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Research article

Hermeneutic Methods in Science

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Abstract
Hermeneutic methods have ordinarily been used in humanities and social studies where theories and descriptions do not explain observable facts, but interpret actions, texts and cultures. However, there is a progressing tendency to synthesize methodological insights and research programs in practices of technoscience as presupposed by actor-network theory or program of integration for qualitative and quantitative methodology in sociological investigations. Alfred Nordmann is convinced that objective scientific knowledge cannot be a subject of exegesis and subject-related interpretations, because knowledge in science depends on conventional language and models as sense-making devices. Therefore, hermeneutics of science is a less coherent project than hermeneutics of technologies. This opinion is interesting to compare to pluralism of scientific descriptions, when alternative conceptual frameworks can be equally valid and justified. The aim of article, thus, is to explain hermeneutic practices in scientific communication and cognition by exposing theoretical and historical arguments which warrant the application of hermeneutic methods in research of nature. It states that, according to perspectivism in cognitive sciences, considering theories as construals, constructivist component in theories of mental modeling and interpretative semiotics, scientific models are necessarily subject-related. In addition, we can find historical evidences that hermeneutics of science is connected with Christian intellectual tradition, natural philosophy and modern technoscience.

Keywords: Hermeneutics of science; Philosophy of language; Semantics of terms; Models in science; Incommensurability; Classifications and semantic networks

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Научная статья

Герменевтические методы в науке

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Аннотация

Герменевтические методы, как правило, применяют в гуманитарных и социальных науках, где концепции и дескрипции не объясняют наблюдаемые факты, но интерпретируют действия, тексты и культуру. Но существует восходящая тенденция синтеза методологических инсайтов и исследовательских программ в практиках технонауки, что предполагает акторно-сетевая теория или смешанная методология количественных и качественных исследований в социологии. Альфред Нордманн считает, что объективное научное знание не является предметом экзегезиса и субъективных интерпретаций, поскольку знание зависит от конвенционального языка и моделей как интерпретирующих устройств (“sense-making devices”). Поэтому герменевтика науки - менее последовательный проект, чем герменевтика технологий. Его мнение интересно сопоставить с плюрализмом научных описаний, когда альтернативные концептуальные схемы являются равно правильными и оправданными. Цель этой статьи заключается в объяснении герменевтических практик науки и познания, которые оправдывают применение герменевтической методологии в исследовании природы. В соответствии с перспективизмом в когнитивистике, который представляет теории конструктами, конструктивистскими компонентами теорий ментального моделирования и интерпретативной семиотикой, модели необходимо относятся к субъекту. Кроме того, мы можем найти исторические свидетельства того, что герменевтика науки связана с христианской интеллектуальной традицией, философией природы и современной технонаукой.

Ключевые слова: Герменевтика науки; Философия языка; Семантика понятий; Модели в науке; Несоизмеримость; Классификации и семантические сети

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INTRODUCTION

Firstly, Alfred Nordmann argued that there is no need for hermeneutics of science, at least, in „normal" regime of enquiry, because in normal science scholars use conventional and objective language for communication.

Secondly, scientists succeed in achieving consensus in regard to the truth of theories and content of terms in contrast to poets, literary writers, humanists, or artists, whose works are subjected to exegesis. As a result, hermeneutic interpretations play a part on the backstage of science, but philology is not a primary scientific occupation. More likely verbal disputes, or disputes concerning the meanings of terms, reveal anomalies in experience of scientists.

Nordmann has mentioned three approaches to hermeneutics of science. One of them, associated with Gaston Bachelard and Thomas Kuhn, presumes that hermeneutics affords drawing a boundary between science and poetry, because scientific language shows transparency, publicity, and intelligibility, whereas poetry implies unconventional usage of language, corruption and unfamiliarity of meanings, subjective interpretations of symbols by readers and authors of cultural texts. Another model for hermeneutics of science is illustrated by Heinrich Hertz's specifications of Maxwell's equations, conceptions of matter, and principles of mechanics. Hertz distinguished philological and philosophical modes of enquiry when "empty disagreements" of scientists and "uncertainty of meanings" can be resolved by physical tests and empirical experimentation closing the debates in a humanistic club of physics. Here hermeneutics works as a preliminary and temporary method before truly scientific treatment. And the third approach to hermeneutics of science differs from others, since it does not exclude exegesis from research practices, though its relevance is explained not by personal knowledge, perception or language skills, but work of abstract models as hermeneutic agents connecting interpretable data and interpretable theories unambiguously.

