



Modeling, Idealization, and Truth

A dialogue between contemporary philosophy of
science and the Aristotelian tradition.

24-25 February 2023

Aula Minor



ANGELICVM
INSTITUTUM THOMISTICUM

Schedule

Friday, February 24th

09:30 **Introductory Remarks**

John O' Callaghan (University of Notre Dame) – “*Truth, Metaphor, and Representation: Thomistic Reflections*”

10:30 Coffee Break

10:45 **Kevin Flannery, SJ (The Pontifical Gregorian University)** – “*Aristotle's manifold models*”

11:45 Lunch Break

13:45 **James Nguyen (Stockholm University, Sweden)** – “*Universality Explanations*”

14:45 Coffee Break

15:00 **Thomas Davenport, OP (Pontifical University of St. Thomas Aquinas)** – “*Thomistic Scientific Realism and the modeling of elementary particles*”

16:00 Coffee Break

16:30 **Afternoon Breakout Sessions**

Saturday, February 25th

- 09:30 **Dave O'Connor (University of Notre Dame)** – “*Bigger than Life: Aristotle's Ideal Hero*”
- 10:30 Coffee Break
- 10:45 **Nicholas Teh (University of Notre Dame)** – “*Essential idealizations and the interpretation of science*”
- 11:45 Lunch Break
- 13:45 **Jonathan Buttaci (Catholic University of America)** – “*Fitting Concepts to Experience': Aristotle, Aquinas, and Geach on Phantasmata as Tools for Thinking*”
- 14:45 Coffee Break
- 15:00 **Santiago Schnell (University of Notre Dame)** – “*Uses and abuses of models in the life sciences: How can life scientists develop better models and theories?*”
- 16:00 Coffee Break
- 16:15 **Mariusz Tabaczek, O.P (Pontifical University of St. Thomas Aquinas)** – “*Aristotelian Causal Modeling of Life in the Context of Contemporary Reflection on the Roles of Models in Biology*”

Abstracts and Biographies

Friday, February 24

09:30 **John O'Callaghan** is an Associate Professor of Philosophy at the University of Notre Dame. He earned a BS in Physics from St. Norbert College and an MS in Mathematics from Notre Dame before going on to earn a Doctorate in Philosophy there in 1996. He has been a prolific author with numerous articles and edited volumes on Thomistic Philosophy, and Medieval Philosophy in general, with a particular interest in Metaphysics and Ethics. He is a past president of the American Catholic Philosophical Association, a permanent member of the Pontifical Academy of St. Thomas Aquinas, and the Director of the Jacques Maritain Center at the University of Notre Dame.

“Truth, Metaphor, and Representation: Aristotelian-Thomistic Reflections”

In contemporary discussions of truths and truth, both culturally and more narrowly philosophical, it is commonly thought that the introduction of images, metaphors, and representations raises a difficulty for characterizing as true what we assert about reality. Most often this difficulty is expressed as calling into question the “literal truth” of the statement. One can extend this worry to scientific discourse insofar as a particular theory goes beyond a formal mathematical structure of statements to employ various kinds of models. Once one gets past the purely formal mathematical features of the theories involved and to their interpretation in a particular domain, one is faced with the question of “literal” truth. The picture that animates this worry seems to be one of statements standing in relation to abstract truths, whatever one might think of the ontology of abstract truths, which truths stand in some relation to reality as such. The use of metaphor, image, and representation in the statements calls into question the relationship of the statements to the truths so conceived, such that one says of them that they are not “literally true.” However, one might ask in what other sense they might be said to be true. Or are

