The Emperor has no Clothes ... Let us Paint our Loincloths Rainbow: A Classical and Feminist Critique of Contemporary Science Policy

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ABSTRACT: The British government's White Paper on science together with government research council reports are used as a basis for critiquing current science policy and its intensifying orientation, British and worldwide, towards industrial and military development. The critique draws particulary on Plato and Bacon as yardsticks to address who science is for, what values it honours and where current policy departs from imperatives of socio-ecological justice. Metaphors of the 'Emperor's new clothes' and incremental spectral shift in attitude help illuminate both the problems and ways forward. The paper calls for a re-integration of classical perspectives with added insights, often ecofeminist, from philosophy, poetics and a theology of reverence. Predication on the values of love, interconnectedness and orientation towards childrens' all-round development should be central to curricular reform. Consistent with the views of Plato, the original founder of the Academy, the utilitarian role of science ought to be balanced with a contemplative role of science as the art of knowing ourselves in relation to nature. Only with such a holistic academic approach can it adequately rise to providing a pedagogy of authentic human development, service to the poor and remedies, rather than contribution, to the ongoing destruction of nature.

KEYWORDS: Philosophy of science, ecophilosophy, ecofeminism, ecotheology, human ecology, geopoetics, reverence, deep ecology, environmental education, science policy, Plato, Bacon.

OBJECTIVE AND VALUES BASIS

This paper asks, has the 'Emperor' of British science policy as dressed by the recent White Paper and the research councils got any clothes? If not, do alternative perspectives predicated upon social and ecological justice represent as much as a loincloth?

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From the outset I wish to make explicit two values perspectives implicit to my critique. One will be the presumption that government policy, post-publication of the 1990 White Paper on the environment, should be consistent with the statement that, 'The foundation stone of (policy for sustainability) is our responsibility to future generations to preserve and enhance the environment of our country and our planet' (Secretaries of State ..., *This Common Inheritance*, p. 10). Secondly, the assumption is made that an ethical science must be conducive of and consistent with 'right livelihood' (Schumacher 1974), meaning dignified, just and compassionate relationship with nature and between peoples. I hold such qualities, which are predicated upon love, to be self-evident percepts of the human soul. As with all such empirical ethical percepts which provide the metaphysical metanarrative from which non-vacuous logical argumentation always proceeds, this is neither requiring of nor amenable to strictly logical definition (cf. Maslow 1962, 1973).

THE WHITE PAPER AND THE PERCEPTION OF SCIENCE

In May 1993 the British government published *Realising Our Potential: A Strategy for Science, Engineering and Technology*. This White Paper is now being implemented in a pedagogical environment where science is struggling to attract quality recruits. Whilst this is partly due to unenticing career prospects, it also reflects a cultural shift in the perceived social utility of science. As Sir David Weatherall, president of the British Association for the Advancement of Science has surmised, there is 'a widespread feeling that science had lost its way ... scientists were tampering with life or unleashing environmental disasters' (*The Guardian*, 25Aug 1993).

In a presidential address to the Royal Geographical Society, Sir Crispin Tickell lays the blame at the door of commercialisation. Warning that the human species is in danger of becoming 'a suicidal success' due to the product of population, technology and consumption exceeding nature's carrying capacity, he concludes that: 'We need to change the culture. Many have lamented the division between the cultures of science and the arts. They are right to do so. But neither is now in charge. Our real bosses are the business managers, and they are not known for their ability to think long' (Tickell, 1993).

The publication of the White Paper and what we have seen of its working through in the first two years, offers an invaluable handle by which to grasp and examine British science policy and its context in global academia and economy. For the first time in twenty years we were given a yardstick of the highest political authority. With it we should be able to ascertain who our science is for, how policy shapes the epistemological constructs of science and who the 'bosses' of such processes are.

In evaluating this new yardstick, I shall draw upon two major lines of scientific teleology in Western thought which, for simplicity, will be referred to as the Baconian and the Classical or Platonic. Such drawing upon philosophical

roots is today unfashionable in many scientific circles. However, it should not be forgotten why the highest degree offered by a university is not a DSc, a doctor (or teacher) of science, but a PhD – a doctorate in philo-Sophia, the love of the Goddess of wisdom. Science as a way of knowing is a branch of Western empirical philosophy. Philosophy precedes science. To ignore the metanarrative within which the epistemology of science has been constructed would be to fall short of any aspiration of objectivity and thereby risk advancing pseudo-science.

FRANCIS BACON AND SCIENTIFIC UTILITARIAN UTOPIA

The principles of the inductive science were laid down in the early seventeenth century primarily by Francis Bacon, 'the father of modern science'. Bacon, who was made Lord Chancellor in 1618, saw the role of science as being to master and control nature for economic benefit.

Merchant (1980, p. 169) remarks that for Bacon, 'The new man of science must not think that the "inquisition of nature is in any part interdicted or forbidden." Nature must be ... put "in constraint" and "moulded" by the mechanical arts. The "searchers and spies of nature" are to discover "her" plots and secrets'.

Renowned for his claim that 'knowledge itself is power', Bacon likened nature to a woman in whose womb can be anticipated 'many secrets of excellent use'. In 'The Masculine Birth of Time' he proclaimed, 'I am come in very truth leading to you nature with all her children to bind her to your service and make her your slave' (Merchant 1980, p. 170). Frequently describing matter as a 'common harlot', he draws on metaphors of repressed sexuality and of torture (as used in the inquisition of 'witches' of his time) in showing how inductive scientific method is the means by which the repeatable experimental situation can be achieved and exploited.

> For you have but to follow and as it were hound nature in her wanderings, and you will be able when you like to lead and drive her afterward to the same place again.... Neither ought a man to make a scruple of entering and penetrating into these holes and corners, when the inquisition of truth is his whole object – as your majesty has shown in your own example [i.e. witchcraft inquisition]. (Ibid. p. 168)

Berman 1981, Pepper 1984, Jones 1987, Griffin 1989 and the Jungs (1993) constitute a chorus of other environmentalist voices exposing these aspects of Bacon's science. The issues were generally not perceived by more orthodox commentators such as Eiseley 1961 or Weinberger 1985. Weinberger opens his preface saying he intends to 'restore the now-forgotten eighteenth-century view that Francis Bacon was the greatest of all the 'moderns' – the thinkers from Machiavelli to Hobbes who recommended turning the human intellect from the contemplation of God and nature to the scientific project for mastering nature and fortune' (p.9). Eiseley ends with a more cautious note:

> The rise of technology (in the nineteenth century) gave hope for a Baconian Utopia of the New Atlantis model. Problem solving became the rage of science. Today problem solving with mechanical models, even of living societies, continues to be popular. The emphasis, however, has shifted to power. From a theoretical desire to understand the universe, we have come to a point where it is felt we must understand it to survive.... If the physicist learns the nature of the universe in his cyclotron well and good, but the search is for power. (pp. 81-2)

Charlene Spretnak points out that various other philosophers of Bacon's period spurned

> the authority of the ancients ... in a quest to find an authoritative and infallible method by which to determine truth ... Descartes declar[ing] ... a practical philosophy by which we would 'render ourselves the masters and possessors of nature'. (1991, pp. 253-4)

Like Caroline Merchant (op. cit.), she emphasises that the closing years of the 'burning times' of 'witches', which affected mainly women living close to nature, coincides with the start of the industrial revolution, colonialism, 'improvement', 'progress', and 'development'. Such ecofeminist philosophers see direct linkage between the repression of women, the rise of science-predicated technology and what US Vice-President Al Gore has described as 'a new kind of addiction ... the consumption of the earth itself [which] distracts us from the pain of what we have lost' (Gore 1992, p. 220).

