Logarithmic Time: its role in current culture and education

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In this short essay I argue that an important part of the education needed for our times is a bold enlargement of our temporal horizons, backward, forward and inward. Current education fails to do so in a manner commensurate with humanity's urgent need to change to a sustainable culture. Gross inequality, war, population growth, loss of biodiversity, and adverse climate change are still widely accepted as inevitable. Tom Athanasiou's *Slow Reckoning* [1] is as cogent now as when it was first published in 1996. Jennifer Clapp and Peter Dauvergne have recently presented a detailed academic study [2] of four different environmental worldviews (market liberal, institutionalist, bioenvironmentalist and social green). Their study provides further evidence that we still lack an adequate consensual view of the global culture in which we are living. Concerning our culture's responses to the overarching sustainability problem , I would group them into five main classes – technical efficiency measures (always trumped by growth), institutions' political reforms (inadequate), radical activism (failing to convince mainstream thought), education (failing to have sufficient influence on our destructive behaviour) and religion (poor track record).

Evidently something is missing. I propose that it is *an adequately large shared vision*. Edward Bellamy's dream-genre novel *Looking Backward* [3], depicting an authoritarian and utilitarian future, provoked a passionate riposte from William Morris. The very last words of his humanistic, socialist novel *News from Nowhere* [4], are "and if others can see it as I have seen it, then it may be called a vision rather than a dream." The lack of a vision - widely shared in general outline but flexible in detail - appears to me a major factor in the fatalism with which most people respond to the known yet avoidable dysfunctions and injustices of our times. One might expect education (in an inclusive sense, which embraces learning together as well as 'leading out') to be exactly the right instrument which we could all use together to address our problems, rather than wait fatalistically for the consequences of unbridled growth to take their course. One reason why education has increased our knowledge of the problems but not our ability to address them is no doubt the fact that education is today an enormous economic institution, as bound up in creating the problems as in solving them. Nevertheless there is, in formal education circles and in society at large, a widespread, albeit subdued, appreciation that there is a problem and a desire to address it.

Our rational picture, our knowledge, of the world (in the broadest sense) is very great, in time, in space and in other, qualitative, dimensions, such as anthropology. Here, I will focus primarily on time. Timescales on which there is firm knowledge range from ~10 Gyr (gigayears, or billions of years), the age of the known universe (that is, the galaxies and other structures expanding from an initial explosion 13 Gyr ago; there may be more but that is speculative) to ~10^{-28} seconds (relating to collisions in the the most energetic particle colliders; again shorter times are of great interest in physics but remain speculative). Nearly all of us, in our day-to day-lives, are concerned with a much narrower range of timescales that is remote from either of those extremes - from a century (our own lifetime; also the conditions of a few nearby generations of our close relatives) to ~ 10 milliseconds (the times of sprint racers are recorded to two decimal places in seconds; human reaction times are a little longer).

We react quickly (~ 10^{-1} seconds) to immediate situations and recover (~1 second) from from minor false alarms. We expect and need air, water, food and sleep on timescales of order minutes, hours and days. Besides our physiological needs we have emotional needs, for social interaction, the respect of others and self-respect. These may require satisfaction on the timescale of hours or days but the needs themselves are developed and change in the course of a life. And the human culture within which respect exists is probably as old as 'human' itself, which, depending on the definition, is ~ 0.1 - 1 Myr (million years). Nevertheless, most people's immediate and conscious concerns about respect are focused on a nexus around 'recognised work', social status, appearance and money. These concerns are in our minds on a range of timescales from less than a second (for example, presentation of the self) to many years (gaining social status).

Notice that these remarks about time relate to a person's psyche. This means that there is an *origin*, or zero, in the kind of time that is relevant here, namely *the present* or *moment of consciousness*. (Newtonian time has no origin and in current physics time is widely - but not unanimously - thought to start with the Big Bang, 13 Gyr ago.) The present is subjective, not objective. Thus, for example, I have a present as I write this word and you have a different present as you read it. I refer to psyche, rather than psychology, because I want to give due weight to the subjective and emotional aspect of the problem of fatalism, and not only to our changing external conditions. The kind of time we are concerned with here is divided by the present into two portions, the past and the future. These portions are highly asymmetric. We know much more, and with much greater reliability, about the past than about the future. Our knowledge of the past extends over an enormous range, from the most recent personal experiences that we can distinguish from 'now', back through

yesterday, last year, centuries, millennia, millions and billions of years, using personal and folk memory and records and the accumulated systematic studies of historians, deep historians, archaeologists, geologists, biologists, geologists and physicists. This range, from ~1 second to ~ 10 Gyr, amounts to 17 or 18 powers of ten. Those interested in natural science have become accustomed, *intellectually*, to this huge range.

