THE RELATIONSHIP BETWEEN RELIGION AND SCIENCE
Critical Studies on Ian G. Barbour's Theory

Indo Santalia
Faculty of Islamic Theology, Philosophy and Politics
Alauddin State Islamic University Makassar
Email: indosantalia@gmail.com

Abstract;

Before rapid developments of science, as we see and experience today, religion - related to beliefs, ideas, institutions, worship, social action, laws and norms, tools, and a holy book as its source – has been exist with its various plural forms. Followers of religion agree that the follower community retained, adhered to, and maintained spiritual values and life norms through creed, belief or faith, ritual worship, and certain habits. Inheritance of religious values through continuous living tradition across generation is a sign movement of religious traditions and culture by humankind since centuries ago. When there is a civilization, a religion will always follow it.

Keywords;

Social Action, Laws, Norms, Certain Habits, Inheritance, Religious Values

Introduction

Knowledge, known as science and technology, cannot be separated from mathematics, physics, chemistry, and biology as its roots. It also has a similar purpose-to glorify human civilization by helping humankind to "alleviate" their physical-material burden when facing power and courage of the

universe. Religion and science are everyday life matters required by human beings wherever they are.

The religion and science relations have been discussed in recent decades. Although the real relationship of religion and science has been a conversation topic since in the classical era, the relation regained its momentum to re-discuss due to human life challenges which are much complex and requires immediate response from religion and science. The religion and science have a major role in life. Religion becomes an integral part of the overall dimensions of human life and science is a major achievement of modern civilization. Moreover, Huston Smith says that, "science is modernity's gold ".[1]

An intellectual who has big contributions to raise an issue in the relation between religion and science is Ian G. Barbour. If it could be said so, Ian G. Barbour is the most important figure in today's discussion topics of religion and science relationship. Barbour's contributions can be read from his intensively works discussed the issues of religion and science.

Short Biography of Ian G. Barbour

Ian G. Barbour was born in 1923, in Beijing from a Scottish geologist father and an American mother. Both of his parents taught at the Yenching University, in Beijing. His parents' professional lives attaching to the academic environment played an important role in his life. Therefore, it is understandable when Barbour's life development filled with academic achievements. At age of 20, he got his undergraduate degree in physics from Swarthmore College. Two years later, he had his master degree in physics from Duke University. In 1949, he completed his Ph.D., also in physics, from the

[1]Huston Smith, *Ajal Agama di Tengah Kedigdayaan Sains?,* translated by Ary Budiyanto (Bandung: Mizan, 2003), p. 22.

University of Chicago. Therefore, at a very young age, i.e. 26 years old, he had completed a doctoral degree, major in physics.

His first professional career began in the field of high-energy physics. However, he taught the subject only for a few years. Barbour, who completed high school at the Christian school, was interested to study philosophy and religion issues. He then decided to study philosophy and ethics at Yale University and graduated in 1956.

In 1955, he started to teach at Carleton College, Minnesota. From the beginning, he had two main duties. He taught in the physics department and assisted an establishment of religion major at the college. In the first years at Carleton, he conducted many researches in physics and wrote papers in several scientific journals. However, since 1960, he involved more in prominent theological activities, especially after his first book published in 1966. In 1972, he pioneered science, technology, and public policy programs at Carleton College.

His first recognition in the discussion of science and religion came in the form of an invitation to deliver series of lectures at Gifford Lectures in 1989-1991. This prestigious academic forum aims to promote study about theology of nature in its broadest meaning i.e. knowledge of God. Since 1888, this academic forum has invited leading scholars, such as William James, Niels Bohr, Seyyed Hossein Nasr, Paul Ricoeur, and Annemarie Schimmel. From these lectures, Barbour published his most important book, *Religion in an Age of Science* and *Ethics in an Age of Theology*.

Since firstly published until now, Barbour's books, especially *Issues* and *Religion in an Age of Science,* could be regarded as obligatory books to students studying science and religion. It is not primarily because of its depth explanation but rather because it has a complete and effective method. Science and religion is very wide-ranging theme and multidisciplinary. In addition, at least, it includes several branches of science, history, and philosophy of science, as well as the history of religion and religious studies or theology in general. Therefore, presenting

this theme to diverse background learners is quite difficult. To these audiences, Barbour has effectively found and managed how to present the theme.[2]

At this point, we can understand why Barbour became a prominent figure in the discourse of religion and science. Thus, it does not mean that there are no other figures contributing in this matter. From a similar background of physics and theology, we can also refer to Sayyed Hossein Nasr, as an example. Similar to Barbour, Nasr is also a great scientist who has attention to the issues of science and religion. There are similarities and differences between these two persons. However, one of Barbour's characteristics-as demonstrated in this paper- lies in his different critical view on the scientific world, including the scientific community.

