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Scientific Logics and Methodologies

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Logic: From Refusal to Evocation

Unfavorable prejudices with respect to logic have kept it at arms-length from methodological problems for some time. During the Renaissance, Montaigne accused Aristotelian syllogistic logic of making minds “muddled and smoky.” German idealism rejected it. Kant and Hegel, for example, finding it closed, complete, sterile and not fruitful, substituted, respectively, a transcendental logic and a contradictory logic. Researchers in social sciences have followed closely behind them, suspecting logic of evading the rich empirical reality and then undertaking to construct methods particular to their sciences. All this primitive, age-old mentality even led thinkers to relativize logic culturally and ideologically. This scorn resulted in both ignorance and a belated evolution of logic.

Of late, the boundaries of this ostracism are more and more retracting and the idea of a contribution of logic to methodological and doctrinal research no longer negatively clashes with the consciousness of the researcher. This change is due to three principle factors: research in logic by Bertrand Russell, Gottlob Frege and Ludwig Wittgenstein has shown that this discipline cannot be reduced to the syllogistic, which is only one part of it. Next, the success of methodologies in physical sciences, resulting in part from the contribution of logic and mathematics to quantification, led to lessening the discredit against logic. Finally, Quine’s reflections on the philosophy of logic showed its involvement in all undertakings in radical translation. Radical translation being the decoding of statements of a subject language into those of a metalanguage different from the source language, all research in the field can be considered as an effort at radical translation. Quine argued why and how logic – especially bivalent logic – is embedded in such a venture without, however, being relative and vivid.

This chapter will attempt to initiate thought between logic and methodology. It comprises the key concepts to which the concept of logic refers, i.e. “reasoning,”

“argument,” and “proof.” By defining logic as the science of reasoning, I determine the nature of reasoning and identify the sophistic pitfalls which are strewn about the field of argument. A series of rules designed for researchers and those who write scientific texts are proposed.

Logic and Functions of Language

Like all terms in ordinary language, “logic” is an ambiguous concept. Out of the various possibilities, we will choose five essential meanings.

In its scientific sense, which is the subject of this work, “logic” means “the operation of the mind” and includes three fundamental concepts: calculation, rule, combinatorics that we will examine through the concepts of “reasoning,” “argument,” and “proof.”

In the common meaning, i.e. *doxa*, “logic” refers to “opinions,” “personal vision,” or “group vision.” More basically, the term refers to what I would readily call “ontological assumptions” of a linguistic community, an ideological group, a culture, a people, a civilization, a theory, i.e., the set of beliefs, values and hypotheses which serve as their cognitive or pragmatic horizon, premises or postulates of arguments. The assumptions may be relative, as, for example, in the expressions, “I have my logic, you have yours;” “European logic,” “African logic,” “Asian logic;” or in “logic of political parties.”¹ They can also be absolute, objective, made of the set of universal values and beliefs of humanity; for example, “logic of human and citizen’s rights.”

In a third meaning, “logic” is a synonym of “method,” or “approach,” “process of scientific activity,” or “conditions of possibility” as in the expression: “Logic of scientific discovery.” In another sense, it refers to the quiddity or essential meaning of a concept. In the expressions such as “logic of domination,” “logic of politics,” “logic of forgiveness”, for example, the term is used to refer to both their quiddity and the conceptual constraints thereby linked as the very result of their meanings. Finally, “logic” designates the structural or structuring organization of something; e.g. “logic of cities.” There are certainly semantic affinities between the last meanings of the concept, just as there are other meanings. But it is important to draw a line of demarcation between the second which is subjective and the first which is objective.

The physical and social sciences are all aimed at knowledge, thanks to which we can hope to leave behind ignorance, a source of irritation and intellectual or pragmatic confusion. Knowledge, however, can only fulfill this function provided that it is the expression of the truth. The relationship between the informed subject and the subject of acquaintance or knowledge, the truth cannot be sought in a particular science, each having its particular subject according to which it determines its criteria of truth. Despite their diversity of empirical content, these sciences refer no less to the requirement of non-contradiction and consistency. These values of scientific rigor vest the various regions of the episteme, and consequently appeal to logic, the science of valid inferences, the sources of conditions of consistency and non-contradiction.

