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Kāla and *Dik**

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1 Introduction

1.1 Possible confusion in present-day notions of time

Our understanding of the ideas of *kāla* (time) and *dik* (direction/space) is a function of two variables: (1) the ideas themselves, as understood by people who used them, and (2) our present understanding of the nature of time and space. It seems inevitable that we view the past through the filter of the present, so a clear understanding of past ideas, presupposes clarity in present-day ideas of space and time, especially time. Present-day ideas, however, may be confused, as they are in the case of time, and, like a foggy filter, this confusion in present-day ideas may block a correct understanding of past ideas.

For example, consider the following remark of Irfan Habib.

> "And yet it may be asked whether Buddhism did not have its own contribution to make to the development of the caste system. The karma doctrine or the belief in the transmigration of souls which formed the bedrock of Buddhist philosophy, was an ideal rationalization of the caste system, creating a belief in its equity even among those who were its greatest victims."[1]

Let us analyse this remark in some detail to judge how thick are the layers of confusion; the point is not to belittle the well-known scholar, but to illustrate the wide prevalence of confusion about time.

1.2 Conditioned coorigination and the structure of time

First of all, there is the obvious observation that the "karma doctrine or the belief in the transmigration of souls" is NOT the bedrock of Buddhist philosophy. The Buddhist notion of time and causation is incorporated in *paticca samuppāda* (conditioned coorigination) rather than *karma*. *Paticca samuppāda* rather than *karma* is the bedrock of Buddhist philosophy, and the Buddha declared that he who understands *paticca samuppāda* understands the *dhamma* and he who understands the *dhamma* understands *paticca samuppāda*.

There *is* a confusing similarity between the pictures of time underlying the notions of *karma-samskāra* and *paticca samuppāda*. In the background of both there is a belief in a quasi-cyclic

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[1] Irfan Habib, *Essays in Indian History, Towards a Marxist Perspective*, "Caste in Indian History", p 168.

cosmos, each cycle being of enormous duration. In a bold analogy, each cycle of the cosmos was commonly reduced to a mere day and night of Brhmā. The Samkhya-Yoga notion went further and reduced it to a mere instant in the mind of the yogi. The Buddhist notion of instant develops in the other direction the Samkhya-Yoga notion which reduced a cycle of the cosmos to an instant. Indeed, as I have suggested elsewhere, the notion of *paticca samuppāda* is today best understood by inverting the analogy of cosmos-as-instant into the analogy of instant-as-cosmos: a string of instants in ordinary time is made analogous to a sequence of cosmic cycles not by condensing a vast cosmic cycle into something as momentary as an instant, but by amplifying the momentary instant into something as vast as a cosmic cycle. Each cosmic cycle of a few billion years is not a millisecond (*ksana*), but each millisecond is an aeon, within which entities go through birth, growth, decay, and death. In Hermetic terminology, the instant is a microcosm; the ultimate application of the principle "as above so below". From a mundane perspective, the pace of time is not enormously speeded up, it is enormously slowed down. Both analogies may be visualised using string beads: each bead represents an instant/cosmic cycle, and the string represents the causal connection between instants/cycles.

But the existence of this analogy, between a sequence of cosmic cycles and a string of instants, need not blind us to the differences between *karma* and *paticca samuppāda*. The more technical differences I will not discuss here in detail.[2] However, the less technical differences are apparent enough. For example, *nibbāna* is available at the very next instant: there is no presumption that one is obliged to wait until at least the next cycle of the cosmos. Again, while the Buddha accepted the idea of a quasi-cyclic cosmos, as part of the common physical world-view, transmigration of souls could hardly be the bedrock of Buddhist philosophy considering that the Buddha never once spoke of anything like 'soul' or *'ātman'*. Indeed, *paticca samuppāda* differs from the Augustinian notion of causation (and Max Mueller's translation of it as "Law of Causality") if only because the Buddha does not admit the continuation of identity even from one instant to the next.

To give a stock example, the seed is not the cause of the plant else the seed would produce a plant in the granary itself, whereas actually it only reproduces itself (each instant). To understand the idea of 'reproducing itself' let us apply the above analogy of instant as cosmos. Each instant the seed undergoes a cycle of birth, growth, decay, and death. Despite a possible diastema between one instant and the next, the causal trace that the seed leaves behind in the first instant produces a similar seed in the next instant. The seed in the next instant, though not identical, is so similar that we speak of the seed reproducing itself.

The seed in the ground does produce a sprout, but it is manifestly a *different* seed, having absorbed water, and having got bloated up etc. Though the differences are now visible, we continue

[2]Technically, this amplification permits the instant to have a non-trivial structure in the manner of tense logic, since there is no temporal sequence within an atomic instant, so that all events within the instant are simultaneous. That is, more than one logical world, in the sense of Wittgenstein, may be associated with each instant. However, the associated Wittgensteinian worlds do not merely indicate some imagined possibilities, but exist in a physical (ontic) sense; hence also this notion of instant permits a quasi truth-functional logic of the kind needed in quantum mechanics. On the other hand, when the Buddha permits the possibility that "the world is both finite and infinite", the semantic interpretation that he provides ("the universe is finite up and down, but infinite across") clearly connotes quasi truth-functionality, rather than, say, a cyclic negation within a many-valued truth-functional logic. In my opinion, Nagarjuna and Dinnaga only further emphasize the quasi truth-functional nature of Buddhist logic naturally associated with this notion of time. See, W. H. Newton-Smith, *The Structure of Time,* Routledge, London, 1980; C. K. Raju, *Time: Towards a Consistent Theory*, Kluwer, Dordrecht, 1994, Chapter 6b; C. K. Raju, "Mathematics and Culture", in *History, Time and Truth, Essays in Honour of D. P. Chattopadhyaya*, Daya Krishna and K. S. Murthy (eds) Kalki Prakash, New Delhi, 1998.

to call it by the same name 'seed' as a matter of convention. The seed alone is not the cause of the plant just because the seed in the granary is not the same as the seed in the ground: the seed in the ground has changed visibly, and this change is due to 'other causes'. Indeed, the seed changes every instant (even in the granary), but its name remains the same (just to economise on names), so the original seed is surely not the cause of the sprout, it has no 'power' to create a sprout, it is at best a cause of another seed very similar to itself, it has the power only to create this other seed, which it does. Down to the eighth century CE, Buddhists like Sāntarakshita and Kamalasīla used such a notion of cause to ridicule the idea of a God who created the world at a finite time in the past: if God alone were the cause of the world, then the world would have always been existing (just as the sprout would have existed in the granary), for the power to create the world (its causal basis) would always have been existing.

1.3 The politics of causal analysis

Secondly, one may enquire in what sense the "karma doctrine" might be held responsible for the continuation of the caste system. In Orientalist writing, the notion of *karma* is inevitably identified with transmigration. But there is also the notion of *karma*, or an action and its consequences, in an everyday sense, where a mundane action, such as picking up a glass and drinking it, leads to a mundane consequence, such as quenching of thirst. With only one actor, causes and consequences are easy to identify. What happens to this mundane notion of cause when more than one actor is possibly involved? In a social context, can a 'part' of an observed effect always be traced back to a unique cause? After all the logic of Irfan Habib's assertion is this: for the continuation of the observed social phenomenon of caste, the doctrine of transmigration is a key 'cause'.

The Buddhist notion of cause needs further amplification in this context. To return to the seed, the Buddhists argue that it being clear that the seed *alone* is not the cause of the sprout, it is only a matter of convention to regard the 'seed' as the 'main' cause and the earth, and water etc. as 'subsidiary' causes. In current terminology, one would say that for any event in a social context there is always at least a chain of causes, hence a multiplicity of causes, and singling out one among this multiplicity of causes is purely a matter of politics. This becomes clearer if, instead of seeds in the granary, one thinks of patriarchy, which glorifies the producer of the seed while belittling the mother who bears it!

Somewhat more abstractly, one can think of the distribution of income in a feudal or capitalist society, which is rationalized by making the owner of land or capital a 'cause' of production, who is hence entitled to reparation in proportion to his 'merit' (land, capital). Though more abstract, the politics of the underlying causal analysis is very much a part of our everyday life—consider, for example, the interest to which one is 'entitled' on the savings (accumulated merit!) that one deposits in a bank account.

Applying this understanding to the point under discussion, it was politically convenient for Christian missionaries from the 16th century CE onwards to locate the cause of all social evils, like caste, in the religious philosophy which they opposed, hence wanted to blame. It is curious that their doctrinaire causal analysis is today so widespread and conventional, even among Marxists, when it does not stand critical scrutiny: even authoritative sociologists like Weber observed long ago that caste is not a phenomenon that is confined to any particular religious group in India. Caste, as an endogamous structure, continues to cut across religions. So the existence of a rationalization within the religious philosophy can hardly be the 'main' cause for propagating the caste

system. On the other hand, the form of the caste system at the time of the Buddha was different[3] from what it is today—with e.g. a divergence of opinion whether kshatriyas were to be regarded as superior to Brahmins—though the *astika* version of the *karma* philosophy was presumably the same.