It seems to me that Nordmann prefers the last approach, a restricted view for hermeneutics of science, when the meaning of terms is discussed until models have passed the process of adaptation, calibration, tuning, and acceptance for conventional usage. Properties of things and knowledge of tendencies are exteriorized in models revealing the capacities and causal structure of natural phenomena (Nordmann, 2008, p. 375-376). In the empiricist view of Nancy Cartwright, a hermeneutic circle allows to connect abstract theories and perceptual data due to mediating function of models. Models become autonomous agents, distinct from objects as well as theories. Models, not scientists, read the world and, being impersonal readers, interpret the theories (Cartwright, 2008, p. 390).

Margaret Morrison, Mary Morgan and Cartwright explain in many details what the scientific models are. They can be descriptions of facts, diagrams, mock-ups, simulations, measures, equations, or conceptual schemes. Facts and objects are not imagined apart from models, which represent, substitute, and interpret facts and objects for enquirers. Models must properly fit the world as well as the theories of the world. Unlike models, theories are abstract, contingent, and lack concrete meaning. A set of models provides a semantic interpretation for a theory. However, the models may be more phenomenological, and others stay more theoretical. Models are part of theories if they are interpretive and may be developed like tools of representation for empirical phenomena (prototypes, classifications, statistical data, visualizations, or whatever else) (Hartmann et al., 2008; Knuuttila et al., 2025).

Following Ludwig Wittgenstein, the received view in the philosophy of science considers the world of science as the totality of facts described in empirical statements (even if propositions are only one way of representation among others): "There are clear criteria for the truth of such descriptive statements – and no hermeneutics required for thus producing a description of what is true in a world" (Nordmann & Bylieva, 2025, p. 14). It means that truth criteria must be explicit, rational and conventional, even when it is not so (Morgan & Morrison, 1999, p. 352), and scientists do not necessarily agree on what is good science and the best theories at present. Later Wittgenstein became convinced that the structure of the world is not disclosed in language games and not supposed to be represented by symbolic isomorphisms.

There is inconsistency if we approve hermeneutics in preliminary research and reject hermeneutics for the advanced stage of investigation. Kuhn famously proposed the idea of normal scientific practice, but it is not how he understood history of science and life of communicating communities. He devoted much attention to how humans learn language, get familiar with the meaning of terms, and socialize in professional groups of scientists. From his point of view, language depends on cultural experience, both alive and variable. And science is integrated into diverse social contexts where there is no uniformity of language and the meanings of signs. Since Karl Popper and Paul Feyerabend, many philosophers have been questioning the existence of normal scientific practice. Scientific models are not universal, and this means that scientists must come up with limits of their application to the real world. According to Cartwright, models communicate some amount of descriptive and factual content conveying partial truth in relation to objects; they fit certain circumstances, but not others. Therefore, scientists produce knowledge sensitive to contexts of cognition. If so, we can regard seriously not only hermeneutics of technology but also of science, especially technoscience where research methods, fields, and practices experience hybridization. In the following chapters, I formulate philosophical and historical reasons, which might warrant the hermeneutic methods in science.

ARE MODELS SUBJECT TO INTERPRETATION?

Models as sense-making devices are quite convincing idea to me. Humans find the way to the world via cognitive labor: analyzing and comparing data, prototyping, building models of objects, fitting models to theories and one to another, theorizing sophisticated problems. That is compatible with a semantic and set-theoretic view of theories as well as a broader semiotic reading of scientific models explaining their expressive, descriptive, manipulative, explanatory, and predictive power.