As a being in need of knowledge and action, man is separated, spatially and temporally, from others for whom, however, he would like to have a relationship

with. The physical confrontation in the form of violence (war, conflict or any other form of duel) represents a form of relationship, but one which is self-destructive precisely because violence is a plan to eliminate others. The true relationship that men are searching for is thus not provided by physical violence but by language. It is the mediator which is both necessary and sufficient by which a bridge is established linking one mind which is speaking to another mind which is listening, understands, and responds. Ludwig Wittgenstein, in his *Investigations philosophiques [Philosophical Investigations]* refuting the thesis of a private language, showed its social character, defining man as an essentially linguistic being. Indeed, there is no realm of his activities, whether they be serious or not, which does not proceed from and return to language since he uses it to interpret his relations with others, either in the form of questions to answer, problems to resolve, orders to give, or information to communicate. Using the analogy of the toolbox, Wittgenstein translates this diversity of functions, or “games of language” that can be reduced to four essentials:

1. Directive function: language, in a propositional, directive or argumentative form is used to give orders. “I order you to leave” (propositional form); “Go away!” (canonical form of the directive order); “I ask you to leave because I want to close the door” (argumentative form). In this function, the language first targets not the truth of the assertive propositions, but rather obedience (or lack thereof), execution (or lack thereof) of an action by the person to whom the order has been suggested. We do not characterize an order as true or false. We carry it out or refuse to carry it out.
2. Expressive function: here, the play of language is a form of life by which one expresses feelings. “I like him; I like him because it is he.” The epistemic values of linguistic entities of this function are the need for comfort, sympathy, sharing and not of truth, etc. You do not immediately respond, “it’s true” or “it’s false” to someone who tells you, “I’m hungry” or “I’m sad” unless you are very cynical!
3. Performative function: the speaker accomplishes an activity by the fact of saying: verbs such as promise, “solicit,” etc. accomplish the act of promising, of soliciting; etc. Thus, the justice of the peace, speaking to a man and a woman in front of him on the occasion of given ritual circumstances, “I pronounce you man and wife,” establishes the relationship of a couple by the performative word.
4. Communicative function of information. This function is accomplished by formulating, either affirmatively or negatively, proposals or structured sets of proposals as, for example: “A torrential rain pounded the city all last night or The flight to Cotonou was delayed because a torrential rain pounded the city all last night.” This function is concerned with entities of language (propositions, statements, endowed with the value of truth or arguments composed of propositions or statements). Science being the field of the episteme of this function, the subject of the study of logic is science.

The Pragmatic Function of Language

The presentation of the diversity of uses of language in four functions would lead us to believe that they are applied mechanically, that each region of the episteme corresponds to a sole and unique function. This is not the case. Certainly, the division of uses of language into four functions elucidates for us what is done or can be done with language. But such a division, though indeed pedagogical, is not illustrated in daily life where any statement or discourse can exemplify if not all, at least two or three of these functions. For example, expressive language includes an informative and directive dimension. The statement, I'm hungry, would not provoke sympathy (or lack thereof) if it did not have informative content. Moreover, it addresses the listener in this form: "give me something to eat." In a similar fashion, informative language promotes a directive thrust. The statement, "Classes at the university have not started up again" leads to a plurality of behaviors or actions in various listeners: work on other activities, procrastination, etc. Placed in its canonical form, the directive inferred is: Do something else. Even performative language, in addition to being informative, (the priest or the mayor informs the world of a new matrimonial relationship by witnessing the event) includes the directive function, inviting the couple and the audience to a certain type of conduct.

An exhaustive examination of the relationships between the language functions will result in the following situation: communicative and directive functions are embedded in all the others. The former deals with knowledge, science and the latter with action. They both place us in front of the traditional couple of the human cognitive experience: science/action, truth/action, know/do are included in this periphrase: communicate to have it made or done.

