An Evaluation of Two Realist Philosophical Approaches for Rigorous Interdisciplinary Communication

Fr. Joseph R. Laracy

Department of Systematic Theology
Department of Mathematics and Computer Science
Seton Hall University

joseph.laracy@shu.edu

Abstract

A major concern for scholars in the fields of systemics and cybernetics is promoting rigorous interdisciplinary communication. The Canadian philosopher and theologian, Bernard Lonergan, SJ, and the American physicist and theologian, Ian G. Barbour, have made significant contributions in this space. While their approaches are clearly distinct, both Lonergan and Barbour are philosophical realists. Each in their own way, they propose a shared epistemology and an inclusive metaphysical system for diverse fields, hence facilitating interdisciplinary communication. In this article, we concisely explicate their unique approaches as well as critique particular aspects. These rigorous approaches to interdisciplinary communication show promise for cybernetics and systems theory.[1]

Keywords: *Interdisciplinary Communication, Ian Barbour, Bernard Lonergan, Epistemology, Metaphysics, Theology & Science, Realism, Thomism*

1. Goal

The International Institute of Informatics and Systemics (IIIS) is a scholarly society dedicated to interdisciplinary communication and integration. Recent work by IIIS President and Fellow, Nagib Callaos, and Fellow, Jeremy Horne, has demonstrated the importance of interdisciplinary communication for those engaged in the advancement of scientific research (Callaos & Horne, 2013). Ian Barbour (1923–2013) and Bernard Lonergan, SJ (1904–1984), offer sophisticated approaches for rigorous interdisciplinary communication through a shared realist epistemology and metaphysics. This article strives to *begin* to address fundamental questions such as,

Can one build philosophical bridges to promote interdisciplinary communication?

Can one unify discipline *A* and discipline *B* within a comprehensive conceptual scheme?

What type of integration can be achieved between discipline *A* and discipline *B* when a systematic synthesis is achieved through a shared epistemology and an inclusive metaphysical system?

2. Epistemological and Metaphysical Foundations

In light of the polyvalent nature of some key terms, we carefully specify their meaning in the context of this paper. The English word, "epistemology," is derived from the Greek term, ἐπιστήμη (*episteme*), meaning "knowledge" or "science." Epistemology is the subdiscipline of philosophy concerned with the nature of knowledge, epistemic justification, the rationality of belief, and other issues (Dubray, 1909).

"Metaphysics" comes from the Greek phrase τὰ μετὰ τὰ φυσικά (*ta meta ta phusika*), literally "the beyond the physical," or more colloquially "beyond the physics (of Aristotle)." Metaphysics addresses the most general and fundamental principles underlying all reality and knowledge. Metaphysics is the science of being as being, seeking knowledge through causes. The material object of metaphysics is being, the whole of reality (subjective or objective, possible or actual, abstract or concrete, immaterial or material, infinite or finite). Metaphysics is unique in that its focus is "being as being" (the formal object). According to the Irish-American philosopher, William Turner, "everything that exists comes within the scope of metaphysical inquiry" (Turner, 1911).

Other sciences are restricted to one or several aspects of being. For example, the field of physics investigates phenomena from the point of view of quantity, or more precisely, measure. Mathematics is concerned with things that can be characterized by abstract structure and relationships (measurements being only one dimension thereof). Metaphysics has no such restrictions.

Ian Barbour, an experimental physicist and Protestant theologian, and Bernard Lonergan, a philosopher and Catholic theologian, both suggest a "critical realist" epistemology. Barbour's preferred metaphysical framework for a systematic synthesis between disciplines, in particular natural science and theology, is the process thought of the British logician, mathematician, and philosopher of science, Alfred North Whitehead (Whitehead, 1969). Lonergan, on the other hand, develops his own generalized empirical method (GEM) in which the being investigated is that which occurs within consciousness (Lonergan, 1992). We concisely explicate these two approaches as well as briefly critically engage aspects of them.

3. Fr. Bernard Lonergan, SJ

Bernard Lonergan was born in in Buckingham, Quebec, Canada in 1904. As a young Jesuit, Lonergan's academic interests were quite multidisciplinary. Lonergan studied philosophy at Heythrop College, London, as well as mathematics and classics at the University of London. He ultimately earned the Doctor of Sacred Theology (STD) degree (the ecclesiastical equivalent to the American research doctorate, i.e., the PhD) from the Pontifical Gregorian University in Rome. In the coming decades he taught at Le Collège de l'Immaculée-Conception, Montreal; the Thomas More Institute, Montreal; Regis College, Toronto; and his alma mater, the Pontifical Gregorian University, Rome (Dunne, 2018).

