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Formal Logic and Intellectual Logic

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Abstract:

Logic carries a dual meaning: the first relates to its pursuit of pure formality, while the second concerns preserving logic within philosophy and thought. The development of logic has required it to move beyond the balance between its subject and method. To continue advancing after centuries of stagnation, logic had to prioritize either conceptual understanding or truth-oriented goals. Historically, this debate dates back to Aristotle, who maintained the conceptual view of logic, while contemporary figures like Frege introduced function and argument concepts to move beyond the dispute. Symbolic logicians initiated a revolution by viewing Aristotle's logic as purely formal, free from metaphysical influence. However, divisions remain among logicians and philosophers regarding the conceptual versus truth-based interpretation of logic. The full pursuit of formality demands leaving behind conceptual representations to focus on truth, a stance opposed by those who seek to maintain the connection between formal and natural logic.

Keywords: Formal Logic, Epistemology, Informal Logic, Conceptual Logic, Truth-Based Logic, Symbolic Logic

INTRODUCTION

One of the serious mistakes researchers might fall into when addressing the topic of intellectual logic is making hasty assumptions. The most problematic of these is the belief that adopting this view is an attack on pure symbolic logic or what may be termed the contemporary formalist approach to logic. In fact, the aim of defending this kind of logic is to justify the legitimacy of engaging with philosophical and intellectual dimensions of rational activities.

Robert Blanché argues that it is necessary to acknowledge the philosophical analyses of logic rather than dismissing them as vague or unclear. As Paul Valéry suggests, such inquiries lie outside the scope of science in its strict and precise sense. Once such acknowledgment is made, we should value the new logical findings, which may be compared to the beginnings of experimental research in the modern age—or even to the early development of mathematics in ancient Greece.

Another common misconception about studying this type of logic is the assumption that it is a return to traditional logic and its various methods. The truth, however, is that while we do refer back to traditional logic, we do so with regard to one of its essential components. Despite being a formal science, traditional logic aimed to preserve procedural reasoning that remained connected to natural language. Nonetheless, traditional logic can no longer fully serve the purpose; its old schematics are partial. Therefore, Blanché believes it is necessary for both intellectual logic and contemporary symbolic logic to develop in parallel without one eliminating the other.

The strong association of modern logic with pure formalism has, to some extent, distanced it from its philosophical roots. For this reason, the logician Robert Blanché is seen as a conservative thinker, one who insists on reconnecting logic with philosophy. Philosophy still preserves natural language in expressing its issues and meanings. This stance is especially important in light of growing efforts to strip logical reasoning of the linguistic expressions that link it to philosophical inquiry. Blanché advocates for preserving meanings, as they are central to most logical activities.

Blanché's position and defense of this perspective are clearly expressed in his book Les structures intellectuelles ("The Mental Structures"). In it, he seeks a comprehensive system of concepts and critiques some traditional results and principles in logic. One such critique is directed at the classical Square of Opposition, which he replaces with a new structure of oppositions composed of six elements. He calls this the "logical hexagon," which introduces directed oppositions among propositions. Although modest, this contribution represents a significant addition to traditional logic.

His defense of philosophical intellectual logic is even more explicit in his book La Raison et le discours ("Reason and Discourse"). There, he clearly states that the book was written to defend intellectual logic, in which meanings and ideas are preserved. This, in turn, requires logic to be detached from mathematics and pure formal systems, and instead kept within the realm of philosophy—where ideas and meanings, as expressions of human rational activity, are given due importance.

Defending this kind of logic does not mean rejecting formal logic based on symbolic language. Rather, Blanché seeks to assign both natural logic and symbolic logic their appropriate roles. This is the task that should be undertaken by the philosopher who studies logic, as well as by the logician who engages with philosophy. From this standpoint, we can preserve both innate reason and natural foundations—without letting them obstruct the expansion and progress that other symbolic languages make possible.

Logic in Its Dual Meaning

There has long been considerable disagreement among logicians regarding the scope and subject matter of logic—disagreement that even extends to the very concept of logic itself. As Bertrand Russell states: "As the concept of this discipline expanded and various approaches entered into it, it became almost impossible for two philosophers to use the word 'logic' with the same meaning." (Moussawi, The Place of Logic in Contemporary Analytical Philosophy, 2007, p. 68)

The persistent effort by philosophers to defend their intellectual positions has often led them to construct specific forms of logic to support those views. The history of philosophy is rich with intellectual disagreements, and these have left a clear impact on the development of logic.

There have been claims that logic has now detached itself from philosophical thought and become an independent field—reaching the status of an exact science. However, this is only a hypothesis, not an established fact.