Methodology in Religion and Science

The interaction between science and religion (theology) often begins around a method: how should we relate theology and science? In the past four decades, we have witnessed a wide range of important proposals on the methodology. Although it is significantly different to key issues, the proposals still form a somewhat continuous developmental path. The line starts from an initial understanding of various research proposals that exist today.

Some types propose to characterize the relationship between science and religion. The types express basic assumptions that strongly shaping public and scientific discourses. The methodology applied by Barbour becomes the most widely used in this field. Barbour mentions four (4) types of science-religion relationship and their sub-types, as follows:

[2]See Zainal Abidin Bagir, "Riwayat Barbour, Riwayat "Sains dan Agama", in Ian G. Barbour, *Juru Bicara Tuhan, Antara Sains dan Agama,* translated by E.R. Muhammad (Bandung: Mizan, 2002), pp. 23-24.

1. Conflict, including scientific materialism and biblical literalism. Scientific materialist claims that the world only consists of material. There is no room for soul, spirit, or God. Moreover, they have a claim that the only way to gain the knowledge of the truth is through science. And, the religion does not reveal any real valuable aspects of human world. Biblical literalists believe that the Bible should be read literally without any interpretations. The Bible itself gives us true knowledge about the world, humanity and God. This group often has view that science is a challenge to the biblical faith.

2. Independence, to strengthen science and religion using opposite methods and different languages. This view believes that science and religion entirely separated from one to another. Therefore, there is no conflict, but at the same time, there is also no interaction or even a dialogue. Some experts argued that science and religion research methods are completely different, for example, between sense and faith. Science based on facts while religion based on values. Science is objective, but religion is subjective. Science can be manipulated, but religions are not. Scientific language refers to the world's pictures, but religion uses language to describe our emotions, hopes, and believes.

3. Dialogue, as a model for linking science and religion including questions about limits and alignment of methodologies. Although science tells us many things about the world, some questions proposed by science cannot be answered by science itself. For example, if the universe has a beginning, what happened before that? Why do we feel compassion or altruism? Why does the universe exist? The other group claims that the ways that science apply to study its theory is partially similar to theology. Science and religion apply data (empirical facts for science; scripture, religious experiences, liturgy for religion) and involve scholars to

discover what is true. In addition, they use common sense and aesthetic values to choose one theory from other theories that compete one another (in theology, a theory is known as "a doctrine"), and so on.

4. Integration, including natural theology, nature and systematic synthesis theologies. The natural theology is an attempt to start with the world and find something about God i.e. God exists, God's nature, God's will and purpose, and so on. The natural theology begins with theology and seeks to incorporate scientific discoveries. The theology involves theological reformulation of the invention. The systematic synthesis goal is to merge science and theology into a single framework. It often combines the two using a single metaphysics system, for example processes metaphysics of Alfred North Whitehead or Thomistic. In this way, concepts such as space, time, matter, causality, mind, spirit, and even God, are all applied in theory and in theological and scientific researches.[3]

From 1980s to 1990s, various methodology types appear and many of which respond directly and strengthen the Barbour. For example, theologian and biochemist, Arthur Peacocke, published a type listing differences and similarities exist in approaches, language, and attitudes of theology and religion. A theologian from Georgetown, John Haught, mentioning conflict, contrast, contacts, and confirmation. The first three are similar to the first three types of Barbour. However, Haught confirms that identifies are different type of relationship between science and religion and they different to Barbour's. Haught adopts this relationship type from the philosophy of science. What he means by the confirmation is there are some important philosophical assumptions underlying

[3] See John Haught, *Science and Religion: From Conflict to Conversion* (New York: Paulist Press, 1995), pp. 73-74.

science that derives from theology. One of philosophical assumptions is that the universe is dependent (contingent). Its present elements and law may be different from its previous condition. It means that, if we want to know what is "out there", we have to observe and collect data. So underlying scientific empirical method rests on an assumption that nature is dependent. This assumption, historically, lies on the doctrine of creation in Christian theology: God created the universe as His free action and God - as a possibility - could have created it differently to what exists now. Therefore, in this "second order" way, the Christian theology underlies philosophy of science and, in turn, the view of nature from which science works.

