Deficiencies of Aristotelian Logic from the Perspective of Symbolic Logic

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Abstract:

Ancient logic in general, and Aristotelian logic in particular, have been subject to several criticisms due to its dominance from its emergence until the 19th century. After prominent mathematicians discovered a new logic that used a precise symbolic language, its premises and methods of proof underwent changes, leading to the emergence of different logical frameworks. One of the key points on which symbolic logicians agree, and which has sparked considerable debate, is Aristotle's ignorance of empty categories and personal boundaries. This includes the direct and indirect transitions in his arguments, such as reasoning by contradiction, reasoning by intersection, or the four types of propositions containing the letter "P", which represent universal questions indicating presupposition to particular questions indicating existence. Symbolic logic rejects these aspects.

Keywords: Logic, universal question, particular question, existence, assumption, universal limits.

Introduction:

Aristotelian logic has prevailed for thousands of years without any significant criticism because it is considered to be a complete system, as the German philosopher Kant (1728-1804) noted in the introduction to his book "Critique of Pure Reason": "Logic was born complete with Aristotle and has not taken a step forward"[1]. Furthermore, Poincaré (1854-1912) remarked: "It seems that there is nothing new to be written about intuitive logic, and Aristotle realised its full extent"[2]. Does it make sense that perfection arises from imperfection? If we consider the human mind to be imperfect, it is impossible for perfection to come from it. Based on this premise, symbolic logicians have identified several shortcomings in Aristotelian logic and have agreed that they represent flaws within it. The question then arises: What are these defects?

Can these shortcomings be considered as such, or should we simply regard them as inherent limitations of Aristotelian logic? In order to discuss the subject of the shortcomings of Aristotelian logic from the point of view of symbolic logicians, however, it is necessary to explain briefly what Aristotelian logic and symbolic logic are. This will allow us to delve deeper into the research and clarify what is criticised and what is really lacking in the view of symbolic logicians. Have they been able to overcome these shortcomings and fill in the gaps with their new developments?

Aristotelian Logic:

Humans have implicitly engaged in logical thinking since their existence on this earth, but the first person to formulate and refine the rules of syllogistic logic was the Greek philosopher Aristotle. His philosophical views dominated the era of Greek science, and his system of logic

[1]- Kant, Critique of Pure Reason by A. Tresmesugnes and B. Paraud Published by P.U.F (Presses Universitaires de France), Paris, 1963(Page: 4).
[2]- Henri Poincaré, Science and Methods Published in : Flammarion, Scientific Philosophical Library.08 (P:172)

remained the dominant one throughout the Middle Ages, the Renaissance and even the 19th century[1]. Logic was seen not only as a tool for reasoning in all the sciences, but also as the only tool for human thought.

One of the characteristics of Aristotelian logic, according to Aristotle, is that it is a logic of terms (logique des termes). It studies inferences that result from combining universal boundaries or concepts by a single relation, namely inclusion, to form simple categorical propositions. These propositions are then classified into four types according to their quantity and quality (universal affirmative, universal negative, particular affirmative, particular negative). By combining them, we obtain either direct inferences, such as opposition (contradiction, contrariety, sub-contrariety), or indirect inferences, such as syllogism, which can be either valid or invalid depending on certain conditions.

Aristotle defined what he meant by a complete syllogism and how the four types of propositions (Barbara, Celarent, Darii, Ferio) fit into the first figure. He relied on them to determine the validity of syllogisms in the second, third and fourth figures using certain laws, including conversion and obversion[2]. However, Aristotle's philosophy focused only on universal categorical issues and did not take into account personal issues, individual limitations, or the variety of relational issues. As a result, his theory of syllogism does not adequately explain all inferential patterns, especially in mathematical reasoning[3].

Aristotle is credited with being the first to discover and consider the concept of formal validity (la validité formelle). He was not concerned with the content of the proof, but with its form. Aristotelian logic is therefore a theory of the formal validity of arguments. By way of example:

"All men are mortal.
All Greeks are human.
Therefore all Greeks are mortal".

Aristotle was not concerned with the concept of "human" or "Greek" or "mortal", but with the form of the syllogism, which we would now call the argumentative schema (schéma argumentatif)[4]:

"All A is B.
All C is A.
Therefore all C is B".

This means that Aristotelian logic is a formal logic because it was the first to consider the use of variables to represent the form of the syllogism, independent of the meaning of the terms, although he did not fully realise the potential of these variables[5].

