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Non-Western Logic

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It is believed in the West that logic began with Aristotle, and that logic is universal. The core of Western thought—including present-day formal mathematics and the philosophy of science—is premised on the belief that logical truths are universal, that they are necessary truths, and that logical deduction is certain and infallible. These beliefs about logic however are untenable, both historically and philosophically, in a larger picture which takes the non-West into account.

Philosophically, present day formal logic, like the 12th c. CE text, *Organon*, attributed to Aristotle, supposes that deduction relates to two-valued logic. In such a logic, an affirmation A conjoined with its negation (~A) makes a contradictory pair, from which any conclusion B whatsoever can be validly inferred by the rule of inference known as *reductio ad absurdum*: $(A \wedge \sim A \Rightarrow B)$, to put it symbolically, with "~" denoting "not", "$\wedge$" denoting "and", and "$\Rightarrow$" denoting the usual (material) implication. For example, A could be the proposition "This pot is red", so that its negation ~A would be the proposition "this pot is not red". From the contradictory pair $(A \wedge \sim A)$, one can validly infer something completely unrelated like B: "The age of the cosmos is 8000 years". Such proofs by contradiction are common in present-day mathematics. However, such a deduction would be invalid with a variety of logics that one can conceive of. The alleged certainty of deduction, therefore, rests on the *belief* that two-valued logic is universal or at least special in some way.

However, the various logics used for inference in India, prior to even the historical Aristotle, were neither two-valued nor even truth-functional. The *Dīgha Nikāya* provides an example. As the Buddha explains in the *Brahmajāla Sutta*, there are four alternatives:

(1) The world is finite, this is one case.
(2) The world is not finite, this is another case.
(3) The world is both finite and infinite, this is the third case.
(4) The world is neither finite nor inifinte, this is the fourth case.
(5) There are no other cases.

The semantic interpretation of the third case is that the world may be finite in one direction, but infinite in another. This presents no inherent absurdity, and could conceivably be in the nature of things.

The meaning of the fourth case, not so well brought out in the English translations of the *Dīgha Nikāya*, may be better understood as follows. Consider a person who refuses to take a position, and denies that he affirms any of the first three cases above. His position can only be described by the fourth case.

The need for such a fourth case is apparent from the thinking then prevalent. Likewise, the absence of any further cases is a reference to further negations used by pre-Buddhist thinkers like Sañjaya the Sceptic, who tried to wriggle out of even this fourth position, and whose comprehensive refusal to take any position whatsoever was described by the Buddha as being like the "wriggling of the eel".

These four cases are systematically used by later-day Buddhist thinkers like Nāgārjuna and Dinnāga who taught at the University of Nalanda. The latter developed a theory of (logical) quantifiers, "for all", "for some" etc., based on this sort of logic. From the perspective of present-day formalist treatments of logic, it should be noted that Buddhist logic is not a multi-valued but is rather a quasi truth-functional logic.

The Jains had a related but different logic called the logic of *syādavāda* ("perhaps-ism"), based on the idea of *anekāntavāda* (no-one-point-of-view-ism). Attributed to Bhadrabāhu, instead of four alternatives, this logic has a seven-fold judgment (*saptabhangīnaya*) based on seven possible combinations of three primary values: *asti* (is), *nāsti* (is not), *avaktavya* (inexpressible), taken one, two, and three at a time.

Syad asti. ("Perhaps it is.")
Syad nāsti. ("Perhaps it is not.")
Syad asti nāsti ca. ("Perhaps it both is and is not.")
Syad avaktavya. ("Perhaps it is inexpressible.")
Syad asti ca avaktavya ca. ("Perhaps it is and is inexpressible.")
Syad nāsti ca avaktavya ca. ("Perhaps it is not and is inexpressible.")
Syad asti nāsti ca avaktavya ca. ("Perhaps it is, is not, and is inexpressible.')

Haldane sought to interpret the Jaina logic of *syādavada* by temporalizing the three primary values. Thus, consider an experiment in which a person is asked to judge whether or not a sensory stimulus, at the threshold of perception, is present. If this experiment is repeated several times, a person might in one case judge the stimulus as present, in another as absent, and may remain undecided sometimes. Combining these possible experimental outcomes in all possible ways gives us the seven different judgments used by *syādavāda*. Thus, it is quite possible that a person may, at one time say that a stimulus is present, but may, on a later repetition of the same experiment, say, about the same stimulus, that it is absent, and on a third occasion say that he is unable to decide.

