

November 11, 2011

Dear Prof Roy,

Reading Professor Surendra Mohan Ganguli's article titled, "Philosophy of Space, Time and Motion" in the July-August 2011 issue of *Science and Culture* (Vol. 77, p. 286) brought back to mind the ancient Indian thinking on linguistics and the study of utterance as described by Dr. Navjyoti Singh. Dr. Singh, presently of the University of Hyderabad, contributed a paper titled, "Foundations of Logic in Ancient India: Linguistics and Mathematics". [Dr. Singh's paper is one among papers contributed to a symposium titled "*Science and Mathematics in Indian Culture*"; proceedings have been edited by A. Rahman, and published by the National Institute of Science, Technology & Development, New Delhi; 1984, p. 79]. In a section under the heading "Ancient Linguistic Tradition of Study of Utterance" Singh discusses how 'paradoxes' like those attributed to Zeno stand negated were one to go by ancient Indian thinking. I intend to bring the ancient Indian position, as interpreted by Singh, to the attention of the readers of *Science and Culture* because of its relevance and importance.

I should really be not using the verb 'negated' – it may be better to say, "Given the modes of analysis evident from ancient Indian thinking, especially in regard to linguistics, paradoxes like Zeno's could not have been formulated at all in the Indian context". At this point it is convenient to quote relevant points from Dr. Singh's, mostly in his own words:

The tradition in which language became an object of study developed on the base and milieu of Vedic [correctly, Vaidic] practices. A need to standardize Vaidic incantation (*samhitapaatha*) gave rise to reflection on and study of the phenomena of utterance. This was the beginning of ancient Indian phonetics. Not only the general conditions for correct pronunciation were matters of concern but also the theoretical aspects of utterance demanded examination: both *siksha* and *pratishaakhya* classes of [ancient] literature deal with the theoretical aspect of utterance. The study of utterance for elegant *samhitapaatha* led to syllabication of sound and

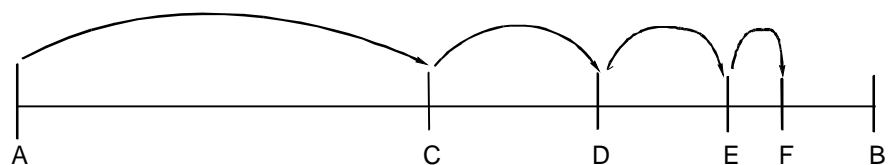
development of the notion of quantity of syllables. Sounds differing according to the modes of their production by the vocal apparatus were studied. Also, the natures of accent as well as accent-tone relations were explored to improve *samhitapaatha*.

From the point of view of foundations of logic, the most significant was the insight that utterance is a temporal process. This insight was behind the concept of syllabic quantity. The act of speech is serial production of syllables and each of them has a length in time. Syllabic quantity was strictly related to actual duration of audition and hence to time and breath cycle. This was a realization that time is not infinitely divisible. On the other hand, it inheres the property of being compulsively additive. As is said, "Time passes"; it necessarily passes as if units of time add up compulsorily. The act of speech is compulsive addition of syllabic quantity. This is an expression of an insight, that material phenomena have a property of compulsive additivity or that of temporality and change. Its significance to logic is tremendous as Zeno's paradoxes of denial of motion (formulated in the 4th century BPE) and time cannot arise on this background. [Singh refers here to "The History of Zeno's Arguments on Motion" by the historian of mathematics Florian Cajori: *The American Mathematical Monthly*, Vol. XXII, 1915, p. 1]

Zeno's paradox of motion is: Suppose a body can move from A to B. In that case it has to reach a point (say C) exactly midway between A and B. Then a point D midway between C and B. Then a point E midway between D and B. Then F and so on.

However many such points the body may cross, there will always be a gap between its position and B. Hence this process of approach can go on indefinitely, thus the body will never reach B. Hence motion is not possible.

Here Zeno treats time as infinitely divisible, like space. In fact, he completely spatialises time. If space is accepted as infinitely divisible, but time as additive the



paradox does not arise because additivity of time makes motion from A to B possible.

Zeno's paradoxes arise because of the acceptance of infinite divisibility of time. This point is better appreciated if we see the impact the concept of syllabic quantity had on later Indian thought, in Astronomy, in Mathematics, and in Philosophy.....

At this point Navjyoti Singh proceeds to give what he describes as three unique examples, without parallel elsewhere in the world, of division of time into different types of intervals and their naming as well as the special impact they had to each subject. I will not go into details of these matters here except to wonder if biological phenomena, e.g. 'steps' in Evolution have there own uniquely defined 'intervals' of time that keep adding up..

In a concluding section of his paper Singh summarizes his position on Zeno's paradox of motion from the standpoint of what he calls "Foundational Inclination of Early Indian Linguistics" as follows:

The insight that utterance is fundamentally a temporal process is uniquely emphasized in Indian thought. Central to temporality is additivity. This is what is implied when one says "Time passes". Time is analogous to compulsive addition. The act of speech is a serial addition of 'syllabic quantity'. The temporal nature of utterance in [properly, as seen in] Indian thought was later extended to temporal nature of thought and human action in general.

This insight was the reason why Zeno's paradoxes of denial of motion, time and space [for a discussion of the natures of these paradoxes see essay by F. A. Shamsi, Islamabad, Pakistan, in Indian Philosophical Quarterly, Vol. XV, 1988, p.1] were never appreciated in India. Zeno's acceptance of infinite divisibility of time was behind these paradoxes. In the face of the deep insight that time is

compulsive additivity of different types of 'interval', Zeno's paradoxes appear no better than tricks. This is very significant as far as Indian mathematical tradition goes. It was Zeno and his teacher Parmenides [a senior contemporary of Socrates] who developed the logic of *reductio ad absurdum* in the particular sense of the principle of the excluded middle and indirect proof. It was this logical device that played a central role in Greek mathematics but was never used in Indian mathematics.....

In light of what Navjyoti Singh has said we can see for ourselves that at the end of an act of making an utterance we lose control over what we have uttered – you cannot take back what you said – time has passed and entropy has increased. You cannot go back in time, and I wonder if there is any meaning in thinking you can go back to the "same" place in space you came from because in the interval that has passed everything in the Universe has changed places – all mutual positional relationships have changed. What meaning do Zeno's paradoxes retain?

Common human experience says any little girl can run from A to B, Achilles will always overtake the tortoise and the arrow will always reach its target! The paradoxes can have meaning only in an imaginary spacetime where an object can move back and forth, in a "dead" world where there is no compulsive additivity in any of the four dimensions. A converse statement of Zeno's paradoxes could thus be: "There is no 'passage' of time".

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