Semiotics as a field of study investigates how signs acquire meaning, connect one to another and get interpretation by users in communication. It does not divide the types of discourses, whether scientific or literary tales we communicate; in sense that all of them follow the rules of structure and understanding. For Cartwright prepared and unprepared descriptions ground representative models by which theories and covering laws can be interpreted and related to observable objects and situations in the world, because theories are simulacra if taken without derivative phenomenological laws and generalizations. Unprepared descriptions bear all information gathered in relation to phenomena under research. They are made in multiple, ordinary conversational, phenomenological, experimental, or partly theoretical languages and by multiple language means from graphical to propositional. Whereas prepared descriptions are more selective and proper for building models of scientific objects.

All languages function as precategorized signifying systems, which symbols can describe a type (regularity), a token (single fact) and a tone (quality) of phenomena if to adopt Charles Peirce terminology. In cognitive semiosis, phenomena are arranged, classified, named and notified, and this is how languages provide speakers with conceptual maps, or mental models for organizing experience. In scientific language the modeling achieves a similar purpose as for perceptual data or general theories, also called grand and fundamental theories. The last ones aim to explain as many observable phenomena and known models as possible. A unifying account of modeling in cognitive processes was proposed in works concerning the conceptual structure of language by Kuhn; model-based reasoning by Hesse, Philip Johnson-Laird and Nancy Nersessian; cultural schemata theory by Roy D’Andrade; connectionist networks by Claudia Strauss and Naomi Quinn; mental modeling in collective systems by David Kronenfeld; usage-based interpretation of language and ICM in cognitive linguistics (Wassmann & Bender, 2015).

Still, it is not clear what are scientific models as autonomous agents among other representations and descriptions of objects in phenomenological, experimental, or theoretical languages (Morrison, Morgan, Cartwright), given these languages are essentially mixed (William Quine, Wilfred Sellars). Models can be justified apart from a theory and even data, as in thought experiments and with idealized models. However, models do not seem ontologically detached as a kind of third entity, standing away from other conceptualizations like terms, propositions, taxonomies, axiomatizations, or theoretic descriptions, even if simulative reasoning based on models is something more than inductive, abductive, and deductive arguments in logic (Nersessian). That’s why the different models give us good means to analyze the epistemological toolbox of science.

Some examples of models in science are accounting-balance model in monetary economy theory, perfectly rational agents in decision-making social theories, the Hardy-Weinberg equilibrium, the MacArthur-Wilson and Lotka-Volterra equations in population ecology, the Price equation in evolutionary theory, or statistical models of wildland fires in environmental studies. They are compatible with the middle-range theories, which serve to represent a particular phenomenon or explain a set of empirical data in social and other branches of science. However, the models are used on lower (data models, scale models, taxonomies, classifications) and upper levels (equations, abstract models, computer simulations) in research, where they differ in functions and features (Frigg & Hartmann, 2020). In addition, phenomenology and theories have moving boundaries, and what was once a theoretical entity becomes observable like cells and molecular structures, genes, electromagnetic fields, atoms, and black holes. On the other hand, observable phenomena can be re-theorized in the subsequent thought like space, motion, force, gravity, planets or blood circles. Observable and detectable objects also differ in their epistemic reliability, the last ones depend on the theoretical descriptions and the assumptions in a greater degree. All this, however, does not prioritize phenomenological generalizations over theories and vice versa, endorsing constructive realism in relation to models. Even if theories may fail or function as approximations, in particular because they model only selected features of a targeted system and involve abstractions and idealizations according to model-based interpretations of science.

Material models and samples provide scientists with copies of objects and typical representatives of natural kinds. Material models do not reflect all features of objects, representing necessary aspects and behavior. They are used to show spatial positions, shapes, connections, and proportions of parts (globus, anatomy maps, molecular models); movements and interactions of objects (car on inclined surface, airplane kit, billiard balls model of ideal gas); particular physical and other effects (field lines of magnet, movement of spring bodies); internal and external design and landscapes (architecture models); standard representatives of a kind (material samples). The real objects can deviate from typical features of models like diseases, pathologies, and variations of norm in bodies; physical properties of atoms in isotopes; and chemical structures of matter in mixtures, alloys, and polymers.