To communicate is to share. The word, which appeared in the work of Nicole Oresme around 1370, referred to the pooling of currency – objective data. In linguistics, pooled objective data are information that is shared by interlocutors in a relationship of dialogue with the effect of modifying their common cognitive environment; the information transmitted is aimed not only at reducing their degree of uncertainty or ignorance, but also at creating a human symphony. It is not rare to find in this dialogue-based relationship of ideas an affective relationship where feelings, a common presence, a warm feeling of togetherness – values which as may generate action as much as truth – are shared. What is the purpose of communicational truth and passion if not action? Truths only have meaning and relevance if they are used, dealt with to clarify and inflect action. Of what use is a feeling if it is not used towards a cause, an action? At the end of the day, the purpose, the vocation of language lies in the pragmatic function from which the other functions are detours.

In the final analysis, a linguistic communication, an invitation to action, is addressed to either man's cognitive region (epistemic beliefs, reason) or his conative region (desires, emotions, passions, pathos) or to both, in hopes of causing the action or the behavior sought, whence the functional entanglement above. The link between the informative and the directive will only lead to action if it convinces or persuades. Will the

problem of conviction or persuasion concern the propositional form or the argumentative form of the informative function? Can a series of statements, even repeated, extract lasting support? Should I say, “I want peace, I want peace, I want peace” to convince or should I provide arguments?

To convince, says Jean-Blaise Grize, is to lead someone to recognize the truth or the accuracy of a fact or its necessity; whereas to persuade is to lead him to believe, to do, to want something (Grize 1996:8). How can we lead this person to X other than by proof, demonstration, relevant reasons? It is thus not by the proposition, but by the argument that the conviction or the persuasion is established. Argumentation, says Grize, “is a chain of arguments, i.e. the presentation and articulation of facts in favor of a given thesis or against it” (Grize 1996:8). The science which defines the conditions of presentation and articulation of these facts is called “logic.”

Logic and Reasoning

In reading this title, “logic and reasoning,” the reader will probably have the impression of a pleonasm in that logic is defined as the science of reasoning. The impression is not at all justified. Reasoning is a special type of thought where an inference is involved, where conclusions are drawn from premises, postulates or axioms. The logician is concerned with the accuracy, or lack thereof, of reasoning by asking himself questions like: does the conclusion follow from the premises? The argument is said to be valid in the case of an affirmative response, but invalid or sophistic in the case of negative response. Thus, one can conduct reasoning that is not logical, just as we can formulate logical expressions that are not necessarily reasoning. By way of an illustration of the first case, let’s consider the following arguments:

1. Deductive Reasoning (inference or conclusion of *one* from *all*)
 - a) All men are mortal (premise or postulate).
 - b) Socrates is a man (premise or postulate).
 - c) Thus, Socrates is mortal (conclusion or inference).
2. Deductive Reasoning
 - a) Everything that is rare is expensive.
 - b) An inexpensive horse is rare.
 - c) Thus, an inexpensive horse is expensive.
3. Inductive Reasoning (inference of *all* from *one* or *several*)

All crows are black because we observe some that are.
4. Deductive Reasoning
 - a) All believers are generous
 - b) Jean Le Croix is a believer
 - c) Thus, $2+2=4$

The first argument – logical, i.e., valid in that the conclusion necessarily follows from the premises – confirms our belief in our rationality on behalf of which we emit doubts as to the accuracy of the second and the third, and we laugh at the last because it is so cockamamie. Why do we accept the first and reject the others? It is the task of logic to answer this question. What is reasoning or argument? Before we determine its nature, we should stress its importance in our human activities.