Finally, as is implicit in Irfan Habib's remark, it is not even clear that "the doctrine of karma" provides an unambiguous argument in favour of the caste system: for, closely associated with transmigration, there is the notion of deliverance, or ultimate unity, which is stressed by schools like Advaita Vedanta. According to the well-known story, Sankara, the founder of Advaita Vedanta, was returning from a bath, when he encountered a chandāla on the road, and instinctively shrank back. Observing this, the chandāla ridiculed Sankara, asking him whether his behaviour was consistent with his monistic teachings. Recognizing the strength of this argument, Sankara prostrated himself at the feet of the chandāla. (It is not very pertinent that some subsequent accounts of this event tried to minimize the damage by claiming that the chandāla was actually an incarnation of Siva.) More recently, Advaita Vedanta has been adopted by reformers like Sri Narayana Guru, and championed by thinkers like E. C. G. Sudarshan[4]

To summarise, given a multiplicity of causes, the identification of one of them as the 'main' cause is usually a matter of subjective prejudice. Blaming the "karma doctrine" for the caste system, as has traditionally been done, seems to be a case in the point, especially since "the doctrine of karma" also provides strong arguments *for* equity. In any case, belief in transmigration is too facile an explanation for the persistence of a bewilderingly complex and unique social problem like caste.

1.4 Transmigration and equity

> Only
> The fool fixed in his folly may think
> He can turn the wheel on which he turns
>
> T. S. Eliot[5]

Why, then, is the "karma doctrine" such a favorite flogging horse? Why is it so facilely identified with 'fatalism', with the inevitable turn of the wheel (*kālacakra*)? It is important to understand this since 'transmigration' and the associated notion of quasi-cyclic time is the key to several (not all) schools of philosophical thought. But, among scholars educated in the Western tradition, the 'doctrine of transmigration of souls' is today so very disreputable that the historical origin of this disreputability, and the resulting confusion about transmigration, needs to be made widely known, at the expense of reiteration.

This doctrine of transmigration was cursed (anathemised) by the Western church, at the time of Justinian, and has been avoided by Western thinkers for centuries since then. So deep-rooted is the resulting confusion about transmigration and 'cyclic time' in Western thought that even thinkers

[3]Uma Chakravarti, *The Social Dimensions of Early Buddhism*, Oxford University Press, Delhi, 1987, contains a survey of various opinions on this matter along with a review of textual citations. The Sonadanda sutta of the *Dīgha Nikāya* contains an interesting account of the 'essential' qualities of being a Brahmin, with Sonadanda successively discarding appearance, knowledge of the mantra-s, and lineage as inessential.

[4]E. C. G. Sudarshan, personal communication, 31 Dec 1997. The point under debate was exactly that Advaita Vedanta encouraged the inequity of the caste system.

[5]T. S. Eliot, *The Complete Poems and Plays 1909–1950*, New York, Harcourt Brace, 1952, p 184.

like Newton[6] and Nietzsche, who so strongly attacked the church, got misled by this confusion. In this context, the following is rather amusing.

Early Christianity, like the early Eliot, accepted the doctrine of *karma-samskāra* and transmigration of souls (in the context of quasi-cyclic time). Subsequently it was rejected within Western Christianity for exactly the reason that it was used as an argument *for* universal equity, and this idea of universal equity went against the 'Christian' ideas of virtue that then suited the state church.

Prior to Constantine, Origen of Alexandria, explicitly argued, in the Neoplatonic tradition of that black Athena, that transmigration of souls perfectly combined both equity and justice: while God had created all souls equal, they did not perform equally, and it was a reflection of divine justice that in subsequent cycles of existence they started off with an initial station in proportion to their merit and demerit that they had earned in the previous life.

> In which certainly every principle of equity is shown, while the inequality of circumstances preserves the justice of a retribution according to merit.[7]

Moreover, unlike the vindictive and transcendent God subsequently imagined by Augustine, Origen's immanent God was a benign Neoplatonic unity: God would not blame some people and torture them for ever as Augustine asserted, but eventually, all souls would return to their initial blameless state, all would recombine with the one, and so all would be delivered. Equity was the starting point and also the goal of human existence in Origen's thinking.

But equity meant that Christians and 'heathens' must be treated on a politically equal footing, along the secular (but misrepresented[8]) traditions of the Roman empire before Constantine. This political equity did not suit the Roman church which was gathering political strength. Hence, Jerome and Augustine argued viciously against Origen, misrepresenting him in the process.

Jerome argued that Origen's views jeopardized Christian ideas of virtue since 'a virgin may chance then to be born a prostitute'; the thought was so horrifying that no one noticed that Jerome had cleverly slipped in *chance* where Origen would have put in God's judgment, which was presumably infallible.

> For no one chooses of himself either where or with whom, or in what condition he is born[9]

Jerome's real objection was, of course, to equity: that 'Archangels and Angels, the devil and the souls of men whether Christian, Jews or Heathen' all would eventually be delivered.

The key point here is not to defend an unjust social system of caste, but to point out that those who attach a confused label of 'transmigration' or 'cyclic time' as a catch-all term to all sorts of

[6]Not many people seem to know that Newton's lifework concerned not physics, but an 8-volume history of the church, and that his biographers deliberately suppressed his obsession. Also, not many people seem to know that his lifework still remains hidden, to date, and only drafts of it became available a couple of decades ago.

[7]Origen, *De Principiis*, Book II, Chap ix, in Alexander Roberts and James Donaldson (eds) *Ante Nicene Christian Library*, Vol X, *The Writings of Origen*, Tr. Frederick Crombie, T&T Clark, Edinburgh, 1895, p136.

[8]e.g. E. Gibbon, *Decline and Fall of the Roman Empire*, points out that secular records do not bear out the church propaganda about religious persecution by the Roman state before Constantine, and that the figures of martyrs are gross exaggerations. Gibbon Vol 1. *Great Books of the Western World*, Vol 40, R. M. Hutchins (Ed. in Chief), Encylopaedia Brittanica, Chicago.

[9]Origen, *De Principiis*, cited earlier, p 132.

distinct pictures of time, from *paticca samuppāda* to quasi-cyclic time, and then go on to impute the origin of inequity to it, are victims of a curious political process of rationalizing inequity that started by rejecting 'transmigration' in the sense of quasi-cyclic time on the considered ground that it implied an unacceptable equity!

We have already seen the second stage in this process of theologising inequity: the belief that, even in a social context, causes of a phenomenon can always be localised (e.g. in a particular religious belief in 'transmigration'), is itself a fallout of this religious dogma. This dogma of localising all blame was essential for the shift from 'transmigration' to 'resurrection' which transformed the picture of Hell from Origen's temporary reform school to Augustine's eternal torture chamber. (Augustine's God needed to accurately identify individuals as the primary *causes* of evil, hence deserving of *eternal* torture.) So, when one blames the karma doctrine as an ideal rationalization for the caste system, it is not quite clear what exactly is being rationalized!

1.5 Transmigration and equity: Lokāyata

It should be pointed out that a thousand years before the curse on 'cyclic' time, by Justinian and the Fifth Ecumenical Council, the Lokāyata had rejected quasi-cyclic time and the notion of 'transmigration'. The two ways of rejecting quasi-cyclic time, however, differed fundamentally in at least two ways. First, the Lokāyata differed from both Buddhists and Nayyayikas in accepting the empirically manifest (*pratyaksa*) as the sole means of right knowledge. In particular, they rejected also inference (*anumāna*) or reason. While there is some doubt whether they rejected inference also in the practical sphere, there is no doubt that they resoundingly rejected authority as a means of right knowledge. Therefore, unlike Western Christianity, the Carvaka rejection of quasi-cyclic time did not move time and eternity to a metaphysical plane supported only by the authority of theologians: they rejected also the associated notions of heaven and hell. As Ajit Kesakamballi put it

> Fools and wise men alike, on the dissolution of the body, are cut off, annihilated, and after death they are not.[10]

Consequently, the Lokāyata also rejected the idea that good or bad actions or ritual offerings would fetch any reward or punishment in a subsequent life whether on earth or in heaven or hell.

> When he dies... the four bearers take his dead body away; till they reach the burning-ground men utter forth eulogies, but there his bones are bleached and his offerings end in ashes....

Therefore, also, the parricide(d) Ajatasatru, in his question to the celebrated wise men in his kingdom, including Buddha and Mahavira, asked about the benefits *in this life* of the life of a recluse.[11] (Incidentally, Ajatasatru rejected Ajit Kesakamballi's above answer as irrelevant—as someone when asked about a mango responds with a description of a jackfruit tree!)