Philosophers explain the reference of taxa in terms of similarity and essentialism, classes and universals, constructions and natural grouping. Merging of these ideas is possible because different models represent the world differently. There is no one shared opinion on how classifications correspond to the world. Analysis of biological taxa has shown that species, particularly related to peripheral isolates, hybrids, syngameons, asexual and symbiotic organisms, do not satisfy one or another criteria for biological kinds and attribution to higher classes (Stanford, 1995). First, this means that variations of species are greater than presupposed by the idea of “natural kindness.” Second, any single criterion for grouping individuals (morphological, cytological, ecological, genetic, or phylogenetic criteria) should not be privileged. Third, variations of traits and criteria of grouping are responsible for pluralistic systematizations, equally valid and justified. Fourth, divisions in species and kinds depend on objective properties of individuals along with pragmatic reasons of investigators who can take into account clinical, pathognomic, epidemiological, ecological and other features of species (see, e.g., (Baron, 1996) and (Burrell et al., 2016)).

John Dupre (1981) states that taxonomic realism implies the existence of one correct classificatory system, excluding alternative models; however, species do not display uniformity. According to other opinions of philosophers, realism admits pluralism in classifications and theoretical frameworks (Philip Kitcher). No wonder that phylogenetic studies of biological species have influenced the revisions of traditional views and redistribution of units under taxonomical rubrics. What results in wide proliferation of biological theories. Phylogenetics reasonably pretends to dismiss previous classifications but does require extensions to be more analytic. Another remarkable fact is that, developing the Hubble sequence, astrophysitists have created new classifications of galaxies (Lundmark, de Vaucouleurs, Vorontsov-Velyaminov, Sandage, York, and other systems). Due to gravitational interactions, distortions and collisions, galaxies acquire irregular shapes and difference in structure, size, density, radiation and other characteristics, not strictly supposed by typologies. Astronomers have been finding the unusual types of objects like ring and dwarf galaxies, clumpy and transition galaxies, and quasar and blazar galaxies improving former taxonomical models by the addition of new criteria, types, prototypes, and divisions along with the application of automated methods of data analysis for multi-class classifications (Yeganehmehr & Ebrahimnezhad, 2025). Taxonomies become more pluralistic and less realistic in constructivist interpretations, though philosophically contested. Another illustration may be Nebula clouds, relating to many cosmological objects with diffuse structures, gaseous matter, dust, and regions of star formation. They refer to parts of space, which turn out to be irregular galaxies, galactic embedded clusters, molecular clouds of interstellar matter as Herbig-Haro objects and dark cold nebulas, luminous HII regions near hot stars or, as well, clouds around a dying stars and supernova, where physical and chemical events differ dramatically.

Finally, our main question may be asked: are scientific models detached from the authors and, as a result, not subject to interpretation? Perspectivism in cognitive sciences, treating theories as construals, constructivist ideas in theories of mental modeling and the interpretative component in semiotic models of communication do not lead to this conclusion. We know well that natural languages do not possess clarity and unambiguity. If scientific communication alters from other discourses in clarity, transparency, and tendency to conventional expressions, its capabilities and linguistic means as a condition of interpersonal communication in science deserve theoretical explanation and evaluation as a hermeneutic issue. In addition, Robert Merton thought that scientists are disposed to collaboration because of common ethos and epistemic imperatives. Jurgen Habermas saw readiness for understanding and finding consensus as a preliminary condition for rational communication among humans. We do not have *a priori* and empirical evidence that communication of scientists is perfectly rational, supportive, and cooperative. For cognitive theorists, interpersonal communication connects diverse cultural communities, and only shared experience can unify lexical meanings and create wholes from individual units. In certain social theories, consensus among scholars and conventionality of language are not a norm, but theories are costly in terms of multiple resources, and many of them are not seriously contested with a time what works for stabilization of knowledge. Michael Polanyi was convinced that understanding science and scientists requires background knowledge, salient, personal, and not explicitly expressed in formalisms and propositions. This means that knowledge is interconnected with the individual states of mind as much as the shared world (whatever it is).

These extended contexts allow us to understand philosophy of science as hermeneutics of science and technology. Philosophers ask for foundation and background of knowledge, logical soundness of reasoning, ontological presuppositions, social and cognitive biases of scientists and established theories, possible consequences of discoveries, and future prospects of human thoughts. Philosophers must be attentive to the usage of words, symbols and language, but scientists do much the same for the advancement of knowledge. Hertz might prefer experimentation to “philology” and empty disputes concerning words, but he did a lot of conceptual work in *The Principles of Mechanics* and described his book plainly as the new interpretation of Newtonian physics.

