The Harmony Principle

C. K. Raju

Abstract

Ethics is central to Philosophy. Upanisadic and early Buddhist thought took values seriously. More recent Indian philosophical practice, this author argued with Daya Krishna, abandons this focus, and fails to engage moral questions with the same creativity, falling either into a repetition of utlitiarianism or into a purely religious understanding of ethics. Krishna objected strenuously to the idea of ethics as an imposition of order on human life, seeing ethics rather as an enrichment and freeing of human life from constraint. **In this essay, it is argued that ethical models are anchored in beliefs about the nature of time.** Drawing on ideas from the mathematical foundations of physics and evolutionary biology, an ethic of spontaneity based on the principle of harmony is proposed — an ethic that is neither utilitarian nor religious in the usual sense. Taking seriously Krishna's objections to the use of the word "order," the present essay instead defends a notion of ethics as instituting a kind of "harmony," a metaphor borrowed from Western music theory, to explain the underlying physics of time.

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The Harmony Principle

C. K. Raju
AlBukhary International University
05200 Alor Setar, Malaysia
ckr@ckraju.net

1 Introduction

The late Professor Daya Krishna was a prolific correspondent. He loved to carry on *samvād*, whether in everyday conversation, or through letters, or more formal articles in the *Journal of Indian Council of Philosophical Research*.

I once wrote to Daya ji about what seemed to me a paradox in contemporary Indian philosophy. It is one thing that Indian philosophers in the academia do not engage with science, or even with its history and philosophy. It is quite another thing that they do not engage with ethics. Ethics, after all, is at the core of philosophy. Without an ethical principle one often does not know how to respond to something fundamentally new, such as the bewildering variety of new developments in science and technology which impinge on our daily life. I was disappointed that Indian philosophers remain engaged in studying Spinoza, Kant, Hegel and the like, or they were immersed in Sanskrit texts—neither of which provide much guidance about new developments. Few Indian philosophers have been willing to address such philosophical problems of mundane life in contemporary times. When a new law is passed by parliament, such as the Cyber law, no one considers it necessary to consult any Indian philosopher to ask whether the law would be compatible with contemporary Indian ethics. However, it would be regarded as inexcusable if our lawyers failed to consult similar laws formulated abroad—which formulation might well have assumed altogether another ethical context. Philosophers seem to have made themselves irrelevant to our society.

So I wrote to Daya ji complaining that Indian philosophers had never put forward a normative ethical principle. How could there be any sort of real philosophy without ethics, I wondered?

In his usual way, Daya ji responded promptly. He said that one Banerjee had proposed a normative ethical principle in 1935. That response addressed only my statement, but not the issue I had in mind. Indeed, my letter to Daya ji was in the context of my book *The Eleven Pictures of Time*.[1] That book dwells on the latest military strategy propounded by Huntington after the Cold War. That strategy overtly aims to promote Western dominance by expanding

its "soft power"; it aims to control all human behaviour by inculcating in people a desired set of values.

The use of values as part of military strategy is a novel and dangerous idea, but it is a natural extension of the idea of using religious beliefs to achieve political dominance.[2] This process of inculcating values or conditioning (as in the Pavlovian conditioned reflex) is cynically seen as a process akin to programming a computer. Just as a computer can be made to behave in any desired way by means of a program, so also humans can be conditioned to behave in a desired manner by means of values inculcated at an early enough age. Now, I have no doubt that human beings are not machines, and that it is possible for individuals to ask awkward questions, and thereby transcend their past indoctrination. However, statistically speaking, this seems to happen only occasionally: few individuals I know ever manage to get rid of what they were taught in childhood. And, so far as Huntington is concerned, in a situation of electoral democracy, a 50% success rate is good enough!

My other concern was that the non-West, in general, and Indian philosophers, in particular, have had no say in the formulation of these values. In the absence of an autonomously generated ethic, there is nothing to prevent people from being swept away by the pressure of peers and propaganda, as indeed seems to be happening today. After a dozen years of peer pressure in schools, which reinforces the propaganda from TV, the dreams of children mainly seem to revolve around possessing the latest piece of Western gadgetry. To fulfil these consumerist dreams, they aspire to sell most of their lives as wage slaves, doing things they do not particularly like doing.

As already stated, there can be no *swarāj*—no freedom or autonomy in any real sense—until one has reflected upon the values around which one bases one's life (or the Constitution of the country). But Indian philosophers (at least those formally engaged in the study of philosophy in our universities and institutions of higher learning) have reflected and written far too little on any of this.

2 Time and ethics

Given the philosophical vacuum about ethics, most people in India get sucked into one of the two widely-prevalent ethical models. Capitalism provides one model, and various religions provide the other.

Capitalism is often confounded with "materialism" etc., but is better understood, in this context, through utilitarianism.

The utilitarian principle: act so as to maximise the expected present value of lifetime utility.

Capitalism redefines the ordinal notion of "utility" in cardinal terms as money. Consequently, those people who follow the capitalist ethic, spend their lives maximising the present-value of lifetime earnings. In a word they maximize profit.

Accumulated earning, or wealth, is displayed through consumption: which is hence the socially-accepted index of virtue. The more one consumes, the

more virtuous one feels. Any sort of environmentalist ethic which seeks to modulate consumption without challenging this fundamental capitalist value is futile, perhaps deliberately so.

The other sort of ethical model is that provided by various religions. Now, as Toynbee remarks,[3] the pith of religion is not belief, but participation in ritual performance. That is, the one who goes to church, temple, masjid, or gurudwara is readily recognized as a "good" Christian, Hindu, Muslim, or Sikh, and that is quite compatible with consumerism.

This is a far cry from opposite value of non-acquisition and minimal consumption or austerity which goes back to the asceticism inherent in, say, the Buddhist tradition of *bhikkus* or the Jain principle of *pratyāhāra* or similar ideas of *tyāga* or non-attachment in Hinduism and Sufism—ideas which were propagated by Mahatma Gandhi and were widely prevalent until barely 50 years ago.