Lonergan developed his now popular "generalized empirical method" (GEM) in his 1957 book, *Insight*. The GEM divides the process of human knowing into four levels: experience, understanding, judgment, and decision. Lonergan refers to the GEM as a "transcendental method" and a "critical realism" (Beards, 2011). Like Ian Barbour, his realism is inspired by the practice of natural science. Lonergan and Barbour seek to avoid the errors of "naïve realism" on one hand, and empiricism on the other (Barbour, 1974, p. 11; Lonergan, 1990, p. 224).

Truly naïve realism posits that human perceptions are *direct* registers of external reality. It also ignores the immateriality of form, the relationship of the concept to the thing, and the abstraction of essences from substances. Attempting to be faithful to the realism of the brilliant philosopher and theologian, Saint Thomas Aquinas, Lonergan accords a priority to being and affirms that the human person can make true judgments of fact and of value. In light of Immanuel Kant's *Critique of Pure Reason*, Lonergan also attempts to incorporate a "critical aspect" to his epistemology. Lonergan's approach is to establish a theory of cognition in a critique of the operations of the mind. Lonergan, like his fellow influential Jesuit philosopher and theologian, Karl Rahner, believed that one needed to investigate the conditions for the possibility of knowing. This led to ideas such as Rahner's *Vorgriff*—man's possession of an *a priori* pre-apprehension of God which establishes the necessary condition of the possibility of empirical knowledge (Phillips, 1992, p. 257).

Lonergan hoped that the GEM would inspire an "intellectual conversion" by which an individual personally engaged the tasks of a cognitional theory, an epistemology, a metaphysics, and a methodology. He described this "conversion" as a "breakthrough" into the operations of one's own mind (Lonergan, 1992, p. 532). This process may be similar to Saint Augustine's well-know, transformative experience in the summer of 386 AD when he read "a few books by the Platonists" and learned about the existence of

spiritual realities, the eternity of the soul, and the notion of evil as a privation (Augustine, 2012, p. *xv*).

Lonergan's critical realism emerges from a personal journey of philosophical self-appropriation, using exercises that stimulate insights from mathematics, the natural sciences, and common sense. For Lonergan, the key question is, What do I do when I know? In *Insight*, Lonergan states,

> The crucial issue is an experimental issue, and the experiment will be performed not publicly but privately. It will consist in one's own rational self-consciousness clearly and distinctly taking possession of itself as rational self-consciousness. Up to that decisive achievement all leads. From it all follows. No one else, no matter what his knowledge or his eloquence, no matter what his logical rigor or his persuasiveness, can do it for you (Lonergan, 1992, p. 13).

In order to successfully reach the fourth level of the GEM, i.e., decision, Lonergan suggests that one needs the intellectual conversion that consists in the getting the first three levels correct. The American philosopher, Thomas (Tad) Dunne, makes a fascinating connection between GEM and systems theory in his analysis of Lonergan's approach. He writes,

> GEM may be characterized as a systems approach that correlates the subject's operations of knowing and choosing to their corresponding objects. Hence it understands objectivity as a correlation between the subject's intentionality and the realities and values intended. A subject's intention of objectivity functions as an ideal to be continuously approached. That ideal may be defined as the totality of correct judgments, supported by understanding, and verified in experience. Because our knowledge and values are mostly inherited, objectivity is the intended cumulative product of all successful efforts to know what is truly so and appreciate what is truly good. Clearly, we never know everything real or appreciate everything good. But despite any shortfalls, this principal notion of objectivity—the totality of correct judgments— remains the recurring desire and the universal goal of anyone who wonders (Dunne, 2018).

The German philosopher and theologian, Andreas Losch's, research has shown that Lonergan's critical realism includes the medieval sense of the term "realism," vis-à-vis the reality of universals, i.e., "those ideas which, while excluding whatever constitutes the difference of things of the same genus or species, represent that which is necessary to their constitution, is essential, and is therefore common to all, remaining fixed in all vicissitudes (*universalia post rem, in re*)" (Pichler, 1912). Conversely, Barbour's critical realism is primarily concerned with the question of the existence of the spatio-temporal universe in light of Kant (Losch, 2017, p. 104). The American philosopher, Phillip Thompson, points out that Lonergan made a significant contribution with his epistemology as it created a "bridge," or

"single perspective," that could be shared by multiple disciplines, e.g., mathematics, natural science, philosophy, and theology, to promote an authentic dialogue (Thompson, 2009, p. 1).

