

## CHAPTER 4

### Difficulties with Regard to the Nature of Time ; Zeno's Paradoxes

In the previous chapter we noticed that 'time' admits of no logically perfect definition. We shall now note that there are difficulties also with regard to the nature of time. There are philosophers who maintain that the concept of time involves several inconsistencies. Some of them have questioned the supposed infinity and continuity of time. The concept of space no less shares the same fate. There have been doubts with regard to the distinction of time into past, present and future, and also with regard to the concept of time-flow.

The doctrine of the unreality of time has had powerful exponents among the Advaitin and the Buddhist philosophers.

We now propose to discuss some special arguments against the reality of time.

Zeno's Paradoxes of Motion and the Denial of Time

It may be said that Parmenides' philosophy is the starting point of a strong negative attitude towards time. It was he who first introduced into western Philosophy the idealistic conception of an immutable timeless reality behind the passing show of sense. Zeno's paradoxes, Plato's metaphysics, Bradley's dialectic and McTaggart's paradox are the outcome of this fundamental conception.

Zeno, the most prominent of the Eleatic thinkers, invented a number of paradoxes which, he thought, demonstrated the impossibility of change, and established the Parmenidean conception of being as timeless. His arguments seem to assume the premises granted by his opponents, and then showing the absurd conclusions deduced from them. We cannot, however, be sure of Zeno's intention in formulating the paradoxes, nor of the original formulation. But the philosophical interest in them has been sustained through twenty-four centuries since his time, and it is a proof of their subtlety, ingenuity and greatness. We derive four of these arguments in Aristotle's<sup>1</sup> Physics, which shall be our primary source with regard to Zeno's arguments.

All these arguments presuppose the existence of many things. It appears that with these arguments Zeno sought to prove that there is not a plurality of things, or if you say there is, then there is no motion. Zeno used his great

logical power to advance his master's doctrine by showing that the ideas of plurality and change lead to logical antinomies. In particular, he criticised the concept of time in these four paradoxes.

The paradoxes may be brought under two groups according as it is assumed that time (and correspondingly space) is either discrete or continuous i.e., either composed of indivisible instants (indivisible points in the case of space) of short and finite duration, or else infinitely divisible.

The Arrow and the Stadium paradoxes are directed against the contention that time is composed of indivisible instants. The two paradoxes are independent arguments and are intended to prove that if time is composed of indivisible instants, motion cannot occur.

#### The Arrow Paradox :

In the Arrow Paradox Zeno wants to show that as in the process of flight the arrow will have to be at consecutive positions at consecutive instants, it will be at rest in each of these positions. But a collection of 'rests' does not surely amount to a movement; in otherwords, the flying arrow is at rest, and that is a palpable contradiction<sup>2</sup>.

The Arrow paradox of Zeno has raised profound debate concerning the possibility of motion.

Peirce<sup>3</sup> reformulated the argument in the form of the following syllogism:

Major Premise : No body in a place no larger than itself is moving.

Minor Premise : Everybody is a body in a place no larger than itself.

Conclusion : Therefore, no body is moving.

Peirce finds fault in the minor premise. He thinks that the minor premise is true in the sense that, during a very short time the space occupied by a body may not be larger than itself; and this can only give rise to the conclusion that during no time a body can move no distance.

But it is to be noted that this argument of Peirce is incomplete, for he ignores the conception of motion inherent in the major premise.

Bertrand Russell<sup>4</sup>, on the other hand, draws our attention to the major premise. He thinks that Zeno is assuming that when a body is moving it should be in a state of motion, which is qualitatively different from a state of rest. Now, the moving arrow, at each instant, is where it is; that means that

it is at rest. But a state of motion is essential to motion. If the arrow is at every instant at rest, there can be no motion. Russell analyses Zeno's argument in this manner.

Russell seems to have a misunderstanding with regard to the assumption inherent in the major premise. To deduce the absurd conclusion that motion is impossible, Zeno seems to be adopting the view that a moving body is not qualitatively different from a static one, and that motion can be recognized only by change of position. This is also Russell's own view. In a temporal instant, when a body does not change its position, there can be no motion. If there were any intrinsic change in a body due to motion, then the major premise formulated above would not stand.

The whole force of Zeno's argument, therefore, seems to be based on the conception that motion must be analysable into states of motion and not into states of rest, that motion cannot be compounded of immobilities.