To what can one attribute this change? At the level of beliefs, beliefs like hellfire and brimstone, or doomsday, which once induced people to accept religious values and become virtuous (as in "God fearing") have fallen into disrepute since they are seen as being unscientific. This is a bit paradoxical, since Western philosophers have repeatedly maintained that values are independent of facts, so science ought not to have any bearing at all on values. However, in practice—and values are all about practice—a value system is not merely a bunch of deontified postulates divorced from facts, for it has to be credible. And the credibility of various religious systems of values depends upon the belief in the validity of the underlying facts: if there is no hell or hereafter, there is no particular need to accept the the related values conventionally labelled as good.

At a deeper level, in my analysis, values flows from beliefs about time. This is what I tried to bring out in *The Eleven Pictures of Time*, and this was the topic on which I wanted to initiate a *samvād*, first with Daya ji, and then with all Indian and Western philosophers.

Consider, for example, the ethic of *karma-samskāra-mokṣa* in the Upaniṣads,[4] which is central to all Indian philosophies, and ought to be studied as Daya ji used to emphasize. This ethic is situated within an underlying belief in a recurrent cosmos. The interpretation of this ethic as "spiritualism", by orientalists like William Jones et al., is incorrect for it confounds the Western notion of soul (which is metaphysical, post-Augustine) with the Upaniṣadic notion of *ātman*, which is a physical belief.

Thus, *mokṣa* is deliverance from the cycle of birth-death-rebirth. The rebirth is not something that takes place here and now—it is a situated in a cosmological context, for individuals are believed to be reborn billions of years later across a cycle of the cosmos.[5] Not only individuals, but all events in the cosmos approximately repeat, somewhat the way in which each routine day is approximately a repetition of the previous one.

This cosmological belief may be true or false, but it is a physical belief, not a spiritual or a metaphysical one, since it is refutable. It is easily possible to conceive of a cosmos which is not like that, so it is certainly logically refutable in the sense of Popper. (It is also empirically refutable as would be clear later on.)

Therefore, one needs to understand this belief from the perspective of physics, not the "spiritual" perspective of orientalists.

In physics, today, cosmology is done using general relativity. That provides us with three basic cosmological models known as the Friedmann models (all beginning with a bag bang). Which model corresponds to the real cosmos depends upon the amount of matter in the cosmos. If there is enough matter, we get a closed Friedmann model—a cosmos which oscillates. Such a cosmos, which merely goes through phases of expansion and contraction, must be distinguished from a (quasi) recurrent cosmos, described above, in which, in each cycle of the cosmos, events similar (but not identical) to those in the preceding cycle repeat. For this to happen, the so-called "arrow" of time must turn around (like a boomerang).

I cannot overemphasize that it is a very dangerous source of confusion to refer to this situation as "cyclic" time, "eternal return" etc. To distinguish a recurrent cosmos from (a) a simple oscillatory model, and also from (b) a situation of "eternal recurrence", it is better to call this "quasi-cyclic time". The difference between quasi-cyclic time and the incoherent notion of "cyclic time" is explained in detail in my book *The Eleven Pictures of Time*, starting from the very title, which opposes the linear-cyclic dichotomy by using 1 and 1 to make 11 instead of 2.

Astonishingly, a recurrent cosmos is perfectly possible on current physics. In fact, on Newtonian physics, recurrence is inevitable if the cosmos is closed: any microstate of the cosmos would then recur to any desired degree of approximation. This is the substance of the Poincaré recurrence theorem. As I have shown, a suitably generalised form[6] of this theorem applies to any kind of deterministic evolution. That includes general relativity with the geodesic hypothesis. In fact, recurrence applies also to probabilistic evolution, as in a Markov chain, as used by Nietzsche. (I should add parenthetically that though my own reformulation of physics[7] rejects all the formulations—Newtonian physics, general relativity, and stochastic Markovian evolution—and though it is non-deterministic, it still does not rule out a recurrent cosmos, though this recurrence need be neither eternal nor exact.)

Anyway, since the Upaniṣadic notion of *ātman* is anchored in such a physical belief about quasi-cyclic time,[8] it is equally a physical notion. Therefore, it is problematic to translate "*ātman*" as "soul", which is a prime example of something metaphysical in Western tradition. The centuries of propaganda about Indian "spirituality" are based on the wrong association that this translation encourages. Even if "*ātman*" is translated as soul, it should always be understood that a different (and physical) notion of soul is being referred to. The ethic of *mokṣa* (or the expanded and grassroot level ethic of *dharma-artha-kāma-mokṣa*) is an entirely pragmatic recommendation provided those physical beliefs are accepted.

To summarise, the Upaniṣadic ethic is anchored in a physical belief. This is a belief about the nature of time: that the cosmos is (quasi) recurrent or that time is quasi-cyclic. This belief though a physical (refutable, falsifiable) belief is not necessarily a false belief; though refutable, it is not already refuted

by present-day physics. The desire for *mokṣa* or deliverance is what naturally follows, from a completely pragmatic viewpoint, if the underlying physical belief about the cosmos or the nature of time is granted.

I have argued that this relation of values to time beliefs applies also to a variety of religions, and to the utilitarian value principle.

For example, quasi-cyclic time, and ideas very similar to *karma-samskāra-mokṣa*, were very much a part of pre-Nicene Christianity, as stated by Origen, its most outstanding exponent. In his *De Principiis*, Origen was quite explicit that cosmic recurrence was neither exact nor eternal.[9] He also understood this *karma-samskāra* or deeds-retribution as a means to support equity and justice.[10] All were born equal to begin with (showing God's belief in equity), and were accorded different stations in life according to their deeds (showing God's justice).

Origen's view is entirely contrary to two current stories (a) that Christianity believes in "linear" time, opposed to "cyclic" time, and (b) that *karma-samskāra* is a doctrine of inequity and injustice unique to Hinduism. It is necessary to point this out because, unfortunately, even numerous academics go by such myths relying on their social acumen to guess what is "credible", and without the discipline of checking things out.

After aligning with the state, there was no way the post-Nicene church could accept non-Christians on par with Christians (any more than the state can accept non-citizens on par with citizens). Therefore, the church was now fundamentally opposed to equity, and hence it hailed Augustine's doctrine of inequity, according to which God would put non-Christians in hell for eternity after death, as described by Dante,[11] creating a permanent and eternal separation between Christians and non-Christians. This transformation from the value of equity to inequity was engineered through a shift in time beliefs from Origen's quasi-cyclic time to Augustine's apocalyptic time (which, incidentally, is not refutable, since doomsday has been round the corner for ages). It is this transformation from a physical belief (quasi-cyclic time) to a metaphysical one (apocalyptic time) which made the soul metaphysical in post-Nicene Western thought. That is, the pre-Nicene ethic and the post-Nicene modification of the Christian ethic both related to time beliefs.