Robert Blanché argues that the modern drive to make logic a fully scientific discipline has pushed it beyond the balance that once characterized traditional logic. That earlier form of logic tried to preserve both its subject matter and its method. But with the rise of formalism, this balance began to shift. Logic, it seemed, was forced to choose between two goals—and had to sacrifice one in order to advance the other.

This dual perspective on logic is not new. It existed even in traditional logic. Aristotle's logic, for example, allows for two interpretations. One is based on conceptual meaning; the other focuses on empirical reference. These two interpretations often compete, depending on the prevailing aim.

The turn toward form and the push to frame logic as a purely scientific enterprise have drawn criticism. These concerns have come not only from philosophers but also from logicians themselves—many of whom regret the loss of procedural explanation. A familiar pattern in the development of sciences is that they sometimes drift away from their original paths. They explore new directions that were not foreseen. Geometry, for instance, no longer deals with the measurement of land; physics has become distinct from natural science. But such changes are not necessarily harmful. Words gradually acquire new meanings.

The real danger lies in the failure to move beyond outdated uses of logic and its terminology, especially when dealing with new developments in logic. As is well known, logic regained momentum more than a century ago after a long period of stagnation. It now competes with the intellectual rigor of fields like mathematics. As a result, the purpose of logic has also shifted. It now focuses primarily on the study of pure mental operations. Still, we continue to use the word logic as before—even though its aims and goals have clearly changed. For this reason, the term has taken on a dual meaning. As Blanché explains:

"The new meaning, adopted in the redefined science, did not eliminate the old one. The older meaning remains present in our minds when we describe precise mental operations." (Blanché, Reason and Discourse, 2010, pp. 16–17)

The subject and method of logic become defined over time and through various stages. Like other sciences, logic begins by sharing methods with related fields. Gradually, however, it must develop tools suited to its specific needs. At this point, there emerges a union between subject and method. If conflict arises, it is the method that is revised, since it still serves the subject. Later, once the method becomes refined and tested, it is treated as part of the very essence of the subject. Only then does the science take on its final form, and its subject becomes clearly defined.

Disciplines should be defined by the methods they adopt in pursuit of knowledge—whether those disciplines are formal or non-formal. Arthur Eddington (1882–1944) points out that the procedures used in physics are, in effect, what define a concept.

Formalist approaches to logic have gone beyond eliminating material meanings and replacing terms with symbols. They have weakened the significance of concepts and logical operations themselves. Even logical constants have been sidelined, and symbols are treated as mere variables. In contrast, Aristotelian logic retained a kind of duality. Aristotle clearly stated that syllogism and demonstration do not belong to external speech, but rather take place within the mind. Logic, for him, results from the correctness of thought. Accurate expression is the outcome of accurate reasoning.

Therefore, the ultimate aim of logic is to examine flawed reasoning in order to avoid it—as is done in the study of sophistical fallacies—and to analyze valid and productive reasoning that is recommended for use. As he writes: “Syllogism is the tool of demonstration, and demonstration is the tool of science. For this reason, Aristotle’s successors remained faithful to him when they chose the title Organon—meaning 'instrument'—for the collection of his logical works.” (Blanché, Reason and Discourse, 2010, p. 20)

Modern philosophers launched sharp attacks on formal logic, especially during the campaign led by Descartes. This raised serious questions about the value of formal logic in philosophical thinking. However, others continued to show interest in logic—though in different ways.

Notably, the Port-Royal logicians—Antoine Arnauld and Pierre Nicole, both theologians and mathematicians—approached logic from a distinct perspective. Their influential work Logique ou l’art de penser (Logic, or the Art of Thinking) stands as a unique contribution to the philosophical tradition of logic[1]. One key feature of the Port-Royal Logic is its limited reference to formal logic. At the time, logic was taught as memorized texts given to students. However, the Port-Royal logicians proposed a different approach. They saw logic as an art of thinking rather than a theoretical science. In their view, it was a practical discipline. As they put it, it is "the art by which a person learns to guide their mind in the pursuit of knowledge" (Blanché, Reason and Discourse, 2010, p. 20)

The logic of Port-Royal followed Descartes’ method, which aimed to avoid excessive formalism. Yet even the formal logician Leibniz shared this Cartesian perspective. He believed that logic is the art of thinking, used not just to recognize what is present but also to uncover what is hidden. This is the same idea proposed by Boole, who held that logic’s goal is to discover arguments and evaluate them. Kant also considered logic to be a law of understanding—a tool that determines the proper use of reason.

