in the collection.

I. A Glance at Ancient Physics

Although at the time of Christ's birth, Hellenic science had produced nearly all its masterpieces, it was still to give to the world Ptolemy's astronomy, the way for which had been paved for more than a century by the works of Hipparchus. The revelations of Greek thought on the nature of the exterior world ended with the *Almagest*, which appeared about A.D. 145, and then began the decline of ancient learning. Those of its works that escaped the fires kindled by Islamic warriors were subjected to the barren interpretations of Muslim commentators and, like parched seed, awaited the time when Latin Christianity would furnish a favorable soil in which they could once more flourish and bring forth fruit.² Hence it is that the

1. [*Catholic Encyclopaedia* (New York: R. Appleton, 1911) vol.12, pp. 47-67. Lightly edited.]

2. [This article contains many statements that might be corrected in the light of modern scholarship. We have chosen to let them stand because of the historical