In the process of modification, Augustine used the theological trick of misrepresenting Origen: he confounded Origen's idea of quasi-cyclic time with the "Stoic" idea of eternal recurrence.[12] On this ground, Justinian and the 5th Ecumenical Council cursed Origen, and the "doctrine of pre-existence".[13] It is remarkable how this misrepresentation has stuck: in over 16 centuries since Augustine, the West has repeatedly (mis)understood any kind of recurrence to mean "eternal recurrence". The purported dichotomy between "linear" and "cyclic" time encourages this blind spot in Western thought. As Mircea Eliade put it, the work of leading poets such as T. S. Eliot, and writers such as James Joyce is "saturated with the nostalgia for the myth of eternal repetition".[14] Philosophers like Nietzsche,[15] and scientists like Newton[16] and Hawking,[17] too, have confounded any sort of cyclicity with "eternal return". In current discussions of the grandfather paradox of time travel[18] one repeatedly encounters

the same mistake. Confusion about recurrence seems eternally recurrent in the West!

Note that people like Newton and Nietzsche were extreme opponents of the church establishment. So it is a terrific intellectual victory for church propaganda about time, that it could derail even the most thoughtful of its opponents in this way. In my terminology, the substance of this propaganda is that quasi-cyclic time has been misrepresented as supercyclic time by deceptively lumping both into an ill-defined and incoherent category of "cyclic" time (which is seen to be dichotomous with an equally incoherent notion of "linear" time). Because this has been such a long-term source of confusion in Western thought, I reiterate that unlike the ill-defined and incoherent of "cyclic time", and "linear time", quasi-cyclic time is a physical belief, regardless of whether it is valid or invalid.

The linkage of time perceptions to ethics applies also to Buddhism. The relevant notion of time here is the notion of "*paticca samuppāda*", an understanding of which was equated by the Buddha with an understanding of the *dhamma*. This is a deep and tricky point about Buddhist ethics, and I hope the physical sense in which I understand *paticca samuppāda*[19] will be clear by the end of this paper.

We can also see how time relates to ethics in Islam. Al Ghazāli's notion of ontically broken time[20] (imprecisely but catchily called occasionalism) relates directly to the ethic of surrender to Allah, which is at the heart of Islam. Through the Sufi and Bhakti traditions, such time beliefs are still widely prevalent in India. The relation of time perceptions to ethics is so clear, and so readily understood even at the level of popular Hindi cinema (e.g. *Waqt*) that, despite some tricky points involved, it does not call for further comment before an academic audience.

The utilitarian ethic too relates to time beliefs. As I have already discussed this elsewhere[21] I will only recapitulate some points. The capitalist ethic assumes that the future can be rationally calculated. This is a fundamental assumption, intertwined with the notion of deferred consumption: children study now, and sacrifice their desire to play, just so that they can earn more later. If rational calculation of the future were not possible, or practicable, this would be a very foolish thing to do. With ontically broken time (or occasionalism, or providential intervention), it is not possible to calculate the future. So, the capitalist ethic requires a belief in a world which evolves in an orderly way according to some "laws" (instituted by some god, as opined by Aquinas, and as made known to ordinary mortals by his scientific prophets like Newton).

This belief (in the predictability of the future) is *prima facie* contradictory with the other belief underlying the utilitarian principle, namely that rational (or irrational) choice is at all possible. For if the world does evolve according to orderly laws alone, and human choices play no role in determining the future, then Laplace's demon can obviously calculate the entire future (including the choices one would make). This is basically a conflict between two distinct notions of time, "superlinear" time (according to which the future is decided by some 'laws") and mundane time (according to which one's actions and decisions now create a certain future, as one believes in everyday life). However, clubbing

both pictures of time into one incoherent category of "linear time" allows one to use either picture of time as convenient, and to argue that the determinism associated with superlinear time (which enables the future to be calculated rationally) is compatible with the human freedom associated with mundane time (which enables us to choose to bring about a particular future).

Then there is the peculiar assumption that the utility of future consumption can be discounted at the prevailing bank rate of interest! (If not, it is not clear what discounting rate to use or how to calculate "present value".) Further time beliefs underlying utilitarianism are elaborated in my book. (For example, there is a specific belief about the lifetime of an individual. Thus, Buddhists might argue that the child is a different individual from the adult, therefore, forcing the child to forgo play to the advantage of the adult is unjust to the child.)

Here I will only summarise the big picture: ethical models in common use (both utilitarian and religious) are anchored in beliefs about the nature of time. The acceptability of the ethical model depends upon the credibility of the underlying beliefs about time, which is usually decided by reference to existing science.

3 Science, religion and time

The other part of my thesis is that a new science is needed since religious beliefs have penetrated into existing science through the notion of time which is at the interface of the two. One way in which this happened is through mathematics on which science is based. Thus, the Western cultural belief that mathematics involves eternal truths goes back to the idea articulated by Plato and Proclus that mathematics is best suited to mathesis (or recollection of knowledge that the soul had in past lives) because mathematics concerns eternal truths which most easily arouse the eternal soul.[22] Though the notion of the soul had changed, this belief persisted in Christian rational theology.[23] This belief is, of course, quite different from the Indian philosophy of *gaṇita*,[24] and is misplaced even in the context of present-day formalism.

The penetration of cultural beliefs into science is clearly problematic. We already saw above the contemporary attempt to control human behaviour by modifying values, and we saw how time perceptions were modified to modify values. But time is also at the base of scientific thought. So, this modification of time perceptions affects science (and we saw some preliminary examples above). The problematic part is that science is believed to be universal, so that makes some values seem more credible, especially to the scientifically illiterate.

Understanding the entire chain of influence makes for a long story. To cut it short, I will start with Newton, for, Newtonain physics is easy to understand, and, on another common myth, that is where science began.