Second: symbolic logic

In the modern era, a new logic emerged and was given different names, the most important and widely used of which is Symbolic Logic (logique symbolique), because it refers to the tool developed by contemporary logic and considered to be the best guarantee of achieving the desired precision. If we go back to its forerunner, Leibniz (1646-1716), he used the term

[1]- Herve Barreau, Epistemology Published Presses Universitaires de France, Paris First Edition: 1990. Page: 17
[2]- Marie Louise Rour, Principles of Contemporary Logic,Translated by Mahmoud Al-Yaqoubi Published in Dar Al-Kitab Al-Hadith, Egypt. First Edition: 2012.Page: 19
[3]- Same Reference.Page: 20
[4]- Theoprdie.com, "What is Contemporary Logic?" Thursday, February 11, 2016, Denis Cerba.
[5]- Mary Louise Roor, Same reference, p. 18.

symbolic logic as a synonym for mathematical logic (logique mathématique) or calculus (calcul rational). In addition, it was used not only to refer to symbolic logic, but also to denote basic mathematical concepts as pure logical concepts[1]. Russell (1872-1970) used both Symbolic Logic and Formal Logic as synonyms, stating "Symbolic Logic and Formal Logic are two terms which I use interchangeably"[2]. Contemporary logic has also been called the algebra of logic, a term attributed to George Boole (1815-1864), who named it as such in his theory. Peano (1858-1932) was the first to use the term mathematical logic, and he intended it to mean two types of research: the first research is the formulation of the new logic using symbols and mathematical ideas, and the second research is the philosophy of mathematics.

Finally, contemporary logic was called modern symbolic logic, with the intention of making it more pictorial than what Aristotle had produced. This term is found particularly in the writings of Russell, as we mentioned earlier. The best definition that can be given to symbolic logic is that it is concerned with inference, as if to say that symbolic logic is the science of inference[3]. One of its characteristics is that it deals with simple and compound propositions in propositional logic, with personal and empty domains in predicate logic, and with various relations in relational logic.

The second characteristic of symbolic logic is that it is a formal deductive system that does not rely on philosophical criteria (such as first principles and intuitive reasoning) to judge the validity of statements. It is sufficient to check that they have been derived according to the established rules of the system.

It also uses contemporary methods of proof such as truth tables, abbreviated tables, tree analysis, and the Venn diagram technique.

Third: Criticisms of Aristotelian logic:

Most of the criticisms of Aristotelian logic in previous centuries were directed primarily at the syllogism as the only tool of deduction. These include the attempts of Ibn Taymiyyah (1263-1328 AD) and Roger Bacon (1294) in the 13th century. Also the criticisms of Francis Bacon (1561-1626 A.D.) in the 17th century, as set out in his book "Novum Organum", published in 1620, where he states: "The logic we have now does not help us to acquire or discover new knowledge"[4]. In other words, the Aristotelian syllogism does not help us to go from the known to the unknown because the result is already present in its premises. Even Descartes, when examining the method, dispensed with logic altogether, since it is only suitable for representing truth. Instead, he relied on algebra and geometry because they are free from error and doubt.

The nominalists criticised Aristotle's logic and regarded syllogism as a mere acquisition or appropriation of what is desired as it moves from the universal to the particular. They saw it as the transfer of the predicated property, verified in all individuals, to one or more individuals. However, since Aristotle was never concerned with all individuals, but rather with the universal, which signifies the essence and reality of a thing, and not with individuals who possess this essence, the syllogism does not move from "all" to "some", but rather from

[1]- Mohammed Thabet Al-Fandi, Philosophy of Sport,Dar Al-Nahda Al-Arabiya, Beirut in 1969(p: 105-126)
[2]- Bertrand Russell, Principles of Mathematics. Mohammed Morsi Ahmed and Ahmed Al-Ahwani‹Dar Al-Maaref, Egypt. 1964 Page: 49
[3]- Mahmoud Fahmy Zidan, Symbolic Logic: Its Origins and Development (Dar Al-Wafa Al-Dunya for Printing and Publishing: Alexandria), 2nd edition, 2010, p. 21.
[4]- Azmi Islam, Foundations of Symbolic Logic (Anglo-Egyptian Library: Cairo), 3rd edition, 1970, p. 2.

"all" to "all" or to "some". Their criticism is therefore based on their confusion between what the concept affirms and its dissolution into a mere "collection of individuals"[1].