we to say that they are literally false, with the result that any statement or set of statements that employ images, metaphors, or representations must be conceived of as literally false, such as, for example, “the poetry of Goethe displays extraordinary depth of feeling,” “Debussy’s Prelude to the Afternoon of a Faun is widely credited with having given birth to modern music.” “Einstein’s general theory of relativity has immense implications for our ordinary conceptions of space and time, particularly the reality of black holes,” and “if the function $f(x)=2*x+c$ is associated with set of ordered pairs of points on a plane it is equivalent to a line of slope 2.” All of these statements appear then to be "literally" false. Perhaps then they are true in some other sense, a "spiritual sense?" An alternative to this way of thinking of the literal truth of statements can be seen in the Thomistic understanding of true statements as the expression of an achievement of the mind in relation to reality, not as standing in a relation to abstracta conceived as "truths." The goal of this presentation is to sketch that alternative account of truth, a crucial feature of which is that in order to have truth the mind must “possess some feature of its own” in order to be true to reality. The suggestion will be that in its simplest form that “feature of its own” is precisely its representational character expressed in judgment, such that literal truth requires representation and is not undermined by it, representation that often includes the use of images, metaphors, and analogies. There may be “spiritual truths.” But typically our ordinary claims about the world as well as our most complicated scientific theories are not among them. Typically, the latter or quite literally true if true at all.

10:30 Coffee Break

10:45 **Kevin Flannery, SJ** was born in 1950. He studied at Xavier University (Cincinnati), Ohio State University, and University College Dublin before entering the Society of Jesus. As a Jesuit he completed an M.Div. and a STL at Weston School of Theology, as well as a B.A./M.A. and a D.Phil. at the University of Oxford. Beginning in 1992, he was Professor of the History of Ancient

Philosophy at the Pontifical Gregorian University in Rome, serving as Dean of the Faculty of Philosophy from 1999 until 2005, and becoming emeritus professor in 2020. He is the author of *Ways into the Logic of Alexander of Aphrodisias* (Brill, 1995); *Acts Amid Precepts: The Aristotelian logical structure of Thomas Aquinas's moral theory* (The Catholic University of America Press/T. & T. Clark, 2001); *Christian and Moral Action* (IPS Press, 2012); *Action and Character according to Aristotle: The logic of the moral life* (The Catholic University of America Press, 2013), and *Cooperation with Evil: Thomistic Tools of Analysis* (The Catholic University of America Press, 2019).

"Aristotle's manifold models"

This essay considers what appear to be Aristotle's contradictory approaches to scientific methodology. In the *Posterior analytics*, he conceives of genuine science as having its basis in the experience of particular entities which eventually, within particular scientific contexts, gives rise to universals which "come to rest in the soul," these universals in turn giving rise to definitions and names that correspond to the essences of the particular entities experienced. On the other hand, in works other than the *Analytics*, he speaks positively of words proper to contexts quite different from the contexts to which the particulars to which they refer belong. The essay considers in this regard analogies, paradigms, and metaphors. In the end, however, it argues that we do not live in a world made up entirely of models. As useful as they are, models do depend for their sense upon basic, everyday perception of things as particular instances of certain universals.

11:45 Lunch Break

13:45 **James Nguyen** is an Assistant Professor in Theoretical Philosophy at Stockholm University. He holds a PhD from the London School of Economics and Political Science, and completed postdoctoral research at the University of Notre Dame and University College London and the Institute of Philosophy,

University of London. Most of his research concerns the philosophy of model-based science, but his philosophical interests are wide and include the philosophy of science (including physics, the social sciences, and the humanities) more generally, as well as epistemology and aesthetics. He is particularly interested in how we reason about the world through simplified representational systems.

“Universality Explanations”

It is commonly assumed that in order for a model to explain the occurrence of some phenomenon in the world, the former needs to accurately represent the latter. It is also clear that many such model-based explanations are essentially idealised: the structure of our models explicitly diverge (in known ways) from the structure of the phenomenon we seek to explain, and moreover, these idealisations are, in some sense, essential to the resulting explanation. These two observations are in tension with one another: how can model-target divergences play an essential role in facilitating accurate representation, as required if they explain? I dissolve this tension by exploring model-based ‘universality explanations’ in science. In such cases, roughly speaking, idealised models define a space of possible systems that, at a certain level of grain, exhibit the behaviour to be explained. Taking recent work by Michael Strevens on the one hand and Robert Batterman and Colin Rice on the other as my foil I argue that idealised models that work in this way are neither ‘second-best’ explanations, nor inaccurate representations. I further suggest that this style of reasoning is more common than previously suggested. This talk is based on joint work with Patrick Shields and Nicholas Teh.