At the beginning of Newton's *Principia* we find the famous quote about time: "Absolute, true, and mathematical time... flows equably without relation to anything external..."[25] Note the three adjectives, "absolute", "true", and "mathematical". To eliminate any residual doubt, Newton adds the clause

about "without relation to anything external". Clearly, the time that Newton discusses is metaphysical, and not physical—for something which has no regard to anything external cannot possibly be a physical entity. How did this metaphysical notion of time come to be at the basis of Newtonian physics? Why did Newton feel compelled to make time metaphysical? As I said, this is a long story. This concerns Newton's attempts to understand the Indian calculus,[26] and assimilate it with his religious beliefs that (a) God ruled the world with eternal laws (as maintained by Aquinas), (b) that these laws, since eternal, must be written in the perfect language of mathematics, and (c) that this perfection was only possible in metaphysics, and never physically. Briefly, Newton made time metaphysical because he thought this made calculus perfect and met Descartes' objections that it was not rigorous.

Of course, this is incorrect. To make the calculus rigorous one does not need either Newton's fluxions or formal real numbers. For example, calculus can be done perfectly well over the field of rational functions. This is a so-called non-Archimedean field since it is larger than the field of formal reals, which is the largest ordered field to have the Archimedean property. Briefly, infinities and infinitesimals exist in any non-Archimedean field so that limits are not unique, unless we discard infinitesimals. (This was the way the calculus actually developed in India; polynomials were called unexpressed numbers, so that rational functions entered naturally as unexpressed fractions.) This process of zeroing or discarding infinitesimals involves a philosophy of mathematics different from formalism, for the notion of infinitesimal is not God-given as 18th c. Europeans mathematicians like Berkeley took it to be (in stating his objections to Newton's fluxions). Nor is the notion of infinitesimal necessarily Robinson-given, as in non-standard analysis: infinities and infinitesimals in a non-Archimedean field are "permanent" and do not enter merely at an intermediate stage. In the other direction, this philosophy of zeroism can also be used to do calculus over a finite set of numbers (smaller than the continuum) as in calculus done with floating point arithmetic using computers, which suffices for all practical applications (and is rigorous with the philosophy of zeroism, though not with formalism). In any case, a particular mathematical (mis-)understanding of the calculus ought not to be used to decide the nature of time, the way Newton did.

In making time metaphysical, Newton took a retrograde step, for his predecessor and mentor Barrow had quite explicitly poked fun at Augustine, indirectly calling him and his followers "quacks" for evading a physical definition of time.[27] Barrow had proposed the even tenor hypothesis for physical time: "equal causes take equal times to produce equal effects", in a meaningful way. However, Newton applied "even tenor" to mathematical time where it was meaningless, though it appealed to his religious predilections. Consequently, Newtonian physics lacked any physical definition of "equal intervals of time".[28]

This had serious percussions for Newtonian physics. Newton's second "law" of motion is today regarded as a definition of force. However, it is bad definition, for the right hand side (i.e., the rate of change of momentum) is undefined in the absence of a physical definition of equal intervals of time. Consequently, as Popper[29] rightly pointed out, some (refutable) physics can be extracted from

Newtonian physics only by eliminating time (e.g. planetary orbits are ellipses instead of Galilean parabolas). Note that the reversibility of Newtonian physics is directly contrary to the irreversibility of aging which is a part of mundane experience, but here falsification is avoided by the usual tricks of "saving the story", in this case, by passing on the burden to thermodynamics to reconcile observed irreversibility with the time reversibility of Newtonian physics.

To go on with the original story, with the advent of Maxwellian electrodynamics, time entered into physics in an essential way. If we somehow define a measure of time so as to make Newtonian physics valid, that makes Maxwellian electrodynamics invalid. To obtain a physical definition of equal intervals of time, Poincaré postulated that the speed of light is constant.[30] This postulate[31] (not the Michelson-Morley experiment[32]) led to the special theory of relativity.

Poincaré understood that this fundamentally alters the equations underlying physics. He realized that one now needed to solve not the ordinary differential equations of Newtonian physics, but what he called "equations of finite differences",[33] and what we would today call delay differential equations or functional differential equations. Physically this corresponds to history-dependent time evolution: electrodynamic forces travel at the speed of light, not at an infinite speed.

However, credit for the theory of relativity was grabbed by Einstein. Because Einstein was neither a mathematician nor the inventor of relativity,[34] he did not understand this key mathematical point about history dependence till the end of his life, and incorrectly tried to approximate one type of equation by another.[35] Because credit for relativity incorrectly went to Einstein, he became a figure of great authority. Because science, in practice, relies heavily on authority, this mistake persisted for a century. In fact, the first solution of the functional differential equations of the retarded 2-body problem of electrodynamics in a serious physical context was given by me[36] only in 2004, a century after Poincaré invented relativity.

4 The tilt in the arrow of time

However, this correction to the Newtonian paradigm, by admitting history-dependence, is not enough. There is an additional problem. Experiments are needed to verify or refute a physical theory. Experimentation as a process of testing is meaningful only if it can throw up some surprises. On mundane time beliefs, we suppose that the past is decided, but the future is not, and is hence potentially surprising. We believe our actions create or bring about a particular future, in some tiny way. However, these mundane time beliefs do not cohere with the time beliefs used to write down the differential equations of physics, which time beliefs I have called "superlinear time". (Thus, differential equations require calculus, and, as noted above, it is incorrectly but widely believed that the only way to do calculus is to use the continuum or the formal real numbers, so that time must be topologically like the real line.)

To ensure coherence between these conflicting pictures of (mundane and su-

perlinear) time, I had proposed to modify the above (history-dependent) equations a step further, and allow a "tilt" in the arrow of time. A "tilt" is not a new physical hypothesis; rather it is a rejection of the common physical hypothesis of causality that interactions propagate only from past to future. Causality is a theological requirement: if God is to distribute rewards and punishments on the day of judgment, he needs to identify individuals as the cause of a good or bad act. The physical world, however, need not be causal. Whether or not it is causal needs to be decided by experiment! But to design such an experiment, we first need a theory of a non-causal world. Rejecting hand-imposed causality allows not only the past but also the future to influence the present. There is a quantitative difference: past influence predominate over future one's.

A "tilt" involves a radical new mathematical understanding of time evolution in physics: this is time evolution according to mixed-type functional differential equations.[37] (In contrast, Poincaré, for instance, had considered only retarded functional differential equations). In colloquial language, a "tilt" allows anticipation, in addition to history dependence. This new understanding of physics (as incorporating history dependence + anticipation) is expected to include quantum mechanics.[38] One can now ask the question in reverse: what sort of ethics flows from this revised and corrected time belief in physics?