HAS EVE FRAMED BACON?

A draft copy of this paper was sent for criticism to Peter Dawkins of the Francis Bacon Research Trust. He returned the view (personal correspondence, 11 November 1993) that I had 'greatly misjudged Bacon', adding that, 'You are certainly not alone in this, as there seems to be a growing number of persons awakening to the fact that mankind is hurting and destroying his environment, who blame science for this, who look for a scapegoat and who then consider Bacon will do.'

He cites the *Novum Organum* where Bacon refers to, 'Man, the servant and interpreter of Nature ... for Nature is not conquered save by obedience...' Referring to Bacon's hermeneutical exegesis of the Biblical 'Genesis', Dawkins concludes for his advocatee that, 'A gardener masters or conquers nature entirely by his loving service to the nature of his garden ... nature is only commanded by love...'

So are the ecofeminists framing Bacon? One of his best know works is about a utopian state, the 'New Atlantis' (1605). Weinberger (op. cit.) shows that this was revisionary attempt at completing Plato's Atlantean vision in the *Critias*. Here Bacon speaks admiringly and with astonishing prescient vision of flying machines, submarines, climate control and what we would now know as genetic engineering. All are described as contributing to a high standard of living. But

there is also a chilling aspect to this reality. It carries no moral apology apart from the presumption of the superiority of humankind. We might be forgiven for referring to the utilitarian view of science as being a 'Baconian' perspective in the context of such passages as where Bacon looks forward to,

> ... parks and inclosures of all sorts of beasts and birds, which we use not only for view or rareness, but likewise for dissections and trials; that thereby we may take light what may be wrought upon the body of man.... We try also all poisons and other medicines upon them, as well of chirurgery as physic. By art [science] likewise, we make them greater or taller than their kind is; and contrariwise dwarf them, and stay their growth: we make them more fruitful and bearing than their kind is; and contrariwise barren and not generative.... We make them also by art greater much than their nature.... (Bacon 1974, p. 241)

PLATO'S 'SPLENDID ENTERTAINMENT'

Whilst recognising the importance of figures like Thales, Heraclitus, Empedocles, Democritus and Aristotle, I shall predicate my exposition of a classical alternative to Bacon on Plato (c. 427-347 BC), whose views on cosmology, mathematics, evolution and human ecology have been so influentially expressed in western thought through the *Timaeus* and *Critias*.

Plato opens these twinned dialogues by portraying his mentor, Socrates, as hoping that the outcome of the scientific discourse in which the assembled thinkers are about to engage will be 'splendid entertainment' (*Timaeus* 27).

He then gives the main part in this dialogue to Timaeus. It is reasonable for us to class Timaeus as a scientist in the modern sense because Critias tells Socrates that Timaeus, 'knows more about astronomy than the rest of us and has devoted himself particularly to studying the nature of the universe' (27-8).

Socrates reminds Timaeus to invoke the gods before speaking. Timaeus enthusiastically obliges. He replies, '... surely, if we are not quite crazy, as we embark on our account of how the universe began, or perhaps had no beginning, we must pray to all the gods and goddesses that what we say will be pleasing to them first, and then to ourselves' (27). Having so reinforced Socrates' anticipation of intellectual pleasure, Timaeus proceeds with his famous and powerful dualistic metaphysical statement of first principle: 'We must in my opinion begin by distinguishing between that which always is and never becomes [and] that which is always becoming but never is' (27). I consider Plato's making of this distinction, rather than recognising the underlying Zen-koanic unity of these two processes, is the pivotal difference between dualistic post-Socratic western thought and holistic eastern thought as exemplified by Taoism.

From this point on Plato, through Timaeus, lets the cosmos and its human ecology unfold. The world was created 'a living being with soul and intelligence' (30) which 'in its imitation of the eternal nature resemble[s] as closely as possible the perfect intelligible Living Creature' (39). Time is defined as 'an eternal

moving image of the eternity which remains for ever at one' (37). Historical human ecology is traced right down to Critias later telling of the felling of the 'thick woods' on the mountains of prehistoric Greece at the time of Atlantis, so that, 'You are left [as with little islands] with something rather like the skeleton of a body wasted by disease; the rich, soft soil has all run away leaving the land nothing but skin and bone' (*Critias* 111).

The soul is endowed with both 'reason' and 'harmony' (*Timaeus* 37) and (cosmological) harmony 'has motions akin to the orbits in our soul' (47). The faculty of sight and the observation of the heavens made possible by it, 'has caused the invention of number, given us the notion of time, and made us inquire into the nature of the universe; thence we have derived philosophy, the greatest gift the gods have ever given or will give to mortals' (47). The gift is both metaphysical and pragmatically ontological: it helps us know what is, what we are, and it shows us how to live as happily as we can. Such scientific inquiry enables us to 'see the revolutions of intelligence in the heavens and use their untroubled course to guide the troubled revolutions in our own understanding, which are akin to them, and so ... correct the disorder of our own revolutions by the standard of the invariability of those of god' (47). Timaeus goes on to say that the same applies to sound, hearing, rhythm and music. In so doing, Plato justifies the contemplative hedonism of his holistic natural philosophy. He claims that, '... as anyone who makes intelligent use of the arts knows, (such percepts are) not to be used, as is commonly thought, to give irrational pleasure, but as a heaven-sent ally in reducing to order and harmony any disharmony in the revolutions within us' (47).

Science, as most universities now call natural philosophy, is therefore central to right livelihood. In composing the soul it must be especially pleasing, Plato implies, to '... Pan and the Muses' (*Critias* 108; cf. *Phaedrus* 279). Plato is certainly not opposed to utilitarian uses of science. Indeed he affirms, 'two types of cause, the necessary and the divine. The divine we should look for in all things for the sake of the measure of happiness in life that our nature permits, and the necessary for the sake of the divine, reflecting that without them we can not perceive, apprehend, or in any way attain our objective' (*Timaeus* 68-9). But it is clear that the utilitarian uses must be in service of the divine if the preconditions for human happiness are to be met. The main emphasis is on the transcendental knowing of reality.