This idea appears again in the work of Gottlob Frege. He described logic as the study of minds. That is, it concerns itself with what is common across minds—what is shared, not what is individual. He made a clear distinction between logic and psychology. As explained:

“The distinction between the logical and the psychological, which must be maintained rigorously at all times, is also a distinction between what belongs to the nature of the mind itself

[1] When the book was translated into English, the phrase "Bourbilly" was added to its title, referring to the Bourbilly Abbey. This abbey was a Christian monastery located southwest of Paris. It served as the theological center of the Jansenist movement. The Jansenist movement was a religious and political movement that arose within the Catholic Church in France during the 14th century. It emerged as a reaction to certain changes in the Catholic Church and royal absolutism. Among its most notable members were Antoine Arnauld, Pierre Nicole, and Blaise Pascal.

and what relates, by contrast, to the particular traits of this or that individual mind" (Bouveresse, 2019, p. 47)

This view draws close to the idea of a kind of logic concerned with thought—alongside the mechanical or computational aspects that apply universally.

Dr. Ahmed Moussaoui supports the hypothesis that logic remains tied to philosophy. He uses a historical method to argue this claim. If we look at the history of logic, it is difficult to pinpoint its true beginning—especially when we consider its implicit uses.

Still, one can say that logic found its formal foundation with Aristotle. He developed its principles by drawing on the reasoning of his predecessors. As Antoinette Raymond writes in her book on formal logic:

"Classical logic is the product of centuries of reflection on the problem of reasoning. This reflection began at the dawn of philosophy, with the pre-Socratic thinkers. If Parmenides was the first to express the principle of identity, then Zeno of Elea played an even more significant role in the development of logical thought" (Raymond Antoinette, 1967, p. 31)

The diversity of views among researchers about logic has raised major questions about its subject matter, its method, and its ultimate purpose. These questions were addressed not only by philosophers like Blanché but also by mathematician-logicians such as Russell, Brouwer, and Hilbert. For instance, Aristotle's debate with the Pythagoreans provided an early model of reductio ad absurdum.

The work done before Aristotle laid the foundation for the later development of logic. Socrates, for example, engaged the Sophists in dialogue, urging them to provide consistent definitions instead of manipulating language for persuasion. This approach is reflected in Plato's dialogues. However, Aristotle criticized the Platonic method of binary division. He found that it relied too heavily on the interlocutor's agreement at each stage. To address this, he introduced the middle term, which links premises in a more systematic way. With the middle term, syllogistic reasoning becomes necessary. In this sense, Aristotle is rightly seen as the true founder of logic.

One of the core issues that arose from Aristotelian logic was the problem of formality. In his Prior Analytics, Aristotle used symbolic expressions. In the Posterior Analytics, he used verbal language. For this reason, Aristotle's logic cannot be considered purely formal. Some valid syllogisms, in fact, cannot be explained without reference to specific terms carrying real attributes. Jan Łukasiewicz notes:

"It is often said that formal logic concerns only the form of thought—how we think—without reference to the particular objects we think about... But if thought is a psychological phenomenon, and psychological phenomena have extension, then can we really speak of a 'form' that has no extension?" (Łukasiewicz, 1961, p. 25)

To relate logic to thinking implies, in some sense, a relation to psychology. Logic may reflect how thinking actually works. Thought involves operations like analysis, synthesis, memory, imagination, perception, and abstraction. Through these processes, we arrive at judgments—understood here from a psychological perspective. Frege, as mentioned earlier, touched on this connection.

Logical judgment, however, also rests on certain fundamental principles—such as identity, non-contradiction, and the excluded middle. These are shared between logic and metaphysics. Yet metaphysical reasoning treats them as existential truths. The mind necessarily submits to them. (Moussawi, The Place of Logic in Contemporary Analytical Philosophy, 2007, p. 87)

Edmond Goblot takes a different view of logic's relationship with psychology. (Goblot, 2012, p. 33)

He argues that if logic is concerned with what ought to be, then psychology focuses on what is. Psychology describes, while logic prescribes. Psychology is a natural science that seeks causal laws. But because logic also takes place in time and space, it raises a key question: how do we determine an event through its prior causes?

This is answered by positing mental assumptions. Causal necessity, the concern of psychology, corresponds to logical necessity, which is independent of time. A logical consequence follows from a principle. If the principle is true, the consequence must also be true. Yet unlike causal events, logical consequences do not necessarily follow temporally. In psychology, a judgment is a fact—whether true or false. But in logic, the aim is to distinguish precisely between truth and falsehood.

Husserl offered another comparison between psychology and natural science. He viewed psychology as a core philosophical discipline within epistemology. Psychological phenomena are internal, while physical phenomena are external. As he explains:

“Psychology can be defined as the science of inner phenomena, just as natural science is the science of external phenomena.” (Husserl, 2010, p. 222)

Not all philosophers or logicians welcomed the idea of connecting logic to metaphysics. The Polish logician Łukasiewicz emphasized that ancient Greek schools disagreed on this issue. Some debated whether logic was merely a tool for philosophy or a part of it.