History-dependent evolution leads to one sort of paradigm shift: the future is not determined by the present alone; one needs to know the entire past history. It is a time asymmetric form of evolution, for while future can be determined from the past, past cannot be retrodicted from a knowledge of the future—entropy, or lack of information, increases towards the future. This corresponds to the mundane belief that the future is more uncertain than the past.

A tilt leads to a further paradigm shift. In this case, future is not determined even by the entire past history. With a tilt, physics ceases to be mechanical: The idea of the cosmos as God's grand piece of clockwork governed by some grand "laws" of physics is thrown out once and for all. At each instant, living beings create a tiny bit of the future cosmos, and they do so in a way that would surprise God!

Philosophers object to reductive explanations, when their primary objection is to mechanical explanations. They go by the mental picture that atoms, molecules etc. are all describable in a mechanical way, so that trying to connect human behaviour to physics, which concerns atoms molecules etc., is misguided because it denies the possibility of human creativity. What is at fault here is not reductionism but the naïve mental picture about atoms and molecules, which is about a century out of date. Atoms and molecules are neither particularly simple things, nor do they necessarily behave in a completely mechanical way.

On the other hand, neither complexity (epistemically broken time) nor quantum indeterminism (through the collapse postulate, ontically broken time) is the magic wand some naively think it to be. Complexity, for example, is just a more sophisticated restatement of the old "god of the gaps" argument: "We don't understand this (lightning striking churches) therefore it is the work of God". In this restatement, complex assemblies of atoms and molecules somehow magically acquire properties entirely absent at the level of the constituents. The objec-

tion to reductionism ought not to be mere nostalgia for an enchanted childhood world of magic. A whole crop of new medicines are based on the reductive understanding of the physics of biomolecules. Likewise, quantum indeterminism (or occasionalism) is as contrary to creativity as ("hard") determinism.[39]

In this situation, the great advantage of a tilt is that it provides us with a non-mechanistic model of how the world evolves, conditioned, but not determined by, the past. This is remarkably similar to the notion of *paticca samuppāda*.

An important feature of the tilt relates to thermodynamics. Thermodynamics, as its name suggests, started off with the issue of steam engines and a gas in a box. But it evolved into statistical mechanics, which has given us a remarkable idea: that of entropy. Entropy is a measure of disorder. A key principle of thermodynamics is the so-called second law of thermodynamics which asserts that the entropy (of a closed system) never decreases. A stronger formulation (more pedantically called the H-theorem) is that the entropy (of a closed system) goes on increasing until it reaches its maximum. The stronger formulation is needed to explain why heat flows from hotter to cooler bodies. The spread of heat increases disorder. The idea of disorder is a very general idea, which goes far beyond steam engines: the everyday observation of irreversible aging illustrates increasing disorder.

A long-standing problem has been the inability to relate the entropy "law" to Newton's "laws".[40] (There is at present no serious way to do statistical mechanics with general relativity.) The problem is not that one cannot derive the entropy law from Newton's laws; rather the problem is that the entropy law is contrary to Newton's laws: if Newton's laws hold, there is no way entropy can increase or decrease, it must stay constant. An easy way to see this is that Newtonian evolution is reversible, hence this is called the reversibility paradox. That is, Newtonian evolution is contrary to the everyday observation of irreversible aging.

The fault does not lie with the way entropy is defined. This is clear from another famous objection, called the recurrence paradox, which relates to the good old Poincaré recurrence theorem mentioned above: for a gas in a box, evolving in a Newtonian way, every microstate must recur infinitely often. So no matter how entropy is defined, it cannot increase or decrease. The text-book resolutions of these paradoxes are unsatisfactory despite involving (implicitly or explicitly) a variety of increasingly obscure concepts such as coarse-graining, ergodicity, mixing etc.

In contrast, history dependent evolution provides a clean resolution of the paradoxes of thermodynamics (since the hypotheses of the Poincaré recurrence theorem break down, and history dependent evolution is not reversible). With history dependent evolution, past decides future, but not vice versa, which is the same thing as saying that we have more information about the past than the future, so that entropy increases towards the future. So, we also have a simple explanation for entropy increase.[41]

With a tilt, the situation is a little more complex. Now, past conditions the future, but does not decide it. Just as history-dependent processes increase entropy, anticipatory processes decrease entropy. Such anticipatory processes

will manifest themselves as spontaneous and causally inexplicable events. That is, with a tilt, spontaneous events are possible, and these will decrease entropy. A decrease of entropy is the same as creation of order, so creativity is possible. We can visualize that both entropy increasing and decreasing processes exist. The former predominate, therefore entropy still increases on the whole.[42]

5 The tilt, life, and ethics

We have seen how common ethical principles depend upon assumptions about the nature of time. The attempt to transform human behaviour led to the transformation of these time beliefs, and these transformed time beliefs have crept into physics. Finally, we have seen, how, if physics is de-theologised, this leads to a new notion of time.

Having arrived at this new notion of time which represents the best scientific knowledge available to us today, we can turn around and ask: what ethical principle follows from this new notion of time?

Now, many theologians in a zealous attempt to guard ethics as their provenance, and to keep scientists away from it, have repeatedly attempted to disconnect ethics from our knowledge of the world (since ultimately they want to base ethics on things like the belief in God and scriptures, which are under their social authority, whether or not they explicitly admit this motivation).

Therefore, I reiterate that my attempt to base ethics on physics is not based on any naïve confusion between facts and values. However, an ethical principle, if it is to be persuasive, must involve all our knowledge about life and its place in the vast cosmos. Certainly this knowledge is fallible, and may change, so the resulting ethics need be neither eternal nor absolute. However, an ethical principle based on knowledge is more persuasive as a basis of mundane action than an ethical principle based on the mere beliefs of a voluntarily blind, deaf and anosmic person. Those ethical principle are brittle, and shatter when questioned. If the underlying beliefs (about time) are physical, they must confront physics. If not, they can simply be denied. There is no sense in speaking of "free will" or volition in a way which wishes away physics.

This was what I thought I had pointed out in my letter to Daya ji. In my book, I had proposed a new ethical principle arising from this new notion time in physics involving a tilt.