We have now before us two alternative ways to escape from Zeno's conclusion that motion is impossible : either we have to assume that a moving body is different from a stationary one, at any instant, by some distinctive feature other than change of position, (2) or we can accept that motion can be compounded of immobile states.

Russell rejects the first alternative. This brings him very close to the second alternative 'that the arrow at every

moment of its flight is truly at rest'. But that does not mean that he accepts Zeno's conclusion that motion is not possible. He, on the other hand, maintains that in motion a body is at different positions at different instants, and that, since, at each instant the body is in a unique position, it is indistinguishable from a stationary one at that instant. Russell contends that motion can be explained only as a phenomenon necessarily referring to different instants. In the given syllogistic form 'is moving' is equivalent to 'is moving at a given instant', which, of course, is meaningless.

This argument of Russell resolves the Arrow paradox from the logical or semantical point of view. But the idea inherent in this argument is that motion is a relation and not a quality, and this idea is a necessary presupposition of the Law of Inertia. According to classical mechanics, a body in uniform motion is in all respects identical with itself when at rest, except as regards position.

Bergson has vehemently opposed this conception of motion of the classical physicists. He suggests that the intellect operates in a 'cinematographical' manner<sup>5</sup>. Just as in a motion picture movement is represented by the intellect as a series of static states. The arrow paradox falsely reduces the flight of the arrow to a sequence of static positions along the path of its flight. According to Bergson, the entire flight of the arrow is a single indivisible act or event.

From a sequence of immobile states the motion of the arrow cannot be generated<sup>6</sup>.

It should be pointed out that Bergson lays too much emphasis on intuition, when he says that reality is to be known only by intuition, and that reason analyses and falsifies reality. Russell's main contention, on the other hand, is that philosophers are usually ignorant of the mathematicians' analysis, and have adopted 'other and more heroic methods of dealing with the *prima facie* difficulties of continuous motion'. According to Russell, objections against the discontinuous nature of time, presented by the mathematicians' analysis, can be overcome by means of a special hypothesis. From the continuous nature of sense-data we are led to infer a "compact"<sup>8</sup> series of infinite timeless units. Russell is not against the continuity of time as perceived; experienced time may represent itself in a continuous way, but this does not imply, as he says, that there is a corresponding continuity in the objects of experience.

Russell's theory does not seem to answer Bergson's charge against the spatialisation of time. It involves us, on the otherhand, into the difficulty of a dualism between perceptual time and physical time. For Bergson duration is not merely one instant replacing another. It is essentially a flux, a continuous whole of past, present and future. Russell's analysis does not give us convincing reasons for the experienced continuity of time.

If, against Russell's analysis, it is correct to say that Zeno intended to establish that motion cannot be compounded of immobile states, then an interesting point may be worthy of notice. Zeno seems to have anticipated the modern conception of motion. According to the special theory of relativity the relative spatial extension of a particular body in uniform motion gets shortened by a factor depending on its speed<sup>9</sup>. The absolute theory of space is rejected on this theory. With regard to Zeno's paradox this theory seems to have a special relevance. Relativity theory seems to imply that a moving body occupies a smaller place than itself when moving than when at rest. Then it should be admitted that motion is qualitatively different from rest, that is to say, motion cannot be compounded of immobile states.

#### The Stadium Paradox :

The Stadium paradox drives us to the paradoxical statement : double the time is equal to the half.

This paradox of motion is most obscure, since it is not clear what proposition it intends to refute. Let us analyse the argument :

The two diagrams given below represent two sets, B and C in relation to set A.

	(i)				(ii)		
B	1	2	3	B	1	2	3
A	1	2	3	A	1	2	3
C	1	2	3	C	1	2	3

The set A, we are told, is stationary, while the sets B and C are moving in opposite directions to one another with equal velocity. Since the two moving sets take the same amount of time  $X$  to come face to face with the stationary set A, between themselves they will take half the time  $\frac{X}{2}$  to confront one another. That is to say the same distance is traversed by the same set of moving things in different times viz.  $X$  and  $\frac{X}{2}$ . This almost amounts to saying that a whole is equal to its half. And this shows, according to Zeno, that motion, as it involves contradiction, must be unreal.

It might be urged that the paradox proceeds from the change of the standard of comparison. In the context comparison is made between a stationary set with two moving sets. Aristotle protested against the fallacious assumption that given the same speed, a thing of some length will spend the same time, opposite a body of the same length, regardless of the fact that the body is still or moving<sup>10</sup>. Aristotle's criticism points out that Zeno had confusions about the relativity of motion : he ignored whether the body being passed was still or moving.