In contrast to Plato, Bacon draws us more towards that uncomfortable edge of technology; that portrayed by e.e. cummings (1969), where, 'Progress is a comfortable disease ... A world of made is not a world of born - pity poor flesh and trees, poor stars and stones, but never this fine specimen of hypermagical ultraomnipotence'. In this, Bacon was distinctly modern. His livelihood aspirations went *beyond* the demands of frugal sufficiency. Unlike that of Plato, his science contained implications which inevitably harnessed science to *an* economy, one increasingly to dominate as *the* economy (Duffy, 1994) colonising both the commons and knowledge.

THE EMPEROR HAS NO CLOTHES…

PLATO AND ECOFEMINISM

Although I shall argue shortly for a recovery of Platonic scientific teleology, its predication of the rational over feeling falls short of ecofeminist ideals. Some of Plato's thought is astonishingly feminist to the extent that he himself remarks upon it through Socrates in the opening dialogue of the Timaeus. Gender equality was a distinctive though contradicted characteristic of parts of the Republic. And in the Symposium (201), Plato attributes his whole philosophy of love to the wisdom of a woman, Diotima of Manitinea. But Plato sharply loses 'new man' points in the Timaeus. The text starts by articulating a goddess predicated cosmology (24-8). But then, as the character Timaeus takes over from Critias' preamble, Plato effects a theocratic gender paradigm jump. Matrifocality in the form of the Goddess is displaced by a transcendent patrifocal deity, 'the maker and father of this universe' (28). Plato's creation myth is beautiful and Gaia-like. Nevertheless, with the outstanding exception of the nature-inspired passion-driven divine madness of the Phaedrus (244-5), the broader context of his thought is a transcendent spirituality at the expense of the immanent. The created world is but an inferior representation of the eternal. The eternal, and not the world, is thus the proper focus of a philosopher's life, this being articulated not through the feelings, but through reason.

Later in history, Church philosophers could only delight at the rediscovery of writings which could be interpreted to so corroborate a theology of creation fallen through the imputed sin of Adam.

World-transcending spiritualities, on their own, have not provided adequate defence of women, nature, or the gentle souls of men over time (Watts 1976). The influence of ancient Sparta on Plato's thought (Russell 1946) may have effected this philosophical 'poisonous pedagogy' (cf. Miller 1987) which is reflected in his denigration of the body, scorn of passion and censorship of feeling in literature. His ecology, though sound, is ambivalent. The same Plato who later in life established his Academy in a grove just outside Athens and ends the *Phaedrus* with Socrates venerating 'beloved Pan' of the 'holy place of the nymphs' (*Phaedrus* 278), earlier echoes the ivory tower aloofness of many subsequent academics – Socrates (possibly tongue in cheek) telling the country-loving Phaedrus that, 'I'm a lover of learning, and trees and open country won't teach me anything, whereas men in the town do' (231).

Merchant (op. cit.) concludes that scientific rationalism, which has been the final outcome over time, has caused 'the death of nature'. Nature requires our embodied concern, our empathy if we are to live sustainably, at-one with it. This is not to discard reason or the transcendent. They are a vital parts of the whole. But to divorce reason from feeling and sensuality in a hierarchy of epistemolgical validity can only split the psychosomatic totality of life and eventually, injure both psyche and soma.

Ecofeminism is a movement that attempts a re-weaving of world and spirit (cf. Diamond & Orenstein 1990, Plant 1989). Later in this paper, we shall draw

upon it as an understanding which can recover much of value from the Classical world view – what Empedocles might have predicted as a return of the Golden Age of Aphrodite after a long period of love being overwhelmed by strife.

THE WHITE PAPER: A NEO-BACONIAN CHARTER

In Platonic classicism and Baconian utilitarianism two major poles in scientific teleological thought can be identified. The need for a tripole has been hinted at – an ecofeminist perspective grounded, as is ecofeminism, in deep ecology (Seed et al. 1988). We shall return to this later. For now, holding these cognitive tools as yardsticks in the mind, let us analyse and evaluate British science policy.

The White Paper opens with the statement that:

> The understanding and application of science are fundamental to the *fortunes* of modern nations ... (being) intimately linked with progress across the whole range of human endeavour.... They provide ... a vital part of *humankind's armoury* for solving long-standing, world-wide problems, such as poverty and disease, and for addressing new global challenges such as those facing the environment' (1.1; emphasis in this and the following extracts is added.)

Science is here presented not as a way of knowing, but as a means of problem solving. Problem solving is, of course, part of the role of science, but heavy use of such language as 'challenge' and 'fighting back' augments a combative rather than a co-operative or symbiotic approach to nature. The causes admitted to, however, are laudable. Poverty and ecology are rallied to bolster the continuing need for scientific advance.

Scientists are not necessarily combative when they first enter the field. Gaillard (1991) has shown that social utility, as in concern for humankind, is the dominant motive influencing practitioners to choose or alter a scientific career. One wonders about the psychology of those many school leavers who choose veterinary science because they love animals, or forestry because they like trees, then find themselves employed in factory farming or clearfelling. Does scientific training, as distinct from education, somehow square the dissonance often apparent between the ideal and the job? Could there be a form of intellectual dishonesty at work; what Tart (1988), based on his work with consciousness and hypnosis, calls a 'consensus trance induction process', whereby a consensually validated world view is shaped by pedagogy, advertising, media, etc. to the detriment of alternative world views?

Howard Levine (1991), a former director of the US's Public Understanding of Science Programme, has argued the importance of making explicit 'the implied social contract, or bargain, between science and the larger society'. But for the White Paper, it becomes apparent after the first paragraph that the contract is to be a three-way closed shop in a market place subsidised by the taxpayer:

> Technology foresight, jointly conducted by industry and the science and engineering communities, will be used to inform Government's decisions and priorities. The process will be carefully designed to tap into the expertise of people closest to emerging scientific, technological and market developments. The aim is to achieve a *key cultural change* ... between the scientific community, industry and Government Departments. (1.18.2)

Science is to be the first line of defence in the armoury which Britain's historic role in free trade demands. We must apply science to remain on top in what financier Sir James Goldsmith has called 'a Hell's merry-go-round' of development. Without alluding to any critique of techno-economic history and its environmental consequences, the Paper says:

> The history of the United Kingdom has shown the *intimate connection between free trade, the application of science to tradeable products, and national prosperity*. The industrial revolution which played so large a part in creating the modern world was made possible by our great engineers of the eighteenth and nineteenth centuries. In a world where ever fiercer competition prevails, history's lessons are highly pertinent. (1.2)

Thus motivated not by the sense of wonderment (which Aristotle said is the root of philosophy), but by *fear* of being trampled from behind on the racetrack of competitive progress, science must 'generate relevant and industrially applicable results' (1.8). The paradigmatic mindset is one in which, 'The major challenge facing the United Kingdom today is an economic one. The nation's first priority must be to improve the performance of the economy to meet the competitive challenge...' (2.1). It is therefore necessary that 'opportunities should be generated, on a much larger scale, for interaction between scientists and business*men* involved in the day-to-day business of selling in competitive markets' (2.29).