A key aspect of the above notion of time is that it makes it possible [for living beings] to diminish entropy spontaneously. Since entropy is understood as a measure of disorder, "diminishing entropy" should translate into the same thing as "increasing order".

With this in mind, the new ethical principle was stated as follows.

Order principle: act so as to increase order in the cosmos.

As I explained in my book, this subsumes the common biological ethic of "survival". It goes beyond anthropocentrism and includes all living beings and even extra-terrestrial life (which probably exists on the above physics which allows order creation everywhere). As such, it is also a guide to practical action.

However, Daya ji immediately reacted to the word "order". He gave the example of Soviet Union: he said there was order there, but that such order was not necessarily desirable. I dashed off a long letter to him explaining the precise sense in which I used the word order. However, a year or so later, I gave a talk on this at Melbourne. A couple of people including Don Miller again objected to the word "order" on similar grounds.

Clearly, howsoever much one may wish it away, the sad tale of two cultures comes back to haunt us. Scientists tend to use words somewhat carelessly, because these words are often used merely as pointers to precise theoretical and mathematical constructs for which there are no exact equivalents in the English language. "Order" for me is the same thing that Schrödinger and other authors called negentropy. The difference is that where Schrödinger, for example, proceeded intuitively, I am proceeding with a definite new physics in mind, as also a theory of how this notion of "order" relates to life and the cosmos.

Order, in the physical sense in which I use the term is essential for biological survival. At the physical level, a human being is a vast collection of molecules which exist in a highly ordered state. The tiniest departure from this order entails illness and death. The orderliness of the body is a must for the continued existence of a living organism.

In fact order, in this physical sense, is not only essential for the survival of human beings, it characterizes life. This can be better understood by the way this notion of order relates to human behaviour through the theory of evolution

The existing theory of evolution already provides insight into human behaviour by connecting it with the behaviour of other animals. While survival of the individual is certainly a key concern, even basic urges such as those related to reproduction make sense only in reference to a larger biological unit, such as the species. So, the evolutionary ethic may be stated: act so as to maximise the probability of the survival of the species.

This principle explains why (even in non-capitalist societies) most people are so concerned with acquiring territory (e.g. wealth) and social status, and trying to consolidate it. Combined with the process of reproduction and rearing this seems to describe much of the life of most people.

The question now is, is that all that there is to life? Is there anything to life beyond survival (of the species)?

Certainly, the environmentalist is concerned with other species on the planet. So, to side-step prolix quibbles about the reality of altruism, let us rephrase the above question. Let us expand our concerns from individual to species to all life on the planet to all life in the cosmos.

So, is that the ultimate ethical concern: preservation of life in the cosmos?

Note that I seek answers acceptable to the sceptic—the answers must rely only on "public" knowledge, and on valid physics, not on private religious beliefs or metaphysical assumptions.

Note also that, in this generalised form, the evolutionary ethic is subsumed by the order principle. For life, whatever its chemical or physical constituents, is characterized as an orderly state. Even a single protein molecule is in a far, far more ordered state than the molecules of a gas in a box—which latter state

is the "natural state" of disorder or thermodynamic equilibrium, according to thermodynamics. Preservation of life in the cosmos is preservation of this order. The order principle, however, speaks of increasing order (which is possible with a tilt), so it clearly goes a step further.

In fact, the tilt helps to clear up a number of confusing aspects related to both: the theory of evolution in biology and to ethical principles in philosophy. For example, the philosophy of ethics takes for granted the existence of volition. It takes for granted that human volition, though independent of the past, nevertheless somehow determines the future—for the above ethical principles all enjoin one to bring about a certain future state, hence assume that it is possible to do so. The philosophy of ethics routinely proceeds by ignoring the manifest contradiction of such beliefs with the knowledge of the world which comes from physics. This attitude may have been appropriate in the West where theologians, who ruled, regarded themselves as superior to physicists. But today this incoherence between philosophy and physics cannot be wished away by putting philosophy and physics in two separate university department which do not interact with each other. The tilt, on the other hand, admits the possibility of spontaneous choice which may be conditioned by the past, but is not determined by it; it also explains how these spontaneous choices can nevertheless relate to future events.

Current biology does not give an adequate account of the origin of life: or the origin of order. The theory of evolution provides many insights, but certain aspects of it remain cloaked in obscurity. A key issue is the origin of mutations (and the origin of life itself). Evolutionary theory attributes this to "chance". If this "chance" is not to be a mere word which magically conjures up a "god of the gaps", to explain anything and everything, we need a precise quantitative model of this "chance" (such as a model of time evolution according to stochastic differential equations) which tells us how much chance leads to how much mutations, in how much time. Such an enterprise, however, is doomed to failure: we have already seen how, throughout the 19th c. (when the current theory of evolution was formulated) the mechanism of chance was unsuccessfully used to try to explain increase of entropy. We have also seen that, within Newtonian physics, chance can neither increase entropy, nor increase order (decrease entropy), both of which must stay constant. If accounts such as the Ehrenfest model combined with hand-waving techniques like "coarse graining" have any validity, what they show is only this: chance increases disorder. None of this is any good for biology. Note incidentally, how chance is used to perform one sort of magic in thermodynamics, and the opposite sort in biology.

Spontaneity, on the other hand, increases order; combined with history dependence, it allows this state of increased order to be maintained. It also shows how this order increase can remain immersed in a sea of order decreasing (or entropy increasing) processes.

However, it is clear that Daya ji and Don Miller both had not thought about "order" in quite the same way. They thought of "order: in the ordinary (dictionary) sense of word. They thought of it not at the physical or biological level as I did, but of the connotations at the social level, where order could

possibly be mechanical or authoritarian. They objected to order in this sense of regimentation. The thing that one intuitively feels is wrong with regimentation is the absence of spontaneity. So "order", they felt, could be an imposition on human beings, just as much as the rituals of "civilized" society were an imposition on Huckleberry Finn.

Of course, I thought I had carefully explained this in my book: that creation of order corresponds to spontaneity, and that (in the physical sense of "order") there is no way to produce order mechanically (for that would give us a perpetual motion machine of the second kind). However, if the matter was not clear to Daya ji and Don Miller, that itself is sufficient cause of worry. Furthermore, even many scientists lack clarity about spontaneity in science, since they share Newton's religious vision of a clockwork cosmos, and hence see science as something intrinsically mechanical. This lack of clarity is at the root of paradoxes, such as the Grandfather paradox, as I have explained elsewhere.