Zeno's point may, however, be interpreted in another way. It may be considered that Zeno was eliciting the inconsistency of absolute definition of motion. His point might be that if motion were treated as non-relative, paradoxical results would follow. To avoid the embarrassment motion has got to be treated as relative; but its relativity makes it less than real.

#### The Dichotomy and Achilles Paradoxes :

These two paradoxes of Zeno are based on the hypothesis of infinite divisibility of space and time. These are intimately related. According to the former, motion cannot begin at all. For before an object can traverse a distance, however small, it must first traverse half the distance; and before it can move through half, it must cover half a quarter, and so on ad regressum. So if the object is to traverse any distance, whatsoever, in a finite time, it must complete an infinite number of operations in that time, which is impossible. This paradox can be applied to time itself, or for that matter, to any clock, for it is equally difficult to understand how time can advance from a given initial instant.

By the Achilles argument Zeno claims to show that granted the possibility of motion, the slowest runner will never be overtaken by the swiftest runner. The pursuer must first reach

the point from which the pursued started. In the mean time, the pursued must have moved further, and must in that way always remain ahead. The distance must be decreasing in a given proportion ad infinitum because of the infinite divisibility of space, but it can never be overtaken by the swiftest runner.

Aristotle has tried to solve Zeno's paradox by saying that we must distinguish between infinite divisibility and infinite length. The spatial distance to be traversed is infinitely divisible, not infinitely long, and the time required to traverse is also infinitely divisible. Hence the time available is adequate to traverse the distance. Thus Aristotle in his first rejoinder alleged Zeno of illegitimately identifying infinity of parts with infinity of extent<sup>11</sup>.

In his second rejoinder Aristotle has denied that an infinite division actually exists in a period or line. And to the question whether one can traverse an infinity either in time or in space, Aristotle's point is that one cannot traverse an infinity of actually existing divisions, but one can of potentially existing ones. By an actually existing division Aristotle means one, that is actually marked. By infinity Aristotle intends an extendible finitude<sup>12</sup>. On this account, the number of actually marked out divisions can be increased. The number will always remain finite. So there is no need to traverse more.

But strangely enough, Aristotle makes concessions to the traversal of potentially existing divisions. His finitist account of infinity as merely an 'extendible finitude' is intended to avoid all collections that are more than finite. All such actual infinite collections, he thinks, will contain sub-collections which will also be actually infinite in the same sense. But, in Aristotle's opinion, this is impossible. This seems to be the reason at the back of his finitist account of infinity. Aristotle, however, does not apply this analysis of infinity to potential divisions.

Some thinkers<sup>13</sup> opine that this paradox of Zeno presents no difficulties to those who are adequately trained in mathematics. It has been urged that there is some mistake in the argument. It ignores the fact that the number series, for example,  $\frac{1}{2}, \frac{1}{4}, \frac{1}{8} + \dots$  has the finite sum of 1. So the proposed solution is that the infinite series of time-intervals involved has a finite sum; therefore, Achilles must catch the tortoise. It should be remarked that this reply does not differ much from Aristotle's first rejoinder that infinite divisibility does not imply infinite length.

It seems that this solution misses Zeno's point. On the assumption of continuity of space and time, which is at issue, Achilles must go through all the points in space and all the instants in time; in order to overtake the tortoise;

that is to say, he must perform an infinite sequence of acts. The question is ; whether he can actually complete the sequence. In other words, if space and time are assumed to be infinitely divisible, it becomes difficult to explain how Achilles would ever draw level with the tortoise. In the Dichotomy paradox motion appears to be impossible because it cannot start.

There are now two ways before us to solve these two paradoxes :

- (i) either we are to abandon the concept of becoming or temporal transition. We can regard instants as similar to points in space.

or

- (ii) we may abandon the hypothesis of infinite divisibility of time and of the concept of point like instants.

Bergson resolved the paradoxes by saying that only space is infinitely divisible, motion and time come in 'indivisible units'<sup>14</sup>. Whitehead also adopted the same procedure. To quote Whitehead,

"There is no nature apart from transition, and there is no transition apart from temporal duration. That is why an instant of time conceived as a primary simple unit is nonsense"<sup>15</sup>.