14:45 Coffee Break

15:00 **Thomas Davenport, OP** is a professor Incaricato of Philosophy at the Pontifical University of St. Thomas Aquinas (Angelicum). He a BS in Physics from the California Institute of Technology and a PhD from Stanford University studying theoretical particle

physics. The focus of his scientific research was writing and testing simulations for high energy particle colliders like the LHC at CERN. After joining the Dominicans in 2010, he studied philosophy and theology in preparation for his ordination to the priesthood in 2017. He earned a PhL from the Catholic University of America in 2018 and is working towards a PhD in Philosophy at the Angelicum with a concentration on philosophy of nature and philosophy of science. He is a frequent speaker on topics related to the intersection of faith and science and a contributor to a number of projects in this area. In addition, he serves on the Board of Directors of the Society of Catholic Scientists.

“Thomistic Scientific Realism and the Modelling of Elementary Particles”

Aristotelian and Thomistic philosophy are considered a form of "Moderate Realism" on the question of universals, when compared to Platonic Realism and Nominalism. On the surface, they may not seem so moderate with respect to questions around "Scientific Realism" and the question of unobservable physical entities. In particular, Thomistic Moderate Realism presumes the immateriality of the intellect and that the world is made of substances composed of prime matter and substantial form, positions that most contemporary philosophers of science, Realist or Anti-realist, find problematic. In this paper, I will situate Thomistic Natural Philosophy with respect to contemporary conversations on Scientific Realism, arguing that it is not a form of naive Scientific Realism or Anti-realism but a form of sophisticated Scientific Realism, closely analogous to the "semirealism" of Anjan Chakravartty. I will further discuss how the fuller hylomorphic commitment of Thomistic Natural Philosophy can provide additional support for the success to certain kinds of modelling and idealization, with some examples drawn from particle physics.

16:00 Coffee Break

16:30 Breakout Sessions

Breakout Room 1 (Aula Minor)

- 16:30** **Joseph Milburn** – “*Newman’s Attacks on Scientific Fundamentalism: Lessons for Cartwright?*”
- 16:55** **Claire Murphy** – “Models as Artifacts: An Aristotelian-Thomistic Perspective”
- 17:20** **Dominic Dold** - “Stability as a Constraint on Scientific Models”
- 17:45** **Sara Panteri** – “Aristotle’s Posterior Analytics and the Relation between Geometry and Mechanics”
- 18:10** **Timothy Kearns** - “Teleology, Dynamical Systems Theory, and Least Action—An Aristotelian Interpretation of Dynamical Models”

Breakout Room 2 (TBA)

- 16:30** **Sam Pell** – “Aristotle’s account of Color and the Hard Problem of Consciousness”
- 16:55** **Patrick Shields** - “Idealization and Effective Theorizing in Modern Physics”
- 17:20** **Daniel Usma Gomez** - “Aquinas as a Philosopher of Mathematics”
- 17:45** **Marta Bielinska** – “The Best System Approach and Scientific Practice”

Saturday, February 25

09:30 **David K. O'Connor** is Professor of Philosophy and Concurrent Professor of Classics at the University of Notre Dame, where he has been a faculty member since 1985. He is currently the Director of Undergraduate Studies for the Minor in Business and the Common Good in the Mendoza College of Business. Professor O'Connor held the 2020-21 Rev. Robert Randall Distinguished Professorship in Christian Culture at Providence College. His academic work is centered in ancient philosophy, moral philosophy, aesthetics, and Catholic thought.