The axioms of Lonergan's metaphysics are not a "set of propositions, but the dynamic structure of the human mind" (Lonergan, 1992, p. 532). The GEM's metaphysics includes the relationship between the processes that direct one's curiosity as well as the realities that one wonders about. Concisely describing Lonergan's vision, Tad Dunne, writes,

> The assumption is that when they operate successfully, the processes of wonder form an integrated set isomorphic to the integral dimensions of reality. For example, the scientific movement from data to hypothesis to verification corresponds to Lonergan's view that knowing moves from experience to understanding to judgment, as well as to Aristotle's view that reality consists of potency, form, and act. In GEM, then, metaphysics comprises both the processes of knowing and the corresponding features of anything that can be known. (Dunne, 2018).

Interestingly, Lonergan posits three stages of metaphysics. He defines "latent metaphysics" as the immanent and operative structure of human knowing, guided by the unrestricted desire to know. "Problematic metaphysics" is how he describes the attempts throughout the history of philosophy to make explicit the so-called "latent metaphysics." Finally, Lonergan defines "explicit metaphysics." He claims that one may reach this level only after one has achieved "self-appropriation." In fact, Lonergan's "method of metaphysics" is primarily oriented toward self-appropriation, which is a personal achievement (Lonergan, 1992, Chapter 14).

In his 1972 book, *Method in Theology*, Lonergan groups the processes by which theology reflects on religion into eight specializations (research, interpretation, history, dialectic, foundations, doctrines, systematics, and communications), each with functional relationships to the others. These processes may be applied in a beneficial way (*mutatis mutandis*) in other disciplines or interdisciplinary settings. In fact, Lonergan expanded the concept of functional specialties to other disciplines such as ethics, historiography, and the social sciences by associating his notion of "doctrines, systematics, and communications" with "policies, plans and implementations," respectively (Lonergan, 1990).

Lonergan proposes four levels of human self-transcendence: being attentive, being intelligent, being reasonable, and being responsible. He suggests that they are applicable both for understanding the past and for preparing the future. One learns about the past by moving upward through research, interpretation, history, and a dialectical evaluation. One may prepare for the future by moving downward through foundational commitments, basic doctrines, systematic organizations of doctrines, and communication of the

resulting meanings and values. Lonergan emphasizes that the future moves quickly and continually into the past (Dunne, 2018). There are many striking parallels between Lonergan's work and that of second-order cybernetics. The reader is referred to (Laracy et al., 2019) for an analysis of some of these issues.

4. Ian G. Barbour

Ian Graeme Barbour was born on October 5, 1923 in Peking (now Beijing), China. He earned a BS from Swarthmore College, an MS from Duke University, and a PhD, from the University of Chicago, all in physics. He began his career as a physics professor at Kalamazoo College, focusing his research on the use of photographic emulsions to study cosmic-ray mesons. During Barbour's first sabbatical, a Ford Foundation Fellowship enabled him to study theology at Yale Divinity School. Barbour's formal theological education at Yale was a decisive experience in his development as an interdisciplinary scholar. He enjoyed his classes so much that he extended his sabbatical leave from Kalamazoo College an additional year. With supplementary course work taken over two summers at Union Theological Seminary in New York, Barbour earned the Bachelor of Divinity degree. He would go on to teach for many years at Carleton College in Minnesota. He was invited to give the Gifford Lectures (1989-1991) and received the prestigious Templeton Prize (1999) (Laracy, 2019, Chapter 1) .

One of Ian Barbour's significant contributions to interdisciplinary communication in general, and the relationship of theology and science in particular, is his four-fold typologies of interaction. He describes how theology and science, indeed any two fields, can be in a relationship of *conflict*, *independence*, *dialogue*, or *integration* (Barbour, 1990). As mentioned earlier, Barbour also advocates a common epistemological and metaphysical approach for both theology and science. Coming from a scientific background as an experimental physicist, Barbour views theories as representations of the world. He was always a philosophical realist. In the inaugural issue of *Zygon: Journal of Religion & Science* in 1966, Barbour first introduced his notion of critical realism (Barbour, 1966b). His epistemology was greatly popularized with the publication of his now classic work, *Issues in Science and Religion* (Barbour, 1966a).