This is not to deny that some research may have 'intrinsic scientific merit' (1.8), or that 'there are educational and cultural reasons for funding research', but the White Paper leaves us in the dark as to what these might be, except where Big Science is concerned, now re-named 'Mega Science' (6.19) by the OECD. In Mega Science it is conceded that, 'the prospects of commercial exploitation and "spin-off" are severely limited' (6.15) and a competitive approach would be too costly because, 'like the science itself, the cost (of competition) nowadays can be astronomical'. Thus, 'science needs Government and public funds' (1.7) and co-operative global collaboration is appropriate in pursuing (undefined) 'worthwhile opportunities' (6.19) in areas like particle physics and astronomy. The 'pooling of effort in the pursuit of common research objectives' is also appropriate 'where shared human problems are addressed'. The two examples given are the World Climate Research Programme, which, of course, addresses probable links between climate change and technology-fuelled development, and the Human Genome Project.

While acknowledging that 'science and technology do not respect political or national boundaries (6.1), the Paper avoids serious mention of *economic* boundaries other than to remark that international co-operation will involve 'facilitating foreign access to the *patented* findings of research undertaken in the United Kingdom'. This might be worrying for the Third World, given the findings of Gaillard (op. cit.) that far from helping to develop indigenous science, the increasing commercialisation of science accelerates the brain drain from South to North. However, through the Technology Partnership Initiative the UK is willing to build on its 'track record in transferring environmentally-sound technologies' to developing countries and 'the Overseas Development Administration has a key role to play in promoting sustainable development in countries supported by the British Aid Programme' (6.4). Notwithstanding the weighty consideration given to the topic in the Government's White Paper on the Environment (This Common Inheritance, 1990), this is the *only* mention made of *sustainability* in the Science and Technology White Paper. It is curious that the appliance of science in this respect appears to be confined to developing countries. Curious too that 'key issues' globally include 'environment, human population and AIDS' (6.1), but there is no suggestion that population is only a problem inasmuch as it is combined with levels of *consumption*, such as economic growth promotes and for which the Third World is not primarily responsible.

PROSPERITY AND QUALITY OF LIFE – THE NEW RESEARCH COUNCILS

The Paper states that 'when [Government] funds science, as it must ... [with] large sums of public money' it is to achieve 'wider benefits, above all the generation of national prosperity and the improvement of the quality of life' (1.7). Prosperity and quality of life are repeatedly linked in this way. While prosperity has clearly been argued to be a function of competition in free global markets, and therefore concerns material wealth, *no definition of quality of life is offered.* Neither is any mention made of the distribution of prosperity and quality of life, either within British society or between nations. Mission statements are reproduced for all six reorganised research councils, including the Economic and Social Research Council. Four are paragraph-long statements, 20% of the space being taken up by the same mantra-like ending, '...thereby enhancing the United Kingdom's industrial competitiveness and quality of life' (pp. 29-31). There are two variations. The Medical Research Council, turns priorities round, claiming it is '...thereby enhancing health, the quality of life and the United Kingdom's industrial competitiveness' (p. 30). The Particle Physics and Astronomy Research Council's equivalent is given below. Each research council will have, 'Chair*men* ... selected ... to bring in relevant experience from the industrial and commercial sectors most closely related to the Council's missions' (3.31).

It is difficult to see how such proposals can be referred to as anything other than a businessman's science charter. None of the mission statements refer to anything other than a utilitarian function for science. With the Biotechnology and Biological Sciences Research Council the neo-Baconian intent is particularly manifest with the statement that it aims at 'enhancing the management of biological resources and their utilisation and interactions with the environment, placing special emphasis on meeting the needs of users of its research and training output, thereby enhancing the United Kingdom's industrial competitiveness and quality of life' (p. 29). No mention is made of such issues as environmental sustainability, biodiversity or meeting the needs of the poorest in society. No concession is made to the Platonic perspective. The implicit values structure speaks to a scientistic (not a scientific) paradigm of control and domination over nature, reinforced by gender-exclusive patrifocal language.

Additional evidence that the White Paper is rooted in the thought of the general era of Bacon is provided by a speech delivered to the British Association by the Paper's instigator, William Waldegrave. In addressing the audience about the 'ignorance of and even hostility to science, which is too widespread in Britain', he reminded them of the 'spectacular English [sic] explosions of intellectual energy' under Elizabeth I and Queen Anne (*The Guardian*, 3 Sep 1993, p. 6).

SCIENCE POLICY TO PROFIT FROM WAR

In a chapter on defence science and technology, the Paper notes that, 'As the Gulf conflict illustrated, technology can provide the decisive edge in military operations' (4.1). It is in this chapter that the only mention is made of a specific environmental technology: 'water pollution control' (4.7) is cited as one of the 'spin-offs' from military research. New conceptual ground is broken with the frank statement that military purchases of commercial technology 'produces opportunities for "*spin-in*" from the civil to the defence sector' (4.6).

Measures such as the Defence Research Agency's Pathfinder programme will ease opportunities for industry and 'allow industry to influence the nature of the Agency's work to facilitate wider future applications' (4.12). In these respects the White Paper is commendable for its openness in rendering so lucid the relationship between state and the military-industrial complex which has placed Britain second in the league of global arms exporters, with 20% of world market share (*Guardian Weekly*, 12 Sep 1993).

The failure to define the non-economic 'worthwhile' aspects of fundamental or basic research might raise questions regarding its possible military applications. The mission statement for the new Particle Physics and Astronomy Research Council states that it has

> To promote and support high-quality basic research and related post-graduate training in astronomy, planetary science, and particle physics, which takes account

> of the potential for contributing to the United Kingdom's industrial competitiveness and quality of life, but whose main objective is the improved understanding of the concepts and principles underlying physical phenomena and their consequences. (p. 31)

It is quite possible, and hopefully the case, that *here* we do have a genuine aspiration towards the Platonic ideal. If so, it is an expensive one, and should be made more explicit so that its social contract in relation to the poor, the old, the sick, the degraded in nature, the ordinary taxpayer, and so on can be subjected to scrutiny. If fundamental research is not significantly for contemplative purposes, then the long term contribution to industrial competitiveness and quality of life should be monitored, perhaps with due application of normal discounting procedures to the stream of distant benefits duly weighted for the probability of their occurring (Van Horne 1980, Bromwich 1976). Should basic research not be justified on grounds of either contemplative or social utility, it ought to be clearly stated as an elitist activity (parallel to the dominant group in Bacon's New Atlantis), or its military rationales ought to be subjected to democratic scrutiny. Such scrutiny must include ethical appraisal.