[10] As recorded in the *Sāmanna Phala Sutta* of the *Dīgha Nikāya*. T. W. R. Rhys-Davids, *Dialogues of the Buddha* (3 vols), London 1899–1921, Vol 1 pp 68–69. Jaina records have a parallel description. A more easily available translation is that of Maurice Walshe, *The Long Discourses of the Buddha: A Translation of the Dīgha Nikāya*, Wisdom Publications, Boston, 1995.

[11] *Sāmanna Phala Sutta*. Rhys Davids cited above. The term 'recluse' is an incorrect translation; what is meant is not a person who leads a reclusive life away from society, but a non-householder.

Secondly, unlike the case of Western Christianity, the Lokayata rejection of quasi-cyclic time was intended to work *for* equity, since the objective probably was to persuade people that they were being exploited by being misled:

> It is a doctrine of fools, this talk of gifts. It is an empty lie, mere idle talk, when they say there is profit therein.

1.6 Karma and the physical world

So much has been written about the metaphysical and social implications of the "karma doctrine" that its physical dimension has been neglected. So, one can ask whether the "karma doctrine and the doctrine of transmigration of souls" is all rationalization and dogma, or whether it can have some scientific or physical basis. (Like Buddhism, the scientific view accepts the empirically manifest and inference from it as the means of right knowledge, in principle, though there is little option but to accept testimony or authority in practice. Setting aside the notion of time and logic in quantum mechanics, the philosophy-of-science view of right knowledge differs from the Buddhist view mainly on the question of the logic that ought to underlie inference.)

But first one must understand the notion itself. 'Transmigration', in the Indian/Neoplatonic/early Christian context, refers to a picture of time in which the entire cosmos approximately recurs after vast[12] [see box] periods of time. I call this picture quasi-cyclic time; since the underlying cosmic recurrence need be neither exact nor eternal. A simple way to understand the idea of cosmic recurrence is to revert to the analogy of cosmos as instant. *Within* each cosmic cycle there is birth, growth, decay, and death. *Between* a cosmic cycle and the next there is change, but also a substantial continuity. Between one cycle and the next an individual surely changes, but the changes may be slight, just as they are for the seed between one instant and the next, so that in recognition of the similarity, we continue to call the seed by the same name. What precisely constitutes a 'slight' difference is an interesting philosophical question, and a formal answer to this question is of considerable practical utility (for e.g. computerised recognition of signatures) but is not immediately relevant: at a mundane level we understand perfectly well that one genuine signature is only 'slightly different' from another. Over a number of cosmic cycles, just as over a large period of time, the 'slight' changes may accumulate and become substantial.

[12]The specific period of time for a cosmic cycle mentioned in the Puranas and the Bhagvad Gita is 8.4 billion years. This is comparable to the modern figure for the age of the cosmos, so that the time-period of a cosmic cycle, in a modern cyclical cosmology, such as the closed Friedmann model, must be at least an order of magnitude more. Both these figures for the age of the cosmos need to be taken with a pinch of salt. The first figure, as its sources suggest, probably post-dates Aryabhata I, and was presumably obtained simply by identifying the largest availabletime period (for a planetary cycle) with a cosmic cycle. The need for such large numbers was probably related to a need for more precise astronomical calculations, which, in turn, were probably needed for better navigation due to the enormous expansion in trade with the Roman empire. The second figure is dubious not only because current estimates of the age of the cosmos are constantly changing and known to be prone to large errors, but also because it is not clear that such large periods of time are physically meaningful. Intuitively, the difficulty is that time may run at a different 'pace' in different parts of the cosmos, being 'faster' here and 'slower' there, even perhaps running 'backward' in the appropriate regions of a time-symmetric cosmology. While these apparently paradoxical notions of 'faster', 'slower' and 'backwards' can be formalised, we shall not do so here, and shall simply point out that the philosophically correct formulation of the doubt is through the question: Is there a proper clock? That is, over such a vast period of time, is there any actual physical system that can measure proper time as defined in general relativity? If not, the vast period of time is physically meaningless.

Quasi-cyclic time ought not to be confused with eternal recurrence (or eternal return) as it is by Augustine, Nietzsche, Mircea Eliade.[13] and a host of others. In the above analogy, eternal recurrence would correspond to things being 'forever' the same, it would correspond to confusing 'a slight difference' with 'no difference', it would correspond to taking too literally, as the Stoics perhaps[14] did, the analogy of a string of instants with a necklace of beads. It would amount to confusing harmony with cacophony: a needle spiralling down to the centre of a gramaphone record produces harmony; the same needle when stuck in a circular grove produces unending cacophony. If one is not Nietzsche's ubermensch, it is hard to imagine Sisyphus happy.

'Transmigration' in the context of quasi-cyclic time must be carefully distinguished also from the vulgarised notion of 'transmigration' corresponding to life immediately, or a short time, after death, which suggests the image of a disembodied soul shopping around for an appropriate foetus in which to be reborn. 'Transmigration' is also surely not the same as 'metempsychosis' (for it is not the psyche or soul which changes, but the body); nor even does 'transmigration' coincide with the Stoic idea of palingenesis or anakuklosis, an idea which is currently understood in a way (exact recurrence) that I have called super-cyclic time.

'Transmigration' in the context of quasi-cyclic time is *not* open to any elementary logical or physical objections. At the other extreme, it is not so clear that it *must* occur, in the sense that current physical theory necessarily implies recurrence, as Nietzsche thought. The Poincaré recurrence theorem[15] only tells us that recurrence is necessary for a confined collection of a finite number of particles evolving according to some deterministic rule, such as Newton's 'laws' of motion or its relativistic generalisation (i.e., geodesic flow on a manifold, which manifold may satisfy the Hilbert-Einstein equations). The standard text-book refutations of the associated recurrence paradox are quite invalid.[16] However, it is not at present clear e.g. that the entire cosmos does evolve deterministically according to some 'laws of physics', or that it can at all be understood as a gigantic piece of clockwork.[17]

Technically, *instantaneity* (e.g. history-independence), rather than *determinism* is the key hypothesis underlying recurrence. This is clear, on the one hand, from recurrence theorems for probabilistic evolution of a stochastic process which is Markovian (i.e., history-independent).[18] On the other hand, this is clear from the way the (phase flow) hypothesis of the recurrence theorem breaks down with the acceptance of history-dependence. Non-technically, instantaneity means that what happens at one instant depends only upon the instant that is immediately adjacent (to

[13]Augustine, *The City of God.* Tr. Marcus Dods, in R. M. Hutchins (Ed) *Augustine*, Great Books of the Western World, Vol 18, Encyclopaedia Britannica, Chicago, 1952. G. G. Walsh et al, *Saint Augustine, The City of God*, Image Books, New York, 1958. Martin Heidegger, *Nietzsche*, (Tr) D. F. Krell, Vol II: *The Eternal Recurrence of the Same*, HarperCollins, San Francisco, 1984. Mircea Eliade, *Cosmos and History: The Myth of the Eternal Return*, (Tr) W. R. Trask, New York, Harper, 1959.

[14]Stoics derived *heimarmene* (fate) from *eiro* (string beads). The slightest uncaused movement (Epicurean *clinamen*) would shatter the cosmos. S. Sambursky, *Physics of the Stoics*, Routledge and Kegan Paul, London, [1959] 1987.

[15]For a precise statement of the general form of this theorem, and its proof, see C. K. Raju, *Time: Towards a Consistent Theory*, Kluwer Academic, Dordrecht, 1994, Chapter 4.

[16]For details, see C. K. Raju, cited above.

[17]The basic reason for this is the possibility of time travel of the second kind, see C. K. Raju, "Time Travel and the Reality of Spontaneity," *Found. Phys.* (to appear).

[18]Instantaneity corresponds to evolution governed by ordinary differential equations (Newton) or hyperbolic partial differential equations (Hilbert-Einstein), or unitary evolution in Hilbert space (Schrödinger). For details of how history-dependence leads to a breakdown of the hypothesis underlying Poincaré's recurrence theorem, see C. K. Raju, *Time: Towards a Consistent Theory*, cited earlier, Chapter 5b.

the past or the future), so that additional knowledge of the state of things at more distant past instants is not any further useful for prediction. History-dependence means that the happenings in the distant past can directly influence the future without the necessary mediation of the present (though we can imagine such mediation if we wish).

As regards current scientific and philosophical thought, the more important thing is the long-lasting influence of Augustine's misrepresentation of Origen. Augustine misrepresented Origen's idea of quasi-cyclicity by eternal recurrence, a notion he condemned by portraying it through an image of Christ being repeatedly crucified. In the same breath, he suggested resurrection as the alternative to transmigration.

> Heaven forbid that we believe this, for Christ having died once for our sins, rising again, dies no more.