The Peripatetics saw logic as an instrument, while the Stoics considered it an essential part of philosophy—and also its primary method. Sextus Empiricus (c. 160–219 BCE) reported the Stoic view and noted that philosophy was divided into three fields: logic, physics, and ethics. The same tripartite view was supported by Diogenes Laërtius (c. 200–250 BCE) and Zeno of Citium (c. 326–264 BCE). The Stoics even likened philosophy to a living organism: logic represented its bones and nerves; ethics was its flesh; and physics its soul. (Laërtius, 1986, pp. 39–41)

The Peripatetics saw logic as a tool for philosophy. The Platonists believed logic was both a tool and a domain of philosophy itself. This was discussed by Ammonius in his commentary on Prior Analytics, as translated in Łukasiewicz’s Aristotle’s Syllogistic. He explains: “If you use syllogisms based on concrete terms, as Plato does in his argument for the immortality of the soul, you make logic part of philosophy. But if you treat syllogisms as patterns using abstract symbols—such as ‘A is predicated of B, B is predicated of C, therefore A is predicated of C’—as Aristotle and the Peripatetics do, then you treat logic as a tool of philosophy.” (Łukasiewicz, 2001, p. 26)

The Relationship Between Logic and Philosophy: Between Tradition and Reinterpretation

The commentary provided by Ammonius on Aristotle's Prior Analytics differs from what appears in the original text. When Aristotle demonstrates the relationship between cause and effect, or when he addresses the nature of the soul, he uses concrete terms. For this reason, Aristotle views logic as both a part of philosophy and its principal instrument.

In the Islamic medieval tradition, the relationship between logic and philosophy was also explored. Al-Ghazali, in his work The Incoherence of the Philosophers, engages with metaphysical questions in his critique of philosophical thinkers. On the one hand, he separates Aristotelian logic from Greek philosophy. On the other hand, he still uses logic as a component of philosophical reasoning. He makes this clear in Deliverance from Error, stating:

"If logic is rejected, this rejection, according to logicians, merely reflects a flaw in the mind of the one who denies it—and even in his religion, if he claims that his religion depends on rejecting it" (Ghazali, 1969, p. 22)

Although Aristotelian logic has been formal from its inception, this has never severed its connection with philosophy. Despite the developments it underwent, logic remained closely tied to philosophy—especially during the ancient and medieval periods. In modern times, there were serious attempts to establish a new methodology to replace traditional logic. However, as Moussawi points out:

"These attempts did not succeed in separating logic from philosophy. The notion of self-evidence, which Descartes made the foundation of his method, is no less metaphysical than Aristotle's concept of essence in linking logic to philosophy." (Moussawi, The Place of Logic in Contemporary Analytical Philosophy, 2007, p. 94)

Aristotelian logic has been subject to two opposing interpretations. But by the end of the 19th century, traditional logic became a topic of debate. Some scholars argued for its integration within philosophy—either from a critical standpoint or based on a historical understanding of its evolution. For instance, Hamelin maintained that Aristotelian logic is not purely formal. When Aristotle uses the middle term as a cause and essence as the basis of syllogism, this, according to Hamelin, indicates that logic is deeply embedded in his philosophical system.

Léon Brunschvicg (1869–1944), in his dissertation on "The Metaphysical Power of Syllogism in Aristotle's Thought," argued that: "The purely formal appearance attributed to Aristotle's logic... in fact erased its ontological foundation. As a result, logic came to be seen as a purely formal system of inference, in which verbal expressions alone were thought sufficient to justify conclusions. In doing so, some believed they were granting logic the status of an independent, positive science, while in truth they were only obscuring the true nature of scientific inquiry" (Brunschvicg, 1912, p. 48)

On the other hand, a shift occurred with the rise of symbolic logicians. Jan Łukasiewicz considered Aristotle's Prior Analytics to be a purely logical work, free of any metaphysical traces. He viewed syllogistic theory as entirely formal and disconnected from psychological considerations. He compared Aristotle's logic to mathematical theories and even argued that syllogism surpasses them in precision. According to him, Aristotle's logic should be assessed independently of later interpretations or philosophical commentaries.

A major point of contention in the interpretation of Aristotelian logic has been whether it is conceptual in nature or extensional (i.e., concerned with reference and truth-conditions)[2] Conceptual and Extensional Logic: A Renewed Tension in Contemporary Thought

This debate has caused a deep division among logicians. It has made it more difficult to separate the formalist perspective from the conceptual one regarding how logic should be defined.

