Lifestyle at the Edge of Chaos

Robert Samuels

The tenuous balance between emergent self-organisation and disorganisation is the edge of chaos. We are witnessing an exponential but insidious emergent disorder in global climatic conditions, partially disguised, shrouded with uncertainty. Interacting atmospheric, built environment and human factors are exceedingly complex; one review of salient literature during 1993 alone covers 380 papers, with suggestive evidence of global warming. Policy-makers propose adopting the precautionary principle, Rio and Berlin signatories are committed to CO_2 stabilisation and reduction, and environmental design for responsibility and sustainability is promoted at tertiary level. Yet "bottom line" fiscal arguments prevail; "best practice" is frequently a reliance on the goodwill of industrialists rather than to disadvantage them with carbon taxes, and generally we are threatened with economic chaos and rampant unemployment if economies stop growing.

Just 50 years hence, when, in all likelihood, atmospheric CO_2 concentrations and world population will have doubled, and consumption levels of urbanised developing countries approximate those of the developed world today, our children will inherit a world where disorganisation reigns: a supreme act of intergenerational inequity. Is there a glimmer of hope: a renewable energy revolution? Or is there embedded in this apparent panacea an ecological fallacy i.e. when energy is clean and abundant will we not consume ourselves into extinction? In all probability, only lifestyle change (in the context of in-built eco-design) could have the necessary impact on otherwise unavoidable climatic chaos.

Keywords: climatic chaos, precaution, economic threat, intergenerational inequity, renewable energy, in-built sustainability, lifestyle.

PEOPLE–ENVIRONMENT AND EMERGENT DISORDER PARADIGMS

Complexity theory has detected principles common to many walks of life, in social and economic systems equally as in biochemical and ecosystems. A spontaneously emerging self-organising tendency seems to be inherent in the global process, and "simple" initiating events evolve into hierarchically complex systems of such immensity as to defy imagination. This spontaneous and adaptive emergence is said to occur in that tenuous space between order and disorder, where novelty is endemic, thresholds are reached and breached, and phase transitions occur in quantum leaps. *This* is the "edge of chaos" (Langton, 1992; Kauffman, 1992; Waldrop, 1994). Here complexity breeds, unabated, effortlessly. But here too the fragile balance between emergent self-organisation and emergent disorganisation is struck. Dynamic equilibrium *is* the status quo. "A system can exhibit complex lifelike behaviour only if it has just the right balance of stability and fluidity" (Waldrop, op.cit:308, citing Langton).

The relevance of this analogy for an interdisciplinary approach to environmental psychology and environmental sustainability, or *people–place–planet interaction*, derives from the inevitable and substantial impact that people and the built environments they inhabit have on the natural order and on eco-system equilibrium. At this juncture in time, as the 20th century merges with the 21st and a new millennium is born, the chaotic and abysmal side of complexity–out–of-control seems to loom menacingly as never before in the recorded history of humankind. The importance of responsible attitudes and accountable behaviour cannot be emphasised enough (see Samuels, 1994). Ultimately, it is people's expectations, preferences, motivations and the experiences and situations they find acceptable and satisfying (or not) that dominate in any people–place–planet equation, irrespective of the degree of sustainable potential built-in to the system. *Benign environmental design* is crucially necessary, but not sufficient in itself.

The universe is imbued with intelligence, both as potential for life and incarnate in life-forms. At the human scale, *beliefs become biology*, "if the body's intelligence is at full strength, disorder and chaos do not attack a cell" (Chopra, 1989).

Thoughts are materialised as chemicals: fear and adrenalin, pain and endorphins, or depression and melatonin are inseparable.

In much the same way, *beliefs become behaviour*; and these ways of life, consciously or unconsciously, preserve or destroy ecological equilibrium. Awareness, thus, is the crucial element in people–place–planet relationships, first there must be attention and intention, then appropriate action can follow.