Subsequently, the church accepted resurrection, so that this confusion between quasi-cyclicity and eternal recurrence came to be institutionalised by dumping both notions into a category of the 'pagan' idea of 'cyclic' time, to which was opposed the church's idea of 'linear' time. ('Linear' time is an equally confused notion, and what is meant here is Augustine's notion of apocalyptic 'linear' time, rather than the mundane notion of past-linear future-branching 'linear' time, or the physicists idea of time as superlinear 'linear' time: the real line.)

Continuous propaganda by the church, for some 1500 years, has converted this into so deep-seated a cultural prejudice, that it has become a confusing point even in current authoritative scientific opinion about time. One can easily find numerous examples of Augustine's misrepresentation and the resulting confusion in modern-day physics and philosophy of time in e.g. Popper's pond paradox,[19] the tachyonic anti-telephone,[20] or Hawking's chronology condition,[21] or chronology protection conjecture.[22] or the grandfather paradox[23] that seems to obstruct the latest big-science attempts by NASA to build time-machines as the only way to deep-space travel. I do not discuss this confusion here, since I have discussed this in detail elsewhere.[24]

To summarise our answer to the question raised at the beginning of this subsection, the "doctrine of karma and transmigration of souls" is based on a physical picture of quasi-cyclic time. There is nothing in current physical *theory*, which rules out the possibility of time being quasi-cyclic, though sustained religious propaganda against quasi-cyclic time has penetrated the thought processes of various scientific authorities.

1.7 Summary: pictures of time and information poverty

It is clear from the above discussion that time-beliefs are a central aspect of both religious and

[19] K. R. Popper, *Nature* **171** (1956) 538; **178** (1956) 382; **179** (1957) 297; **181** (1958) 402.

[20] D. A. Benford, D. L. Book, and W. A. Newcomb, "The Tachyonic Antitelephone," *Physical Review D* **2** (1970) 263–265. The development of the theory of tachyons essentially ended with this paradox.

[21] S. W. Hawking and G. F. R. Ellis, *The Large Scale Structure of Spacetime*, Cambridge University Press, 1973.

[22] S. W. Hawking, "Chronology protection conjecture" *Physical Review D* **46** (1992) 603–611. Subsequently, Hawking has changed his views slightly, "Space and Time Warps by S. W. Hawking as at 18/10/95". S. W. Hawking, personal communication of 16 Dec 97.

[23] Kip S. Thorne, *Black Holes and Time Warps: Einstein's Outrageous Legacy*, W. W. Norton & Co., New York, 1994. John Earman, "Recent Work on Time Travel" in *Time's Arrows Today* (ed) Steven F. Savitt, Cambridge University Press, 1995, pp 268–310. C. K. Raju "Time Travel and the Reality of Spontaneity", *Foundations of Physics* (to appear).

[24] C. K. Raju, *The Eleven Pictures of Time* (to appear).

scientific thought. Politically motivated changes in the time-beliefs, underlying subsequent religious dogma, have crept into current scientific thinking. The present social context (of industrial/information capitalism) then ensures, in two ways, that these views become widespread.

(a) The widespread scientific illiteracy (information poverty) that is a necessary consequence[25] of the capitalist production process ensures that, in deciding their physical world-view, most people (at least 95%) are compelled to rely upon scientific authority (*sabda*/reliable testimony), rather than a comprehension of scientific theories based on inference (*anumāna*) from the empirically manifest (*pratyaksha*).

(b) Industrial capitalism developed its own closely related view of 'linear' time ('time = money') which decides current lifestyles from birth to death, at least for the Indian elite. With this picture, the object of life is neither deliverance nor heaven, but the object is to maximise the present value of one's lifetime earnings. (Hence the rush for admission to engineering and medical colleges, though most students remain disinterested in engineering or medicine.) I have analysed elsewhere the deeper-seated temporal assumptions underlying this lifestyle; the point here is only that one tends to judge the plausibility of a certain picture of time, by checking the consistency of this picture with the implicit temporal assumptions on which one's lifestyle is based, and this way of making a judgment may not be reliable.

The conclusion is that the possible physical validity of quasi-cyclic time must be re-examined *ab initio*, and not on the strength of this or that authority. If we disregard fiats like those of Popper or Hawking, and misunderstandings like those of Einstein or Benford et al, then there is nothing in the physical theory *per se* which conflicts with the idea of quasi-cyclic time or 'transmigration'. Correspondingly, to understand *kāla* it may be necessary to set aside the weight of current authoritative scientific opinion (and life-style). In particular, to reinterpret Irfan Habib's observation in our present context, the scientifically illiterate victims of the capitalist production process should not make the mistake of imagining that state and media confer authority on scientists in any way that is even remotely 'just', so that the opinion of a socially respected scientific authority, like Einstein, or Hawking, on time has even a slightly greater *a priori* plausibility of validity or even coherence.

2 Time and the grammarians

Since time is so holistic a notion, a mere catalogue of formally expressed descriptions of time would be as inadequate as the descriptions of the elephant by the four blind men: one must at once grasp all of it! So, to understand time, one must ideally start from the core of the philosophy, which is what was attempted above. This, however, presumes some familiarity with various views. Accordingly we will follow an iterative process.

2.1 The definition of time

To emphasize the close connection of time and language, let us begin the next iteration with the view of the grammarians.

Panini[26] says

[25] C. K. Raju, "Mathematics and Culture", cited earlier.

[26] Panini, Ashtādhyāyī, I.2.57. *The Ashtādhyāyī of Panini*, S. C. Vasu, Motilal Banarsidass, New Delhi [1891], 1964.

kalopasarjjane ca tulyam padāni

which has been translated thus: "And a rule for [the meaning/usage of] time (*kāla*) and sequence (*upasarjjana*) is equally [unnecessary]."

Time, after all, is a matter of everyday experience. Any formalisation may run into insoluble paradoxes, so why formalise it by giving a definition? However, in his great commentary (*Vyākarana Mahābhāsya*), Patanjali proceeds to define time.

> That through which we observe the growth and decay of material bodies [murtimān: lit. the material forms of bodies] is called 'time'. That same [time], when associated with an action receives [the name] 'day' and 'night'. With which action? With the movement of the sun. That same [associated action] when repeated several times receives [the name] 'month' and 'year'.[27]

2.2 Bhartrhari's elaboration

In what sense can the growth and decay of material bodies be attributed to time? Bhartrhari[28] explains this with two analogies.

> Just as water penetrates into a water-wheel and drives it, so also it [time] penetrates and drives (kālayati) all parts (kalāh) [of material bodies]; hence it receives the name kāla [time].

Though the very name *'kāla'* derives from this role of time as the driver of the cosmos, one should not extend the mechanical analogy of the water-wheel too far to imagine the kind of fatalistic world-view—the clockwork cosmos—implied by the divine watchmaker so popular with Newton's contemporaries. Hence, Bhartrhari's second analogy qualifies the first:

> Just as the string of a bird catcher both binds and permits the [movements of the decoy] bird, time binds and permits the operation of the universe.

Bhartrhari's commentator, Helāraja[29] explains that a bird-catcher releases a decoy bird by slackening the string. The bird catcher then tugs at the string to make the decoy bird move to attract other birds. But the decoy cannot fly away like a free bird, because it is pulled back. Similarly, the cosmos and all beings in it are caught in the web of time, and undergo creation, growth and destruction.

[27] Patanjali, *Vyākarana Mahābhāsya*, II.2.5. *Patanjali's Vyākarana-Mahābhāsya Tatpurusahnika*, ed with translation & explanatory notes by S. D. Joshi and J. A. F. Roodberger, Publications of the Centre of Advanced Study in Sanskrit, No. 7, University of Poona, Poona, 1973.

[28] Kālasamuddesa, karika 13–15. *The Kālasamuddesa of Bhartrhari's Vākyapadīya (With the Commentary of Helārāja)* (Tr) Peri Sarveswara Sharma, Motilal Banarsidass, Delhi, 1972.

[29] p. 51.

2.3 The two birds

The string restrains, but does not bind rigidly; there is the possibility of a little freedom, somewhat like the possibility of a little providential intervention in Newton's clockwork cosmos; when the string is slack, the bird is free to move this way or that. There is also the potential of ultimate freedom: the decoy may one day snap the thread which binds it. Given Patanjali's reference to 'the material forms of bodies,' the analogy suggests that the decoy and the free bird it attracts are similar to the two birds in the Mundaka Upanishad.[30]

> Like two birds of golden plumage, inseparable companions, the individual self and the immortal Self are perched on the branches of the selfsame tree. The former tastes of the sweet and bitter fruits of the tree, the latter tasting neither, calmly observes....
>
> The fruits here are the fruits of action, the effects of past causes. The body, the material form of *atman*, is bound to the world; it is caught in time and the cycle of cause- effect-cause; hence it undergoes creation growth and decay. When the atman, identifying with Brhman, realizes its true indestructible nature, it is freed from tasting the fruits of its action, it transcends time; it attains immortality (*moksa*, freedom from rebirth).