Ted Peters also developed an expanded type giving an additional nuance to the Barbour's quadruplicate type. For example, the view on the "conflict" that distinguishes between atheist scientific materialism, which rejects the idea of God, and scientific imperialism, that assumes only science can produce pure knowledge, even the knowledge of God. Peters also includes ethical issues simultaneously involving science to establish new models of "integration", as what he mentions as "an alignment of hypothesis", in which the discovery of common themes in theology and science encourage us to explore further the themes.

Different Perspectives on Reality

Religion and science have a unique way of process. There are some things unite the two, but in many cases they are also often disputed. Barbour believes that religion and science do not have significant differences. Challenges to religions or beliefs do not come from opposition of science and religious contents however from the assumption that the scientific method is the only way to acquire knowledge. Therefore, attentions to methodological issues found by scientists and theologians have broad implications on the worldview of modern human.[4] Unfortunately, in his book,

[4]Ian G. Barbour, *Issues in Science and Religion,* (n.d.: Harper & Row Publisher, 1971), p. 137.

Barbour does not provide a detail explanation about what he means the scientific method. Barbour's description straightly directs to the scientific existed method's characteristics.

According to Huston Smith, the scientific method focused on controlled experiments and gave us modern science. Science, in general, which consists of full attention on nature and its system, is as old as hills out there. What the controlled experiments generally added to science is proofs. True hypothesis can be separated from a false hypothesis, and large buildings may be established based on the proven truths. We, according to Smith, generally refer the buildings as 'scientific views', but 'scientific cosmology' is actually more appropriate due to an ambiguity of the 'world' word. The building of science was a worldview only for those who assuming science, in principle, is able to assess all existing things.[5]

According to Barbour, there are two closed related elements to the scientific method, namely experience and interpretation. The experience consists of observations and data of *experimental* science products. While the interpretation component includes concepts, laws and theories as its theoretical side. An ideal procedure, Barbour said, started with observations that will formulate temporary hypotheses and the implications will be tested experimentally. This experiment will develop a more complete theory construction that in turn will suggest new experiments that create modification and extension of the theory. However, these ideals are often unrealized. In many cases, flow of the scientific method is not that simple. There are many interrelated things, not linear, cannot be distinguished clearly, although its end will still return to the theory,[6] either retaining the old theory or generating a new theory.

---

[5]Huston Smith, *Ajal Agama di Tengah Kedigdayaan Sains?,* Translated by Ary Budiyanto, p. 9.

[6] Ian G. Barbour, *Issues in Science and Religion,* p. 138.

Barbour extensively discusses theories and laws. In his view, the laws are correlation between two or more concepts that are closely related and observable. The laws describe systematic arrangement of experience that is an attempt to describe observations in terms of a regular pattern. The laws may indicate a causal or not causal relationship. Therefore, the laws are the correlation between concepts that are closely associated and observable.

While a theory is an integration and generalization of conceptual scheme from the law, comparing to the law, a theory is an extension of direct and comprehensive observation that linking greater scope of phenomenon with higher generality. The theory is generally formulated through inductive and deductive principles. At this point, Barbour provides a critical perspective. In his view, the principle of inductive and deductive does describe some scientific aspects, but there is an important thing missing from both processes that become a reference formulation of the scientific method theory. The missing part is the creative imagination.[7] To support his assumptions, Barbour provides numbers of examples. Many creative ideas happened unexpectedly in a flash of intuitive, as in the case of Archimedes shouting "Eureka" when he was in a bathtub. When Darwin discovered his evolution theory, he also experienced the same thing. Darwin indeed had read Robert Maltus' books: The human population pressures. At that moment, Darwin found a similar concept that will provide a key to evolution; the idea of natural selection was born. Poincare's classic essay also illustrates how some his crucial ideas "spontaneously" appeared during his leisure breaks. However, Barbour warned that the "flash of knowledge" might not happen in an empty space without any prior preparations. Darwin obtained a "flash of knowledge" after he gained sufficient knowledge of the field that he would study. At this point, creative imaginations serve to reinforce an

[7]I. Bambang Sugiharto, *Postmodernisme, Tantangan bagi Filsafat* (Yogyakarta: Kanisius, 1996), p. 93.