The 100-nation, 2,500 scientist-strong, Intergovernmental Panel on Climate Change (or IPCC) 1995 Madrid report "Summary for Policy Makers" has drawn our attention to, and confirmed that: "the balance of evidence suggests a *discernible human influence* on the global climate". The message from the world's premier scientific body is unambiguous. We are witnessing an exponential, but insidious, emergent disorder in global climatic conditions. To wit (to mention but two indicators): the El Niño disruption of Pacific Ocean currents — intimately correlated with water temperature changes — causing droughts and floods over large areas of the earth's surface, usually occurs once every 4 to 5 years; 1995, however, marked the fifth year of consecutive El Niño events. 1995 was also the warmest year on record (in the last 140 years) — with the four warmest years all occurring in the 1990s.[1]

Consistent within the possibilities inherent in the "edge-of-chaos" paradigm, is the chance that warming could trigger a threshold mutation (a disproportionate, emergent disorder change), a "runaway release" into the atmosphere of carbon stored in natural reservoirs, from plankton-deficient oceans, dying forests, melting tundras, "in which case it would no longer matter what we do as regards our own emissions" (Pearce, 1993a, citing Jeremy Leggett). Evidence for sudden exponential consequences from minor changes can be found in the 1987 malaria epidemic in Rwanda. Here a high-altitude, malaria-free region experienced a huge rate increase following a small change in minimum temperature and rainfall (Brown, 1996).[2]

The IPCC also believes that there is now a greater chance of "surprises and unanticipated rapid changes" in the world's climate. The latest concern relates to *ocean currents*. Deep ocean circulation in the northern hemisphere is driven by the formation of ice in the North Atlantic, which also sustains the Gulf Stream, thus keeping Western Europe several degrees warmer than it would otherwise be. Changes in ice conditions due to global warming might result in a shift in the Gulf Stream current, which could cause Europe to cool significantly as the rest of the world warms up (Pearce, 1995a). This is not as far-fetched as it may sound. Mackenzie (1995b) reports a striking shift in deep water currents discovered in the Mediterranean sea, where a new inversion in salinity manifests as a temperature increase with depth rather than the reverse. This is possibly due to salinity changes since 1987 in the Adriatic, which feeds the Mediterranean, possibly due to increased evaporation, itself due to global warming.

Widespread concern about the impact of humans on the sustainability of the world environment culminated in the 1992 Rio Earth Summit, which set the scene for international cooperation. Adequate finances for green funds (called "greed funds" in some quarters!) were, however, not forthcoming; and cutting-edge energy-saving technology is not being transferred (free, or at-cost) to developing nations where populations are still growing rapidly.[3] At the core of the *people–place–planet* equation is energy–environment interaction. Energy-use is at the centre of the lifestyle at the edge-of-chaos paradigm. Whatever maintains life consumes energy. The source of that energy, the way in which it is generated and used, and the side-effects and waste products left after use are *the* crucial parameters impacting on the sustainability of eco-systems and the biosphere.

At the Climate Conference in Berlin 1995, implementation of greenhouse gas reduction and atmospheric concentration targets was delayed to the Geneva Conference in July 1996. In the Geneva Declaration more than 140 nations bound the industrialised/developed world to legally-enforceable *significant* cuts in greenhouse gas emissions *from the year 2000.* In principle, these targets and timetables will be decided upon in Kyoto, Japan in December 1997, but 15 oil and coal producing nations have objected to setting targets. In the meantime, current agreements to hold CO_2 emissions to 1990 levels are binding in honour only, and the race to grow continues unabated. Developing and poorer countries with emission deadlines still be to set (stabilising at year 2000 levels, for the sake of argument) understandably seek to develop as much as possible before the cut-off dates; while developed countries defend their "right" to high standards of living

[1] 1995 was 0.4°C warmer than the average for the 1961–1990 period (Pearce, 1995b).

[2] The "butterfly effect" in Chaos theory**:** a small change having a disproportionately large effect.

[3] Latest IIASA projections, taking declining world-wide fertility rates and possibly enhanced death rates into account, estimate that world population will possibly not rise much above the predicted 10 billion by 2050 (American Association for the Advancement of Science annual conference, Baltimore, Feb, 1996).

and/or to sell oil and coal with equal determination. While Nero fiddles the earth burns.