Hamilton (1755-1804 A.D.) criticised Aristotelian logic for not distinguishing between the subject and the predicate, believing that Aristotle fell short by treating the subject separately from the predicate. Hamilton classified propositions into four types: "quantity, quality, universal, and particular". He tried to correct this by distinguishing between the subject and the predicate, and he took the proposition "Every Frenchman is a European" to mean that the domain of the French is a particular part of the European. On this basis, he introduced four additional propositions to the traditional ones: "all is all", "all is some", "some is all", "some is some", "no one is any one", "no one is some", "not some is some", "not some is some".

A scholar studying the history of logic in Arabic will find that the idea of distinguishing between the subject and the predicate is an ancient concept, recognised by Arab logicians such as Ibn Sina (370-428 AH). Ibn Sina treated this idea in a chapter of his book "Al-Shifa" (The Book of Healing), as did Imam Al-Sanusi Al-Tilimsani (832-895 AH), preceding Hamilton's work. However, their interest in the subject led them to encounter several problems[2], including the emergence of so-called deviant statements that could not be accurately represented. Consequently, they refused to deal with these problems and eventually abandoned the idea when they realised their mistake.

In fact, the problems raised by the theory of the distinction between subject and predicate, with which Hamilton sought to perfect logic, actually led to deviation and the departure of logic from its natural state and function. In the 19th century, with the emergence of scientific developments and crises, contemporary logicians focused on Aristotelian logic and criticised its limitations in terms of limited boundaries, logical relations, types of propositions and forms of inference.

All these developments, which were also taking place in other fields, led to the emergence of another logic, called "symbolic logic". The proponents of this new logic also found other flaws in Aristotelian logic[3], which manifested themselves in what ways?

Fourth, criticisms of symbolic logicians:

One of the points that has been widely debated and discussed in most books on symbolic logic is:

1. The reversal of the positive universal into the particular negation: A major point of debate is the reversal of the positive universal (A) to the particular negation (I). According to the principle of distribution, if the positive universal is true, then the particular negation must also be true. But if the positive universal is false, the particular negation can still be true.
2. Laws of inference: Symbolic logicians have discussed the laws of inference, which state that if the positive universal (A) is true, then the particular affirmation (I) must also be true. Conversely, if the positive universal (A) is false, the particular proposition (I) can still be true. The validity of these laws has been questioned.
3. Invalid syllogistic forms: Symbolic logicians have identified four invalid syllogistic forms involving the letter P: Fesapo, Felapton, Darapti and Bamalip. These forms are considered flawed and their logical validity has been questioned.

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[1]- Mahmoud Al-Yaqoubi, Visual Logic Lessons (Diwan Al-Matbuat Al-Jazairia: Ben Aknoun), p. 176.
[2]- Same reference, p. 178.
[3]- Same reference, p. 183.

Before considering the method of proof used by symbolic logicians to demonstrate the invalidity of these arguments, we should clarify the Aristotelian and contemporary expressions of the four propositions, since what Aristotle considered to be simple and unanalysed propositions, contemporary logicians consider to be complex and analysed propositions. We will show that what is considered valid by the former is considered invalid by the latter.Aristotle expresses the positive universal proposition as "All A is B".Symbolically, this proposition is represented as "(For all S) if S is A, then S is B".The symbolic representation is "Sa(Asb)", where S is a single term.The particular affirmative proposition is represented symbolically as "Some A is B".It can be read as "There is at least one S such that S is A and S is B", and is symbolized as "Sa(Asb)", where S represents a single term.

The reversal from the positive universal (A) to the particular affirmation (I) is a direct inference in which the mind moves from a proposition which is the subject to a proposition which is its converse, which is the conclusion. In this type of inference, the subject of the original proposition carries the reverse proposition, and the subject of the reverse proposition carries the original proposition. Based on the above, the law of inversion can be formulated as follows:

Symbolic representation:

S (A(S) implies B(S)) implies S (B(S) and A(S)).

While Aristotle considered this kind of direct inference to be valid, symbolic logicians consider it to be invalid. In other words, the necessity is false because the subject, S (A(S) implies B(S)), cannot be true, and therefore the conclusion, S (B(S) and A(S)), is also false. To clarify further, we have a valid necessity (the subject) because its subject is false, and the falsity of the subject arises from the fact that S can be an empty term that does not refer to any existing entity, i.e. none of the instances of S is A. So the valid necessity is true. But the invalid consequence (the conclusion) is false, because both of its terms are false (S is an empty term). We conclude that the law of inversion is invalid[1]. According to Aristotle, the inversion from the positive universal to the particular affirmation is a valid conclusion because it satisfies the condition of inclusion, which states that nothing can be included in the conclusion unless it is included in the premise. In contemporary logic we would follow either the tree method of analysis or the classical truth table method.