2.4 Patanjali's crow paradox

Patanjali supplements his definition of time with a paradox, involving another bird—the crow:

> O Crow, you are flying neither in the past nor in the future; and if you are flying now, the whole world is moving; the Himalaya is flying.[31]

Since the crow is flying, the action of flying is not completed, as the present tense signifies, and the flight of the crow is not entirely in the past. Since the action of flying has already begun, the flight is not wholly in the future either. Nor can the flight of the crow be wholly in the present, for in the present there is only one instant, so that the crow must now be motionless like Zeno's Arrow. To say that motion or flight is possible entirely within a single instant is as absurd as saying that the mountain is flying.

'Motion' refers to change of position with time, so at least two instants are required for motion. Both these instants cannot be in the present, nevertheless, the present tense applies to the plurality of these instants. There is only one present instant, but the usage of present-tense covers several instants in the immediate past and future.

2.5 Panini's eleven divisions of time

As Bhartrhari points out, Panini divides time in eleven ways[32]:

> Through activities as adjuncts [*upādhī*-s], [the single entity] time is divided into past, future, and present, [further] divided into [a total of] eleven forms. Among these, past

[30] *Mundaka* 3.1.1. *The Upanisads: Breath of the Eternal*, (Tr) Swami Prabhavananda and Frederick Manchester, The Vedanta Society, Mentor Reprint, 1957, pp 46–47.

[31] *Vyākarana Mahābhasya*, III.2.123.

[32] *Kālasamuddesa*, kārika 37–38.

is of five kinds, future is of four kinds, and present is of two kinds; thus there are [altogether] eleven forms.

His commentator Helārāja further elaborates on the two kinds of present. 'The principal [actual] present is one. The secondary [present] is that which extends into the nearby future and past according to Panini's rule 'vartamānasāmipye vartamānavāda vā'[33] ('For the proximate present, the present tense').

The current Western philosophy of time also recognizes that present may be of two types, a 'real' punctal (i.e., point-like) present, and an extended 'specious' present. As opposed to this, Whitehead[34] suggested that the present should be regarded as really having some duration, so that motion can be present in the present. Though the Bergsonian definition of time as durée, like the definition of time through action, involves what McTaggart called the A-series view of time, this suggestion of a really-extended present is refuted by all early Indian systems of thought, which deny that there can be any succession in the present instant. (Aristotle's doctrine of the non-existence of past and future, which seems an essential aspect of the A-series view, is discussed in greater detail, below.)

3 Discrete vs continuous time

However, underlying Whitehead's suggestion is an idea that has very wide acceptance in current physics and in Western philosophy: the idea that a representation of motion needs the continuum (real line, real numbers.[35] This is, today, also regarded as the standard way to resolve Zeno's paradoxes of motion, such as the Achilles paradox, and Zeno's motionless Arrow is clearly congruent to Patanjali's motionless crow. So, it may help to go a little into the history of the continuum to decide whether the continuum is a 'natural' or valid representation for time.

3.1 Time in Newtonian physics, and calculus with floating- point numbers

Prior to Newton, people like Barrow used spatial/geometric analogies for time—'time is like a line, either strait or circular'—and 'Euclidean' geometry perhaps implicitly presupposed the continuum as Dedekind observed. However, it was after Newton that motion, and physics generally, came to be associated with the infinitesimal calculus. The equations of physics are formulated as differential equations of some sort. Today, the infinitesimal calculus is based on the theory of the continuum. Therefore, contemporary physics presupposes that time is a continuum like the real line.

It is well known that European mathematicians had numerous difficulties with the notion of infinitesimals, just as they had earlier had difficulties with zero. These difficulties persisted until the end of the previous century, when the calculus and the theory of the continuum was first put on an acceptable formalistic footing, after Dedekind's cuts and Weirstrass's attempts through 's and 's to make sense out of infinitesimals. It was only *after* this that Hilbert used the continuum

[33] Panini, *Ashtādhyāyī*, 3.3.131

[34] A. N. Whitehead, *Principles of Natural Knowledge*, p 64.

[35] Adolf Grünbaum, *Modern Science and Zeno's Paradoxes*, Allen and Unwin, London, 1968.

to make sense of the propositions of 'Euclidean' geometry, the very first of which fails otherwise.[36] In all likelihood, these difficulties arose because the calculus, which originated in India using a floating point number system, was imported in Europe along with a foreign epistemology which did not match the then-existing European epistemology of mathematics.

The association of the continuum picture of time with physics, today, is very deep seated, but social constructions are changing, and the underlying number system is bound to change further, with the increasing use of computers, which use floating point numbers rather than the continuum. Neither time nor numbers need be represented geometrically by a continuous line which stretches to infinity both ways; for example, the floating-point numbers in any kind of actual computer (not the idealised Turing machine) are better represented by a circle consisting of finitely many discrete points. This is well-illustrated by bugs in common programs: e.g. in the classical version of the popular computer game Tetris, too high a score (more than 32,678) led to a negative score!

The traditional Indian representation of number is very similar to the floating point representation on a computer, with the difference that rules (e.g. about operation with the non-representable numbers [sunya = zero/infinitesimal/ infinity] are to be implemented intelligently rather than mechanically as in a computer program.[37]

One should not therefore imagine that either the analogy of time with a line or the analogy of an instant with a (structureless) point is automatic, or universal, or a necessary aspect of physics. The analogy is merely a historically contingent fact, related to the traditional Western preference for geometry over arithmetic, a preference which perhaps arose because Greeks, Romans, and Europeans upto the 16th century did not know of good ways to represent numbers and calculate with them. After that time, algorismus texts (i.e. Latin translations of Al Khwarizmi, who translated Bhaskara) became widespread, and it became typical to show a happy Boethius (who used the algorismus way) and an unhappy Pythagoras (who used the old way with counters or jettons or tally sticks) on the cover of European maths texts.

To summarise, time as continuum is not necessarily the 'natural' representation, nor is it the only possible representation, even in current physics. The representation of time by the continuum may be merely a historical accident reflecting the way Europe learnt its mathematics.

To revert to Zeno, his Arrow is actually aimed at the discrete representation of time. The suggested conclusion is that discrete time makes motion impossible and illusory, hence the reality of motion compels the belief in a continuum picture of time. The Achilles paradox then brings out the paradoxical nature of the continuum, to reach the final conclusion that motion is fundamentally illusory.

The Nayyayikas would have disagreed, but some other philosophical schools in India would have agreed with Zeno's conclusion. For example, motion assumes the temporal persistence of the body undergoing motion, and the Buddhists, as seen above, would have denied the persistence of the body (or its 'essence') for even two instants. The following responses are interesting in this context.

[36]For an explanation of the quotation marks, and for why the theory of the continuum is needed to resolve the difficulty with the very first of the theorems in the *Elements*, see, my article: 'How should Euclidean geometry be taught?' in Proc. International Workshop on History of Science: Implications for Science Education, Homi Bhabha Centre for Science Education, Bombay, 1999.

[37]C. K. Raju, "The Mathematical Epistemology of Sunya". In Proc. of the Seminar on the Concept of Sunya, INSA and IGNCA, New Delhi, Feb 1997, which provides also an example of a computer programme concerning numbers not-representable on the machine.

3.2 Samkhya-Yoga and Laplace's Demon

The first is the Sankhya-Yoga view of discrete time. Time, here, is visualised as a sequence of instants, somewhat like a motion picture consists of a sequence of stills. The plot of the film, however, develops not so much in the style of Italo Calvino's novels, as in the predictable manner of commercial Hindi cinema! A knowledgeable person, a yogi, can, with a help of a few scenes, easily reconstruct the entire film! Past and future exist in the sense that the traces of the past and the potentialities of the future inhere in a recognizable way in the present.

This sense is formalised by Laplace's demon: that precise observation of the present enables the demon to reconstruct the past and future, so that 'past and future alike are before its eyes'. It is curious that this view is forced in Newtonian physics for the same reason that time is regarded as a continuum: the formulation of Newtonian physics using ordinary differential equations. Though one conventionally speaks of 'initial data' for an ordinary differential equation, and solves it forward in time, one can perfectly well solve an ordinary differential equation backward in time, so that, in Newtonian physics, both past and future can be reconstructed from present data. Given the supercomputing capabilities of Laplace's demon (which can be fairly assigned to the demon by Popper's test) it is highly debatable whether chaos even serves to make the demon myopic, though chaos does obscure the view of scientific illiterates!