Haldane's interpretation of *syādavāda*, making it intelligible in a mundane context, seems, however, not to be correct. It is one thing to say that "This cat is now alive, and will be dead some time later". This is true of most known cats, and presents no difficulty: A is true at one time, and ~A is true at another time. However, it is altogether another thing to say that "this cat is both alive and dead at this moment of time". That sort of thing happens only to Schrödinger's famous cat (or its kittens). It is the latter sort of statement that is meant in Buddhist and Jaina logic, as is clear from the meaning explained by the Buddha. In fact, on Buddhist thought, as further elaborated by Nāgārjuna, a thing—anything—does not persist for more than an instant of time.

Therefore, a statement about a cat, for instance, must refer to that cat at a given instant of time, for an identical cat does not exist at two different instants of time.

In terms of the present-day formal semantics of logical worlds, one might put things as follows. The different possibilities visualized in Buddhist and Jaina logic refer not to multiple logical worlds assigned to different instants of time, but to multiple logical worlds assigned to a *single* instant of time. In other words, Buddhist and Jaina logics relate to a world-view in which time is perceived to have a non-trivial structure, an (atomic) instant of time is perceived not as a featureless geometrical point but as a microcosm. Hence, members of a contradictory pair can well be *simultaneously* true.

This can be understood at the mundane level as follows. Consider the statement "This pot is both red and black". We could rewrite this, less informatively, as "This pot is both red and not red". Since earthen pots made by hand are rarely of a single color, this is a statement about a naturally prevailing state of affairs that is commonly observed. The statement, as framed, seems like a contradiction. But, it could be argued, this is an imprecise natural-language statement which should actually be written more carefully as, "This part of the pot is red, and that part of the pot is not red".

However, such a reinterpretation raises some issues. First, there is the well-known issue of the whole not being the sum of its parts. It is being assumed that the pot can be subdivided into parts. If the pot is physically shattered to carry out this subdivision, one can continue to speak of parts of the pot, but one cannot continue to speak of the pot. Therefore, the reinterpretation does not capture the exact sense of the natural language statement. Thus, the idea of a thing being both true and false is not such an odd idea, and no catastrophic consequences need follow from it.

Secondly, how can we be sure that the apparent contradiction can always be resolved by suitably shattering the identity of the pot? Thus, a certain part of the shattered pot may continue to be both red and black, so one may want to divide the pot in a particular way. Now it may happen that, in a certain part of the pot, red and black are so entangled, that it may not be clear how to separate them. The remedy obviously seems to be to make a finer division of the pot, and a still finer division, and so on, until the pot is suitably atomized. However, there is an assumption here. The assumption is that the entanglement and the resulting contradiction will somehow eventually resolve themselves with this process of reduction; that the entanglement cannot persist at the atomic level, where a thing either is, or is not. Apart from the fact that atoms are neither red nor black, there are several problems with such an assumption. For example, this assumption is contrary to what our most sophisticated theories of physics tell us. The behaviour of physical systems at the atomic level is described by quantum mechanics, which tells us that there may exist entangled states that cannot be disentangled without fundamentally altering the system. The existence of such entangled states, incidentally, provides the hope today for future technology based on quantum computing, and it has various physically measurable consequences.

On the structured-time interpretation of quantum mechanics, these entangled states are interpreted to arise because time really has a microphysical structure (in the sense explained above, in the context of Buddhist and Jain logic) so that the logic of the microphysical world is quasi truth-functional. (In the structured-time interpretation of quantum mechanics, such a quasi truth-functional logic is related to the postulates of formal quantum mechanics.) To summarise, the logic of the empirical world may well be quasi truth-functional: i.e., we might have a situation where a proposition is both true and false at a single instant of time. Hence, we cannot automatically assume that the "contradictory" properties of a pot can be made to disappear by atomizing the identity of the pot.

Theoretically, from the viewpoint of present-day formal logic, one can conceive of an infinity of different logics, such as 2, 3, ..., *n*-valued logics, or non truth-functional logics. Among the infinity of logics that are available how can we be sure that two-valued truth-functional logic is the correct and universal choice? Suppose the choice is made culturally; that is, suppose we say that two-valued logic is what has been conventionally used in the West, and this is the logic that should be chosen since the West is culturally dominant. (A similar argument was given against intuitionists; it was argued that they were not adequately socially dominant among mathematicians, *hence* they were incorrect!) However, if such a weak argument is the ultimate basis of deduction, then deduction can at best give us a local cultural truth. On the other hand, suppose the choice is made empirically, then, as we have already seen above, we might end up with the logic of quantum mechanics, which need not be two-valued. Therefore, it is not clear that there is any way the existing choice of logic in the West can be justified .