Critical realism is the theory of knowledge that Barbour uses throughout his scholarly work. Barbour argues that scientific theories and theological doctrines offer partial, revisable, abstract, but *referential* knowledge of the world. Such knowledge can often be expressed faithfully with models and metaphors. Unfortunately, Barbour's description of critical realism is quite "informal." At times, he defines his terms by means of mere negation. For example, Barbour rejects the positivist position that views theories as

merely summaries of data, the instrumentalist position that sees theories as simply useful tools, and the idealist position that reduces theories to mental structures. In order to justify his starting point in realism, which he ultimately hopes to apply across disciplines, i.e., both in the natural sciences as well as theology, Barbour confronts the other common epistemologies present in the mid-twentieth century (Laracy, 2019, p. 98). Barbour writes,

> Against the positivist, the realist asserts that the real is not the observable. Against the instrumentalist, he affirms that valid concepts are true as well as useful. Against the idealist, he maintains that concepts represent the structure of events in the world. The patterns in the data are not imposed by us, but originate at least in part in objective relationships in nature. The object, not the subject, makes the predominant contribution to knowledge. Hence science is discovery and exploration, not just construction and invention (Barbour, 1966a, pp. 168–169).

Here we note a clear contrast with the even more Kantian "radical constructivist" epistemology popular among second-order cyberneticists (von Glasersfeld, 1995; Heylighen, 1997; von Foerster, 2003). The German-American philosopher and psychologist, Ernst von Glasersfeld, defines "radical constructivism" with the following two principles:

1) Knowledge is not passively received either through the senses or by way of communication, but is actively built up by the cognizing subject.
2) The function of cognition is adaptive and serves the subject's organization of the experiential world, not the discovery of an objective ontological reality (von Glasersfeld, 1988, p. 88).

Although they represent a great diversity of viewpoints, Barbour mentions Max Planck, Albert Einstein, Norman Robert Campbell, William Henry Werkmeister, Alfred North Whitehead, Thomas Nagel, and the Neo-Thomists, as significant thinkers (or schools of thinkers) who support some form of philosophical realism. Barbour acknowledges that the creativity of the human imagination and the presence of mental constructs influence the interpretation of experiences, including scientific ones. Consequently, Barbour proposes a "critical" realism that acknowledges the creativity of the human mind. It also supports the actual presence of patterns in events that are not the product of mental operations. Barbour insists that this realism must recognize the indirectness of reference *and* the realistic intent of scientific language. According to Barbour, critical realism supports both the highly abstract nature of theoretical physics, as well as the requirement for corresponding experimental investigation (Barbour, 1966a, p. 172).

Barbourian critical realism posits that scientific theories are representations of the objective world. Barbour avers that a theory is generally acknowledged by scientists to be *valid* if it is both true and useful. Always concerned to avoid naïveté, Barbour also recognizes that all scientific theories are incomplete and selective, i.e., they describe particular aspects of

the natural world for specific purposes. His epistemology therefore strives to avoid both the errors of "literalism" and "fictionalism" in theoretical models. Barbour's critical realism takes these models seriously, but not literally. Ultimately, Barbour posits that being, *as event*, precedes knowing (Laracy, 2019, pp. 103–104).

Barbour's ontological foundation is "process thought," a general school that can be traced all the way back to the sixth century BC with the pre-Socratic Greek philosopher, Heraclitus of Ephesus. Heraclitus' theory of a "ubiquitous dynamicity" speculates that a cosmic fire is the source of all change in the universe. His philosophy is often concisely summarized with the maxim: "everything flows." It is sometimes expressed in the popular saying: "No man ever steps in the same river twice." With the later development of the theories of atomism of Leucippus, Democritus, and Epicurus, a "counter-model" emerged that would be highly influential in Western thought for many centuries to come (Seibt, 2017). Eventually, the "substance metaphysics" of Aristotle decisively eclipsed Heraclitus' approach. Process thought did not make a serious return until the twentieth century with Alfred North Whitehead.