Can we get along without arguing, without reasoning? How many times have I heard students in Côte d'Ivoire saying: "We don't want to reason; we want to eat;" "Where is reasoning going to get us?;" "What use is reasoning?;" Such questions seek to avoid the response that they all fear: to know or to understand. Isn't the objective of the study of logic and of all educational disciplines to help us to know or understand, to satisfy the need of curiosity which is characteristic of human existence? But what good is it to know when there is neither a model nor an ethic? What good is it to understand when the understanding leads to discouragement or skepticism, or shirking responsibilities?

This rushing to judgment, expression of a fact, of the unhappy, jaded Ivorian consciousness lead, however, to a paradox similar to that of the negation of philosophizing. To those who said that philosophizing was not necessary, Aristotle gave this argument: "If we should not philosophize, then we must philosophize (to show that we should not philosophize). Thus, we should philosophize." In a similar fashion, if we should not reason, then we should reason (to show that we should not reason); thus we must reason. Not wanting to reason, unless we resort to force, is still reasoning since we give reasons for or against, whether these reasons are relevant or not. To not want to reason but rather to eat makes no sense since we should argue, i.e., give reasons to support the idea that we should eat rather than reason. And thus to proceed as such is reasoning. Whether we are philosophy students or not, we are condemned to reason, because reasoning or argumentation is part of our-being-in-the-world. It is a fundamental activity of our life in relation to our fellow man. Human life is full of significant decisions and choices, with respect to what there is cause to do, or have done or believe. To decide if we should send our girls to school or not, if we should vote for or against the death penalty, if we should believe or not what an official says, if we should carry out a task or not, etc., all this requires that we provide arguments, i.e., reasons. To establish or refute a fact, a statement, either to convince an audience or to dissuade them from doing something or to inform them of something is part of our daily activities. We carry out these activities by giving reasons; and to give reasons is to suggest arguments or reasoning.

From this perspective, our scientific theories of the physical or human world and our daily linguistic activities represent sets of arguments, or reasoning.

An argument, in the sense that we will use it, is a mental operation by which intelligence makes an inference meant to be logical in view of establishing that something is or is not the case. By "inference," I mean that a conclusion (what we are trying to establish) is derived from one or more premises. The inference is logical if and only if there exists a link of organic necessity between premises and conclusions.

Suppose that you wanted to establish the following: “Mr. Tartempion cannot vote.” You should only do it by giving reasons in view of answering the question which may be asked of you, “Why?” Your reasons can be, for example:

- (1) Only those who are registered on a voting list can vote.
 - (2) Mr. Tartempion is not registered on a voting list.
- (Therefore, Mr. Tartempion cannot vote).

Such an argument is a unit of reasoning in that it includes one and only one inference, or one and only one conclusion, namely: “Mr. Tartempion cannot vote.” It is formulated in a hypothetical-deductive or syllogistic form. There are other forms of presentation that operators or fonctors of premises and conclusions provide. Operators of arguments introduce the premises of an argument: “because,” “since,” “for,” “for the reason that,” “insofar as,” or equivalent expressions. Among the expressions introducing the conclusion of argument, we find: “therefore,” “consequently,” “thus,” “it follows that,” “it ensues that,” “we can conclude that,” “the result is that,” or their equivalents.

There are, however, arguments in which there is no expression indicative of a conclusion or premises. Here is an example from Fichte:

Practical reason is the root of all reason. The laws that govern the activities of reasonable beings are of an immediate certainty; their world is only certain because these laws are certain. We cannot renounce these links without the world and ourselves being plunged into absolute nothingness; it is, in part through our morality that we come out of this nothingness and that we maintain ourselves above this nothingness.

The first sentence of this argument is the conclusion. How do we know this? By paying attention to the context, by reflecting on the meaning of the words and, more generally, in asking ourselves these two questions: (1) What exactly is the point that the speaker wants to establish? (2) What reasons does he give? A practical way of identification is to insert (verbally or mentally) between two phrases or segments of phrases expressions such as: “The reason for this is that,” “for,” “because.” These are only a few suggestions. No formula; philosophical thought or logical analysis is not a mechanical activity with applications of fixed criteria.