It is disturbing to see ethical sensitivity seemingly lacking in certain applications of science. For instance, the Economic and Social Research Council report 1991-1992 tells that:

> When Ronald Reagan announced his 'Star Wars' Strategic Defense Initiative there was widespread astonishment at the audacity of the scheme. Some found it difficult to comprehend the scale of the project, others railed against the astronomical costs involved. However when the public came back to earth, their amazement was eclipsed by growing concern within the scientific community about *one vital question*: how can you know that a system as complex and as important to the world's security will work on the day? (p. 24)

The impact of such technology on human lives is too great for questions as to its probity to be left unaddressed. Recognising this, an OECD report on American science policy in the sixties warned,

> What is at stake, ultimately, is not the growth rate of basic research but the view that the scientist has of himself and his role in society.... Somehow the R & D explosion spearheaded by the military has permitted the scientific community to live with something near to a personality split: to be a principal agent of change in our society during the work hours in the laboratory and yet not feel committed to the consequences of such change as it enters our daily life. The state of 'pureness' of intentions and 'non-involvement' in consequences will no longer be possible in a society fully permeated by science ... [representing] a betrayal of the very principles that made science possible and made it great. (OECD 1968)

The contemplative contribution of Big Science should not be underestimated, particularly now that it provides new perspectives on philosophies of interconnectedness and consciousness (Bohm 1983, Penrose 1989, Tarnas 1993,

Zohar 1990). But society has a right to call to account scientists who display such dangerous arrogance as did Enrico Fermi who, after working on building the atom bomb, is reputed to have said, 'Don't bore me with your moral scruples. After all, it's superb physics' (Hallen 1989). Lack of public accountability and respect for the implicit social contract can lead to sudden disruption of Big Science programmes. Alter and Logan (1991), for instance, show how NASA's budget was slashed by 75% between 1967 and 1974 as political support waned following the moon landing. The loss of the space shuttle Challenger was arguably a symptom of the organisational strains induced by subsequent organisational degeneration. This in turn further fuels public distrust of Big Science programmes.

For science to be valued in society it must be practiced with humility. It must take its place alongside other epistemologies and not presume to establish technocracy. As Jacques Delors said in his address to European church leaders when President of the European Community,

> Believe me, we won't succeed with Europe solely on the basis of legal expertise or economic know-how.... If within the next ten years we haven't managed to give a soul to Europe, to give it spirituality and meaning, the game will be up. This is why I want to revive the intellectual and spiritual debate on Europe. I would like to create a meeting place, a space for free discussion open to men and women of spirituality, to believers and non-believers, scientists and artists. (Hulbert 1993)

SCIENCE EDUCATION: CHILDREN

Failure to address such implicit critiques as that of Delors are felt by some scientific educators to account for difficulties in attracting bright young people into their faculties. The White Paper attempts to address this, expressing such pedagogical intentions as: 'The government wishes to harness the intellectual resources of the science and engineering base [i.e. graduates from tertiary educational institutes] to improve economic performance and the quality of life.' Reference to this happening, 'in future' (3.9), indicates policy change. It is suggested that PhD training in universities should become 'more closely related to the needs of industry' (7.17).

As graduates undertaking a PhD are in mature control of their own lives, there is little cause for concern here and many would welcome a move towards more applied PhD research. But such is not the case for children within an age category or a social class where schooling to a government curriculum is compulsory. Of these, the Paper disturbingly states that, 'the Government ... has embarked on a *radical agenda* of changes in the education and training system, including changes in the school curriculum ... for the whole of compulsory schooling'. This will 'ensure for the first time that all pupils, girls as well as boys, will study a broad and balanced programme of science and technology right through to the age of 16' (7.2). It continues, 'more young people must perceive science and

engineering in industry as an attractive and worthwhile career. They must also see the value of developing the entrepreneurial skills which will help businesses exploit more effectively the results of research, science and technological development' (7.7). Such mechanisms as science festivals should be used to persuade the public of the importance of these changes, encouraging 'diffusion among the public at large of an appreciation of what science is' (7.32). Significantly, 'what science is' goes undefined. However, we are reassured that in our schools, steps towards the 'radical agenda of changes' mean that 'Pupils can now expect *impartial* and accurate careers guidance and access to work experience' (7.2).

One might ask whether this will be 'impartial' within the wider playing field of life, or only on the field drawn up within the paradigms of the White Paper's 'key cultural change'. With such an inadequate philosophical base, what safeguards are there to prevent a limiting of children's horizons on life, a shutting down of their world views, so they are induced to understand the economy's relationship to life as being perforce a Baconian application of science, engineering and technology to competitive industry? The White Paper after all makes no concession to the possibility that the excitement, wonder and joy of pursuits like science and the other arts might be worthy ends in themselves. Instead, it hijacks what we might call the 'wow factor' of a child's enthusiasm and packages it into feeding greed beyond sufficiency's need. There is no hint that the Platonic 'splendid entertainment' of such pursuits might actually substitute for material consumption, thereby reducing the need for wealth creation as a contributor to quality of life and correspondingly, reducing human impact on nature. Instead, we might be forgiven for feeling not a little empathy with Pink Floyd's controversial chart-topping 1980's lyric from *The Wall*, 'We don't want no education; we don't want no thought control; no dark sarcasm in the classroom – Hey! Teacher! Leave them kids alone!'

It is important for policy makers to realise that such countercultural views run surprisingly close to the mainstream surface and will breed cynicism of manipulative policy. As a few academics and civil servants were scrutinising the government's intentions in the White Paper, hundreds of thousands of British children were being exposed to a contrary perspective put forward in Michael Crichton's best-selling book, *Jurassic Park*, made into a Spielberg blockbusting movie. Reflecting on a Baconian *New Atlantis*-type dinosaur theme park gone mad, Crichton's character, Malcolm, says of a scientist:

> He's an engineer, they're technicians. They don't have intelligence. They have what I call 'thintelligence'. They see the immediate situation. They think narrowly and they call it 'being focused.' They don't see the surround. They don't see the consequences. That's how you get an island like this.... Scientists have an elaborate line of bullshit about how they are seeking to know the truth about nature. Which is true, but that's not what drives them. Nobody is driven by abstractions like 'seeking truth'. Scientists are actually preoccupied with accomplishment. So they are focused on whether they can do something. They never stop to ask if they *should* do something. They

> conveniently define such considerations as pointless. If they don't do it, someone else will. Discovery, they believe, is inevitable. So they just try to do it first. That's the game in science. Even pure scientific discovery is an aggressive, penetrative act. It takes big equipment, and it literally changes the world afterward. Particle accelerators scar the land and leave radioactive byproducts. Astronauts leave trash on the moon. There is always some proof that scientists were there, making their discoveries. Discovery is always a rape of the natural world. Always. The scientists want it that way. They have to stick their instruments in. They have to leave their mark. They can't just watch. They can't just appreciate. (Crichton 1991, p. 284)

SCIENCE AND WOMEN

The White Paper also addresses ways of drawing more women into science: 'Women are the country's biggest single most under-valued and therefore under-used human resource' (7.13). Whilst valuing the gender-inclusive intentions, one might ask whether a woman would have expressed it in such consumptive language. Women have other ways of seeing such instrumentalism (Kirkup et al., 1992). Scots poet, Mary McCann (1992 pp. 64 - 65), addresses profound concern in her poem, 'Working for Moloch'. Consistent with theologian Walter Wink's view that in a modern context we must again name, unmask and engage the age-old 'principalities and powers' (Wink 1992), she re-invokes Moloch, the Old Testament fire-filled stone idol into whose red hot arms the children were sacrificed to ensure material prosperity.