3.3 Is motion a mental construct?

Let us, however, revert to the present issue of concern: the discrete vs continuous nature of time. Vyasa's oft-quoted comment on sutra 52 of Patanjali's *Yogasūtra* is a particularly illuminating description of the discrete view of time.[38]

> Just as the atom is the minimal limit of matter, so the instant (ksana) is the minimal limit of time. Or the time taken by a moving atom to leave one position and reach the next is an instant....two instants cannot occur simultaneously. For it is impossible that there be a sequence between two things that occur simultaneously. When a later instant succeeds an earlier without interruption, there is a sequence. Thus, in the present there is a single instant, and there are no earlier or later instants. Therefore, there is no combination of them. But these instants which are past and future are to be explained as inherent in the mutations. Accordingly the whole world mutates in any single instant.

Vyasa further asserts that the discrete nature of time means that time is a mental construct, illusory like the motion one sees in a motion picture.

> The continuous flow of these [instants] is a sequence. Instants, and sequences of these [instants] cannot be combined into a real thing (vastu). Hours [of forty eight minutes], days of thirty [such] hours and so on are constructs of the intellect (buddhi). Thus, time, being of this nature, does not corresponds to any real thing, but is a structure by a mental process that follows perception or words.

[38] Yoga Bhasya III.52. Translation based on J. H. Woods, The Yoga-System of Patanjali. . . , The Harvard Oriental Series, Vol 17, Cambridge, Mass., 1927, p 289.

3.4 The linguistic resolution of the crow/arrow paradox

Against this background, the crow/arrow paradox may now be elaborated as follows. There seems to be an unstated belief that if motion takes place, it must take place somewhere and somewhen: Zeno's tacit test of reality is that for motion to be real, there must be a unique temporal site for motion. Patanjali's linguistic resolution of the paradox is that this persuasive belief is groundless, since the term motion, by definition, applies to at least two instants of time.

3.5 Discrete vs continuous time or well order vs total order?

To push this insight further, the discrete vs continuum nature of time is, thus, of very limited relevance to Zeno's paradoxes as follows. Whether time is continuous or discrete, a unique temporal site for motion is impossible: motion cannot take place at an instant of time, whether the instants are regarded as a discrete sequence of natural numbers or as points on the real line.

The point is also not that there are gaps between natural numbers, and no gaps between real numbers: after all a non-Archimedean (e.g. Non-Standard) extension of the real number system will show up huge gaps between the real numbers, which need to be filled with an infinity of infinitesimals. The difference is actually this. While both natural and real numbers are totally ordered, only the natural number system is well-ordered. (This ordering is the natural ordering relative to the operations of multiplication and addition, for it is, of course, possible to appeal to a transfinite induction principle like the Well-Ordering Theorem to well-order the set of real numbers.) Consequently, one can find two natural numbers, such as 1 and 2, which are adjacent to each other, since there are no natural numbers between 1 and 2: this is not possible for real numbers, since there is always a real number between any two real numbers, so two real numbers can never be 'adjacent'.

This property of not being well-ordered is hardly unique to the continuum: since it also applies to any dense order, such as that of rationals, or of floating point numbers with arithmetic to arbitrary precision.

From the point of view of the current philosophy of science, the curious thing here is that one cannot discriminate between the two distinct theories (discrete vs continuous time) purely on the principle of falsifiability. Whether one uses the continuum or floating point numbers, any actual empirical prediction will involve computation, so that the theories would have exactly the same empirical consequences. Thus we have a concrete example of two distinct physical theories, the dispute between which can never be settled. From a practical point of view, however, the dispute between discrete and continuous time is, at the moment, largely vacuous.

4 The Nyaya-Vaisesika view

4.1 The reality and continuity of time

Against this background, one may better appreciate the Nyaya-Vaisesika view of the continuity of time and space which does not depend so tightly on the incidental mathematical properties of the underlying number system used to represent time. (This is natural enough since the Nyaya-Vaisesika, refutes the ideas of Sankhya!)

First, however, a quick review of the Nyāya philosophy is in order. The Nyāya system accepts four means of proof (pramana):[39] *pratyaksa* (the empirically manifest), *anumāna* (inference), *upamāna* (analogy), *sabda* (word/testimony). The last is defined[40] as the testimony of a reliable person (such as the authoritative report of an experiment). As already, observed, this differs from the Buddhist and Lokāyata view. The Buddhists reject the appeal to authority, with Dinnaga tersely stating that the reliability of the testimony must either be manifest, or it must be an inference. They also reject analogy as possibly misleading, and accept only *pratyaksa*, and *anumāna*. The Lokāyata ('people's philosophers', materialists) accept only pratyaksa.

The continuity of time and space is expressed aphoristically in the Vaisesika-sutra[41]

> Tatvambhāvena

Time and space are continuous in the sense that they are one. The interesting thing about this is that this one-ness is a way of expressing continuity that is independent of historical contingencies surrounding the origin of the real number system. Though their entity-ness and eternality is established exactly like that of air[42]

> dravyatvanityatve vayuna vyakhyate

they lack the plurality of air. The collision of air with air[43] is a mark of its plurality, which is absent in kāla, dik and akāsa. Thus, the Nyaya-Vaisesika denies the Sankhya-Yoga view that time can have parts, hence it denies that time can be either atomic, or discrete.

The parts of time which we commonly speak of—viz. past, present and future—are not truly parts, but are due to external limiting adjuncts.

Correspondingly, Nyaya-Vaisesika also denies the Sankhya-Yoga view that time is a mental construct. Time, space and aether, are real entities (*dravya*), like air, since their reality and entity-ness is established in essentially the same way. The difference is only that time, space, and aether are not perceptible to the senses, they are not manifest, but their existence must be inferred. The inference is on the following basis.[44]

> the marks of time are posterity (aparam), simultaneity (yugapat), slow(ciram), quick (kshipram) etc.

while[45]

> distant, near etc. are the marks of space (dik).

Hence, though not manifest, time is, and time is one, the divisions into past, present and future being external to it; thus, in the Nyaya-Vaisesika view, past, present and future all exist, even though past and future may both not be perceptible just as distant space is not perceptible.

[39]Nyāya-sūtra 1.1.3. *The Nyāya Sutra-s of Gotama*, (Tr) S. C. Vidyabhusana [1913], Oriental Books Reprint Corporation, Munshiram Manoharlal, 2nd ed, New Delhi, 1975.

[40]Nyāya sūtra 1.1.7.

[41]Vaisesika sutra, in 2.2.8 for kāla, and 2.1.12 for dik, identical with 2.1.29 for ākāsa. *The Vaisesika Sutra of Kanāda With the Commentary of Sankara Misra, and Extracts from the Gloss of Jayanārāyana* (Tr) Nandalal Sinha.

[42]Vaisesika sutra, in 2.2.7 for kāla, and 2.2.11 for dik, identical with 2.1.28 for ākāsa.

[43]Vaisesika sutra, 2.1.14.

[44]Vaisesika sutra 2.2.6.

[45]Vaisesika sutra, 2.2.10.

4.2 The existence of the past

In contrast, Aristotle opined that time barely existed since the past had ceased to exist, the future had yet to come into existence, and the present was but a knife edge without thickness, so that it barely existed in an indistinct way.

Augustine's view of time as subjective develops on this theme of the non-existence of past and future. How can one say that walking along the regular route took twice as long as walking along the short-cut when both refer to the past which no longer exists? Since only the present exists, there can only be 'a present of things past—memory'. One might choose to repeat this experiment, by repeatedly walking along the regular route and the short cut, but that would refer to the future, which is equally non-existent, there being only 'a present of things future—expectation'. The present itself was manifest, which is presumably what Augustine meant when he stated that there is 'a present of things present—sight', but the length of the regular route and the short cut are too long to fit into it.

It was in this context that the general relativistic (B-series) view of an all-existent spacetime manifold came as a shock, since it put present, future and past on the same ontological footing. Hence Einstein consoled Besso's widow by asserting that Besso continued to exist in some sense, and Hermann Weyl made his oft-quoted assertion that 'the objective world simply *is*, it does not happen.'

The movement of time travel from science fiction to big-science, via general relativity, has not helped to ameliorate this shock! The past and future really exist because, general relativistically, one might well be able to build a comfortable time machine to go and visit the past before one's birth or the future after one's death. A time-machine would make the past and future manifest and non-inferential, it would be an improvement on Laplace's demon, without any possibility of chaos obscuring one's vision!

The existence of past and future was seen in a different way by Nyaya-Vaisesika. In the first place, the Nayyayikas would have pointed out that the ontological status of an entity does not depend on its being manifest (*pratyaksa*). The aether (*ākāsa*), for example, is non-manifest, but is yet regarded as existent through a process of inference (*anumāna*).

Thus, Kanāda[46] asserts that

> Existence is that to which are due the belief and usage, "It exists", in respect of entity (*dravya*), attribute (*guna*), and action (*karma*), though existence is different from entity, attribute, and action.