"Bigger Than Life: Aristotle's Ideal Hero"

As Aristotle understood dramatic poetry, the tragic hero is an idealization, intensification, and elevation of human agents. This idealization focuses on how action (praxis) constitutes success (eudaimonia) or failure. Through tragedy's intense and elevated idealizations, we are brought to a peculiarly intimate satisfaction both emotional and cognitive. The distinctive cognitive satisfaction wrought by this intimacy makes tragedy more philosophical than history, as Aristotle said. But the cognitive satisfaction of tragedy does not collapse into philosophy's satisfaction. I will develop this account of Aristotelian idealization with a view to Wagner's music drama and Maritain's aesthetic theory.

10:30 Coffee Break

10:45 **Nicholas Teh** is an Associate Professor of Philosophy at the University of Notre Dame, a member of the History and Philosophy of Science Program, and the director of Notre Dame's Philosophy of Scientific Thought Initiative. He has published widely on the interpretation of modern physics and the significance of "symmetry" in physical reasoning. He is the co-editor (with James Read) of the recently published "The Philosophy and Physics of Noether's Theorems" (CUP) and the author of a forthcoming monograph on symmetry, also from CUP.

“Essential idealizations and the interpretation of Science”

It is a commonplace that idealizations are essential to artistic thought and representation, whereas---despite the ubiquity of idealizations in contemporary science---various philosophers are less than comfortable with idealization as an essential part of scientific thought, explanation, and representation. In this paper I will present an argument for why idealization is indeed essential to science, and I will discuss the implications of this insight for the interpretation of what physics tells us about the world, including the issues of "determinism", the "quantum measurement problem" and so-called "time reversal". I will also discuss the question of whether a science such as physics is inherently more "unificationist" in its ambitions compared to one such as biology.

11:45 Lunch Break

13:45 **Jonathan Buttaci** is an assistant professor of philosophy at the Catholic University of America. He earned an MA in classics and a PhD in philosophy from the University of Pittsburgh, having previously studied philosophy and classics at the University of Notre Dame. His current research focuses on Aristotelian accounts of mind, knowledge, and learning, including how later thinkers have received and revised Aristotle's account.

“Fitting Concepts to Experience’: Aristotle, Aquinas, and Geach on Phantasmata as Tools for Thinking”

According to Aquinas, "our intellect understands material things by abstracting (abstrahendo) from phantasmata" (ST Ia q. 85 a. 1). Here Aquinas takes himself to follow Aristotle, despite the fact that Aristotle restricts abstraction (aphairesis) to understanding mathematical and not material objects. One aim of this paper is to examine Aquinas's reception of Aristotle on this point. Furthermore, despite favorably citing Aquinas, Geach criticizes

abstractionist theories in *Mental Acts*. In an appendix, however, he briefly excuses Aquinas from his criticisms. Another aim of this paper is to examine Geach's reception of Aquinas.

To accomplish both aims, I return to Aristotle's account of theoretical intellect in both mathematical and scientific studies. Although for Aristotle abstraction is a specifically mathematical mode of generating intellectual objects, it nevertheless can illuminate how we inquire into physical things. In both cases, intellectual consideration proceeds through an intelligent engagement with and conscious shaping of phantasmata, "fitting a concept to my experience" (Geach, *Mental Acts* ch. 11 p. 40). Aristotle posits a single intellectual power responsible for both activities, the agent intellect (*nous poiētikos*). This partially vindicates Aquinas's more generic notion of intellectual abstraction; this activity taken generically, in turn, partially vindicates Geach's view of Aquinas's benign abstractionism.

14:45 Coffee Break

15:00 **Santiago Schnell** earned his undergraduate degree in biology from Universidad Simón Bolívar (Venezuela), and then his doctorate degree in mathematical biology from the University of Oxford (United Kingdom) in 2003. Dr. Schnell was appointed Junior Research Fellow at Christ Church and Senior Research Fellow of the Wellcome Trust at the Wolfson Centre for Mathematical Biology at the University of Oxford between 2001 and 2004. He was assistant professor at Indiana University in 2004, and joined the faculty at the University of Michigan in 2008 as an associate professor in the Department of Molecular & Integrative Physiology, in the Department of Computational Medicine & Bioinformatics, and a William K. Brehm Investigator at the Michigan Comprehensive Diabetes Center. He was promoted to professor in 2015, appointed as the John A. Jacquez Collegiate Professor of Physiology in 2016, and acted as department chair of the Department of Molecular & Integrative Physiology between 2017 and 2021. From September 1st, 2021, he has been serving as the William K. Warren Foundation Dean of the College of Science