In his Lowell Lecture of 1925, Whitehead stated that "nature is a structure of evolving processes. The reality is the process" (Whitehead, 1931, p. 106). Whitehead soon went on to develop this view into an entirely new metaphysics. Originally presented at the Gifford Lectures, it would take its published form in the 1929 book *Process and Reality*. Whitehead begins his quest stating that his goal is to develop a speculative philosophy, "a coherent, logical, necessary system of general ideas in terms of which every element of our experience can be interpreted." (Whitehead, 1969, p. 5)

Whitehead's goal was to develop a metaphysics with both a rational side, i.e., "coherent" and "logical," as well an empirical side, i.e., "applicable" and "adequate." Ian Barbour adopts, adapts, and in many ways simplifies Whitehead's exceptionally detailed and complex metaphysics. He identifies four aspects of Whitehead's system that he views as particularly consistent with twentieth century science, and its evolutionary, many-leveled view of nature: the primacy of time, the interconnection of events, reality as an organic process, and the self-creation of every entity (Barbour, 1966a, pp. 129–130).

Overall, Ian Barbour judges process metaphysics to be an amiable first philosophy for the natural sciences. He notes that both process thought and modern science rely on concepts of temporality, indeterminacy, and holism. Like evolutionary biology, Barbour highlights the fact that process metaphysics emphasizes historical continuity. Barbour's philosophy of panexperientialism, a variety of dipolar monism, posits that every actual, integrated event, no matter how small, includes the capacity for

"experience." This subjective aspect may be described as "mind" or "consciousness" in higher-level organisms (Barbour, 2002, p. 112). Interestingly, Barbour acknowledges parallels between his Whiteheadian metaphysics and the general systems theory of Ludwig von Bertalanffy, the systems philosophy of Ervin Laszlo, and the first-order cybernetics of Norbert Wiener, which emphasize concepts such as hierarchy, constraints, emergence, communication, and feedback (Barbour, 1997, pp. 291–292).

5. Evaluation

While it is impossible to address all the nuances of the thought of Barbour and Lonergan in a short article, in this section we assess aspects of their thought that clearly contrast with classical, Aristotelian-Thomistic realism. Philosophical realism is regarded by many as the noetic and ontological foundation for all human knowledge, especially scientific and theological investigations. As the Spanish physicist and philosopher, Mariano Artigas, points out, "the philosophical realism required to validate the knowledge of experimental science is already implicit in scientific activity, since the central role played by experimental control is incompatible with idealist, empiricist, or skeptical approaches" (Artigas, 2006, p. 150). Artigas argues for three fundamental philosophical principles in the actual practice of science:

1) There exists in nature an order that can be captured by human understanding.
2) One can be certain about possessing the truth.
3) There is continuity between ordinary knowledge and experimental science (Artigas, 2006, pp. 150–152).

In light of Descartes and Kant, both Barbour's and Lonergan's critical realism does not given an adequate account of the important metaphysical fact that the simple actuality of being precedes the knowing of any particular individual. Barbour's critical realism seems to constitute an attempt to elevate potency over act, creating two interrelated problems. First, Barbour envisions that being precedes subjective knowledge as "process" or "fluid event," not as actuality (Barbour, 1997, p. 294). Second, "being as process" cannot be fully known. The human mind grasps only changing parts, not the actual whole. Unity is a transcendental property of being—all being is intelligible as one (Aquinas, 1954).

Ian Barbour's critical realism seeks to address what he sees as the partial, cumulative nature of scientific discovery as well as acknowledge the dynamicity of the cosmos. He focuses on potency and the "immediacy" of entities in the world. However, physics, or an ontology like Whitehead's, that in some respects is more "physical" than "metaphysical," is unsuitable to explore the most fundamental questions of reality. A rational metaphysics must acknowledge an underlying, stable reality. Absolute, eternal primacy

is "in act," the ground of potency. In created beings, a state of potentiality precedes that of actuality. A rational metaphysics must presuppose that there is a stable truth to discover about a thing, i.e., essences. There is also the truth of *esse*—the act of being—known through affirmative judgment (Laracy, 2019, p. 192).

Whether in the form of subjective idealism, or in the more reasonable approaches of Barbour's and Lonergan's critical realism, there is an inclination for those who adopt a Kantian critique of knowledge to attempt to offer a "correction" to the spontaneous certainty of methodical, or moderate realism. The existence of a "bridge" between the mind and external reality is an axiom of realist epistemology. Of course, one does not prove axioms because they are by definition self-evident. The French philosopher and historian of philosophy, Étienne Gilson, expresses this idea with an "intuition of being"—an intellectual vision of the notion of *esse* in any sensible datum (Gilson, 2012). The noted physicist, historian & philosopher of science, as well as Catholic theologian, Fr. Stanley Jaki, OSB, was very critical of the post-Kantian critique of knowledge. Jaki argues

> that even the fact, let alone the nature, of external reality, however ordinary, cannot be proven by mere logic or mathematical formulas does not make one's immediate registering of external reality a less than fully rational process. To know the existence of things is in fact the very first step in reasoning. Any critical knowledge or philosophy which does not accept this will remain a mere criticism of criticism and not a criticism of the external reality one registers, and not even one's own registering it (Jaki, 1993, pp. 108–109).