The possibility or necessity of determining logic empirically however strikes at the root of another fundamental difference between Western and non-Western perceptions of logic. In the West, logical truths are regarded as necessarily true, and are privileged over empirical facts, regarded as being only contingently true. *Hence*, present-day mathematical proof is required not to involve the empirical, since that would diminish the sureness attached to a mathematical theorem. Hence, also, the present-day belief in the philosophy of science, that when the conclusions of a physical theory are refuted by experiment it is the hypotheses that stand refuted, and not the process of inference which led from hypothesis to conclusion. (Here it is necessary to distinguish between validity and correctness. The point is that it is believed that no empirical fact can invalidate a correct mathematical proof.)

Therefore, even if one were to go about trying to settle the nature of logic empirically, this would have consequences, startling from a Western perspective. Empirical observations are fallible, and subject to revision. So if the nature of logic is decided empirically, logical truth would have to be regarded as *more* fallible than empirical truth: deduction would have to be regarded as *more* fallible than induction, since the nature of the logic used for deduction could only be decided inductively. This would stand much of Western thought on its head.

This would, however, leave much of non-Western thought unaffected. The belief, that metaphysical (e.g. mathematical) truths are privileged over empirical truths, is not necessarily shared by the non-West. In traditional Indian thought, for example, logical truths are ranked below empirical truths. Thus, the empirically manifest (*pratyakşa*) is regarded as the first *pramāṇa* (proof), and this is a means of proof accepted by *all* traditional Indian schools of thought, without any known exception. Inference (*anumāna*) or deduction is regarded like estimation as an *inferior* means of proof by the Lokayata school and rejected, just as analogy is regarded as an inferior means of proof by Buddhists, and rejected in comparison with the empirically manifest and inference.

Thus, there appears to be no serious way out of this dilemma about the nature of logic, and most of Western thought would hence need to be reworked in the future to avoid this incorrect assumption that two-valued logic is somehow universal.

From a historical perspective we can understand how this Western myth about the universality of logic developed.

The word "logic" derives from "logos" meaning "word" or "reason"—a term imbued with deep religious signficance by the ("Neoplatonist") philosophers of Alexandria, like Proclus, who refer to it as "divine". The reason for this, as sated by Plato, was that geometrical truths based on reason were thought to be eternal—like the soul, and unlike empirical things (like the body) that are by nature perishable. Proclus explains that mathematics derives from the Greek word *mathesiz*, meaning learning, so that mathematics is the science of learning. According to the Socratic belief all learning is recollection of knowledge already in the soul; hence it was thought that mathematics, since it embodies eternal truths, and stirs the soul reminding it of its past lives, thus justifies its name as "the science of learning" or the "science of the soul". This belief in eternal truths was also understood quite literally as implying a world which existed eternally, a subject on which Proclus wrote a book.

After the Christian church revised its doctrines of creation and apocalypse in the 4th c. CE, it found this belief in eternal truths, past lives, and an eternal world, implicit in mathematics and logic, contrary to the revised doctrines. The church hence viciously persecuted the philosophers of Alexandria, burning their books, smashing their temples, lynching them, and eventually making a law declaring a death penalty on them. The philosophers, found a more congenial base in Jundishapur in Iran.

This religious significance of logic or reason however remained part of early Islamic rational theology (aql-i-kalām), and it received a big boost when the philosophers moved from Jundhishapur to the Bayt al Hikmā (House of Wisdom) in Baghdad, with the support of Caliph al Māmun. The belief in reason then acquired such force in Islam, that even key opponents of the philosophers, like al Ghazālī, conceded that God was bound by logic and could not create an illogical world, or a world in which something might have contradictory properties.

Though incidental to al Ghazālī's primary objective, this concession about logic marked a fundamental shift which has gone unnoticed. Plato and Proclus had thought that logical and mathematical truths were necessary truths in the sense that they were eternally true or true for all time. In al Ghazālī 's vision, Allah continuously created the world afresh each instant, therefore nothing could last eternally. With al Ghazālī's concession that Allah could not create an illogical world, the notion of necessary truth acquired a new meaning. That is, al Ghazālī regarded logical (and mathematical) truths as necessary truths in the sense that they were true in all conceivable worlds (that Allah could create), and not in the sense that logical truths were eternally true.