Nāgārjuna and Zeno :

The foregoing analysis of Zeno's paradoxes suggests a comparison with Nāgārjuna's dialectic of motion. Nāgārjuna's kārikās in his Mūlamadhyamaka-Sāstra deal with the same problem with much the same logic. Zeno's paradoxes were constructed to refute the possibility of motion and consequently to deny the reality of time and change. Nāgārjuna's dialectic is an attempt to reveal the unintelligibility of the concepts of space, time and motion.

It seems that Zeno sought to defend his master, Parmenides, by mocking the mockers, by demonstrating the contentions of his opponents to have contradictory implications. The technique has the appearance of reductio ad absurdum. Nāgārjuna's technique was to adopt, for the sake of argument, the assumptions of his opponents, and to show them to imply absurd consequences. This also is closely similar to reductio ad absurdum.

The Greek philosopher appears to be a monist. He was eager to establish the unreality of motion, for he followed Parmenides in denying plurality. His opponents were possibly the atomists.

In Nāgārjuna's argument, we can recognize at many points the Sāṅkhya and the Vaiśeṣika thinkers as the opponents. At

places he argues against the atomists. Philosophically he tried to prove the latent absurdity of all views. Nāgārjuna was not a monist. And practically he denied that he was asserting anything. He looks like an absolute sceptic<sup>16</sup>.

However, both Zeno and Nāgārjuna claimed to show the logical inconsistencies in our conception of motion and time.

#### Nāgārjuna's Dialectic of Motion :

In every case of motion, Nāgārjuna says, there must be three factors - the space traversed, the moving body and the motion. A space or locus of past motion is not characterised by motion, similarly a space or locus not yet traversed is not to be characterised by motion either. Then what part of space is to be the locus of the present movement<sup>17</sup>? Here Nāgārjuna seems to be contemplating a time continuum that can be exhaustibly divided into past and future, leaving no room for the invisible present in which movement can be said to be occurring.

The question now is : why do not we observe the locus of the present movement ? Here Zeno's argument comes to our minds, and Candrakīrti's comment seems to suggest the same. He explains the invisibility of the locus for present movement by attacking the claim that the space occupied by a walking foot, for example, constitutes the locus of present movement.

The argument runs in the following manner : For any particle of matter within the foot, if the particle is at the top of the toe, the space occupied by the whole foot is to be characterised as 'traversed' ('gata'); if the particle is at the back of the heel, the space occupied by the foot is 'not traversed' ('agata'); if the particle is in the middle of the foot, the space is divisible into two sections. But since each particle can in turn be subdivided, it is not possible to discover a part of the foot which occupies a path of present motion<sup>18</sup>. So it may be said that the problem of infinite divisibility is implied in Nāgārjuna's argument, though it is not explicitly stated.

Nāgārjuna then examines the claim that there is movement in the ground of the present motion, hence the place where activity is, is the locus of present motion. Nāgārjuna raises the question : how can movement occur as a characteristic of the 'ground of present movement', for the phrase 'the ground of the present movement' becomes meaningful only with reference to movement occurring at present. Candrakīrti interprets Nāgārjuna as saying that the attribution of movement to the ground on which it occurs, entails the absurdity of two movements. The ground is one thing, and the movement another. The first movement is possessed by the ground by definition as 'the ground of present movement'. The ground should possess this as an apriori property. But the movement that is

actually taking place is contingent. So it characterises the ground from outside as a second movement.

But there can be no movement without a mover. Every movement requires a subject; this subject must be either a mover or a non-mover. The subject of a movement cannot be a non-mover. How can it be a mover? The problem of the double movement entailed by the previous analysis of locus and movement reappears in this case also. 'The mover moves' absurdly entails two movers and two movings.

Nāgārjuna's argument in some respects appear to be Zenoian. It may be interpreted as contemplating a time-continuum divisible into past and future exhaustibly, leaving no room for the durationless present in which motion could occur.

In Nāgārjuna's argument the concept of the beginning of movement involves a vicious circle. He seeks to establish that the distinctions of space and time are dependent on the arising of motion; motion, on the other-hand, is inexplicable without these temporal and spatial distinctions. Before the movement begins, these divisions of space and time cannot be identified. But the beginning of movement must take place in one of these divisions of both time and space, and can be identified only in relation to them. Thus the relation of the movement with the divisions of space and time is circular.