So, it seems to me better to relate this abstract notion of "order" more closely to human experience. To this end, let us ask how evolutionary ethics is "implemented". When an animal takes a decision, does it carry out an evaluation of all future consequences? As any chess player knows, few people ever calculate beyond level 3 even in the game of chess, which requires a rigorous evaluation of future consequences. And, as any computer programmer knows, a rigorous evaluation beyond level 25 is a difficult task, even for a supercomputer, which may take longer than the human life span to do it. Accordingly, the animal's decisions are more usually based on immediate sensations of pleasure and pain which are "hardwired" to these longer-term consequences. For example, reproduction is crucial to the survival of the species, and engaging in reproductory activities generates the appropriate emotions and sensations of pleasure.

In this sense, spontaneous creation of order is "hardwired" to the deep sense of satisfaction one gets from a creative insight, the creative satisfaction that one gets from e.g. spontaneously arranging ideas, or musical notes, in a particularly interesting and novel pattern. Unfortunately, Western music has been robbed of this key element of spontaneity, which is still manifest in, say, Indian music. However, though there seems no satisfactory English word for it, the Western musical concept which comes closest to this notion of spontaneity is harmony: several notes being struck together to create a pleasing effect.

The more precise analogy I have in mind is to Popper's pond paradox—in a non-circular pond, the creation of a convergent ripple is causally inexplicable since it requires a conspiracy of causes. All the molecules at the edge of the pond must conspire to act together—if one seeks a purely causal explanation that is. This paradox is easily resolved[43] through spontaneity. Just as history-dependent processes cannot be explained teleologically, so also anticipatory processes cannot be explained causally. With a tilt, therefore, some processes must be causally inexplicable. (However, these processes will pertain not to ponds, but to living organisms, which can amplify tiny spontaneous events.)

Therefore, the only change that is probably needed to meet Daya ji's objections is to rename order as harmony, and the order principle as the harmony principle.

Notes

[1] C. K. Raju, *The Eleven Pictures of Time*, Sage, 2003.

[2] Samuel P. Huntington, *The Clash of Civilizations and the Remaking of World Order*, Viking, New Delhi, 1997. Huntington's logic is also a natural extension of Toynbee's. Where Toynbee seeks to understand history through "civilizations" rather than nations, which are ephemeral on a historical time-scale, Huntington seeks to understand world politics through a few "civilizations" rather than a large number of nations.

[3] Arnold J. Toynbee, *A Study of History*, abridgement of vols. vii–x by D. C. Somervelle, Oxford University Press, 1957; reprint, Dell Publishing Co., vol. 2, p. 112.

[4] E.g., Śvetaśvatara Upaniṣad 1.6. Trans. Prabhavananda and Frederick Manchester, *The Upanishads: Breath of the Eternal*, Mentor, New American Library, 1957, p. 118.

[5] The recurrence time is a day and night of Brahma, stated to last a thousand yuga-s in Bhagwad Gitā 8.17. This is elaborated in the Viṣṇu Purāṇa (*The Vishnu Purana*, trans. H. H. Wilson, London, 1840, reprint, with an introduction by R. C. Hazra, Punthi Pustaka, Calcutta, 1961, chp. 3, pp. 19–24), where it works out to 8.64 billion years. The astronomical rationale for the calculation is found e.g. in the *Āryabhaṭīya* where it emerges that 1 day of the gods = 1 year of humans, just because the gods stay on (mount Meru on) the north pole, where day and night last for some 6 months each: "The gods see the sun after it has risen for half a solar year" (*Golā*, 17).

[6] C. K. Raju, *Time: Towards a Consistent Theory*, Kluwer Academic, Dordrecht, 1994. (Fundamental Theories of Physics, vol. 65.) Appendix to chp. 4.

[7] For an overview of this reformulation of physics, and its relation to quantum mechanics, see *Time: Towards a Consistent Theory*, cited above. For the reformulation of Maxwellian electrodynamics, see S. Raju and C. K. Raju, "Radiative damping and functional differential equations", *Mod. Phys. Lett.* **A**, **26** (35) (2011) pp. 2627–2638. For the reformulation of gravitation along these lines, see C. K. Raju, "Retarded Gravitation Theory", in: Waldyr Rodrigues Jr, Richard Kerner, Gentil O. Pires, and Carlos Pinheiro (ed.), *Sixth International School on Field Theory and Gravitation*, American Institute of Physics, New York, 2012, pp. 260–276.

[8] See, e.g. "Life after Death", chp. 1, in ref. 1 for details on how widespread this notion was.

[9] Origen, *De Principiis*. An easily accessible version is at `http://www.newadvent.org/fathers/04122.htm`. (The numbering may differ in other versions.) Particularly see II.1.1 for the definition of "world". II.3.1 for the question whether the world is unique. II.3.5 for the connection of "world" to "age", and the claim that the scriptures speak of a series of ages. II.3.4 for the description of exact recurrence and its denial, and for an acceptance of quasi-recurrence ("a diversity of worlds with changes of no unimportant kind").

[10] Origen, cited above. See II.9.5 for the objection (of his opponents) that God is inequitous. II.9.6 for his claim that God originally created all people equal. II.9.8 for the claim that the observed inequity is retribution due to different deeds: "In which certainly every principle of equity is shown, while the inequality of circumstances preserves the justice of a retribution according to merit."

[11] Dante Aligheri, *Divine Comedy: Inferno*, trans. Charles S. Singleton, Encyclopaedia Britannica, Chicago, 1996. There were no exceptions of any sort; for example, for a description of the treatment meted out to Mohammed, see Canto XXVII, p. 35.

[12] Augustine, *City of God*, XII.13. Trans. Marcus Dods, Encyclopaedia Britannica, Chicago, 1996, p. 405.

[13] See, "The Curse on 'Cyclic' Time", chp. 2 in *The Eleven Pictures of Time*, cited above.

[14] Mircea Eliade, *Cosmos and History: The Myth of the Eternal Return*, trans. W. Trask, Harper, New York, 1959, p. 153.

[15] Martin Heidegger, *Nietzsche*, vol II: *The Eternal Recurrence of the Same*, trans. D. F. Krell, HarperSanFrancisco, 1991.