The pursuit of pure formality in logic demands that the meanings of concepts be set aside. Instead, attention is given to the extension of these concepts and to their truth-values. For this reason, Louis Couturat (1868–1914) writes: “Mathematical logic—that is, in short, precise and correct logic—cannot be based on the vague and unclear notion of the concept. It became possible only with Boole, who founded it upon extension alone, which alone allows for mathematical treatment” (Couturat, 1901, p. 387)

Couturat’s view contrasts sharply with those who wish to preserve a close connection between mechanical logic and natural reasoning. This is why Rapier lamented what he saw as the forced reduction of conceptual judgments into extensional ones. In his view, this shift stands against the living, dynamic process by which the mind operates.

The old debate between conceptual and extensional interpretations has returned in modern logic. However, this distinction is now reframed using the notions of functions and propositions. As a result, contemporary formal logic is no longer a purely extensional system, as Couturat believed. Traditional logic had linked extension only to concepts, which in turn referred to the classes they represented. But after Frege’s contributions, logical semantics expanded. Logic came to apply to propositions as well.

A proposition has both a sense (or meaning), which reflects its conceptual aspect, and a truth-value, which reflects its extensional aspect. If we ignore the meaning and focus only on the truth-value, then we treat the proposition from an extensional perspective. From this angle, only statements that carry truth-values can belong to the domain of logic. (Blanché, Mind and Discourse, 2010, p. 24)

Logic that seeks pure formality tends to avoid guided or content-laden concepts. It treats necessity as a structural condition, not a semantic one.

Note on Concept and Extension

[2] In traditional logic, both the concept (mufahham) and the predicate (maṣdaq) are linked to the idea of the notion (taṣawwur). Each notion implies a set of attributes or characteristics and applies to a group of individuals. The set of attributes forms the concept of the notion, while the individuals who possess those attributes form the predicate of that notion. For example, the term “human” represents the concept of a human, understood to include attributes such as existence, life, and intellect. The term “human” as a predicate applies to any individual human, such as Muhammad, Aisha, Ali, Fatima, Omar, and others. The traditional view of the relationship between concept and predicate considered it inverse: as one expands, the other contracts. However, the contemporary view divides logicians into two groups: those focusing on the predicate, called "predicativists," and those emphasizing the concept, called "conceptualists." A propositional variable is described as conceptual if it applies to a set of meaningful sentences, and as predicative if it relates to a set of truth values (Mousawi, Encyclopedic Logical Dictionary, 2019, pp. 126-127).

In traditional logic, both concept and extension are linked to notions. Each notion consists of a set of attributes or properties and applies to a set of individuals. The set of attributes defines the concept; the individuals to whom these attributes apply form the extension.

For example, the term "human" expresses the concept of a human being. It includes properties like existence, life, and rationality. These make up the concept. The term "human" applies to any individual person—Muhammad, Aisha, Ali, Fatima, Umar, and so on—these constitute the extension of the concept.

Traditionally, the relationship between concept and extension was seen as inverse: the broader one is, the narrower the other becomes. However, in contemporary logic, this relation has shifted. Some logicians now focus on extension—these are called extensionalists. Others emphasize the conceptual aspect—they are known as conceptualists.

A propositional variable is said to be conceptual if it applies to a set of meaningful statements. It is said to be extensional if it is concerned with a set of truth-values. (Moussawi, Encyclopedic Logical Lexicon, 2019, pp. 126–127) [3] And the possibility[4] Logic that seeks to be purely formal avoids the inclusion of directed or content-laden concepts. It holds that some notions lie outside logic. Such notions cannot be reduced to purely extensional concepts.

On the other hand, intellectual logic can coexist with both extensional systems and directed systems. Our thinking works with both. There is a duality in meaning when we deal with propositions. For example, when we assert "All A are B," we can also express it differently, as "All As are Bs." We can also express it as "What is A is necessarily B"

The pursuit of pure formalism has encountered many objections. Critics argue that this abstract approach tries to replace the essence of meaning with sets of empty symbolic diagrams. These diagrams lack real meaning and conflict with intuitive thinking.

The creation of a mathematically styled logic met criticism from French philosophers. They objected to symbolic logic. Also, Goblot asked whether the new symbolic notation excludes ideas that the notation cannot express. Coray thought that symbolic logic is "a dull and sterile science that burdens the mind." (Blanché, Mind and Discourse, 2010, p. 28)

Despite dramatic increases in how much logic follows formalism, opposition came not only from those who rejected the new logic outright but also from those who helped develop it initially.

Louis (or "Louis Couturat") suggests that logic can be seen in two ways. First, as a principle for deductive inference. Second, as a theoretical science. The second view has overshadowed the first. Gentzen proposed natural inference methods that align with natural thought. If the task of logic, in terminological terms, is to create a symbolic language, then an additional condition must be met. We should make logical facts properties of that symbolic language. Freudenthal,

[3] Necessity is defined as what cannot not be, or what cannot be otherwise. The concept of necessity varies across fields: there is physical necessity, metaphysical necessity, and moral necessity. In logic and mathematics, necessity refers to what is true in all possible worlds (Mousawi, Encyclopedic Logical Dictionary, 2019, p. 102).