There are three and only three ways of presenting an argument: (1) either the premises are first stated followed by the conclusion; in this case the conclusion is generally identified by its fonctor; (2) or we may first state the conclusion and end by the premise or the premises preceded by their operator; (3) or we may place the conclusion between two premises. These considerations show that there are no rules concerning the order of precedence of conclusions and premises. The order depends on the intention of the speaker, what he considers to be the most effective to achieve his objectives. If, for example, the speaker considers his conclusion sufficiently reasonable for his audience, he can first state it and then provide the reasons for it. But if he plans to refute an idea or an opinion which the audience holds, it will be more judicious to begin by stating his premises

or reasons, from which he will deduce his conclusion. He will then have a much greater chance of getting his audience to accept a different conclusion from the one which it previously supported.

Finally, we must distinguish between the logical connectors such as the conjunction, the exclusive or inclusive disjunction, the conditional, etc., which are operators for the formation of compound clauses (in formal or informal logic) and the operators or functors of arguments. The conjunctive clause: "Winks and works of art make up a language" does not represent an argument because it includes no inference, i.e., the clauses:

- (1) If art is expressive, it makes up a language ; and
- (2) Because art is expressive, it makes up a language.

The clause (2) represents an argument in the eyes of the functor "because" which provides a reason. This is not the case in (1) which expresses a conditional hypothesis.

Logical operators are not indicative of arguments, but form complex clauses likely to enable their construction.

- (1) "Winks and works of art are languages."
Winks are language.
Thus, works of art are language.

In a more complex way: "Since winks are languages, works of art are as well, given that the former and the latter are language."

- (2) Only those who are registered can vote.
Mr. Tartempion can vote.
Therefore, Mr. Tartempion is registered.

The arguments, no matter what form they are stated in, are formulated using two methods: the inductive method and the deductive method. The former is a generalizing inference of conclusion from specific premises. Induction concludes the specific from the general. It is, in most cases, a dubious or false inferential method in that the premises do not deplete all of the complements or predicates inferred. Karl Popper, one of its most virulent critics, observes that the number of black crows observed is not important ; it does not follow that all crows are black (Popper 1978). In socio-cultural or socio-political fields, inductive arguments result from clichés, prejudices, feelings of hostility, racism, or other. What is true of some is not true of all.

The deductive argument, more in accordance with logical reason is an interference specifying from universal premises. The deduction concludes the truth of "all" from that of "some." The deductive argument is seen in two forms: "Modus Ponens" and "Modus Tollens."

Modus Ponens (literally: mode of asserting) concludes the consequent of a conditional premise if the antecedent of this is repeated as a simple propositional premise. In this form, at least one of the premises is a conditional and the other the repetition of its

antecedent. Example: If it rains, Yao goes to the fields; then it rains; therefore, Yao goes to the fields. In semi-formal language: If P then Q; so P; therefore Q

The *Modus Tollens* (mode of saying) concludes the negation from the antecedent of a conditional if its consequent in the position of premise is denied. If P then Q; or no Q; therefore, no P.

Thomas Jefferson said of argumentative activity: “In a republican nation whose citizens should be led by reason and persuasion and not by force, the art of argument turns out to be of the greatest importance;” and Juliana Geran Pilon: “Civilized life depends on the success of reason in social relations, the predominance of logic over violence in interpersonal conflicts” (cited by Copi: vii). In the same vein, M. Boll and J. Reinhart, in their *History of Logic* write:

The knowledge of at least rudiments of logic is recommended as one of the foundations of the true humanism of our time: excellent intellectual gymnastics, scientific logic is capable of clarifying confused thought, by banishing expressions with ambiguous meaning, by eliminating the vague “more pernicious than error.” Finally, by its very spirit, it warns against the paralogisms of affective origin and against ideological con games, which in our “Enlightenment,” continue to flourish at all levels of society (Boll, Reinhart 1961:9-46).

This intellectual gymnastics which is so indispensable is corrupted by specious arguments called sophisms. These are true epistemological obstacles which we should be aware of, and which reason – in the quest of true knowledge, even temporary or unfinished – should be warned about. I will only mention several examples of sophisms by way of illustration.