SYNERGY AND FEEDBACK MULTIPLIERS

Further complications emerge when weather system disruptions are overlaid on and added to the manifest effects from the contamination of soil, air and water systems already prevalent in urban-industrial megalopolises and industrial–agricultural regions the world over. Where, for example, a forest's resistance is weakened by acid precipitation and it then attempts to cope with, and rapidly adapt to unseasonable climatic change, variability or disruption, the likelihood of succumbing is greatly enhanced. Human immune systems, surely, are similarly vulnerable; an individual whose respiratory system is weakened by years of breathing in low-level ozone/ photochemical smog is likely to be disadvantaged when trying to cope with unprecedented heat waves, such as those that swept the USA and Europe in 1994 and 1995.[4] Australian researchers at the University of Melbourne recently showed how asthma-provoking allergens attach to sooty diesel particles, which, when inhaled provoke or aggravate asthma attacks (SMH, 1996) — a perfect example of synergistic interaction.

The multiplier effect finds a vehicle in both synergy and feedback. Cyclic feedback, of extreme complexity, is of two kinds. *Positive feedback* exacerbates impacts: a temperature rise, and UVB radiation from stratospheric ozone-depletion both diminish the carbon-absorptive capacity of ocean plankton (a major sink) which in turn exacerbates warming i.e. CO_2 emissions rise. *Negative feedback* counteracts impacts. Periods of relative cooling coincide, for instance, with volcanic eruptions, Mt. Pinatubo being the latest case in point.[5] The most salient negative feedback effect, only recently realised, is the masking effect of sulphate aerosols (and also soot). Sulphur dioxide emitted from fossil-fuel power stations, industrial complexes and oil refineries reflects sunlight back into space (the albedo effect), *artificially cooling* regions where acid precipitation is high.

Thus, some places are not warming as fast as expected. Crucially, these are industrial regions, despite the strong global warming trend of about 0.5^{o}C worldwide in the past century; the biggest surge since the last ice age, which ended 10,000 years ago (Nitta & Yoshimura, 1993; Pearce, 1995a). Globally, increased anthropogenic generation of sulphate aerosols could be currently offsetting as much as 50 per cent of CO_2 warming effects (Kaufman & Chou, 1993).

Night-time warming is thus more prevalent i.e. when the reflective effect is not active. Four decades of data from 2,000 monitoring stations in countries ranging from China, USA, Europe, the ex-USSR and Australia show that minimum night-time temperatures are 0.84^{0}C warmer than in the 1950s, while days have warmed relatively less, only 0.28^{0}C (Karl et al., 1993).

In any event, this masking effect of acid rain represents an intractable dilemma. If we scrub sulphur from stacks, will the planet suddenly surge past an edge-state equilibrium, and rapidly warm? Climate models suggest that a 0.4^{0}C *surge* in global temperatures could occur within a *few years* because of the short "residence time" of sulphur as compared to carbon in the atmosphere (Kaufman & Chou, 1993).

PARADIGMS AND FALLACIES

Interactive forces contribute to complex, insidious "situational contingencies" that often escape attention. A false impression of placidness and business–as–usual can be projected when in fact the system could be lurching almost out–of–control. Elements in systems cannot *but* interact sympathetically and reverberate with each other, albeit often subconsciously, or imperceptibly.

Much like the sulphate masking effect, there are a range of contemporary conceptual or paradigm fallacies that are able to disguise the reality of situations, where people misperceive but have no reason to disbelieve their impressions.

The illusion of the sun setting beneath the horizon, of an immobile earth, or apparent star formations in the night sky (a billion light-year delusion) bear testimony to the cosmic trickery humans live with, without affecting their day-to-day transactions. Conceptual misperceptions concerning the people–place–planet equation, however, are now becoming critical to our continued survival and require clarification *post haste.* False impressions lead to inappropriate behaviour.

Uncertainty is the first of these. Due to the complexity inherent in, and the difficulty of simulating and modelling ocean, land, ice, forest, cloud, wind, monsoonal, and volcanic interrelationships, the argument is advanced that until there is clear *proof* of climatic disruption it would be foolish to cut back on emissions and invest hugely in changing energy systems.

To counter this, the precautionary principle was invented by ecologists. Rather than wait to have conclusive proof of climate disruption, which might by then have allowed the system to deteriorate to an irreversible state, it is surely

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4 There were 3,000 additional deaths in the hot 1994 summer in the Netherlands, an increase of 10% (Mackenzie, 1995b: citing Kunst from Erasmus University).