> the cleaners are scrubbing the Institute lavatories
> because women are supposed to do that...
> the young men are doing their PhD's
> because young men are obedient and ambitious
> and someone wants warheads...
> multichannel night seeking radar...
> and science is neutral...
> at the top of the tower the old men and the middle aged men
> and sometimes one woman professor
> meet to form plans, cadge funds and run the place
> because obedient young men turn into obedient old men
> and it's all for the good of the country...
> and science is neutral
> and no one notices Moloch...
> and it's hard to see Moloch because he is both far away and everywhere...
> and no one asks to whom whey are all obedient
> and they say, 'Who's Moloch? Never heard of him'
> as out in the dark Moloch belches
> and grows redder and redder
> and fatter and fatter
> as he eats the children

EXISTING RESEARCH COUNCIL POLICY – 1991-92 REPORTS

Another line of approach in ascertaining the drift of British Science policy can be gleaned from the reports of the research councils. The three most relevant to environmental issues are the Natural Environment Research Council (NERC), the Economic and Social Research Council (ESRC) and the Agriculture and Food Research Council (AFRC). Here I shall refer to those for the years ending 1992 and 1993. The 1992 reports precede the science White Paper, but reflect policy which had time to absorb the 1990 environment White Paper. I shall address 1992 and 1993 separately.

In 1992 the NERC, which had one woman other than the Secretary on its Council of twenty, described its purpose as being to develop 'understanding of Man's impact on his surroundings and ... sensible policies for the exploitation of natural resources' (p. ii). It recognises that space science has 'brought to public consciousness for the first time [sic] the essential unity, and fragility, of the Earth's environmental systems ... [and that] Man's activities are having profound global effects on the natural environment' (p. 6). It is not until the section on 'Highlights from the Universities' on page 17 that sustainability is mentioned for the first and only time, though fittingly with the statement that: '[For taxonomy] to be a really useful science, an understanding is needed of what species do for the structure of ecosystems, and which species perform vital keystone tasks; then judgments can be made of the sustainability of human activities and future policies'. The neo-Baconian utilitarian presumptions underlying this research are apparent from the statement that, 'it is not known how many kinds of plants and animals live on this planet...; it is not known what they all do, or how many of them are vital to the functioning of the Earth's ecosystems; and *it has not been decided* on moral, aesthetic or economic grounds how many species should be conserved'. Scientific reserve permits no hint of outrage that, 'it is known that, largely as a result of human activities, species are disappearing at a rate unprecedented over the past 600 million years of evolution'.

As for the ESRC, its growing emphasis on high quality data collection is consistent, says its research director, with wanting 'high quality research that has a sense of leadership and intellectual excitement – research that will push the frontiers of our knowledge and understanding forward. We are *not here to make subjective judgements on whether a proposal is 'socially' important. Academic excellence is our principal yardstick*' (p. 7). Just how academia has managed to resolve Moore's naturalistic fallacy (Frankena 1939) in so doing is not explained.

The presumption of value neutrality notwithstanding, the ESRC is sponsoring several research programmes which are welcome for their direct or indirect relevance to sustainability. Their *Global Environmental Change* programme in particular includes components which address several of the concerns of this paper, particularly Lancaster University's programme on 'Science, Culture and the Environment' (GEC 1994). One ESRC funded programme has developed a taxation structure to use market mechanisms to reduce waste in packaging.

Another explores food and nutrient flows between London and the agricultural periphery since the 14th century. It concludes, 'There are no indications that there was ever a sustained food crisis in the city. This shows that comparatively simple agricultural systems have the capacity to meet sophisticated demands. Perhaps the future will have more respect for traditional systems' (p. 22). A third, entitled 'High-Tech Myths' looks at the relationship between small firms and technology, concluding that most of the benefit of technical innovation spirals up to large companies (pp. 26-7). The implications of this might be pondered in the light of the White Paper's emphasis on industry.

The AFRC, having made no mention of sustainability in its 1990-91 report, makes a wholehearted commitment in 1991-92 by entitling its report, 'A Basis for Sustainability'. It is clear that most of the work still being sponsored has *no* relation to sustainability, indeed, sustaining soil quality (which is perhaps the most significant quantifiable physical sustainability indicator) gets no mention until page 33 in a 65 page document. But the Council is clearly making a start with new ways of thinking: 'On the one hand molecular biology and genetics describe individual molecules or organisms; they are *reductionist* in emphasis. On the other hand, nutrient management, ecology, pest control and environmental studies require more *holistic* approaches involving the study of integrated systems. These are usefully brought together in the concept of sustainability...' (p. 5).

One might hope in future to see reference to the human ecology/community of sustainable agriculture which is not mentioned at present. This could militate against such statements as, 'Farming can be viewed as an engineering process...' (p. 33), or the agriculture-as-molecular biology thrust of the Government's 'Forward Look' and 'Foresight' reports (Whittemore, 1995), which came out too late for discussion to be included in this paper.

One might also hope to see some addressing of questions as to whether sustainable land and sea use is possible in a framework of global agricultural economics. In what is acknowledged to be 'an increasingly competitive and international market place' (p. 3), it would be valuable to see research commissioned to explore whether a process like GATT can uphold agricultural communities, biodiversity and soil structure, or whether pressures of free trade will undercut everything to the lowest common denominator of greatest exploitation (Lancaster and McIntosh, 1995). If research councils are to serve quality of life as the White Paper suggests, such questions should become paramount. But if they are to do so mainly via the wealth creating filter of industry and with councils overwhelmingly biased towards the cultural perspectives of white upper middle class men, the nature of their social contract with broader British society may be called increasingly into question.

RESEARCH COUNCIL REPORTS – 1992-93

The NERC's 1993 report places considerable stress on science which bears on environmental problems such as trace gas exchange between atmosphere and

ocean, the adaptability of plants to climate change and species diversity in farm woodland ecology. In what is his last annual report as chairman, John Knill comments that, 'NERC's submission to Government on the White Paper argued, as it had at the time of the Morris Report in 1989, for the holistic nature of environmental research but clearly identified areas where change was desirable. Evolution was preferred to revolution....' (p. 3).

The ESRC is less ambivalent in demonstrating that its science contributes to industry. Thus we are told of its semantics research that, 'A leading computer manufacturer has used some of the findings to develop a new word processing package' (p. 5). We are advised that an outcome of research into road psychology is that, 'A major driving school is seriously considering using the technique' (p. 6). and the chief economist of ICI considers that, 'In many ways, the results of social science research are more important than those coming from the natural sciences. They are more relevant to wealth creation and policy making' (p. 10).

There is little of environmental significance in the ESRC report, but in a section headed 'Science Fiction', there is a telling account of Brian Wynne's research into differences in risk perception between scientists and the public. Wynne finds that 'The scientists may calculate the risks, but this involves social assumptions, which often inadvertently suppose an ideal world. The public is interested in how these scientific advances are going to be controlled and managed in the real world.... Scientists, however, rarely recognise that their own knowledge is shaped by social assumptions too.... The experts impose their own social assumptions about what is useful and consequently undermine their own credibility. Scientific bodies do not appear to understand these conflicts' (p. 31).