It is well known that Western thought developed in European universities from 12th c. CE onwards under the influence of hundreds of Arabic texts translated to Latin, at Toledo etc. Particularly important among these were the texts written by al Ghazālī 's Islamic opponent Ibn Rushd (Averroes). For Ibn Rushd, the term "Aristotle" was a generic term for "the Greek sage", linked to the book called the *Theology of Aristotle*, one of the translations of the Baghdad House of Wisdom. Thus, for Ibn Rushd reason and religion continued together.

This Arabic knowledge flowing into Europe naturally alarmed a section of the church and was naturally regarded as spreading heresy at the time of Crusades and Inquisition. Aquinas and the schoolmen, however, undertook to make this knowledge theologically correct.

The first step in this process of theological purification was to deny any Arabic-Islamic contribution whatsoever in these 11th c. CE Arabic texts, and to attribute wholesale to Aristotle, or some other Greek, the authorship of any desirable part of these works. (Theologically unacceptable parts were attributed to various others, like Plotinus.) Since the church could hardly acknowledge publicly that all its knowledge came from Islamic sources, so it had to be pretended that the heathen were mere carriers of what formerly was Western knowledge. The evidence linking these late and obviously accretive texts to the historical Aristotle is expectedly slight, and requires a giant leap of faith, but church history is no stranger to such leaps of faith. This concocted story based on flimsy evidence has been uncritically accepted and repeated innumerable times also by chauvinistic Western historians, for centuries, but hardly stands up to the slightest critical scrutiny. In the process of denying the Arabic-Islamic contribution, the Indian contribution from the Nyāya school, which used a similar system of syllogisms (with two valued logic), and was probably translated in the Bayt al Hikmā, may also have been denied. The point here is not the priority for the syllogism—priority does not have the same importance in the non-West as it has in the West—the point is to understand the historical process by which the syllogism developed. In India, given the wide-ranging non-violent debates between clashing traditions, it was important to evolve a systematics of argumentation. It is easier to believe that the syllogism developed in response to some such social need than to believe the tale that a single individual called Aristotle apparently created a complex theory *ex nihilo*.

Could the similarity between the Indian and the "Aristotelian" syllogism be due to transmission? Certainly, there were regular contacts between India and Greece from before the time of Aristotle, as recounted by Herodotus or as evidenced by Alexander's attempt to find the sea route to India after his army mutinied at the frontiers of India. Secondly, as a key beneficiary of Alexander's loot of Egyptian, Persian and Babylonian books, Aristotle also had the benefit of access to a wide variety of world literature. Thirdly, we know from the rock edicts of Ashoka the Great that he sent an envoy to Ptolemy II to teach righteousness (Dhamma) to the Alexandrians and Macedonians. Fourthly, India had a roaring trade with Alexandria at the time of the Roman empire, and Roman historians complained that this trade was draining a major part of the surplus of the empire. Fifthly, the Alexandrian philosophers were taunted by Augustine for being interested in "the mores and disciplines of Inde". So, transmission of knowledge between India and Alexandria certainly *could* have taken place (in either direction) over a wide-ranging period.

Whether such transmission involved the syllogism is another matter. Thus, the syllogism seems not to have been much used in "Hellenic" tradition. Therefore, it lacks credibility to imagine the pre-Hellenic existence of a syllogistic logic, from 11th c. CE Arabic or later Byzantine Greek texts. The known facts are that the use of the syllogism among Arabs does not begin before the 9th c. CE, and among Europeans not before the 12th c. CE; everything else is conjecture, often motivated for the reasons already stated.

Apart from denying the slightest credit to the non-West in all the accumulated knowledge in the 11th c. Arab texts, the second step in the Christianization process of these texts was to revise the significance of logic and reason: reason was no longer the window to the soul, but reason was promoted in Christendom as a means of argument used to persuade the infidel who would not listen to arguments from the scriptures, but would accept arguments based on reason. Hence, reason (and the logic used by "Aristotle") was declared to be "universal". It is in this way that it historically come to be believed in the West that logic began with "Aristotle", and that it is universal, though both beliefs are incorrect when a larger picture including the non-West is taken into account.

In India itself, the Nyāya tradition was attacked by the Advaita Vedantist Sriharsa, in the 9th c. CE using arguments similar to those of Nāgārjuna. The Navya-Nyaya (new Nyaya) logic emerged subsequently.

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