5 Followed by a 0.5^{0}C drop in average global temperature (Pearce, 1993b).

better to be careful now. Energy efficiency, importantly, is a "no-regrets" option i.e. there is only gain, irrespective of whether or not there is a global crisis pending. And a renewable energy economy could, of course, employ workers displaced from the old polluting fossil and fissile power industries.

Hundreds of billions of dollars are projected to be lost if economies are saddled with carbon taxes or tradeable carbon levies, polluter-pay policies, and emission controls. When push comes to shove, it is still the short-term, politically-expedient (3–5 year governments protecting their backs) "bottom line" that counts.

This uncertainty argument opens the way for governments to claim that meeting international emission reduction targets will depress their economies, lead to rampant unemployment and huge GDP losses. Industrialists and multinational companies can lobby under this umbrella, claim they will be disadvantaged unless other countries act similarly, and carbon taxes are, consequently, not imposed. Rather, it is left to goodwill and conscience and voluntary action, not something industrial barons have been renown for in the past.[6]

Countries selling energy (oil, coal) push their own barrows. The nuclear lobby, now desperate,[7] jumps on the bandwagon, claiming that atom power doesn't contribute to global warming. To top it off, electricity-generating bodies, sensing coming restrictions, propose a global electricity grid, with surpluses in some countries balancing deficiencies in others, with everyone getting a fair go at consuming (thus, purchasing) as much as they possibly can.

To debunk this fallacy of uncertainty, sufficient *indicative data* (see below) must be assembled, widely disseminated and re-formulated in the "risk management" and "duty-of-care" terminology familiar to policy-makers, so that the balance shifts rapidly onto them to show that climate disruption is <u>not</u> happening. Importantly, responsible design must be advocated and expected at tertiary level in all environmental design disciplines, without fail.

Another powerful fallacious idea currently being expounded is that planetary systems have an ***unbreachable homeostasis*** built-in, and can withstand any insult and still find equilibrium. In a geological time scale, this may be the case, witness the *stability* of the percentages of nitrogen and oxygen in the atmosphere over millennia,[8] or the recovery of the planet after the supposed comet-strike some 65 million years ago and the resultant extinction of the 145 million year reign of the dinosaurs. There are also undoubtedly periods when the planet warms and cools irrespective of any anthropogenic activity; the Pliocene (4 million years ago) was 3–4^{0}C warmer than today (Borzenkova et al., 1993). *Most importantly, however, humans were not around at those times to experience and survive such conditions.*

These self-regulating forces are also said to fully account for global temperature stability (at about 20^{0}C), but, inevitably, the industrial emission of greenhouse gases is a powerful *new* factor that cannot *not* be added into the equation. This novel disequilibrium force now constantly impacts on life-systems, human and planetary. The prevalence of stress-related degenerative diseases in contemporary urban populations is evidence for threshold edge-state realities, adaptation distress and system degeneration in humans (Selye, 1956; Dubos, 1968).[9]

Homeostasis in any system must inevitably be subject to entropy, the second law of thermodynamics, like everything else. Within an anthropogenic timescale — let us say, the next 100 to 200 years — the global population is likely to double and possibly even double again, and CO_2-equivalent concentrations in the atmosphere are, simultaneously, likely to double, treble or quadruple — while terrestrial carbon-sinks such as forests diminish — with consequent global warming and climate disruption afflicting all ends of the earth[10].

In other words, *from the point of view of the survival of the human species,* edge–of–chaos criticality must be quickly resolved, or else it is likely that we will not survive past the 22nd century. It would not be the first extinction of a species in the history of planet earth.[11]

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6 Four major Australian companies (BHP, CRA, ICI, Shell) signed cooperative agreements with the government in June 1996, to reduce their greenhouse emissions, which will reduce the anticipated *rate of increase* by year 2000. Emissions will still rise, only less rapidly: from 47m tonnes to 52m rather than 63m (Fairfax, 1996).

7 Witness the British government selling off all their nuclear power stations for less than the cost of building one.

8 Although plant and geochemical data indicate that CO_2 concentrations 400 million years ago were 10 times higher than today (Palmer, 1996).

9 See also Samuels (1976): *The Psychology of Stress: Impact of the Urban Environment,* unpublished Ph.D. dissertation, University of Reading, Berkshire, UK.