Thus, of the *pancamahābhūta*, Earth exists because[47] 'earth has [visible] form, taste, smell, and touch', water exists because[48] 'water has form, taste, and touch,' fire exists because[49] 'fire has form and touch', air exists because[50] 'air has touch'. But[51] 'these characteristics are not found in aether'. Kanada stated[52] the Sankhya view that 'Egress and Ingress—such is the mark of the existence of ether' and rejects it[53] on the ground that this activity does not infer aether, since

[46] Vaisesika sutra, 1.2.7–8, cited above; subsequently abbreviated to VS.
[47] VS 2.1.1.
[48] VS 2.1.2.
[49] VS 2.1.3.
[50] VS 2.1.4.
[51] VS 2.1.5.
[52] VS 2.1.20.
[53] VS 2.1.21.

activity can have only one substantial cause. He finally asserts his own position[54] 'By the method of exhaustion, [sound] is the mark of aether.'

This is quite similar to the grounds on which we today regard an electron as existent, for an electron is surely not manifest; at best what one can see is a track in a bubble chamber, which we interpret in accord with our most sophisticated scientific theories. Thus, the Nayyayikas would have argued, the past and future may not be manifest, they may not be perceptible by the five senses, but that alone one cannot be used validly to infer that the past and future do not exist. That is, the non-manifest need not be non-existent.

The Cārvakas did maintain that the non-manifest was non-existent. They admitted only *pratyaksa* as the sole means of validation. However, this point of view was ridiculed by arguing that, in the Lokāyata view a wife became a widow everytime her husband left the house! So she should wipe her sindur and break her bangles—clearly this sort of thing would make practical life impossible. Hence, existence can surely be inferred.

Secondly, the Nayyayikas did *not* place memory (*smrti*) on a lower ontological footing than direct sensory perception. Possible errors in recollection are not relevant here, for there could also be possible errors in perception, as when one mistakes a rope for a snake. Similarly, there could be errors in inference because of the wrong use of logic or the use of the wrong logic. Nor is the mind-body distinction relevant here. The relevant thing here is the mind-soul distinction—Nayyayikas did not regard memory as an attribute of mind (*mana*) but of soul (*ātman*). 'Memory belongs to the soul which possesses the characteristics of a knower'[55]

The closest thing to this in Western philosophy is the doctrine that 'all learning is but recollection'. We do not know from where the Greeks initially got this doctrine—Plato's Socrates, in *Meno*, vaguely imputes this doctrine to "they"—however this doctrine was internalised in Greek thought. The most dramatic example was Socrates' demonstration that a slave boy inherently had ideas of geometry, recollection of which could be elicited through appropriate questions by the philosopher playing the role of midwife to assist the birth of recollection. Given the oligarchic nature of Greek society, where most people such as women and slaves were held in low esteem, and given the high-esteem in which geometry was held, the untutored slave-boy's innate knowledge of geometry was taken by Socrates to be a demonstration of the existence of the soul. The underlying belief is the same as the Nayyayika assertion (NS 3.2.43) that 'Memory belongs to the soul which possess the character of a knower.'

Interestingly, while Buddhists and Nayyayikas differ on almost everything, they agree on the existence of the past. The Buddhist belief, however, does not require the existence of the soul to demonstrate the existence of the past. The Buddhists would have argued, that the existence or non-existence of a thing depends on its 'causal efficacy'. The past continues to exist till such time as it has produced its fruit.

The subtle, but hugely important, point here is that, in the absence of a theory of action by contact (*samyoga*), such as that used by Nayyayikas, one may need a theory of delayed action; this at least is the case in present-day physics if notions like the aether or the field are rejected. With a theory of delayed action, some entities in the past, though non-manifest, *cannot* be non-existent, unless we admit that some observed effects may have non-existent causes, an admission that seems absurd. So, the past, though non-manifest, may need to exist.

[54] VS 2.1.27.

[55] Nyāya Sutra 3.2.43.

It is beyond the scope of this article to go into the implications of delayed action for current physics, but (1) we recollect the earlier remark that instantaneity forces Poincaré recurrence, under a wide variety of circumstances, and (2) when Poincaré ultimately denied the existence of the aether (*ākāsa*), in his special theory of relativity, he was forced to go into this question. (Einstein, by the way, did not deny the aether, in the sense of action by contact, since he maintained as late as the Einstein-Podolsky-Rosen paradox that action at a distance was 'spooky'; neither did he recognize any difficulties in the relativistic many-body problem due to delayed action.)

While the physics of delayed action is beyond the scope of the present article, an example from African thought may illustrate what this non-non-existence of the past means. When a person dies, he does not cease to exist, but his existence becomes qualitatively different, till so long as there are people alive who personally knew the dead person. Thus, these persons may have memories of the dead person, and the dead person surely is part of the cause of these memories, and how can a non-existent thing be a cause? When the last person alive to personally know the dead person himself dies, the existence of the dead person undergoes a further qualitative change, and he now exists only in the collective memory of the tribe.

4.3 The paradox of the absent present

Quite contrary to Aristotle's view, we find in the Nyāya Sūtra an opponent's position in which the existence of the past goes unchallenged, but the existence of the present is questioned. The Arrow paradox suggests that motion is impossible, the paradox of the absent present suggests that the present itself is impossible! This is stated as the *pūrva paksha* by Gotama.[56]

> The present is absent. For when a thing falls there is only the past time through which it has fallen, and the future time through which it yet has to fall.

Vātsyāyana, in his commentary, elaborates by taking the 'thing' to be a fruit. When a fruit falls, there is the space through which the fruit has fallen, and the space through which the fruit has yet to fall.

Today, this analogy immediately suggests the weakness in the *pūrva paksha*, for there is very clearly the space which the fruit *now* occupies. Take that away, and there would be no fruit at all! However, in imagining this, we are imagining, along with Zeno that at each instant of time the fruit is actually motionless at a point of space, and that the very reality of the fruit depends on this!

The *pūrva paksha*, however, is refuted differently by Gotama and Vatsyāyana. Gotama's reply is as follows.[57]

> If the present be absent, there will be no past and future either, for they are related to it, and their existence cannot be established by mere mutual reference. Further, in the absence of the present, sense perception of the empirically manifest [*pratyaksa*] would be impossible, so knowledge would be impossible [since the empirically manifest is the basis of knowledge]. We know the past and future [only] through [inference from] the present, for we conceive a thing as made or as about to be made.

[56] Nyāya Sutra 2.1.39.
[57] Nyāya Sutra 2.1.40–43.

Vatsyāyana's response is that the objector has missed out the intrinsic dynamism of time by spatialising it.[58]

> In reality time is not be conceived using spatial relations; rather it is manifested through action. Time past corresponds to actions which are completed, and time future to actions which have not yet started, but neither would be intelligible without our understanding of what it is for a act to be going on, and the time at which they are going on now is the present.

This seems to be a view contrary to Patanjali's crow paradox, and along the lines of Whitehead's extended present which provides a locus for motion/action.

5 The Advaita-Vedanta view

Vatsyayana's refutation of the *pūrva paksha* involves a key point that has been the focus of the 20th century philosophy of time, under the name McTaggart's paradox.[59] McTaggart points out that there are two ways of conceiving of time: dynamically (A-series view) or statically (B-series view). Each event has three A-determination: it was future, is present, and will be past. One can also conceive of these statically: each event has a certain relation of futurity, simultaneity, or pastness relative to other events. McTaggart argued that (a) the A-series view was fundamental to time, since there would be no change without an A-series, and (b) that the A-series involves an infinite regress since an event has all three A-determinations. We cannot escape from the paradox in the obvious way by saying that the successive A-determinations are at successive instants of time, for instants of time are equally events and so have the three A-determinations themselves. Hence the conclusion that time is unreal.

This last conclusion clearly suits the Advait Vedanta position: empirical time may be quasi-cyclic, but in an ultimate sense time is unreal. SriHarsa, in his *KhandanaKhandaKhādya* reaches a similar position. As the title of his book suggests, SriHarsa's objective was to destroy the opposing Nyāya-Vaisesika position—quite precisely, to chop it up into little bits and devour it! He aimed to do this using the tools of Nyāya. The Nyāya maintains that time is real, and SriHarsa aimed to demonstrate that it had contradictory properties, and so was unreal. He begins by questioning the meaning of past, present and future.

> In the definition of Cause it has been stated that the cause should invariably be earlier than the effect; and here the world earlier is meant to exclude the present and future times; now we have to consider what is the earlier time which excludes the other two. As a matter of fact, however, no consideration or examination of this is possible... for what after all is the subject of the notion of 'present' and the rest? for is this division of time something intrinsic or adventitious.[60]

He, then, argues, like McTaggart, that any attempt to provide a meaning to these notions leads to an infinite regress.

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[58] Vatsyāyana, *Nyaya-Sutra Bhasya*, 2.1.40–43. See also K. H. Potter, *Encyclopaedia of Indian Philosophy*, Vol II, p 252.

[59] R. M. Gale, *The Philosophy of Time*, Macmillan, London, 1968.