It is in the 1993 AFRC report that we see some of the most interesting adaptations to the White Paper. The report is speckled through with quotations from the Paper as the Council demonstrates its readiness to transmutate into the new Biotechnology and Biological Sciences Research Council (BBSRC). Almost disappeared is last year's keynote emphasis on sustainability. The 1993 report is entitled, 'Meeting UK Needs in the Biosciences'. A picture of a Council meeting at the Royal Society in 1993 reveals that, behind the androgynous initials in the listing of Council members, all but one of the twenty-one present are men, and all are white.

We are told to anticipate a 2-4°C rise in temperature by the end of the next century. In anticipation, research into crop management under environmental change is being sponsored. Animal welfare in production farming also receives support, as does organic dairying and the modelling of silvopastoral systems. £11.2 million out of the Council's £48.8 million expenditure on Coordinated Programmes could be said to be environment related, the largest tranche of which (£8 million) is allocated to the Biological Adaptation to Global Environmental Change programme. By comparison, similar sums are spent on Stem Cell Molecular Biology (£7.5 million), Plant Molecular Biology (£8 million) and Bovine Spongiform Encephalopathy (£9 million) (p. 61).

Of particular interest is the AFRC's public relations research into attitudes to biotechnology and its 'schools liaison' work. The Council seeks 'to understand better the basis of public perception of biotechnology. This will help the Council to present its research in ways that both provide the public with objective information on issues of legitimate concern and provide a basis for rational decision-making' (p. 52). To achieve this a conference is planned to seek consensus on biotechnology. This will allow for dialogue between experts and citizens, with the National Museum of Science and Industry having agreed to take responsibility 'for ensuring impartiality and publishing the findings' (p. 52). The Council is considering both sponsoring and providing expert evidence to this, recognising that 'Public attitudes will influence the extent to which the potential of biotechnology is realised in new products and processes for industry' (p. 52).

The AFRC's research into consumer and school pupil attitudes shows that the extent to which different sources of information are trusted when there is no information attribution include tabloid newspapers (33%), government minister statements (38%), government information leaflets (48%), food industry leaflets (52%), environmental group publications (60%), TV news and quality newspapers (62%), research publications and supermarket information leaflets (63%) and TV current affairs programmes (67%). An ESRC sponsored Institute of Food Research study finds that people 'feel they have little control over the technology which they see as controlled at the level of society .... however, detailed examination of the issues underlying these ethical concerns reveals many of them to be addressable concerns such as animal welfare or human health' (p. 52). Given that the Council sees its programmes as aiming to 'increase public awareness and widen debate on issues of biotechnology that will influence its acceptability' (p.52), it would appear to be a legitimate concern that symmetrical resources should be placed into addressing areas which might conclude that certain aspects of biotechnology or the socioeconomic construct within which it operates may be not acceptable.

HAS THE EMPEROR A LOINCLOTH?

From the values basis stated at the outset of this paper, it must be evident that British science policy represents an Emperor with a substantial vestment deficit. The White Paper in particular perverts science primarily to utilitarian ends, splitting it off from any wider context of seeking to know the harmonies of the soul in relation to nature – that is to say, *it denies the holistic framework of a human ecology*.

The deficiencies in the White Paper are all the more remarkable given cultural changes in attitude of a growing number of scientists and educators, such as that evidenced by the University of Edinburgh's Environmental Initiative. This requires that 'all undergraduates ... should be exposed to teaching about wider and more fundamental issues of society's relationship to the environment,

including complex social, ecological and ethical questions....' (Loening et al., 1991, p. 5). Such indications show that in some quarters of Court, the Emperor's nakedness has been recognised and efforts are being made to halt the procession and tailor at least a loincloth. To call it more than a loincloth would be presumptuous at this experimental stage when, as Loening comments, 'Universities can and do try (alternative) approaches, but nevertheless tend to maintain and transfer the traditional abstracted and reductionist culture' (ibid. p. 38).

Where might we find a loincloth given that the classical one is better, but still hardly tailored to modern needs?

New thinking on science is currently emerging from sources which are often feminist or feminist informed. I say 'new', but as the controversial archaeological revisionary work of Marija Gimbutas (1991) et al. arguably demonstrates, they may be rooted in ways of relating to nature which served humankind for the greater part of its evolution. Patsy Hallen is one example of the new wave. She calls her feminist critique of science 'Careful of Science', the title being,

> ... a dialectical play on the word 'careful', embracing three meanings: (1) be careful of science or 'beware' of science because its capabilities are so life-threatening; (2) take care of or 'cherish' science because it is so precious, one of our most important ways of understanding; and (3) be full of care or do science with care and hence 'transform' science into a life-affirming pursuit by caring labour. (Hallen 1989, p. 3)

One is reminded of how Rachael Carson is said to have returned her marine specimens to the shore after observing them in the laboratory, taking care to do so at the same tidal stage as when they were removed. Such love is perhaps not unconnected with bringing about the clarity of vision which resulted in *Silent Spring*. Perhaps by denying feeling, empathy and compassion as ways of knowing alongside rationality, our knowing itself becomes deficient. Perhaps thus our science policy becomes unbalanced. True objectivity calls for inclusion of the subjective. This makes manifest the relationship between attitude, values and observation. As educationalist David Orr shows: 'Science without love can give us no good reason to appreciate the sunset, nor can it give us any purely objective reason to value life' (p. 18).

Alan Watts (1976, pp. 68-69) further develops this vital point, citing a Chinese poem by Chia Tao:

> I asked the boy beneath the pines.
> He said, 'The Master's gone alone
> Herb-picking somewhere on the mount,
> Cloud-hidden, whereabouts unknown.

Critiquing Western thought, Watts writes,

> But there is a kind of brash mental healthiness ever ready to rush in and clean up the mystery, to find out just precisely where the wild geese have gone, what herbs the master is picking where, and that sees the true face of a landscape only in the harsh light of the noonday sun. It is just this attitude which every traditional culture finds

> utterly insufferable in Western man, not just because it is tactless and unrefined, but because it is blind. It cannot tell the difference between the surface and the depth. It seeks depth by cutting into the surface. But the depth is known only when it reveals itself, and ever withdraws from the probing mind.

Thus to cross-cultural scholar, Gifford lecturer and chemist, Raimundo Panikkar, the heart is central to epistemology: 'Love', he suggests, 'is at the root of knowing.... Knowing without love is not true knowledge. It is only grasping, apprehending, appropriating, ultimately a robbery, a plunder' (1993, p. 66).