10 A temperature rise of only about 4^{0}C (projected as one possible consequence of CO_2 doubling) would be the same as the difference between the present temperature and that which prevailed during the last ice age. This is much like the "butterfly effect" in Chaos theory, op cit.

11 Richard Leakey and Roger Lewin (1996) estimate that there have been 5 major extinction events in the past 500 million years of the 4 billion year lifespan of life on earth, with the sixth looming (within a few decades more

Another fundamental *ecological fallacy* is hidden in the ***renewable energy*** revolution now being advocated as the panacea for the next 50 to 100 years. It might ultimately be possible to provide the world with renewable energy and solar-power, and phase out fossil powered energy with its sulphur, carbon and nitrogen emissions contaminating the biosphere, decommission nuclear-powered stations, and neutralise and somehow safely dispose of radioactive, ionising wastes.

When only non-polluting, affordable and abundant energy (*via* photovoltaic cells, wind turbines, wave power, solar thermal & geothermal systems) is available world-wide, what is likely to happen? *People are likely to use as much as they can*. Levels of consumption will soar; but all other natural resources are absolutely finite. Will we not ultimately consume ourselves into extinction?

Lifestyle is the critical and fundamental issue at stake. It is often overlooked in the headlong rush into technological "solutions" to global warming, ozone depletion, acid precipitation, photochemical air pollution, toxic urban storm-water runoff. This is the "scientists will fix it" fallacy.

Build an efficient car and what is likely to happen? More people will drive further. Even the most astute of scientists is incapable of understanding the complexity and reality of planetary systems. Who could have predicted water from a bonding of hydrogen and oxygen?

At the same time, in our hands right now, we have the intelligence and ecological conscience necessary to change our *ways of life*: pre-empt where we can, be forewarned as best we can, and when all else fails, adapt as needs be.

SNIPPETS OF EVIDENCE FOR GLOBAL WARMING

Towards the development of indicative data

In 1990, 1992 and 1995 the IPCC published assessments of climate change; and two special editions of the *CO_2/Climate Report* (subsequently reprinted in the *Climate Change Newsletters* 6:4 and 7:3) reviewed about 800 papers published in 1992 and 1993. This is not the place to review the reviews. Suffice it to say that the complexity endemic in the issue is absolutely evident in the range of these reviews, and the search for knowledge is still accelerating as evidence mounts of disruption. Greenpeace has noted some 500 extreme weather events around the world since 1990 (SMH, 2 June, 1994). Not a week goes by without some place suffering record-breaking cold and snow-falls (Europe and USA, January 1996), hurricanes ("Luis" in the Caribbean in 1995 was the worst in 50 years), heat waves (two weeks of 50^0C temperatures in New Dehli and northern India in June 1995) or droughts (Brazil, 1992; Australia 1993–95, Spain over a 5-year period, 1990–95) ... and so on.

Ice Melt-Down

Let us consider some contributory and recent evidence for warming of the most obvious kind i.e. *melting ice*. Climate modelling studies predict that polar regions will be the first to detect greenhouse warming. Indeed, there has been a 2.5^0C temperature increase in the Antarctic region in the past 50 years (MacKenzie, 1995c). The Antarctic ice sheet covers an area larger than Europe (Redfern, 1993) and a significant meltdown could cause sea levels to rise significantly. Simultaneously, a decrease in white land cover would decrease the albedo/reflective effect, causing the earth to absorb more heat and radiate less. Moreover, if thawing is significant, huge quantities of frozen methane in polar regions (estimated as between 10^{18} and 10^{21} tonnes, covering some 50,000km^2 in the Beaufort-Mackenzie region alone) could become a major source of a potent greenhouse gas (Kvenvolden et al., 1993; Judge & Majorowicz, 1993).