at the University of Notre Dame. He is Professor of Biological Sciences, and Applied and Computational Mathematics and Statistics. He is also an internationally renowned theoretical and mathematical biologist. His research has substantially altered the view of measuring and modeling enzyme-catalyzed reactions under non-physiology and physiological conditions. He has published over 160 peer-reviewed publications and has received multiple awards in recognition of his research and teaching endeavors. He is a US National Academy of Medicine Emerging Leader in Health and Medicine, and the recipient of the Arthur Winfree Prize, one of the two premier awards in mathematical and theoretical biology. Dr. Schnell is Fellow of the Royal Society of Chemistry, the American Association for the Advancement of Science, the Society for Mathematical Biology, the Latin American Academy of Sciences and Royal Society of Medicine and he served as the President of the Society for Mathematical Biology.

“The uses and abuses of models in the life sciences: How can life scientists develop better models and theories?”

Biology is complex. As a result of this complexity, life scientists use models to understand biological processes and challenge their ideas or hypotheses. Life scientists confront their ideas with data using statistical methods to determine the extent to which their hypotheses agree with experimental perturbations. These perturbations can be carried out on biological models, or if possible, on living organisms. In the experimental laboratory, composite biochemical mixtures, cell lines, and animals are typical models for biological systems. During the last decade biology has become data rich and data more complex, so much so that it is becoming increasingly challenging to test hypotheses using the traditional statistical approaches. As a result of the data complexity, mathematical and computational models are gaining in importance across the life sciences because they are more effective at representing the complexity of biological systems. Mathematical models can be used to test hypotheses by making testable predictions about the future behaviour of systems, and

also Mathematical models can also test ideas or hypotheses by gaining insights into how we can control the behaviour of biological systems. In this talk, the audience will learn how non-mathematical and mathematical models are used and abused by life scientists to test ideas and hypotheses. This overview of biological models will set the stage to discuss the current challenges limiting the development of better models and theories in the life sciences.

16:00

Coffee break

Mariusz Tabaczek, OP is a Polish Dominican and theologian. He holds a Ph.D. in philosophical theology from the Graduate Theological Union in Berkeley, CA and Church Licentiate from the Adam Mickiewicz University in Poznan, Poland. He is a professor of theology at the Pontifical University of Saint Thomas Aquinas. He is also a researcher at the Thomistic Institute at the same University. He is interested in the science-theology dialogue, especially in the issues concerning science and creation theology, divine action, and evolutionary theory. He published a number of articles and two monographs: *Emergence. Towards A New Metaphysics and Philosophy of Science* (University of Notre Dame Press 2019) and *Divine Action and Emergence. An Alternative to Panentheism* (University of Notre Dame Press 2021). His upcoming third book will concentrate on the contemporary Aristotelian-Thomistic Approach to Evolution.

“Aristotelian Causal Modeling of Life in the Context of Contemporary Reflection on the Roles of Models in Biology”

Aristotelian realism was not naive realism. Aiming for perfect knowledge, i.e., Gr. *episteme* (Lat. *scientia*), which comes from demonstration of the reason fact (Gr. *dioti*; Lat. *propter quid*), he was aware of the fact that its ideal is difficult to achieve. He thus acknowledged that investigators of the world of nature must often content themselves with a lesser goal - knowledge that is

probable but not certain, i.e., with Gr. *doxa* (Lat. *opinio*), which comes from a demonstration of the fact (Gr. *hoti*, Lat. *quia*). This opens Aristotle's scientific method to modeling techniques, bringing it into conversation with the current emphasis on and speculative typology and evaluation of the role models play in science. At the same time, Aristotelian modeling, just as his scientific explanation, was causal. In my presentation I will reflect on the extent to which contemporary modeling in biology might be considered to be causal.



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