We will translate the reversal from the positive universal (A) to the particular affirmation (I) into contemporary symbolic form as follows:

1. "All A is B" is translated as "For all S, if S is A, then it is B":
   Symbolic representation: S (A(S) implies B(S))
2. "Some B is A" is translated as "There exists at least one S such that S is B and S is A":
   Symbolic representation: S (B(S) and A(S))

We will solve this proposition using the classical truth table method, as follows

3. We eliminate the personal variables in the two propositions and eliminate the brackets, giving
   QK
   K and Q

[1]- Ahmed Mousawi, The Place of Logic in Contemporary Analytical Philosophy (Institute of Curricula: Algeria), Doctoral Thesis, 2007, p. 107.

4. We convert the proposition into a conditional necessity:
   (QK) implies (K and Q)
5. We construct the truth table and evaluate the truth values of the proposition:
   (QK) implies (K and Q)
   1 1 1 1 1 1 1
   1 0 0 1 0 0 1
   0 1 1 0 1 0 0
   0 1 0 0 0 0 1

Since conditional necessity does not hold in all cases, this means that the reversal from the positive universal to the particular affirmation is not a valid law in symbolic logic.

B- The law of distribution says that the truth of the universal proposition implies the truth of the particular proposition.

The two propositions involved are the different propositions of the whole and of the part. In this law there is a transition from the universal proposition to the particular proposition or vice versa, according to the square of the opposition. However, Aristotle rejects the idea that distribution is a logical opposition. Instead, it is a relation of the whole to the part, since the particular proposition expresses a partial expression of what the universal proposition expresses[1], nothing more. This means that the truth of the whole implies the truth of the part, but the truth of the part does not imply the truth of the whole. We will prove the first part using both traditional and contemporary logic.

In traditional logic, the truth of 'all A is B' implies the truth of 'some A is B', because the truth of 'all A is B' contradicts the falsehood of 'some A is B'. Similarly, the falsehood of "some A is B" implies the truth of "all A is B" because it falls under the law of contradiction, which is the desired result.

In contemporary logic, the validity or invalidity of this law can be proved using either the classical truth table method or the tree method of analysis.

1: We translate the truth "All A is B" implies "Some A is B" into a logical form as follows:
   All A implies B
   Some A implies B
2: We will translate this direct inference into contemporary symbolic language as follows
   S (A(S) implies B(S))
   S (A(S) and B(S))
3: We will solve this proposition using the tree method of analysis as follows:
   Eliminate the personal variables and remove the brackets:
   QK
   Q and K
4: We convert the proposition into a truth tree:
   1) QK (Premise)
      |
   2) ~(Q and K) (negation of conclusion)
      |
   3) ~Q (from 1, elimination of disjunction)
      |

[1]- Mahmoud Al-Yaqoubi, Same reference, p. 92.

4) ~K (from 1, elimination of disjunction)

5: We analyse the branches:

Branch 1: ~Q, K (open)

Branch 2: Q, ~K (Open)

6: The result is that at least one branch remains open, which means that the proposition is invalid.

So the truth of the whole does not imply the truth of the part.

The four syllogisms containing the letter P are invalid syllogisms. We will give an example of one of the four syllogisms mentioned above, which Aristotle considered defective because they fulfil the rules of valid reasoning, but are deficient. Symbolic logicians, however, consider them invalid. We will follow the same steps that we used to demonstrate the validity or invalidity of the Law of Contrapositive and the Law of Distribution. Let's take the syllogism "Bamalip".

1: We will translate "Bamalip" into a logical form as follows:

All A implies B

All B implies C

Some C implies A

2: We will translate this syllogism into contemporary symbolic language as follows:

S (A(S) implies B(S))

S (B(S) implies C(S))

S (C(S) and A(S))

3: We will solve this syllogism using the tree method of analysis, as follows:

Eliminate the personal variables and remove the brackets:

QK

KL

L and Q

4: We convert the syllogism into a truth tree:

1) QK (first premise)

|

2) KL (second premise)

|

3) ~(L and Q) (negation of the conclusion)

|

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5: We analyse the branches:

Branch 1: ~L, Q (Open)

Branch 2: L, ~Q (open)

6: The result is that at least one branch remains open, which means that the syllogism is invalid.

"And this means that the syllogism Bamalip is invalid, and in the same way we can prove the invalidity of the other three syllogisms containing the letter P. Mac Coll (1909-1835), Schroder (1842-1902), Peano (1932-1858), Louis Couturat (1914-1668) and Louis Rougier (1889-1982) all tried to prove the invalidity of the laws of distribution and the contrapositive, and thus the invalidity of syllogisms containing the letter P in their symbols. How did they do this?