We have much less knowledge of the future, though perhaps more than most people recognise because many regularities are simply taken for granted. When it comes to cultural affairs, personal and social, our *knowledge* of the future is yet weaker and more short term. Yet our present culture has been created from a vast number of *ideas, dreams, visions, plans and projects*, the ones that came into being having been consistent with many constraints and the rest having barely started or else fallen by the wayside. If we are to change radically from a culture of growth and oppression, we must change our practice.

These remarks, which at the intellectual level are simple, take on a special significance when we consider what they imply for the policy decisions and plans which we, supposedly intelligent beings, make in the here and now. In this essay I use the word *policy* in a broad sense, so that it includes decisions and plans made at the personal level and not only decisions and plans made by governments, etc. The range of timescales is then from ~1 second (for example, quick reaction in live negotiation) to ~10 or 10^2 yr (example, design of infrastructures). In our times, the upper end of this range is however rarely employed, reflecting a focus on rapid, personal gain as against long term social and ecological benefit. These values are deeply embedded in our psyches and operate at the level of political and commercial institutions *and* in our personal thoughts and actions. Such is the background from which our instant thoughts and actions emerge and accumulate. There is a mismatch between our short term individual actions and the long term collective consequences. So far, education, while making these simple ideas *intellectually* clear, has had little practical or wide impact. I am advocating in this essay a greater emphasis in education on connected thought concerning our knowledge of the past, over a vast range of timescales, and our visions of desirable futures, over a more modest but still ambitious range of timescales. Such an expansion of temporal horizons would enable us to clarify and disseminate widely our understanding of many relevant problems. While many specialised problems are addressed by teachers and learners in the ghettos where formal education takes place, there is a notable lack of integration, both of one subject with another and of formal education with day-to-day life, much less with second by second life.

How to achieve the needed integration, so that education may realise its potential in helping us all to live coherent and sustainable lives? One small contribution - not a panacea by any means - I suggest is to develop and internalise the concept of l*ogarithmic imagination*. This term was coined by the archaeologist Andrew Sherratt [5] although the notion of time being represented on a logarithmic scale has been proposed by a number of authors in various contexts. In the present essay I am emphasising the practical problem of achieving a truly sustainable culture and suggesting that short timescales, connected with immediate human reactions, need to be connected with long timescales. This involves the concept of *personal* time, with a present moment of consciousness as zero, so that there is a past and a future. Further, I want to focus on the gentle, implicit introduction of logarithmic imagination, since many people are somewhat, or even severely, allergic to mathematics. Those who understand logarithm concepts thoroughly will know, indeed, that their strict application to personal time will bring the student up against a couple of less elementary features, namely that the logarithm of zero is a singularity and the logarithm of negative numbers is not defined in elementary mathematics. These problems are avoidable in the proposed educational approach. The past and the future have separate logarithmic scales and we use *bins* of time which are equal or approximately equal on a logarithmic scale. There is, however, no necessity to get heavy with the mathematics. One of the simplest examples occurs with the integration of history, deep history, archaeology, geology, evolution and astrophysics. This has been done in numerous 'cosmic walks', in book form and as literal walks past displays at tourist centres. One way of distributing the aeons of Newtonian time in a more human-oriented way is to use the following bins: 1 to 9 years ago, 10 to 99 years ago, 100 to 999 years ago, 1000 to 9999 years ago, 10 to 99 millennia ago, 100 to 999 millennia ago, 1 to 9 million years ago, etc. Less common – possibly new - is the suggestion of logarithmic imagination in connection with the future. (Incidentally, when the shorter intervals of time are the main focus it will generally be better to allow allow slightly uneven bins which accommodate the familiar non-decimal time units. The bins second, ten seconds, minute, ten minutes, hour, day month, year will often be preferable to 1, 10^1, 10^2, 10^3, etc seconds.)

The long timescales of our heritage and of our plans for the future are intimately connected with our short-term thoughts and actions, for the latter play a major role in creating the the former. It is difficult for the individual to hold onto the connections in a world saturated with messages that assume or advocate business as usual. Education with a conscious emphasis on those connections might help us to relate our knowledge to our actions and thereby ease *the great turn* - towards a just, sustainable global culture.

Notes

[1] Tom Athanasiou (1997) *Slow Reckoning: the ecology of a divided planet*. (London: Secker & Warburg).

[2] Jennifer Clapp and Peter Dauvergne (2011) *Paths to a Green World: the political economy of the global environment.* Second edn. (Cambridge MA: MIT Press).

[3] Edward Bellamy (2007) *Looking Backward 2000 to 1887*. (New York: Cosimo). First published 1888.

[4] William Morris (1970) *News from Nowhere,* p. 182 (London: Routledge & Kegan Paul). First published January to October 1890 in *The Commonweal*.

[5] Andrew Sherratt (1980) Introduction, in Andrew Sherratt and G Clark (Eds) *Cambridge Encyclopedia of Archaeology*, p.9 (Cambridge: Cambridge University Press).

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