[16] Newton's mentor Barrow allowed that time could be like a line or circle, but Newton took it to be like a line (for religious reasons). See "Newton's Secret", chp. 4 in *The Eleven Pictures of Time*, cited earlier.

[17] Hawking's "chronology condition"—that there are no closed time-like curves—derives from the same Augustinian idea that any cyclicity in the cosmos is symptomatic of eternal recurrence which should be abolished since it is contrary to free will. S. W. Hawking and G. F. R. Ellis, *The Large Scale Structure of Spacetime*, Cambridge University Press, 1974, p. 189, and its exposition and critique in ref. 1.

[18] C. K. Raju, "Time Travel and the Reality of Spontaneity", *Foundations of Physics* **36** (2006) pp. 1099–1113. For a non-technical account, see the chapter on "Time travel" in *The Eleven Pictures of Time*, cited above.

[19] C. K. Raju, "Atman, quasi-recurrence, and *paticca samuppāda*", in *Self, Science and Society, Theoretical and Historical Perspectives*, ed. D. P. Chattopadhyaya, and A. K. Sengupta, PHISPC, New Delhi, 2005, pp. 196–206.

[20] Al Ghazālī, *Tahāfut al-Falāsifā*, trans. S. A. Kamali, Pakistan Philosophical Congress, Lahore, 1958. S. van den Bergh, *Averroes' Tahāfut al-Tahāfut (incorporating al-Ghazālī's Tahāfut al-Falāsifā)* translated with introduction and notes, 2 vols, Luzac, London, 1969.

[21] "Time as money", chp. 10 in *The Eleven Pictures of Time*, cited above.

[22] Plato, *Meno*, 81–83. *The Dialogues of Plato*, trans. B. Jowett, Great Books of the Western World, Encyclopaedia Britannica, Chicago, 1996, p. 180.

[23] For a non-technical account, see C. K. Raju, *Euclid and Jesus: How and why the church changed Christianity and mathematics across two religious wars*, Multiversity and Citizens International, Penang, 2012.

[24] For an early account see C. K. Raju, "Computers, mathematics education, and the alternative epistemology of the calculus in the *Yuktibhaṣā*," *Philosophy East and West*, **51**(3) (2001) pp. 325–61. For more details, see *Cultural Foundations of Mathematics*, cited earlier, and C. K. Raju, "Teaching mathematics with a different philosophy, part 1: Formal mathematics as biased metaphysics", *Science and Culture* **77**(7–8) (2011) pp. 275–80.

[25] Isaac Newton, *Mathematical Principles of Natural Philosophy*, trans. A. Motte, rev. by Florian Cajori, Encyclopaedia Britannica, Chicago, 1996, p. 8. Emphases mine.

[26] C. K. Raju, *Cultural Foundations of Mathematics: The Nature of Mathematical Proof and the Transmission of the Calculus from India to Europe in the 16th c. CE*, Pearson Longman, New Delhi, 2007. (PHISPC, vol X.4.)

[27] Isaac Barrow, "Absolute Time [Lectiones Geometricae]", in M. Capek (ed.), *The Concepts of Space and Time: their Structure and their Development*, Boston Studies in the Philosophy of Science, vol. XXII, D. Reidel, Dordrecht, 1976, p. 204.

[28] C. K. Raju, "Newton's time", *Physics Education* (India) **8** (1991) pp. 15–25.

[29] K. R. Popper, *Realism and the Aim of Science*. Postscript to *Logic of Scientific Discovery*, vol. 1, Hutchinson, London, 1982. For an elaboration, see C. K. Raju, "Newton's Time", cited above.

[30] H. Poincaré [1904], in: *The Value of Science*, trans. G. B. Halstead, 1913, reprinted Dover, 1958, p. 104, speaks of "an entirely new mechanics [in which] *no velocity could surpass that of light, any more than any temperature can fall below absolute zero*.[Original footnote: Because bodies would oppose an increasing inertia to the causes which would tend to accelerate their motion, and this inertia would become infinite when one approached the velocity of light.] [Emphases mine.] This postulate leads to a proper clock (or equal intervals of time) defined by means of a photon bouncing between parallel mirrors.

[31] C. K. Raju, "Einstein's time", *Physics Education* (India) **8** (1991) pp. 293–305.

[32] C. K. Raju, "The Michelson-Morley Experiment", *Physics Education* (India) **8** (1991) pp. 193–200

[33] H. Poincaré [1902], *Science and Hypothesis*, Eng. trans. Dover, New York, 1952, pp. 169–70, explained that such equations will naturally arise if the aether is rejected.

[34] Einstein is often credited with having "independently rediscovered" relativity, by believing his statement that he had not seen Poincaré's 1904 work. My "epistemic test" is a simple way to check false claims of independence. Einstein fails this test since he he did not understand the need for functional differential equations, and made a mathematical mistake in supposing that they could be approximated by ordinary differential equations by means of a "Taylor expansion". For the epistemic test, see "Models of information transmission", chp. 6, in *Cultural Foundations of Mathematics*, cited above.

[35] Einstein's mistake can be found in his attempts to do the relativistic many body problem, for example, in A. Einstein, L. Infeld and B. Hoffmann, *Annals of Mathematics* **39** (1938) p. 65. For an explanation of why this is a mistake, see *Time: Towards a Consistent Theory*, cited earlier, p. 122.

[36] C. K. Raju, "The electrodynamic 2-body problem and the origin of quantum mechanics", *Foundations of Physics*, **34** (2004) pp. 937–62.

[37] See chp. 5B in *Time: Towards a Consistent Theory*, cited earlier.

[38] See chp. 6B "Quantum mechanical time" in *Time: Towards a Consistent Theory*, cited earlier.

[39] See "Broken time: Chance, Chaos, Complexity" chp. 6 in *The Eleven Pictures of Time*, cited earlier.

[40] C. K. Raju, "Thermodynamic time", *Physics Education* (India) **9** (1992) pp. 44–62.

[41] See "Electromagnetic time", chp. 5B in *Time: Towards a Consistent Theory*, cited above.

[42] Whether or not this predomination is permanent, i.e., whether or not the cosmos eventually recurs, is another issue, which we do not go into here.

[43] "Newton's secret", ref. 16 above.