On this view, any attempt to identify a first instant of motion must fail. For between any instant during the period

of non-movement and any instant during the period of motion there is an infinite number of instants, so no one of them can be identified as the instant of the beginning of movement.

However, an analysis of all the verses of the kārikās reveals a deep preoccupation with the metaphysical problem of how substance can be related to attribute, or an entity to a property, and so forth. Nāgārjuna's arguments are based on metaphysical assumptions to show the unintelligibility of substance-attribute relations, whereas Zeno sought, on mathematical assumptions, to show the impossibility of giving a coherent account of space, time and motion.

The assumption underlying kārikā 1 is that an atom is infinitely divisible. This assumption, however, is not self-evident. That it is not self-evident is proved by the fact that the Nyāya-Vaisesika thinkers do not share this view. According to them, an atom is rather the ultimate indivisible particle. If it were not so then the quantity of the atoms of a mustard-oil seed and that of a mountain would be equal, which is absurd. So this assumption is unwarranted.

Nāgārjuna's argument is also based on the assumption of the equivalence of analytical and empirical statements. In a statement, for example, 'The runner runs', the property of 'running' is clearly a constituent element of the concept of 'runner'. That is why it is an analytical statement. In the

statement "Devadatta runs", the property of 'running' is attached from outside, since we can distinguish between the person Devadatta and the property of 'running'. The distinction between these two types of statements is very important; but Nāagarjuna seems to ignore that. We may, however, imagine that Nagarjuna merely sought to expose the absurdity of some views, by accepting their premises for the sake of argument, and drawing out contradictory consequences.

With the same kind of logic he sought to prove the unreality of rest also. Zeno denied motion, but accepted the reality of the static and the immutable. Nagarjuna's arguments may be said to be more comprehensive, for he shows the unreality of rest also. His dialectic of motion reminds us of Bradley's dialectic. In Bradley's opinion the very notion of a relation is philosophically unintelligible and inconsistent, and this inconsistency alone is sufficient to condemn the concepts of space, time, motion and change as they all involve relations.

## REFERENCES

1. Aristotle, Physics, op.cit. 6.2; 233<sub>a</sub> 21-31; 6.9:8.8,  
263<sub>a</sub><sup>4</sup>-b<sup>9</sup>.

2. This point of view is strikingly similar to an ancient Indian view stated and refuted by Patañjali in his Mahābhāṣya on Panini 3.2.123 :

na vartate cakram isurna pātyate  
na syandante saritāḥ sāgarāya;

:the wheel does not move, the arrow is not thrown, the rivers do not flow to the sea; the whole world is motionless. It has been argued that as there is no motion in the world, there is no time either. Motion that is finished is past, motion that is yet to occur is in the future. Between them no intermediate stage is visible. So there is no stage of present motion, that is to say, motion is impossible.

3. C.S.Peirce, Collected Papers, Vol.5, Cambridge, 1934,  
p.334.

4. B. Russell, History of Western Philosophy, London, 1946, p.833.
5. H. Bergson, Creative Evolution. London, 1954, pp.322-23.
6. H. Bergson, Time and Free Will, Tr. F.L.Pogson, London, 1959, p.112-12.
7. B. Russell, Our Knowledge of the External World, London, 1952, p.143.
8. Ibid, p.138.
9. This is known as 'Fitzerald-Lorentz Contraction'. Dutch physicists Hendrick Lorentz and G.F.Fitzgerald explained, on the basis of the famous Michelson-Morley experiment, that objects contract and clocks slow down when they move through ether at a very high speed.
10. Aristotle, Physics, op.cit, 6.9.240a 1-4.
11. Ibid, 8.8. 263a<sup>4</sup>-b<sup>9</sup>.
12. Ibid, 3.5-7
13. Peirce, op.cit.
14. Bergson, Creative Evolution, op.cit.
15. A.N.Whitehead, Modes of Thought, Cambridge, 1938, p.207.
16. Bhaswati, B.Chakrabarti, Absolute Scepticism, Eastern and Western, Calcutta 1957.
17. Nagarjuna, Mūlamadhyamakasāstra, Kārikā 1 :
 

gatām na gamyate **tavat** agatām naïve gamyate;  
gatāgataviniṁuktām gamyamānam na gamyate.
18. Candrakīrti, Mūlamadhyamakasāstra of Nāgarjuna with the commentary Prasannapadā, Dwarbhanga, 1950.