According to Gilson (and most other Neo-Thomists), being precedes and causes knowledge because:
1) Being precedes perception;
2) Perception precedes apprehension;
3) Apprehension precedes judgment; and
4) Judgment precedes reasoning.

The key philosophical issue here, with much at stake, is upholding the relative priority of being over consciousness. As Aquinas himself clearly claims, there is indeed a constitutive polarity between knower and known as regards created truth. But in terms of being, the *actus essendi* precedes one's conscious nature.

One could argue that Lonergan's GEM implicitly places cognitional theory as "first philosophy" rather than metaphysics, classically understood. Lonergan attempts to validate his metaphysics by beginning with interiority. He clearly desires to affirm metaphysical reality but not from a classical realist starting point. Lonergan gives the impression that he desires to avoid

classical "foundationalism" and establish a novel, cognitional foundation, known and affirmed personally.

Interdisciplinary communication is best achieved when the common metaphysical framework supporting both disciplines addresses issues that are the *most fundamental* or at the highest level of generality, e.g., "being as being" or "the act of being." Traditional Aristotelian-Thomistic metaphysics studies the nature of existence, the universe, and being. Aristotle wisely divided his "first philosophy," metaphysics, into three main sub-disciplines:

1) Ontology—the study of being and existence, e.g., the classification of entities (such as physical or mental), the nature of the properties of entities, and the nature of change in the cosmos.
2) Natural Theology—the study of God from reason alone, e.g., the nature of religion, God, and the world, as well as the rationality of belief in the existence of God, and the relationship of God and creation.
3) Universal Science (Logic)—the study of first principles of reasoning, e.g., the law of non-contradiction (Aristotle, 1908).

When bringing two disciplines into creative, mutual interaction in a coherent way, they should have a common ontology and the same rules of logic. When engaging topics in religion, natural theology is also an indispensable tool, e.g., when attempting an integration of natural science and the theology of creation.

The aforementioned distinction between ontology and natural theology is less determinative for Thomas Aquinas. Aquinas' metaphysics studies being *qua* being—not as God. God is only demonstrated as the necessary first principle of beings. His notion of *esse* as complete and simple, but not subsistent (given over to form), makes possible a fully integrated ontology, rooted in *ipsum esse subsistens*, without transgressing God's transcendence of beings.

6. Conclusion and Next Steps

Philosophy, especially metaphysics and epistemology, has an important role to play in interdisciplinary communication. Some of the insights of Ian Barbour for the theology-science interaction are applicable for bringing other fields into beneficial contact. In addition, Bernard Lonergan's generalized empirical method and functional specialties offer interesting and creative opportunities for interdisciplinary communication. Neither of these proposals are perfect, given the aforementioned epistemological and metaphysical concerns. Nonetheless, Barbour and Lonergan each make a substantial contribution to interdisciplinary communication and their thought merits further study. Recent work by Alan R. Rhoda and Cyril Orji, looking at parallels and the possible influence of the American philosopher,

logician, mathematician, and scientist, C.S. Peirce, on Lonergan, suggests additional directions for future research (Orji, 2015; Rhoda, 2011).

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Acknowledgments

References

Aquinas, T. (1954). *Quæstiones Disputatæ de Veritate* (R. W. Mulligan, J. V. McGlynn, & R. W. Schmidt, Trans.). Henry Regnery Company.

Aristotle. (1908). *Metaphysics* (W. D. Ross, Trans.). Clarendon Press.

Artigas, M. (2006). *Knowing Things for Sure: Science and Truth* (A. McCone, Trans.). University Press of America.

Augustine. (2012). *The Confessions* (D. V. Meconi, Ed.; M. Boulding, Trans.). Ignatius Press.

Barbour, I. G. (1966a). *Issues in Science and Religion*. Prentice-Hall.

Barbour, I. G. (1966b). Commentary on Theological Resources from the Physical Sciences. *Zygon*, *1*(1).