The language of competing theories in science differs in lexicon, which is said to be incommensurable. There exists a break in communication among camps of theorists who support unlike paradigms or programs. Verbal, conceptual, methodological and value differences are responsible for the disunity of science. Many examples used by Kuhn to illustrate paradigm change were not subsequent, but competing ideas: geo- and heliocentrism, particle-wave theories of light, phlogiston-oxygen theories of combustion, Darwinism, and physical relativity. In alternative conceptual frameworks, the same terms are related to incommensurable meanings and unintelligible for minds not converted to a particular worldview and system of knowledge via learning, dialogue, practice, and experience.

In competing theories of evolution, the development of species is interpreted as neutral genetic drift or adaptive selection (Duret, 2008), or genetic scientists may define differently what genes and material of heredity are (Weber, 2004). When theories compete, they classify objects in alternative lexicons and semantic categories (Kuhn, Feyerabend), produce idealized models or typologies of objects (Max Weber, Ferdinand Tönnies), create possible worlds and alien ontologies (Devid Lewis, Nelson Goodman). These worlds can be apt to union, re-combination, or mutual exclusion and annihilation. It takes time and efforts until conventional meanings are accepted by collectives and established by institutes of knowledge.

CASE-STUDIES IN HISTORY OF SCIENCE

Where propositional knowledge, proliferation of meanings, and misunderstanding are possible, hermeneutic techniques have been applied ordinarily: collecting papers, reading the text, getting into conversation, storytelling, reconstructing contexts, learning symbolic codes, and interpreting inputs holistically in light of the whole body of knowledge. Explication, definition, and clarification as logical operations are connected with the right reasoning and understanding of meanings, which turn out to be pluralistic in endless contexts of investigation when unification is a difficult task to accomplish.

In biblical hermeneutics, the *Alexandrian* and *Antioch* schools proposed symbolic and literal ways to interpret holy scriptures. Especially in early Christianity, readings of scriptures were pluralistic and did not follow official rules of faith, giving birth to heresies and misinformation. Scientific schools and intellectual traditions, whether in science or philosophy, are compatible with distinct hermeneutic perspectives on the same subject matter. In order to follow tradition, it is essential to have background knowledge and, else, understand values, conventional meanings, and the horizon of events. What Kuhn called paradigm is more propitious to scientific schools.

Natural theology in Christian tradition has read nature as a scripture written by the divine creator. In this context hermeneutic techniques are more than endorsed. Interpretation of creation makes it possible to understand God's intentions, acts, predestination and providence. Visible and changeable things lead to understanding of eternal and invisible forms of objects, incorporeal entities, the enigma of creation, and the first principles of existence. The revelation of God and his word is given in every material thing, living matter, bodies, and every soul. That is why nature serves as a source for understanding God's wisdom and architecture of universe. Typical questions of natural theology relate to how ordered nature can provide an evidence of divine creativity or how imperfection of nature is consistent with the greatness and the goodness of God.

St. Augustine in *The City of God* and St. Thomas Aquinas in *Summa Theologica* turned the attention to natural phenomena in connection with statements and symbols of the Bible and the corpus of religious texts. Augustine's *Christian Doctrine* is a treatise on biblical hermeneutics, mainly devoted to interpretation of canonical Christian writings. According to this treatise, natural signs and philosophical knowledge create a foundation for theology. In *Summa Theologica*, St. Aquinas (1485/2006) notes, "We cannot see the essence of God; but we know God from creatures as their principle" (L. 1, p. 2). Aquinas discusses the reference of names and predicates and divide names on those applied initially to things and metaphorically to God, and those applied immediately to God, which give knowledge of divine essence and causal power. Attributes of things make possible not only knowledge of abstract substances, but also divine qualities (absolute and affirmative names of God), and are used equivocally for reference both to creatures and creator. Naming things, clarifying meanings, decoding symbols, interpreting scriptures and natural signs are included in the exegetic practices of Christianity.