[4] Possibility is the property of that which does not exist but can exist. It is one of the four modal categories alongside necessity, impossibility, and contingency. Since possibility is not existence, it differs from being actual. However, since it is capable of existence but not necessarily so, it is distinct from contingency, which denies necessity (Mousawi, *Encyclopedic Logical Dictionary*, 2019, p. 141).

for example, did not hesitate to assert that logic is a science of reality (Blanché, Mind and Discourse, 2010, p. 30).

1. The Drive toward Formalism:

The history of logic shows its tendency toward formalism. This tendency is clearer in contemporary logic, compared with the neglect of natural methods of reasoning. Logic came to focus on algebraic-mathematical treatment of issues and propositions. It excluded intuitive content in knowledge.

Rigorous use of formalism appears gradually, especially with Aristotle. He began by considering methods of inference used in debate. Later, he moved toward formal logic by introducing variables—even though he might not have appreciated the full novelty of that shift. He also worked to separate what is mental from what is logical. (Bouchenski, 1951, p. 44)

Thus Aristotle's path aligns with the general trend in logic. "The history of logic since Boole is not only the history of increasing formalization, but also, in solidarity, the history of the weakening of the bond that ties logic to thinking." (Blanché, Mind and Discourse, 2010, p. 33)

The evolution of logic recalls transformations in industry. Major breakthroughs occur when humans shift toward art and creativity, rather than mimicking nature. Humans entered the realm of flight when they stopped imitating birds. Logic has not yet reached that level of transformation seen in industrial fields. However, it is on its way, by turning away from natural reasoning methods.

Modern logicians rejected psychologism. Mid-19th-century logicians followed it implicitly, though often without admitting it. This form of logic contrasts with the other kind—the logic of mathematicians—that deals with objective relations independent of empirical facts. A precise science like logic cannot be under the guardianship of another science.

The farther logic moves from normative judgments and the psychological side, the more it rises in the hierarchy of sciences, approaching mathematics. The new logic—embodied in Peano's formulations, Frege's symbolic notations, and Russell's integrated system—appears as languages fit to express mathematical thought. We now see truly symbolic writing, as Couturat said. The emergence of Cantorian paradoxes made scholars ask about their origin. That inquiry leads back to the nature of logic underlying them. (Blanché, Mind and Discourse, 2010, p. 36)

New logic is intertwined with mathematics. Also, mathematics itself has been emptied of its material content to become a purely logical practice. In 19th-century mathematics, when its principles were reexamined, thinkers attempted to replace calculative operations with ideas. In 20th-century mathematics, they tried to replace constants with variables. Russell described the relationship between mathematics and logic in his Principles of Mathematics. He challenged anyone to draw a clear line between the two in terms of principles. "Since then, the union between logic and mathematics became closer, because it reached complete fusion in one sense." (Blanché, Mind and Discourse, 2010, p. 37)

The distinction between mathematics and logic does not begin to appear until we move to a realistic interpretation of formal models. We do this when we give symbols precise meaning beyond their extensional definitions. We also do this by replacing variables with constants drawn from traditional logical domains.

The overlap between logic and mathematics implies mutual influence between them. Changes in modern mathematics also affected logic. Classical mathematics was dogmatic. Its truths were clear. Each forced itself empirically. And via proof, the echo of those truths became theorems. Then a system of theorems formed, structured by axioms of conventional form. In such a system, logical coherence came to precede empirical truth.

There is something in both that lies outside logic; they cannot be reduced to purely extensional concepts.
On the other hand, intellectual logic can coexist with both extensional calculi and directed systems. Our thinking operates on both tracks. There is a duality of meaning in propositions. When we say "All A are B," we can restate it as "All As are Bs." Or we can express it as "What is A is necessarily B"

The drive toward pure formalism has encountered several obstacles. It met with objections to this abstract turn, which attempts to substitute the essence of meaning with empty symbolic schemata. Those schemata lack real meaning and clash with intuitive thought.

The creation of a mathematically-styled logic was met with some reserve by French philosophers. They showed displeasure with symbolic logic. Meanwhile, Goblot questioned whether the new symbolic notation means we exclude all ideas that cannot be expressed by new symbols. Coray even declared that "symbolic logic is a dull and sterile science that burdens the mind" (Blanché, Mind and Discourse, 2010, p. 28)

As logic increasingly adopted formalism, its critics were not only external dissenters but sometimes those who had contributed to its early development.