achievement of a perfect idea. However, it should be realized that the creative imagination does not necessarily guarantee a truth, even very likely turn out to be wrong. This is where the idea is still important to be tested.[8]

A new theory often arises from 'a new combination of idea' that previously isolated. Barbour believes that scientific and artistic creativity are parallel. To reinforce his assumption, Barbour cites Campbell, as follows:

> Because it has been recognized that although the discovery of law does not ultimately depends on the exact rules, it is on the imagination of very talented people. These imaginative and personal elements are far more prominent in the development of the theory; ignoring a theory will directly leads to neglect imaginative and personal element in science. This result will create fatal differences between science that is "materialistic" and literature, history, and art studies that are "humanistic". ...The impression that I want to instill to the reader is how pure personal ideas as ideas. His theory of universal gravitation, declared by the fall of an apple, is a product of the individual mind, as well as the fifth symphony of Beethoven.[9]

Consistent with this statement, Barbour stated that there is no theory proved correctly. Most theories can be regarded as a theory when the theory has a better alignment with known data and more coherent and comprehensive than the existing theory at the time. Citing Popper, Barbour stated that although the theory has never been proved, the theory should be able to be blamed.[10] Tool for a theory confirmation is an empirical prediction. Although the law allows for predictions, only the

---

[8]Ian G. Barbour, *Issues in Science and Religion,* pp. 143-144.

[9]Ian G. Barbour, *Issues in Science and Religion,* p. 144.

[10] Ian G. Barbour, *Issues in Science and Religion,* pp. 145-146.

theory has explanatory power due to its ability to produce clarification. The theory features an extensibility through a new type of phenomenon that cannot be found among laws. Intellectual satisfaction given by the theory is a product of rational and empirical component.[11]

Critical Realism According to Ian G. Barbour

In his first publication, *Issues in Science and Religion,* Barbour develops a framework to look at science, the so-called "critical realism". This framework includes a series of arguments concerning epistemology (kind of knowledge of what is involved?), language (how knowledge was disclosed), as well as the methodology (how the knowledge acquired and justifiable?). Those arguments form a preliminary "bridge" between science and religion.

Barbour understands critical realism as an alternative to the three main philosophical ideas about science: (1) according to classical realism or "naïve", scientific theories provide a "photographic" overview about the world; (2) according to the instrumentalists, scientific theories are merely calculative tools; (3) the idealists view scientific theories as reality pictures of mental or idea. On the contrary, according to Barbour, scientific theories create partial knowledge, revisable, and abstracts about the world. According to critical realism, scientific theories expressed through a "metaphor". This metaphor is an open analogy, the meaning that cannot be expressed through a single literal statement. Then, metaphors developed into models in science.

For the methodology, Barbour turned to contemporary scientific philosophers, Carl Hempel. According to Hempel, theories and data forms a "hypothetical-deductive" knot in which theories are found by analogy and imaginative models based on the data, while the theory in turn brings in to widespread predictions that can be used to test the predictions. However, philosopher such as Thomas Kuhn has

[11] Ian G. Barbour, *Issues in Science and Religion,* p. 146.

pointed out to the so-called historical and social contextual nature of science. This means that science develops in a specific historical context and both personal and social factors influence those working in the field of scientific research. Data is not completely pure and neutral to the observer; on the contrary, what we consider relevant data and how we incorporate the data into our theories and testing are the decisive factors often referred to as "nature of the data full with a theory". Scientific knowledge is shared knowledge in a society. This knowledge is more inter-subjective than fully objective. Scientific theories work in a wider system of assumptions known as paradigms. Here, idealized experiments or insights influence way of researchers in searching for new data as well as wider application of their theories.

Scientific advances include normal development of a particular paradigm, such as Newtonian mechanics, and its radical replacement during a revolution of paradigms, such as the birth of quantum mechanics. Paradigms include metaphysical assumptions about nature: whether nature is separated or continuous, static or dynamic, purely physical or physical and mental, and so forth. Aesthetic and values play functions in the electoral process of a theory. When two or more theories explain similar data, scientists often choose theory that they consider more beautiful or simple. Anyway, the scientists appreciate disclosure of the truth, so they strongly resist incorrect data report.