Sophistic Arguments

An argument or reasoning is a linguistic activity in which one wants to prove that a certain proposition, called a conclusion, follows or is meant to necessarily follow from data or reasons called premises. It targets the pragmatic function of language, provided that it convinces or persuades. It should then be valid and correct. An argument is valid when its conclusion follows logically from premises; it is correct when its premises and conclusion are materially true. The sophism claims to satisfy these conditions, but, upon analysis, we realize that it does not include any logical relevance; the conclusion does not follow from the premises.

The examination of linguistic functions has identified two cardinal values of language, namely the truth and its associated values on the one hand, and passions or desires on the other. The sophism results from shrewd, malicious, inappropriate combinations, carefully-maintained between feelings, attitudes and reason, a mixture of beliefs and desires with the aim of extracting belief or support. Logicians have attempted categorizations in terms of “sophisms of relevance” and “sophisms of equivocation” and “sophisms of vacuity” (see especially Copi, Fogelin et al.). I propose a classification which conforms to two basic functions of language. Epistemic sophisms and the sophisms of action, respectively, correspond to knowledge and action.

Sophisms of Action

Sophisms of action are related to fallacious arguments proposed to a listener to cause a non-linguistic behavior of a certain kind. This is a biased use of the directive function. The speaker can achieve his objective either by sweet-talking the listener or in forcing him – i.e. by appealing to his feelings: recourse to fear, intimidation, pity, enthusiasm, hostility, etc. is the arm the most frequently used to constrain action. What is psychologically relevant is taken for a logical relevance. The emotionally charged premises can be true, but upon analysis, we realize that they fail to serve as evidence for the conclusion. Certain sophisms are known by Latin names.

Argumentum ad baculum (appeal to force)

This sophism is based on the tacit or explicit use of intimidation, force or threat to elicit action. It thrives in the universe of political and social relations, relations based on force, and others. Example: “We have not signed your contract for the exploitation of the oilfield because you do not share our political opinions.” Even if this argument is an effective way to lead the economic operator to share the political opinions of the speaker, there is no logical link between the premise and the conclusion.

Argumentum ad misericordium (appeal to pity)

This sophism is committed by appealing to the pity, the mercy of the listener, to obtain a certain result. Our relationship with others bears the traces of this, using flattery. Some lazy students do not hesitate to resort to this. “Professor, sir, I need a C in your class. I realize I haven’t really done my best, but if I don’t have a passing grade, I’ll have to repeat the year; but then I will lose my scholarship. Yet, I am the only son of a poor mother chased from the house of her late husband by the traditional heirs.” Here, also, the truth of the premises does not imply that of the conclusion.

Argumentum ad populum (Appeal to the crowd)

This sophism appeals to emotion, to feeling, in order to lead the public to accept a conclusion: “As true Ivoirian patriots, the ones who put the interests of the nation before their petty advantages, realize, the international policies of conflict resolution in Côte d’Ivoire are policies of subjection and neo-colonialism in our dear country, a country of peace and fraternity; it then follows that these are bad policies.” The emotional call to the crowd may stir important feelings, certainly, but that has nothing to do with the truth of the conclusion.” Another example is the following: “I call on you to vote for our candidate because everyone in the region supports his program of government.”

The sophism of the slippery slope: A fallacious argument is called such if it maintains that an action would bring on a catastrophic situation because of a series of causes and effects which, upon examination, can prove to be dubious or avoidable. “You have to keep me in power since my removal will bring on civil war or chaos.”

Epistemic Sophisms

Sophisms of action, as their name indicates, raises this interrogative intentionality: “How do we encourage a particular listener to produce a particular action?” “How do we convince the consumer to buy a particular product?” Epistemic sophisms, those linked to knowledge, are in a different register. Here, we are attempting to understand or know, either by refuting or by establishing an argument.