Louis (Couturat) suggested that logic can be seen in two ways: first, as a principle of deductive inference; second, as a theoretical science. The second conception has overshadowed the first. Gentzen proposed natural inference systems that align with natural methods of thinking. If the formal task of logic is to introduce a symbolic language, we must add another condition: that logical facts become properties of that symbolic language. Freudenthal, for example, did not hesitate to claim that logic is a science of reality. (Blanché, Mind and Discourse, 2010, p. 30)

1. The Pursuit of Formalism

The history of logic shows a tendency toward formalism. This tendency becomes more evident in modern logic, at the expense of natural reasoning. Logic now focuses on algebraic or symbolic treatment of propositions and dismisses intuitive content in knowledge.

The gradual intensification of formalism is clear from Aristotle onward. He began by examining modes of inference used in debates; later, he moved toward formal logic by introducing variables—even if he may not have fully foreseen the novelty of that move. He also separated the mental from the logical (Bouchenski, 1951, p. 44).

Aristotle's path matches the general trend of logic: "Since Boole, the history of logic is not only the history of increasing formalization, but also the history of the gradual decay of the bond that tied logic to thought." (Blanché, Mind and Discourse, 2010, p. 33).

This evolution in logic recalls developments in technology. Crucial advances tend to come when humans abandon direct imitation of nature in favor of creativity. Humans did not succeed

in flight by copying birds but by innovating. Logic has not yet achieved an analogous revolution; yet it moves in that direction by distancing itself from natural thought.

Contemporary logicians rejected psychologism, a view once tacitly followed by many mid-19th-century logicians. This form of logic contrasted with the mathematicians' logic, which studies objective relations independent of empirical facts. Logic, as a precise science, should not be subordinated to another discipline.

The further logic moves from normative judgments and psychological elements, the more it ascends in the ranks of science toward mathematics. The new logic—as expressed by Peano's formulations, Frege's symbolic representations, and Russell's unified system—appears as a suitable language to express mathematical thought. Genuine symbolic notation emerges, as Couturat noted. The appearance of Cantorian paradoxes has led scholars to probe their origin, reaching back to the hidden nature of logic itself (Blanché, Mind and Discourse, 2010, p. 36).

New logic is entangled with mathematics. Moreover, mathematics itself has been emptied of its material content to become pure logic. In 19th-century mathematics, thinkers replaced numerical operations with ideas. In the 20th century, they replaced constants with variables. In his Principles of Mathematics, Russell challenged anybody to draw a boundary between mathematics and logic in terms of their principles. He argued: "Since then, the union between logic and mathematics has grown more intimate, reaching a complete fusion in one of its senses." (Blanché, Mind and Discourse, 2010, p. 37)

The distinction between mathematics and logic begins to surface only when we adopt a realistic interpretation of formal models. That is when we assign precise meaning to symbols beyond extensional definitions. We also accomplish this by substituting variables with constants drawn from the domains of classical logic.

The overlap between logic and mathematics implies mutual influence. Changes in modern mathematics have affected logic. Classical mathematics was dogmatic; truths were clear and forced themselves empirically. Through proof, those truths resonated as theorems. Over time, a system of theorems built itself from a network of axioms, which became conventional in nature. In that system, logical coherence begins to take precedence over empirical truth.

The Relationship Between Informal Logic and Epistemology

In Barthesbay's view, logic is an inseparable part of epistemology. He divides epistemology into three branches:

1. **Meta-Epistemology**: This branch studies the fundamental concepts of knowledge and its theoretical foundations. It also aims to examine epistemological discourse to uncover gaps in critical analysis.
2. **Normative Epistemology**: Its purpose is to develop a set of general and acceptable rules for evaluating and correcting statements. These rules aim to clarify the epistemic standards required to determine the accuracy, quantity, and quality of justification needed for a belief to be considered warranted (Tijar, 2014, p. 77).
3. **Applied Epistemology**: This branch focuses on implementing the principles of normative epistemology. It relies more on epistemic insight than formal logical rules. In this sense, applying critical standards becomes a central task of epistemological thinking. However,

does this suggest a full convergence between informal logic and epistemology, particularly in their critical aspects?

Barthesbay replaces informal logic with applied epistemology. At the same time, he draws a distinction between "applied epistemology" and the "application of epistemology." This distinction follows the same pattern as that between “applied ethics” and the “application of ethical principles.” Applied epistemology examines the role certain acts play in the pursuit of knowledge. An example of this is the process of falsifying hypotheses to justify a specific claim.

In contrast, the **application** of epistemology concerns itself with the specific role that hypotheses play in particular cases. Thus, **applied epistemology** can be said to represent **informal logic**, while the **application of epistemology** represents **critical thinking**. Critical thinking, however, is much broader. It includes other activities such as creative thinking and practical problem-solving.