[60] *Khaṇḍanakhaṇḍakhādya*, IV.139. (Tr) Ganganath Jha, Vol II, Sri Satguru Publications, New Delhi [1911], 2nd ed 1986.

> What you say is quite true; but as a matter of fact, 'when the connection of the circumstances with the Time is actually here, we have the idea of "present"; when that connection is destroyed we have the idea of "past"; and when that connection is yet to come we have the idea of "future".' This also is not right; as in your expression 'is there' if the Present tense is meant to be significant, then it comes to this that you seek to explain the notion of the 'present' by means of the idea of the present; so that you must land yourself either into self-reference or an infinite regress.[61]

He concludes that

> With all this, however, there must be some difference among the several points of time; as it cannot be denied that people have the conception of past, present, and future. And thus the existence of some sort of difference, in a general way, being an established fact, if we are unable to determine what that exact difference is, all that this can justify us to do is to say that the exact nature of the difference is doubtful. This is not right, we reply; as you cannot explain the exact nature of Doubt either. . . .

[61] KKK IV.142.

6 Appendix: The Structure of Time

Physics has aspired to be the standard of universal knowledge for the last couple of centuries, and the way in which the equations of physics are formulated assumes that time is such that it can be naturally represented by the real line. (Therefore, many physicists have argued that the only philosophical problem about time is to fix its direction.) On the other hand, to speak of different kinds of cause-and-effect relationships, such as those involved in *karma-samskāra-moksa* or *paticca-samuppāda-nibbāna* one needs to introduce the possibility of different structures of time: time may be like a line, or it may be branching, or it may be like a circle etc.

6.1 The structure of time and the before-after relation.

These different structures of time may also be seen algebraically in terms of the before-after relationship, though it is not obvious that the before-after relationship can at all be characterised by a *binary* relation, as in ordinary language.

There is a certain subtlety involved in this representation of time by a before-after relation. In McTaggart's terminology, this is a B-series representation, for it takes a "static" view of time, imagining that events in time are laid out before us. Accordingly, various philosophers have felt obliged to give an A-series formulation, where the formalism proceeds without assuming that future events already exist. It is interesting that this can be done. But the A-series formulation is rather more complicated. (And the complications are compounded by Prior's use of Polish logical notation which few non-specialists understand; when I once attempted to present the logic of quantum mechanics in this notation, at a physics conference, nobody at all understood what I was saying.) Moreover, formalistically, this ontological punctiliousness makes not the slightest difference, for one formalism can always be translated into the other. So I will stick to the order-relation formulation in what follows.[62]

The other subtlety involved is that if time is like a circle—supercyclic in my terminology—then a binary before-after relationship is, in principle, inadequate.

Accepting that the before-after relationship may be represented by a binary relation, what are the properties of this binary relation—for example, is it a total (linear) order? does it admit a least element or a greatest element? etc. Algebraically, the order relationship of natural numbers is something so basic that it is taught to children in the Kindergarten. And anyone can readily answer these questions about the order relation in numbers. But in relation to time these are hardly trivial questions. The key point is that time may well have a non-trivial structure. A non-trivial structure of time is incompatible not only with the present-day formulation of physics, but also with Aristotelian logic.

(a) Changing the structure of time may change the formulation of physics. Thus, the present-day formulation of physics as differential equations necessarily involves the notion of a derivative with respect to time. For example, Newton's second 'law' of motion and its generalisation to special relativity[63] involves acceleration which is the second derivative of position with respect to time. Similarly, the Schrödinger equation involves a derivative of the state function with respect to time. Anyone with knowledge of the elementary calculus will readily see that this notion of a derivative with respect to time involves the notion of limit, and presumes that time may be represented by a

[62] A. N. Prior, *Past, Present and Future*, Clarendon, Oxford, 1967. N. Rescher and A. Urquhart, *Temporal Logic,* Springer, Wien, 1971. W. H. Newton-Smith, *The Structure of Time*, cited earlier.

[63] e.g. J. L. Synge, *Relativity: the Special Theory*, North Holland, Amsterdam, 1956.

real variable. (The Hilbert-Einstein equations, in general relativity, also assume this, though they do not single out time in the manner of the other formulations.) This representation of time by a linear continuum assumes that there is a binary order relation between instants of time, but that this binary order relation, exactly like the order relation in real numbers, is a dense, total order. If that were not the case, if for instance there really were forks in time, then it is clear that physics would need to be rethought. (I have argued elsewhere that if one does not admit the possibility of such forks in time, then the demarcation and validation criteria for physics, such as refutability, must fail.)

(b) Changing the structure of time may change logic. Consider a structure of time involving both a fork and a join—a closed timelike curve or a loop in time. This is not a frivolous speculation, but a physical possibility, that may be inevitable. Even Stephen Hawking whose theories are based on a complete denial of closed loops in time has been forced to admit the possibility of such closed loops in time at least at the level of microphysics.[64] But it is not necessary to go into the physics of the situation here, and one can look upon the fork-and-join as representing a hypothetical possibility. Each point on the diagram may be regarded as representing a logical world: in the Wittgensteinian sense of 'all that is the case.' The difference is as follows. We see that time forks at the beginning of the loop. But these separate worlds do not go their independent ways: they rejoin each other in the future. Between the fork and the join, how should one express the state of the real world? Suppose that for some reason, such as the desire to be able to measure time,[65] one were to parametrise time (the dotted line in the diagram). What, then, would be the state of the real world at one 'instant' of time (i.e., for a given value of the time parameter)? It is easy to see that, under these circumstances, the state of the real world at an 'instant' of time cannot be captured by a single Wittgensteinian world, but that at least two such worlds are needed. For the simplified situation sketched in the diagram, two worlds are enough. Let us call these two worlds W1 and W2. Then it may happen that it is the case in W1 that p, while it is the case in W2 that not-p. In other words, Schrödinger's cat may be both alive and dead at a single instant of time.

There is nothing unusual in this so long as we regard the worlds W1 and W2 only as possible worlds. In that case we may know, for instance, that the cat is alive at the fork, that it is dead at the join, but we do not know what happened in-between so that in-between the cat could have been either alive or dead. But in speaking of a non-trivial structure of time, we are speaking of the possibility that both the worlds W1 and W2 are 'real', i.e., that the real world is such that its state at an 'instant' of time cannot be modeled by a single logical world, but that at least two such worlds are needed. Alternatively, one may say that the real world is such that 2-valued logic (or even a truth-functional logic) is not suited to describe it. In either case, admitting a non-trivial structure of time amounts to admitting the possibility that in the real world both p and not-p may be true at a single 'instant' of time. This may seem unlikely at the mesophysical level of everyday experience, with which philosophers typically deal, but there may be no escape from this in the microphysical domain.

For example, consider spontaneous creation and annihilation of an electron-positron pair. A positron may be regarded as an eletron going back in time, as in the well-known Stueckelberg-Feynman interpretation. Thus, the fork and join appear as a spontaneous event; instead of multiple

[64] S. W. Hawking, personal communication, cited earlier.

[65] After the theory of relativity, all measurement in physics is time measurement, since both length and mass can be measured (only) with a (proper) clock. See e.g. J. L. Synge, *Relativity: the General Theory*, Amsterdam, North Holland, 1966.

worlds what we observe are multiple object, since the given object (electron) appears as two different objects (electron and positron), and the properties of these objects seem different, because the same object seems different when it is travelling back in time. Though this kind of physical schizophrenia is harder to imagine for cats, changing the structure of time in microphysics may have unexpected mesophysical consequences, concerning e.g. the fundamental physical characterization of living organisms.

Setting aside the physical question of the likelihood of such alternative structures of time (as judged from everyday experience), let us hypothetically accept for a moment that the world is really like that: that it empirically is the case, in some situations, that both p and not-p. Then the world cannot be described by two-valued logic any more than it can be described by Euclidean geometry. That is, the nature of logic is not an *a priori* matter, as in Aristotle or in Thomist rational theology, but depends upon the empirical nature of the world, and specifically on the nature of time. If the nature of time is an uncertain physical matter, rather than a metaphysical certainty, so is the nature of logic.

If the logic applicable to the real world is not certain, then neither is deduction: for what one can validly deduce depends upon the logic used for the deduction. For example, an arbitrary q may be deduced from "p and not-p" using a 2-valued logic, while this is not the case with a quasi truth-functional logic. Thus, a non-trivial structure of time goes against a very central and fundamental tenet of Western philosophy—the belief in the universality of (2-valued) logic and the accompanying belief in the certainty of deduction.

To summarise, accepting a different structure of time may requires us to review all of physics and philosophy. Nevertheless, one must be prepared for this fundamental confrontation, for the particular kind of cause-effect relationship, underlying the notion of *moksa, nirvana* etc., cannot be understood without an understanding of the underlying belief in a quasi-cyclic structure of time both in the large and in the small.