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## Logic Versus Science

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## Logic Versus Science

### Cover Page Footnote

[1] Thomas Aquinas, *St Thomas Aquinas Philosophical Texts*, trans. Thomas Gilby (London: Oxford University Press, 1951), 11.

## LOGIC VERSUS OTHER SCIENCES

Graeme Wertheimer

### 1. Introduction

In order to assess whether one must address themselves to logic before other sciences, there must be an agreed definition of both logic and science. The *Cambridge Dictionary of Philosophy* and the *Oxford English Dictionary* give definitions of logic and science as:

Epistemic Logic – Epistemic concepts include the concepts of knowledge, reasonable belief, justification, evidence, certainty, and related notions.<sup>1</sup> Logic is reasoning conducted or assessed according to strict principles of validity.<sup>2</sup>

Science – The intellectual and practical activity encompassing the systematic study of the structure and behaviour of the physical and natural world through observation and experiment.<sup>3</sup>

As a student who has recently been introduced to the discipline of philosophy, it is my understanding that ‘philosophy’ is based upon providing a different perspective on things by carefully analysing them, by evaluating them, by reflecting on them and/or by thinking critically about these things, whatever they might be.<sup>4</sup>

To address what St Thomas Aquinas is saying here, we must ask the question of what comes first; one’s world view and then science? Or science and then one’s world view? Do we use understanding and logic to make a hypothesis ready to be confirmed through scientific experiments? Conversely, do we use scientific experiments to create our logical thoughts - our worldview? Before answering these questions, it is necessary to analyse Aquinas’ stance further.

‘*Episteme*’ is an ancient Greek term that means “not knowledge by observation, but knowledge by reasoning and demonstration, as in geometry, mathematics and logic”.<sup>5</sup> St Thomas Aquinas described *Episteme* as “to demonstrate conclusions from principles”. Logic is the formation of an argument through reasoning and demonstration, whereas ‘empirical

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<sup>1</sup> *Cambridge Dictionary of Philosophy*, 2<sup>nd</sup> ed., ed. Robert Audi (Cambridge: Cambridge University Press, 1999), s.v. “epistemic”.

<sup>2</sup> *Oxford English Dictionary*, s.v. “logic,” 2<sup>nd</sup> edn. Oxford University Press, 2010.

<sup>3</sup> *Oxford English Dictionary*, “science.”

<sup>4</sup> Dejan Simkovic, “Knowledge,” *An Introduction to Philosophy and Theology within Catholic Liberal Education*, ed. Angus Brook (North Ryde, NSW: McGraw-Hill Education (Australia) Pty Ltd, 2015), 51.

<sup>5</sup> Raymond A. Younis, “What is Philosophy?”, *An Introduction to Philosophy and Theology within Catholic Liberal Education*, ed. Angus Brook (North Ryde, NSW: McGraw-Hill Education (Australia) Pty Ltd, 2015), 12.

scientific knowledge' is associated with a removal of doubt to conclude that the result cannot be otherwise. In order to get to these conclusions, there must be knowledge of a starting point, such as induction. These starting points are often derived from logic and, hence, we must use logic before the other sciences. I believe this is what St Thomas Aquinas was saying.

## 2. The Link Between Logic and Scientific Knowledge

Logic at a fundamental level relates to propositions and their components, whether they are true or false. This introduces reasoning to imply a truth, a truth that can only be formulated by an argument.

An argument is a connected series of statements, one of which is intended to be the conclusion, while the other statements – the premises – are intended to justify the conclusion.<sup>6</sup> First one makes a claim, then one must give reason for the claim and the resulting collection of statements can be deemed an argument. In order to make a claim, there must be inductive reasoning, in which the premises seek to provide significant evidence (not absolute proof) for the truth of the conclusion.

Plato preferred the philosophical method of formal inquiry known as 'dialectic'. Dialectic, in which a question-response process is followed, is guided by rules of formal logic in which interlocutors begin with a set of questions in their search for answers and, ultimately, truth.<sup>7</sup>

This leads into a popular philosophical question of whether inductive reasoning necessarily leads to knowledge. For example, inductive reasoning could lead to an inference that "all rabbits we have seen are grey, and, therefore, all rabbits are grey", before the discovery of white rabbits. Inductive reasoning may also give a false inference that a sequence of events in the future will occur as it always has been experienced in the past. For example, "if I drop a ball, it will fall to the ground". The moral lesson of induction is that there are various degrees of support that the premises can give for the type of conclusion articulated.<sup>8</sup> Inductive reasoning, whilst a good tool to generate a hypothesis, is not adequate to form a truth. It may supply the foundations for the development of scientific knowledge; however it does not create the scientific knowledge itself.

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<sup>6</sup> Robert Anderson, "Logical Arguments", *An Introduction to Philosophy and Theology within Catholic Liberal Education*, ed. Angus Brook (North Ryde, NSW: McGraw-Hill Education (Australia) Pty Ltd, 2015), 31.

<sup>7</sup> Austin Freely and David L. Steinberg, *Argumentation and Debate Critical Thinking for Reasoned Decision Making*, 12<sup>th</sup> ed (Boston: Wadsworth Cengage Learning, 2009).

<sup>8</sup> Anderson, "Logical Arguments", 36.

As we use logic to develop inductive reasoning, it can be said that we must use logic before other sciences, as logic is what ultimately leads to the formation of ‘scientific knowledge’. Although we rely on inductive reasoning heavily in daily life, we must recognise its limited scope and cannot expect it to explain everything about the truth. Instead it should be used as a means to supply strong evidence for (not absolute proof of) the conclusion.