The Argentine National Antarctic Division reported a cracking of Antarctica's 300m-thick Larsen ice shelf in 1995 and scientists from the British Antarctic Survey reported a huge iceberg, the size of Oxfordshire, shearing off the Larsen shelf at the same time (Mackenzie, 1995c). Scientists at the Norwegian Polar Research Institute reported three icebergs each the size of Cyprus breaking off in 1991 (Redfern, 1993). Both Australian and Norwegian scientists, basing their information on satellite data, report that sea ice around Antarctica is melting and the Arctic cap is shrinking (Mackenzie, 1995c). Indonesian province Irian Jaya's remote glaciers are also disappearing. They once covered 19 km^2 but have been shrinking since 1971, and now there is only 3km^2 left (Peterson and Hope, reported in the SMH, May 1995). Alpine glaciers in Washington state, USA have also been in retreat since the 1980s (Harper, 1993). Frosts have gradually declined worldwide over the past 40 years, affecting not merely urban areas suffering from "heat island" effects. In Australia, this trend is most pronounced in outback Queensland, where minimum night temperature has risen 1^0C since 1950 (Bureau of Meteorological Research, reported in SMH, June 1994.) Less snow cover was detected on Eurasian land masses during the winters from 1989–91 than at any time since records began (Pearce, 1991).

Notwithstanding these melt-down trends, some

than half of the world's species could be extinguished). Where will this leave humankind ?

parts of western Greenland, north-eastern Canada and some of the Soviet Arctic islands have actually cooled down (Pearce, 1991). Precipitation increases, due to global warming and predicted at higher latitudes, will thicken ice in certain places and this is estimated to be *slowing the rate* in the rise in sea levels (up 20 millimetres per decade this century) by about 10 per cent (Gribben, 1995).

An ice meltdown, combined with thermal expansion from warming waters could cause sea levels to rise significantly, projected to be in the range of 1–2m for a doubling to a quadrupling of CO_2 (Gregory, 1993). Much of the world's population lives in coastal areas. Consequences could be devastating: millions of eco-refugees seeking new lands.

PEOPLE–PLACE–PLANET INTERACTION

Understanding relationships between attitudes and behaviours in places is quite clearly a major consideration in any attempt to counteract these emergent planetary disorders and ensure a sustainable future for the planet. People–place–planet value systems must lie at the root of a responsible and accountable approach to environmental design.

In the first instance, designers must ensure that the *potential for a sustainable lifestyle is built-in* to the physical environment, by minimising resources used, using materials with low energy embodiment, employing life-cycle equations to calculate economic and environmental costs, designing solar efficient buildings and integrating renewable energy systems into them. At the wider scale, designing mixed land use urban villages where people can live and work in proximity, and CBD-regions with integrated (and safe) public transportation systems. This is akin to *predisposing the system towards sustainability*. Unless the attitudinal system is similarly primed, these built-in potentials will remain just that. People are the key. What they believe, expect, accept, and even tolerate ... and how they act and ultimately evaluate those experiences; in a word, their lifestyle habits and patterns significantly influence the criticality of the order–disorder equilibrium at the edge–of–chaos.

The criticality of people interacting in their built environments and their impact on planetary sustainability could not be more obvious than in the scenario where the world's population is predicted to double to 10 billion souls, and urban populations to quadruple, within the lifetimes of our children.[12] The sheer numbers, alone, will impact massively on the capacity of urban and eco-systems to sustain themselves, but it is consumption behaviours and lifestyle expectations that are even more critical. When, for instance, thousands of millions of Chinese and Indian[13] and African households have a refrigerator, every American and European household has at least two cars, several TVs and computers, and ageing populations living longer continue to maintain their standard of living and consume resources,[14] where will the resources come from to sustain this exponential growth? And where will all the waste, the effluence which flows from this affluence, go? Of particular concern is the increasing consumption of fossil fuels in developing countries, where growth in energy use of around 6 per cent *per year* for the next 30 years is a distinct possibility (Churchill, 1993).

ATTRIBUTING MEANINGFULNESS

Changing Value-Systems

The meaning attributed to situations is the central rationale for behaviour, whether long-term or habitual, day-to-day routines. Embedded in meaningfulness is awareness — attention and intention, and self-image, past experiences, socialisation, hopes and fears — and knowledge — insight, foresight and hindsight.

As new information emerges, and is validated and disseminated, so meaningfulness changes. But established ideologies and social conditioning do not change easily. Establishment goals and rules become entrenched, roles become internalised and habitual, and potentially disruptive and revealing or indicative information is suppressed (the nuclear industry a potent case in point). Moreover, human nature desires immediate gratification; long-term goals are not readily acceded to. Add to this the insidious nature of climate disruption — the subtle changes, the masking effects and negative feedbacks, the latent, invisible accumulation of stresses — and the likelihood that people in 1996 will act to preserve the life-quality of people in 2050 becomes more and more remote.