Ignoratio Elenchi (Ignorance of the subject): This sophism is committed when a speaker establishes the truth of a conclusion by premises which have no relationship to it. “All children should receive the steady attention of parents. Parents who work full-time cannot provide this attention, thus mothers should not work full-time.

The sophism of the hasty generalization: This consists of inferring general cases from specific cases. This is inductive reasoning: “All horses are white because we have seen some white ones.”

The false dilemma: This states that a given situation presents only two alternatives, one preferable to the other. There is a sophism if our examination shows other conclusions. “Either we disarm, or we fight the war. We do not disarm, therefore we fight the war.”

Ad hominem attacks: We criticize an interlocutor, in his physical appearance, in his person rather than his reasoning to claim to have thereby refuted his argument. “What Socrates said cannot be true because he is ugly.”

The double fault: This is committed when we justify bad actions compared to what others have already done. “You do not have the right to accuse us of poor management since you are not role models in the field.”

A sophistic argument may be committed for several reasons:

1. The calculated will to mislead: The speaker, in a contextual situation, can realize that convincing logical arguments will fail to get his conclusions accepted, and that the audience, uncultivated, not very shrewd, incapable of judgment, or simply a supporter of his cause needs nothing but to be served in one way or another.
2. Ignorance of the speaker: a person can commit a sophism without realizing it, either because he or she has no knowledge of the matter at hand, or because he or she is not sufficiently trained in the field. There is a lack of judgment.
3. Blindly forging ahead, way out. Sometimes a sophism is a means of weaseling one’s way out because it is effective.

A sophism can convince or persuade a cultivated or uncultivated audience, thanks to racial, ideological, tribal, ethnic prejudices, etc. whereas for the same reasons, another sophism or the same may not be convincing.

In all sophisms, whether conscious or unconscious, its author never admits to lying, even when he knows that he is lying.

Logic, Argument and Proof

Upon reading the title of this section, we might be perplexed. Since logic is the combination of clauses by reasoning or argument and we have defined reasoning as an activity of proof, insofar as proving is the synonym of showing, isn't proof another name for argument and vice-versa? The distinction between proof and argument, although nuanced, deserves, nevertheless, to be maintained for a perspective on the nature of logic relatively to the formal sciences and sciences of man or ordinary language.

Logic, the science of the combination of clauses by reasoning invests two cognitive fields: the field of formal sciences or of nature and that of the sciences of man. It provides information to the formal sciences in the form of formal logic, and the second, most often, in the form of informal logic. What is formal logic? What is informal?

Formal logic is this operation of the mind which, from one abstraction to the next, empties the data of language and the physical world of their contents to retain only that their abstract forms, named by symbolic signs for the purpose of purely deductive calculations. Formal logic, like all informal logic, includes the logic of clauses and the logic of predicates, and can include bivalent logic (true and false) or plurivalent logic (deontical, modal, etc.) in the form of formalized systems with rules of construction and especially of mathematical proofs. In the logical proof, we know exactly the operations in play and the conditions which a series of clauses should satisfy. We will define proof, for example, as follows: "A series of clauses makes up a proof if and only if ...". This is not the case in argumentation. "To argue," writes Jean Blaise Grize, "is to display an activity which aims to weigh in on ideas, opinions, attitudes, feelings or behaviors of someone or of a group of people" (Grize 1996:5). There is, on the one hand, an intention to influence the listener since the purpose of the line of argument is to lead his listener to accept a conclusion. Argumentive logic is based on ontological assumptions of values and beliefs; the logical-mathematical approach can thus be applied without mutilating it. "That does not mean," Grize reassures us, "that things happen in any old way and it is legitimate: a) to try to find what are the operations that are the basis of all statements, and b) underline some of the procedures which connect them, i.e. what are the arguments in play" (Grize 1996:4).

In conclusion, I propose some procedures for constructing arguments for researchers. The suggestions given here are a summary of a work in English, *A Rulebook for Arguments* by Anthony Weston.