The overlap between informal logic and epistemology does not imply equivalence. They are not interchangeable. Informal logic has yet to reach the maturity required to become an independent field of study. It still faces many practical and theoretical challenges. At times, it rises to the level of philosophy of logic, epistemological debate, ontology, and educational theory. At other times, it falls to the level of basic instructional exercises. At every level, however, it remains tied to intuition and lived reality. Yet, it lacks a specific and unified method. Therefore, any theory that places itself within the domain of informal logic must first identify its methodological foundation. (Johnson, 2000, p. 258)

One of the main obstacles that has prevented this form of logic from attaining its rightful academic status is the absence of a clear methodological structure.

Some logicians have argued that the term informal logic is a misnomer. They claim that this form of reasoning lies outside the proper bounds of logic. According to this view, its theoretical and cognitive level is much lower than that of formal logic. This criticism has been adopted by Woods and Massey. However, such a view stems from a strict attachment to pure formalism. As Johnson notes: "The criticisms either arise from a dogmatic view of the nature of informal logic or from a mistaken understanding of what informal logic actually is—or from both." (Johnson, 2000, p. 259)

Through examining these critiques, Johnson identified several shortcomings within informal logic. Chief among them is its underdeveloped theoretical foundation. It has not yet achieved full maturity.

The growing association between logic and mathematics, and logic’s movement toward increasing formalization, has intensified criticism of informal logic. Before logic merged with mathematical computation, it already contained elements of argumentation. In fact, its early stages—especially with Plato—were entirely rhetorical and argumentative in nature.

To understand informal logic more deeply, we must do more than confirm it as part of logic. That is only half the picture. We must also determine the nature of the relationship between formal and informal logic. The latter, despite its rejection of pure formalism, still depends on it in some ways. Informal logic has not fully separated itself from formal structures. It remains in need of a new methodological framework, which must itself rely—at least in part—on formal techniques.

The need for informal logic arose from a growing recognition that formal logic alone could not fulfill its broader aims. These aims include developing tools and skills for constructing arguments—goals that cannot be achieved through excessively abstract lessons or rigid symbolic languages that ignore practical communication. Informal logic emerged in the early 1970s as an attempt to overcome this crisis. It was a renewal movement aimed at restoring logic's connection to natural, practical reasoning.

While formal logic dismissed material truth, it now seems to be distancing itself from formalism itself. Early mathematical logicians sought to create a symbolic language that could serve as both a philosophical structure and a measure of coherent dialogue. This tendency began explicitly with Leibniz and reached its peak with Wittgenstein. With the publication of Tractatus Logico-Philosophicus, non-classical logics began to emerge and multiply. As a result, formal truth has become somewhat relative. Carnap, for example, criticized Wittgenstein's view of linguistic absoluteness, noting that language may differ depending on the linguistic system in use.

The revolution in logic echoes the intellectual shifts of the late 19th century. Critical analysis revealed that no element has value except in terms of its function within the system as a whole. However, physical theories add an extra requirement: they must correspond to reality and intuition. Logic, on the other hand, is not bound by such a requirement. Its internal coherence does not depend on external truth. As Blanché notes: "This is evident in many symbolic logical systems that lack any clear intuitive interpretation" (Mind and Discourse, 2010, p. 51)

Nevertheless, this does not preclude the possibility that such systems may have future applications.

CONCLUSION

Logic carries a dual meaning. The first relates to its pursuit of pure formalism. The second concerns preserving logic's place within philosophy and thought.

The drive toward formalism and scientific rigor forced logic to move beyond the balance that once existed between its subject matter and method. To continue developing after centuries of stagnation, logic had to prioritize one goal over the other. These goals are conceptual understanding and truth preservation. However, the evolution of logic has favored the formal goal over the conceptual one.

The debate between the conceptual and truth-oriented views is not new. It was present already in Aristotle, who maintained a conceptual view of logic. For Aristotle, the correctness of expression inevitably follows the correctness of thought. Similarly, the Bourbaki school defended the intellectual dimension of logic. In modern logic, Frege replaced the debate between conceptualists and truth-oriented thinkers with the concepts of function and argument. The history of logic and philosophy demonstrates the close link between them at every stage of their development. Often, logical systems reflect the prevailing philosophical outlook.

Symbolic logicians brought about a revolution by viewing Aristotle's logic as purely formal, free from any metaphysical influence. Yet, a division emerged among logicians over whether Aristotle's logic is conceptual or truth-oriented. This debate also split philosophers between those who adhere to the conceptual view and those who pursue the truth-oriented perspective.

The full pursuit of formalism demands abandoning traditional conceptions and focusing solely on truth. However, this position is rejected by those who seek to maintain a close relationship between formal logic and natural logic.

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