Overall, Barbour offered four criteria for choosing theories: (1) the theory must be in accordance with the known data, (2) the theory must form a completely coherent with other accepted theories, (3) theory must constantly expand its scope, and (4) the theory must be fertile, producing insights and new applications. Meanwhile, it also offers a realist theory of critical truth. Firstly, we say that a statement is true when it refers to the process and the things in the world. Secondly, we decide whether a statement is true or not if it corresponds with the processes. However, if we cannot verify a conformity, we say that the statement is true if it is coherent with other true

statements and they can be pragmatically applied. According to Barbour, our belief about a theory referring to and describing the world is based on more than just a correct prediction of a theory. We even have many reasons to feel confident about a theory adding our understanding (i.e. clarity) about the world and our ability to explain natural processes.

Barbour's main insight bridging science and religion is his view states that science philosophy arguments are equal to religion arguments. Science and religion cognitively claims the world using hypothetical-deductive in the framework of contextualist and historic.[12] The groups construct observation and experience through analogical, expandable, coherent, and symbolic models; and expressed through metaphors. However, Barbour also noted significant differences between the groups. Types of "data" found in religion are different from science. Religion serves non-cognitive functions, such as attitudes to obtain data, personal involvement, and transformation. Religion also contains specific elements that are not found in science, for example stories, rituals, and historical disclosures. On the contrary, science contains high level and low level of laws that are not existed in religion, such as general relativity or quantum mechanics, Kepler's law in astronomy, and or Boyle's law in thermodynamics. The most important thing that religions form consensus differently to consensus in science. At the end, dynamic tensions between similarities and differences of religion and science making the Barbour's approach very helpful.

While Barbour developed his view, scientific realism faces challenges in various different ways. Although the philosopher of science, Thomas Kuhn has focused primarily on internal factors to the scientific community, the 1970s

[12]According to Ian G. Barbour, science and religion paradigms depict "subjective" dan "objective" characteristics. Although the former is more prominent in the religion and mentioned later in science. See Ian G. Barbour, *Myths, Models and Paradigms: A Comparative Study in Science and Religion* (New York: Harper & Row, 1974), p. 79.

sociologists explored social construction of science. The external group's explanation emphasizes on social, political, and economic effects on science. [13] Barbour next arguments stated that the external group's explanations provide a worthwhile improvement to the internals, particularly on personal interests involved in the discovery of new theories (or known as the "context of discovery"). However, there is also an appeal to underestimate the degree to which of social factors or "distortion" to be deleted or filtered when scientific community tested and deployed a theory.

Other scholars have developed Barbour's arguments about critical realism. Although they recognize diversity of views that claim as forms of scientific realism, [14] Arthur Peacocke, for example, argues that there is a "common core" owned by these different views. This core has two characteristics: firstly, scientific developments are progressive and, secondly, the purpose of science is to depict reality. Peacocke applies this way to examine critical reality in theology, for example similar to science, theology at the end, has a realist characteristic: it made a claim to a reality. However, still similar to science theological theories can only produce partial knowledge, revised able, and abstracts about the world and its relationship with the divine or the sacred. Religious belief having many resemblances to a scientific theory, expressed by "metaphors", open-ended analogies, and its meanings cannot be simply expressed in a series of literal statements.

Sallie McFague, a theologian, reflects the emphasis on the model and metaphors of critical realism. McFague further

[13]A useful analysis of such explanations is in Mary Hesse "Socializing Epistemology", in Ernan McMullin, *Construction: The Shaping of Scientific Rationality* (Notre Dame: University of Notre Dame Press, 1988), p 118.

[14] Ernan McMullin, *Construction: The Shaping of Scientific Rationality* (Notre Dame: University of Notre Dame Press, 1988), p. 167.

describes similarity and differences of models played in theology and science. According to this scholar, the models provide orders in theology; while in science, models stimulate new inventions. In addition, Janet Soskice in her metaphors in the religious and scientific language studies emphasize on the difference between metaphor and model. She vigorously defends theological realism and highlights social and contextual nature of scientific realism.