In his *Commentary on Aristotle’s Metaphysics*, St Thomas Aquinas distinguishes two broad categories of beings. He says “There are two kinds of beings: beings of reason and real beings.”<sup>9</sup> Aquinas continues, “The expression being of reason is applied properly to those notions which reason derives from the objects it considers, for example, the notions of genus, species and the like, which are not found in reality but are a natural result of the consideration of reason. And this kind of being (being of reason), constitutes the proper study of logic.”<sup>10</sup> Thus, under the consideration of reason, two kinds of study can be distinguished; logic and philosophy. While logic deals with beings of reason or logical beings considered in terms of probable premises, philosophy deals with real being or being-of-nature in reality.<sup>11</sup>

The common procedure that St Thomas Aquinas refers to in the statement addresses one’s ability to arrive at a truth. It is essential that one uncovers the starting point, the latent presupposition of any action, clarifies it and proceeds from there.<sup>12</sup> ‘Logic’ starts with the premises, goes through a process, and reaches a conclusion. ‘Science’ starts with a conclusion, goes through a process, and reaches a premise supportive of the conclusion.

St Thomas Aquinas describes logic as dealing with ‘second intentions’, that is, with formal relations that attach to concepts expressive of the natures of existent things - first intentions.<sup>13</sup> The concepts come to be in us as a result of our engagement with the sensible world. So it is important to stress that logic concerns formal relations between concepts.<sup>14</sup> This means that logic creates direct knowledge of the world and thus incorporates the view that what is primary in our knowledge are the things of which we first form concepts.

Sciences are idealisations made by way of abstracting from our knowledge of sensible things. It is knowledge of sensible things which is primary and thus prior to the ‘order of

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<sup>9</sup> Thomas Aquinas, *Commentary on Aristotle’s Metaphysics*, trans. John P. Rowan (Chicago: Henry Regnery Co, 1961) IV, N 574, 212.

<sup>10</sup> Aquinas, *Commentary*, IV, N 574, 212.

<sup>11</sup> Ibid.

<sup>12</sup> Ralph McInerny and John O’Callaghan, "Saint Thomas Aquinas" In *The Stanford Encyclopedia of Philosophy* (Spring 2015 Edition), ed. Edward N. Zalta. <http://plato.stanford.edu/archives/spr2015/entries/aquinas/>.

<sup>13</sup> McInerny and O’Callaghan, "Saint Thomas Aquinas".

<sup>14</sup> McInerny and O’Callaghan, "Saint Thomas Aquinas".

learning' the philosophical sciences.<sup>15</sup> This means that before we can turn to sciences as our basis of knowledge, we must first use our common procedure (our logical reasoning) to assess our concepts of the sensible world, and bring forth this knowledge to further investigate it in the form of modern science.

### **3. St Thomas Aquinas on the Relationship Between Logic and Scientific Enquiry**

I agree with St Thomas Aquinas that students should address themselves to logic before other sciences. St Thomas Aquinas is trying to say that in order to reach scientific conclusions based on sound enquiry, evidence, and truths, we must first use logical reasoning because the study of modern sciences is based in part around the implementation of logic in order to gain a greater understanding of the conclusions derived by the science and the process of how we arrived to those conclusions. I think that by common procedure, St Thomas Aquinas is also saying that we should use logical reasoning on a daily basis to justify our critical thinking. We must use our personal logical thoughts to guide our directions, not rely on the principles of 'science', which themselves could eventually be proven wrong through further experimentation. 'Scientific knowledge' claims to be an absolute truth. By following an absolute truth from the beginning, we close our ability to make new discoveries and to question what it is in front of us.

### **4. Conclusion**

It is true that logic does not empirically prove anything. It gives conclusions based on premises but those conclusions are made without being observed. Because they are not observed, they therefore are not entirely proven. Science also does not prove anything. It continually seeks evidence to provide greater support to conclusions, conclusions that are often derived from logic. It is reasonable to suggest then that science seeks to validate logic, but can never truly prove it. Students should address themselves to logic before the other sciences because this is how the sciences came about. As students, we must make observations and arguments, ask questions and critically think about what we experience. We must recognise that critical thinking is partly a matter of having certain thinking skills, but it is not enough to have these skills alone, as it is also a matter of being disposed to use them. This is why Aquinas

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<sup>15</sup> McInerney and O'Callaghan, "Saint Thomas Aquinas".

says we should use logic before other sciences. An understanding and ability to use logic is a requirement before addressing the study of science. Logic is a process of argument formation and addresses the inference to the conclusion to ensure there is a probable, or certain relationship between the two. St Thomas Aquinas says:

The appropriate course of education will be as follows: the instruction of the young in logical topics to begin with, for logic teaches method for all scientific inquiry; then a training in mathematics, which neither need experiment nor lie beyond the range of the imagination; thirdly, in physics, where much more experimentation is demanded though sensation is not surpassed; fourthly, in moral science, which requires experience and a mind free from passion; finally, in wisdom or theology, which transcends imagination and demands robust understanding.<sup>16</sup>

Students who first address themselves to logic are learning the method of scientific enquiry.

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<sup>16</sup> Thomas Aquinas, *St Thomas Aquinas Philosophical Texts*, trans. Thomas Gilby (London: Oxford University Press, 1951), 11.

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