Tertullian considered science as a formation stage for religious consiousness; that is interesting to correlate with the contrary statements of positivists. He believed that philosophical descriptions of the world must be cleared up and improved by religious truth. Natural philosophy had stayed a subordinated field of studies in Christianity and did not advance much until the late Middle ages. Roger Bacon, a representative of medieval science and the monk of the Franciscan order, adopted methods of natural theology in his experimental research as complementary to knowledge of creation. Bacon (1773/1962) was convinced that "the grace of faith illuminates greatly, as also do divine inspirations in the sciences of philosophy" (p. 585). In the book *Opus Majus*, hermeneutic methods are used, particularly in the studies of medicine. Bacon says that humans could live much longer, but due to degradation of environment they have been living less than in times after the fall. Observing how animals avoid a premature death, humanity gets instructions for longevity. In general, humans should disclose the secrets of nature in order to retrieve from it instructions for medical treatment. In *Letter concerning the nullity of magic* Bacon rejected magical effects of incantations, symbols, numbers, and characters, which serve to express the laws of nature, but not supranatural powers. The philosopher rejected treatment based on signs and magical practices "pacifying evil demons" over approval of psycho-physiological efficacy of words and communication in medical therapy. If this approach to therapy somehow continues in narrative medicine, natural theology has a similar continuation in Intelligent Design theories in philosophy. Another remarkable writing in natural theology is Robert Boyle's *The Excellence of Theology, compared with Natural Philosophy* (1674) (McGrath, 2022), where rational knowledge, natural faculties, and physical arguments reveal God's creative power; origins, order and duration of universe; and beginning of human lives (Boyle, 1674/2017).

Beginning from the works of Fridrich Schleiermacher, Wilhelm Dilthey and neokantians, hermeneutics was nominated to be the exclusive method of human sciences, opposite to positive knowledge of nature and distinct from religious exegetic traditions. Earlier it was already introduced into the fields of philosophy, literary studies, politics and law (in jurisprudence, specifically, hermeneutic methods were applied in commentaries for *Roman law* and *Corpus Juris Civilis*). In modern technoscience there appear attempts to synthesize methods of soft and hard disciplines. Bruno Latour in actor-network theory has explained laboratory life and interactions of cognitive actors within laboratory settings in terms of hermeneutic practices — material semiosis, symbolic translations, exegesis of inscriptions, coding scriptures, networking and mutual understanding. In a sense, scientists own exclusive knowledge concerning nature, because it takes much effort to open black boxes of their experiments, reevaluate results and master a language. In last decades social sciences have been adopting quantitative methods, including computational and software techniques. Interpretive approaches are extensively applied by social scientists in connection with data analysis, computer simulations or ethnography research, that is the mixed method research. In the fields of computer science and artificial intelligence, results in linguistic studies, logic and psychology attract enormous attention. Boundaries are obviously dissolving, and technoscience exploits the original territories and methods of humanistic research.

Nordmann & Bylieva (2025) say that the "distinguishing the production of true representations from hermeneutics as a process of understanding oneself by encountering and never quite understanding the other" (p. 11). He thinks that science does not presuppose conversion and change of the individual self. Nevertheless, the most famous theories in science have changed not only our beliefs and worldviews, but also self-perception, modes of behavior and social interactions, generally.

CONCLUSION

The presence of interpretation in scientific cognition can be associated with cognitive modeling itself, fitness of models to data and theories, understanding the lexicon of incommensurable theories, and philosophical questions of science. Models interpret the world(s) and are also interpreted in the subsequent theories, in philosophy of science and public discourse on essential worldview issues. Interpretation does not mean infinite replication of ideas, but theories and believes often come to be pluralistic. Idea of a "scientific model" illustrates it itself.

There is old intellectual tradition, rising from the ancient times, which warrants the application of hermeneutic methods in philosophical and scientific studies. In technoscience hybridization of disciplines and methods is a progressing tendency; in a result, there appear more research publications blending different methodological insights and scientific programs with hermeneutic techniques.