General rules for the construction of arguments

1. Identify premises and conclusions;
2. Present the ideas in a natural order;
3. Begin by relevant premises;
4. Use definite, concrete and specific language (avoiding using general, abstract, ambiguous and vague terms);

5. Avoid bombastic language (do not try to make one's argument good by caricaturizing the opposite argument);
6. Avoid sophistic arguments.

These rules apply to any deductive or inductive argument, each containing certain specificities. Here is a list of types of arguments that we may encounter in the field of social science research.

1. Arguments by examples: A construction of this sort offers one or several specific examples of evidence of a conclusion and raises the question of the sampling of examples, their representivity and the existence of counter-examples.
2. Arguments by analogy: The exercise here is not to multiply examples but to conclude from one example or case to another, provided that they are similar in one way or another and in a relevant way.
3. Arguments of authority: Often, we have to count on the account of others to know what we cannot know ourselves. We leave it to the opinion of those whose knowledge is authentic. The researcher should, however, ask if the authority or expert providing the information or knowledge is qualified or not, impartial or not. He is well advised to look for contradictory accounts in order to confirm or refute the information.
4. Arguments of the causal type: To explain an event, a case, and effect, we often look for the cause. Given the existence of relevant and non-relevant causes, the researcher should show a great deal of precaution, critical ability in the choice of explanatory causes.

When attempting to construct arguments, we must keep in mind that there are two cognitive paths out of three possibilities: 1. Knowing the premises (data, hypotheses, postulates), we must look for one or several conclusions. 2. Or the contrary: knowing the one or several conclusions, we must look for the seminal evidence, the premises. There is no knowledge at all: 3. In the absence of premise and conclusion.

If in the first two cases ignorance is partial or feigned or Socratic; it is complete and real in the latter: "Of nothing, we know nothing." René Descartes' approach is an example: hyperbolic or methodical doubt is shown to be an illusion. "Of nothing, we can know nothing." Holding forth on this maxim is nothing more than an inexpensive sophism.

Note

1. By logic, here, we do not mean that Africans, or Europeans, etc. each have their own way of reasoning or thinking. We would simply like to refer to the idea of differences of beliefs or values, in short, ontological assumptions.

References

- Blanché, Robert, 1970, *Logique et son histoire: d'Aristote à Russell* [*Logic and Its History : From Aristotle to Russell*], Paris: Armand Colin.
- Carney James D. and Scheer Richard K., 1964, *Fundamentals of Logic*, New York: The Macmillan Company.
- Copi, Irving M., 1978, *Introduction to Informal Logic*, MacMillan Publishing Co., Inc.
- Fogelin R.J., Walter S.-A., 1978, *Understanding Arguments: An Introduction to Informal Logic*, New York: Harcourt Brace Javanevich Publishers.
- Gbocho Akissi, 1966, *Introduction à logique informelle* [*Introduction to Informal Logic*], Abidjan: PUCI.
- Gochet, Paul, 1978, *Quine en perspective* [*Quine in Perspective*], Paris: Flammarion.
- Grize, Jean-Blaise, 1996, *Logique naturelle et communications* [*Natural Logic and Communications*], Paris: PUF.
- Parker, Francis H. and Veatch, B. Henry, 1959, *Logic as a Human Instrument*, New York: Harper and Brothers, Publishers.
- Popper, R. Karl, 1978, *Logique de la découverte scientifique* [*The Logic of Scientific Discovery*], Paris: Payot.
- Popper, R. Karl, 1985, *Conjectures et réfutations* [*Conjectures and Refutations*], Paris: Payot.
- Quine, W.V.O., 1977, *Le mot et la chose* [*The Word and the Thing*], Paris: Flammarion.
- Scagrin, Morton L., 1968, *The Language of Logic*, New York: Random House.
- Vax, Louis, 1982, *Lexique: Logique* [*Lexicon: Logic*], Paris: PUF.
- Weston, Anthony, 1984, *A Rulebook for Arguments*, second edition, Indianapolis/ Cambridge: Hackett Publishing Company.