There are, nevertheless, nascent aptitude–attitude–activity paradigms emerging in people–place–planet disciplines. They require nurturing and development. Such paradigm shifts include:

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12 The world's population grew by 100,000,000 in 1995, to 5.75 billion, the largest increase ever, with about 90% occurring in developing countries

13 Developing countries in the Asia-Pacific region will almost double their present consumption of energy by 2010 and account for up to 30% of global greenhouse gas emissions (Gunasekera & Mwesigye, 1996)

14 15 to 20% of the over 60s in Europe will live to over 80 by the year 2000 [Eurostat].

environmental consciousness, environmental responsibility, ecological ethics and deep ecology; attitudes specially relevant to benign urban design

eco-psychology, where the "self" includes the natural habitat, and behaviour which leads to destruction of the world is understood as self-destructive, as an assault on the sanity of a community

energy literacy and the evaluation of the post-occupancy experience of solar efficient buildings i.e. promoting sustainable knowledge and aptitudes, which can then manifest as climate-appropriate behaviour

climate-disruption design i.e. built-in potential to accommodate and adapt to anticipated weather extremes in a warmer world: excessive precipitation, wind storms, rising sea-levels … (a new dimension of "climate-appropriate" design) and

voluntary simplicity, a generalised worldview that could influence lifestyle in general, and includes "acceptability trade-offs" relating to habitability–sustainability evaluations, "quality of life" rather than "standard of living" evaluations, and recognition of the primacy of environmental over economic costs. Self mastery is the ultimate goal here — since we are what we think. Intelligence ultimately both creates and destroys the environment.

Conscience and consciousness would thus seem to be at least as important as built-in renewable energy, energy efficient and benign design and enhanced natural carbon-sinks in urban environments. It is, however, unfortunately true that pessimism rather than realism often results from the dissemination of so-called "doom and gloom" information. Clearly, ignorance, apathy and self-delusion are not answers. A solutions-based approach must thus be inculcated, despite the threatening nature of the issues, in order to help generate vital attention and pro-active behaviour in the face of adversity. All of these paradigm shifts will be indispensable conditions in our attempts to both mitigate climate disruption and adapt to the consequences.

CONCLUSIONS

On March 21, 1994 more than 60 nations ratified the Climate Change Convention. The CCC addressed the greatest challenge ever facing the international community, yet business–as–usual prevails and nations largely concern themselves with making inventories of sources and sinks. Politico-economic expediencies are brought to bear by vested interests, attempting to ensure that international targets do not harm national export competitivity or corporate profits.

In the final analysis, it must come back to each individual acting responsibly. The accumulated effect of individual actions is global behaviour. Local is global.

We should not forget (or be condemned to relive history) that "rigid" cultures have perished in the past when climatic conditions altered and they failed to adapt. Pain (1994) reports, for instance, how the bronze age people of

Canaan failed to adapt to a drying out of their lands around 2200 BC. They attributed the climate shift to the wrath of the gods, built more temples and prayed a lot, rather than generating new irrigation systems, or changing their way of life. The demise of the early Mayan civilisation of lowland Yucatan, another rigid culture where, this time, an elite class considered themselves to be gods, revolved around their failure to reduce their conspicuous consumption when the region's climate became drier around 1600 BC, caused by a warming climate.

Is the collapse of such societies a lesson for us? Bruce Dahlin of Howard University in Washington DC suggests that "entrenched modes of adapting to change" are more of a problem than global warming (cited by Pain, op.cit). Relying on technological fixes, rather than simplifying lifestyles might be an illusion for which we will pay dearly, much like the Canaanites and Mayans. "Maya", of course, means illusion.

Only 50 years hence, when, in all likelihood, both atmospheric CO_2 concentrations and world population will have doubled, and consumption levels of urbanised developing countries approximate those of the developed world today, it is not unlikely that our children will inherit a world where disorganisation reigns; a supreme act of intergenerational inequity on our part.

Life does not owe us a living. It is we who are indebted to the earth.

Unlearning the conditioned belief that humankind has mastery over nature and replacing it with the belief that it has mastery over itself — based on the overriding philosophy of sufficiency — is perhaps the most critical paradigm shift required in the new century.

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