REFERENCES

Aquinas, T. (2006). *The Summa Theologica*. (Fathers of the English Dominican Province, Trans.). Burns Oates and Washbourne. (Original work published 1485) https://www.documentacatholicaomnia.eu/

Bacon, R. (1962). *The Opus Majus*. (R. B. Burke, Trans.). Russell & Russell. (Original work published 1773)

Baron, E. J. (1996). *Medical Microbiology* [4th ed.]. University of Texas Medical Branch at Galveston. https://pubmed.ncbi.nlm.nih.gov/21413252/

Boyle, R. (2017). The Excellence of Theology compared with Natural Philosophy. In M. Hunter and E. B. Davis (Eds.), *The Works of Robert Boyle, Vol. 8: Publications of 1674–6.* Pickering & Chatto. https://doi.org/10.1093/OSEO/INSTANCE.00249915 (Original work published 1674)

Burrell, C.J., Howard, C.R. & Murphy, F.A. (2016). Classification of Viruses and Phylogenetic Relationships. In C. J. Burrell, C. R. Howard & F. A. Murphy (Eds.), *Fenner and White's Medical Virology* (pp. 15-25). Elsevier. https://doi.org/10.1016/B978-0-12-375156-0.00002-3

Cartwright, N. (2008). Reply by Cartwright. In S. Hartmann, C. Hoefer, & L. Bovens (Eds.), *Nancy Cartwright's Philosophy of Science* (pp. 389-392). Routledge.

Dupre, J. (1981). Natural Kinds and Biological Taxa. *The Philosophical Review*, *1*(90), 66-90. https://doi.org/10.2307/2184373

Duret, L. (2008). Neutral Theory: The Null Hypothesis of Molecular Evolution. *Nature Education*, *1*(1), 218.

Hartmann, S., Hoefer, C. & Bovens L. (Eds.). (2008). *Nancy Cartwright's Philosophy of Science* (pp. 389-392). Routledge. https://doi.org/10.4324/9780203895467

Frigg, R. & Hartmann, S. (2020). Models in Science. *Stanford Encyclopedia of Philosophy*. Stanford. https://plato.stanford.edu/entries/models-sciences/

Knuuttila, T., Carrillo, N. & Koskinen, R. (Eds.). (2025). *The Routledge Handbook of Philosophy of Scientific Modeling*. Routledge. https://doi.org/10.4324/9781003205647

McGrath, A. (2022). Natural Theology. In N. Brendan & N. Wolfe (Eds.), *St Andrew Encyclopedia of Theology*. University of St Andrews. https://www.saet.ac.uk/Christianity/NaturalTheology

Morgan, M.S. & Morrison, M. (1999). Models as Mediators: Perspectives on Natural and Social Science. In M.S. Morgan & M. Morrison (Eds.), *Models as Mediators. Perspectives on Natural and Social Science* (pp. 347-388). Cambridge University Press. https://doi.org/10.1017/CBO9780511660108.003

Nordmann, A. (2008). Getting the Causal Story Right: Hermeneutic Moments in Nancy Cartwright's Philosophy of Science. In S. Hartmann, C. Hoefer, & L. Bovens (Eds.), *Nancy Cartwright's Philosophy of Science* (pp. 369-388). Routledge. https://doi.org/10.4324/9780203895467

Nordmann, A. & Bylieva, D. (2025). Hermeneutic Dimensions of Science and Technology. *Technology and Language*, *6*(2), 1-20. https://doi.org/10.48417/technolang.2025.02.01

Stanford, P.K. (1995). Pluralism and against Realism about Species. *Philosophy of Science*, *1*(62), 70-91. https://doi.org/10.1086/289840

Yeganehmehr, A. & Ebrahimnezhad, H. (2025). Classification of Galaxies from Image Features Using Best Parameter Selection by Horse Herd Optimization Algorithm (HOA). *Astronomy and Computing*, *50*, 1-13. https://doi.org/10.1016/j.ascom.2024.100898

Wassmann, J. & Bender, A. (2015). Cognitive Anthropology. In J. D. Wright (Ed.), *International Encyclopedia of the Social and Behavioral Sciences* (Vol. 4, pp. 16-22). Elsevier. https://doi.org/10.1016/B978-0-08-097086-8.12035-5

Weber, M. (2004). *Philosophy of Experimental Biology*. Cambridge University Press.

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