Barbour, I. G. (1974). *Myths, Models, and Paradigms*. HarperCollins College Division.

Barbour, I. G. (1990). *Religion in an Age of Science*. Harper Collins.

Barbour, I. G. (1997). *Religion and Science: Historical and Contemporary Issues*. Harper.

Barbour, I. G. (2002). *Nature, Human Nature, and God*. Fortress Press.

Beards, A. (2011). Generalized Empirical Method. *The Lonergan Review*, *3*(1), 33–87.

Callaos, N., & Horne, J. (2013). Interdisciplinary Communication. *Journal of Systemics, Cybernetics, and Informatics*, *11*(9), 23–31.

Dubray, C. (1909). Epistemology. In *Catholic Encyclopedia* (Vol. 5). Robert Appleton Company. http://www.newadvent.org/cathen/05506a.htm

Dunne, T. (2018). Bernard Lonergan. In J. Fieser & B. Dowden (Eds.), *Internet Encyclopedia of Philosophy*. http://www.iep.utm.edu/lonergan/

Gilson, E. (2012). *Thomist Realism and the Critique of Knowledge* (M. A. Wauck, Trans.). Ignatius Press.

Heylighen, F. (1997, November 12). *Epistemological Constructivism*. Principia Cybernetica Web. http://pespmc1.vub.ac.be/CONSTRUC.html

Jaki, S. L. (1993). *Is There a Universe?* Wethersfield Institute.

Laracy, J. R. (2019). *Theology and Science in the Thought of Ian Barbour: An Evaluation for the Catholic Doctrine of Creation* [STD]. Pontificia Universitas Gregoriana.

Laracy, J. R., Marlowe, T., Valdez, E., & Liddy, R. (2019). Cybernetics of Observing Systems and Lonergan's Generalized Empirical Method. *Journal of Systemics, Cybernetics, and Informatics*, *17*(5), 65–70.

Lonergan, B. (1990). *Method in Theology* (2nd ed.). University of Toronto Press, Scholarly Publishing Division.

Lonergan, B. (1992). *Insight: A Study of Human Understanding* (F. Crowe & R. Doran, Eds.; 5th ed., Vol. 3). University of Toronto Press, Scholarly Publishing Division.

Losch, A. (2017). Wright's Version of Critical Realism. In C. Heilig, J. T. Hewitt, & M. F. Bird (Eds.), *God and the Faithfulness of Paul: A Critical Examination of the Pauline Theology of N.T. Wright* (pp. 101–114). Fortress Press.

Orji, C. (2015). Does Lonergan Know C. S. Peirce? *Philosophy and Theology*, *27*(1), 75–105. https://doi.org/10.5840/philtheol20155522

Phillips, W. G. (1992). Rahner's Transcendental Deduction of the Vorgriff. *The Thomist*, *56*(2), 257–290. https://doi.org/10.1353/tho.1992.0033

Pichler, A. (1912). Universals. In *The Catholic Encyclopedia* (Vol. 15). Robert Appleton Company. http://www.newadvent.org/cathen/15182a.htm

Rhoda, A. R. (2011). Peirce and Lonergan on Inquiry and the Pragmatics of Inference. *International Philosophical Quarterly*, *51*(2), 181–194. https://doi.org/10.5840/ipq201151222

Seibt, J. (2017). Process Philosophy. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy*. Metaphysics Research Lab, Stanford University. https://plato.stanford.edu/archives/win2017/entries/process-philosophy/

Thompson, P. M. (2009). *Between Science and Religion: The Engagement of Catholic Intellectuals with Science and Technology in the Twentieth Century*. Lexington Books.

Turner, W. (1911). Metaphysics. In *Catholic Encyclopedia* (Vol. 10). Robert Appleton Company. http://www.newadvent.org/cathen/10226a.htm

von Foerster, H. (2003). On Constructing a Reality. In H. von Foerster (Ed.), *Understanding Understanding: Essays on Cybernetics and Cognition* (pp. 211–227). Springer. https://doi.org/10.1007/0-387-21722-3_8

von Glasersfeld, E. (1988). The Reluctance to Change a Way of Thinking. *The Irish Journal of Psychology*, *9*(1), 83–90.

von Glasersfeld, E. (1995). *Radical Constructivism: A Way of Knowing and Learning*. Routledge.

Whitehead, A. N. (1931). *Science and the Modern World*. The Macmillan Co.

Whitehead, A. N. (1969). *Process and Reality*. Free Press.