Barbour believes that the use of analogies and models indeed make a real contribution as a productive source of scientific theory. To support his opinion, he illustrates the development of light waves theory which is mostly applied the properties of sound waves theory. However, Barbour critically notes that the use of the model also contains a real danger of the emergence of a tendency to "exceed the limit" that assuming all characters analogy would be presented in a new situation. For example, the failure of the light wave to sound wave analogy producing failed ether investigation. Barbour further explains that the theory was considered as a literal description of reality assumes a studied object is similar to a model. It seems forgotten that the analogy is only a few characters in common, not all of the characters. Similarly, the model simply stated the possibility to conduct an experimentally test to a hypothesis. The theory itself was a symbolic and selective image. [15]

Furthermore, Barbour stated that scientists usually assume realism in their work-studies. Astronomer, geologist, biologist, and chemists usually applied a theory to describe events in the world. Most scientists understand that they are dealing with the structure of the world events and not with data summary, a useful fiction, and or a mental idea. They see science as a pathway to understand and not merely as a tool to manipulate, predict, and control.

[15] Ian G. Barbour, *Issues in Science and Religion,* p. 161.

Although Barbour is more inclined to realism, he also criticizes it, especially against to what he described as naïve realism seeing human mind's roles in the theory formulation. According to him, an appropriate position is a critical realism recognizing the creativity of human minds and the existence of pattern events that were not created by them. In addition, it recognizes indirect reference and objectives of realistic language used in the scientific community. The critical realism can show abstracts characters of physics theory and necessary experimental observation distinguishing it from pure mathematics. The critical realism also confirms roles of mental composition and imaginative activities in a formulation of a theory. Furthermore, it confirms that some ideas supported by observations are better than other ideas based and caused by objective pattern of events.[16]

Theoretical constructions appearing as a product of scientific studies, according to Barbour, should not be understood as a single dimension of effort but as phenomena of many aspects. He argues that scientific efforts involving experiments and theories do not only conduct to create science. Scientific efforts require a logical process and a creative imagination that go beyond logic. Individual activities and originality are significant and occur in the scientific community tradition under the influence of the paradigm. The produced theory is not guaranteed to be the final truth. Therefore, it still opens a possibility to be revised, modified, or even overthrown by a great revolution. However, scientific theory has a reliability and finally, the scientific community will eventually reach a consensus.

Conclusion

According to the writer, there are some aspects of Ian G. Barbour's descriptions deserve further discussion:

[16] Ian G. Barbour, *Issues in Science and Religion,* pp. 171-172

1. Although Barbour argues that there is no conflict between religion and science contents and the source of the difference lies precisely in the views that the scientific method is a primary cause, there is no further explanation about implications of this point of view.
2. The scientific community has a crucial role in constructing a theory and its attached paradigm. However, the formulation of the scientific community itself actually requires more in-depth discussion.
3. Science and theology (religion) in their best conditions seek the truth. The science and theology criticize themself if they cannot express the truth. They are unpretentious and persistent facing mystery. According to the theologians' claim, if it is true that the God is the creator of this marvelous universe, then any revealed truths about the universe found by science will increase our appreciation to the God's great creation.

BIBLIOGRAPHY

Bagir, Zainal Abidin. "Riwayat Barbour, Riwayat "Sains dan Agama", in Ian G. Barbour, *Juru Bicara Tuhan, Antara Sains dan Agama.* Translated by E.R. Muhammad. Bandung: Mizan, 2002.

Barbour, Ian G. *Issues in Science and Religion.* New York: Harper & Row: Publisher, 1971.

_____. *Myths, Models and Paradigms: A Comparative Study in Science and Religion.* New York: Harper & Row, 1974.

_____. *Menemukan Tuhan dalam Sains Kontemporer dan Agama.* Translated Fransiskus Borgias M. Bandung: Mizan, 2005.

Haught, John. *Science and Religion: From Conflict to Conversion.* New York: Paulist Press, 1995.

Hidayat, Komaruddin. *Tragedi Raja Midas, Moralitas Agama dan Krisis Modernitas.* Jakarta: Paramadina, 1998.

Kuhn, Thomas S. *The Structure of Scientific Revolutions.* Chicago: University of Chicago Press, 1962.

McMullin, Ernan. *Construction: The Shaping of Scientific Rationality.* Notre Dame: University of Notre Dame Press, 1988

Sardar, Ziauddin. *Thomas Kuhn and the Science Wars.* UK: Icon Books, 2000.

Smith, Huston. *Ajal Agama di Tengah Kedigdayaan Sains?* Translated by Ary Budiyanto. Bandung: Mizan, 2003.

Sugiharto, I. Bambang. *Postmodernisme, Tantangan bagi Filsafat.* Yogyakarta: Kanisius, 1996.

Supriadi, Dedi. *Menjadi Guru Bangsa.* Bandung: Remaja Rosdakarya, 2004.