First, they considered that every affirmative proposition implies the existence of subjects with a certain attribute, for example: 'Some Africans are Algerians'. This proposition implies the existence of subjects (Africans) who are Algerian, which means that there is at least one individual who is both African and Algerian.

Secondly, they considered that any universal proposition does not assert existence, but only includes the subject class within the predicate class, without any reference to existence. For example: 'All French people are Europeans'. This proposition completely ignores the question of whether there are or are not French people, and so it is not valid to infer from non-existence to existence in the laws of contrapositive and distribution and in such flawed syllogisms. They tried to distinguish between the universal proposition, which has no existential significance, and the particular proposition, which does have existential significance, by distinguishing between formal necessity (which does not rely on the existence of particular subjects, but focuses only on the relations between variables) and material necessity.

This criticism has long prevailed, and its validity seemed unquestionable. In reality, however, logical works have proved the opposite, since Aristotle did not resort to personal boundaries, empty boundaries (such as 'bouc-cerf') or closed boundaries, but was content with total boundaries ('man', 'animal')"[1].

Lukasiewicz (1878-1956) attempted to provide a justification for Aristotle's restriction to total limits and concluded that when Aristotle divided limits into three categories - personal limits, total limits and transcendent limits - he did not allow the second category to be both predictive and subject. Therefore, in Lukasiewicz's Aristotelian theory of measurement, each individual boundary should be capable of being both subject and predicate. As a result, personal limits, which can only be subjects, and transcendent upper limits, which can only be predicates, play no role in his theory of measurement[2].

As for the universal proposition and the particular proposition, as symbolic logicians emphasise, the former means non-existence or presupposition, while the latter means existence. Existence, however, can be understood in two ways: sensory existence, which refers to existence based on sensory experience (external existence), such as "Some pens are red", meaning that there are red pens in reality. However, if we consider the example purely in terms of its form, as expressing a relation between a subject and a predicate, it does not necessarily imply the existence of red pens in sensory reality. This is what we call ideal existence, i.e. existence based on an assumption, such as "Some polygons are squares", which means that among the types of polygons there is one type that is a square. This relation remains intelligible in the realm of essential relations. In this case, Aristotle did not distinguish between these two types of existence and did not differentiate between the universal proposition and the particular proposition from an existential perspective.

Conclusion:

In conclusion, despite all these criticisms, we cannot say that Aristotle was entirely right or wrong in everything we have discussed. It is not valid to discuss any logical law except within

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[1]- Mary Louise Roor, Logic and its Explainer, Translated by Mahmoud Al-Yaqoubi (Dar Al-Kitab Al-Hadith: Egypt), 2008, p. 32.

[2]- Jan Lukasiewicz. Aristotle's Syllogistics in the Perspective of Modern Formal Logic, Translated by Francoise Ganjolle Zaseau sky (J. Vrin: Paris), 2nd edition, 2010, p. 130.

the framework on which it is built, and Aristotle remains to a large extent internally consistent within his own system. It is important to avoid judging him solely by the concepts of contemporary logic. It is therefore preferable to use the term "shortcomings" rather than "errors" or "deficiencies" as used by symbolic logicians. A careful study of symbolic logic shows that its proponents did not seek to correct Aristotle's logic, but rather to extend it and fill in the gaps by adding new topics to support its deficiencies. Some of these additions include extending the theory of inference from a single relation, namely inclusion or entailment, to different types of relations, analysing them, assigning specific symbols to them, and performing precise analytical calculations. Examples of these additional relations include negation in simple propositions and the relations between the components of compound propositions, such as conjunction, disjunction, implication, equivalence, contradiction and double negation. These logical constants allow us to distinguish between the truth and falsity of compound propositions, which Aristotle did not address in his framework. Another addition is the support of natural language (language of words) with its multiple meanings by an artificial language (symbolic language) with a single meaning, since it is a language unrelated to speech, thus avoiding confusion with unintended alternative meanings.

From all this we can say that symbolic logic does not contradict Aristotelian logic, but rather extends and expands it.

The truth is that logic focuses on a single subject, namely the theory of reasoning, but expressed in two different languages.So Aristotelian logic can be seen as a logical framework with its principles, definitions and rules, similar to other logical frameworks such as Russell's or Lukasiewicz's.Instead of using the term "Aristotelian logic", we can use the term "Aristotelian framework" or "Aristotelian system".