Science therefore can and must have a loincloth to clad its Baconian nakedness. It is based on the capacity of the soul to know harmony *as well as* rationality; a combined drawing upon the faculties of thinking, intuition, feeling and sensing (Jung, in Jacobi 1942); head, heart and hand. It demands a sensitivity to if, when and how it might be appropriate to probe, and what if not. It calls for a science of the utmost responsibility, in which knowledge is not divorced from wisdom ... the science of a well-centred philo-Sophia. This may be not easy to contemplate because it requires epistemologies developed most fully in modern theology. Whilst theology might arguably not demand restoration to its traditional place as the 'Queen of Sciences' for the reasons Newman (1852) gives, it must at least be heeded for the metaphysical role it can play in shedding light upon the inner structures of reality (Wink 1992, Panikkar 1990b). Many great scientists, not least Einstein, have always recognised this.

CURRICULAR IMPLICATIONS

In the curriculum, such science might involve studying, for example, how the biochemistry of an approach like organic farming equates with local biodiversity; how biodiversity equates with the optimal balance of arable and stock ... with animal welfare ... with micro and possible macro climatic effects of land use ... with ecological restoration, including the computer modelling thereof for differing eco-niches ... with linkages and multipliers in the local economy ... with the inspiration of artistic creativity through the landscape created ... with using all the senses and treasuring their pleasures ... with the spiritual ability to see anew why food and its production is blessed ... and with the strengthening of human community through people moving more into 'right relationship' with one another and nature (Darwin 1994).

Part of the humility essential to science should be for scientists themselves to address seriously such questions as whether billion dollar space probes to Mars can be justified when homelessness and poverty abound on planet Earth. Teaching children about socio-economic justice, substituting consumerism with creative activity and reducing the likelihood of war through conflict resolution training could be more pressing priorities than preparing them for careers in the arms industry, 'Mega Science', or even research such as how to cope with problems of climate change. Whilst not denying the importance of such research as NERC undertakes, it partakes of displacement activity when pursued whilst

not, at the same time, seriously addressing how to live as a society without continuing to damage the ecosystem. As Loening (1994) puts it, for biologists not to express active concern is for them shamefully to 'preside over the progressive diminution of their subject of study'.

RAINBOW LOINCLOTH

What kind of science are we left with? Perhaps one in which radical honesty becomes the single most distinctive empirical epistemological characteristic. One in which the definition of science might be, the uncompromising application of truthfulness to knowing reality. Such is no more that what 'good and accountable science' has always been, and it is something to celebrate. We may have only a loincloth; our science may be humble; but *let us paint it rainbow.*

Our rainbow loincloth can be symbolic in a number of ways. It represents the reassertion of humility in science. It reflects the importance of being a joyous, celebratory, co-operative, compassionate community in concord through the covenant of social contract, not competition. It recognises that in socio-environmental issues we are all working on a long and difficult front, each like differing hues in the spectrum. Some may seem more colourful than others; others, less so, particularly if we suffer partial colour-blindness; but all are probably vital to shedding wholesome light.

In our metaphor, the visible spectral range should not be thought of as rigid. *Change means spectral shift.* The transformative as distinct from the revolutionary way of achieving change is to encourage and help one another move to the next hue, shade by shade. In so doing, in community, the entire spectral range gradates. This may seem a slow prescription, but it is the only way which recognises where people are at; working with them rather than violating the presumption of deep motivational integrity owed to them. Such an approach also creates enough space to entertain the doubt that in some of the changes we are seeking to encourage, we may be wrong.

REVERENTIAL SCIENCE

In a CSIRO paper, the eminent Australian rainforest ecologist, L.J. Webb acknowledges that, 'We have enough scientific evidence ... to appreciate the singularity of the Australian rainforests...' (1990 p.117). Whilst acknowledging the scope for much more science to be carried out, he goes on to say that it is time to come clean and establish that our reasons for wanting to save the rainforests are not just scientific, or utilitarian for cancer cures etc., but because, 'the tropical rainforest is indeed a sacred forest.... It is hard to explain scientifically that this teeming forest is a special reality, sculpted and detached from water, carbon and dust, that somehow reassures us about our origins and destiny as human species' (ibid. p. 122).

Here we see fulfilment in the second half of life of that 'wow factor' perhaps first experienced as a child when seeing newly into nature, maybe looking down a microscope or up a telescope. Webb articulates for us a recovery of Plato's ideal of science's role in 'reducing to order and harmony any disharmony in the revolutions within us'. In practical terms, Webb's concept of the 'sacred' might be expressed as reverence towards one another and nature. Invoking this concept recently with Professor Donald MacLeod of the Free Church College and Warrior Chief Stone Eagle of the Mi'Kmaq First Nation, Nova Scotia, in the Lingerabay (Harris) Superquarry Public Inquiry, I suggested that such an attitude of reverence means being, 'concerned with the integrity of a thing or person; to value it for itself; to work with it symbiotically, in celebration of its being, with that grace which is consistent with the 'saying' of grace, and not with a graceless spirit of mere utility' (McIntosh et al., 1994, p. 9).

GOOD MORNING!

In 1971, a year before the publication of 'Limits to Growth', it was quite in keeping for the President and Fellows of Harvard Business School at a conference on science policy chaired by Lord Zuckerman to have said of themselves, 'Who are these men ... working as they do at the centers of power in industry and government [feeling] the pulse of a new economic system [and hearing] the drum beat of a new technological march?' (Ewing 1973). Such militaristic language hankers back to a patriarchal Dr Strangelovean era of cold war. It belongs to that same militarily driven school of physicists who gave us 'Big Bang' conceptualisation, with its implication that violent birth is at the heart of cosmogenisis.

Gravitational physicist, Brian Swimme (1990), refutes such a construct. He shows how different a feminist account can be; an account predicated on reverence towards the sacred birthing and ongoing becoming of the universe. Swimme's view is characteristic of how science might alternatively construe reality. Is it necessarily less scientific, given that we necessarily move into the realm of the rhetorical, the poetic, once we depart the world of equations?

He illustrates his point using Starhawk's (1990, pp. 1-3) poem, 'A Story of Beginnings'. She uses not the language of the weapons physicist, but that of gentle birthing, reminiscent of the biblical womb of God of *Job* 38:8,29, or *Romans* 8:22 in which 'up to the present time all of creation groans with pain like the pain of childbirth'. Such imagery is subjective in its objectivity; personal in the calling of its political message:

> Out of the point, the swelling
> Out of the swelling, the egg
> Out of the egg, the fire
> Out of the fire, the stars
> Out of the rain of stars

the congealing, molten world
The air you breathe passed through the lungs of dinosaurs...
Feel yourself rocking
cradled in the night sky womb arching around you
alive with a billion billion dancing points of life

Breathe...
Hear the story woman

She says
The labor is hard, the night is long
We are midwives, and men who tend the birth and bond with the child...
To pull a living child out of ... the mother
we are simultaneously poisoning,
who is ourselves

Starhawk moves on to roll out the history of the 'First Mother': the condensation of the waters, the softening of 'every sharp edge into soil', and the evolution of life, so that:

She is alive in us: we are alive in her as in each other
as all that is alive is alive in us
and all is alive

She concludes with an understanding of power very different from that of the gentlemen from Harvard, or the writers of the White Paper. She points not to power over, but to empowerment from within:

When we are afraid, when it hurts too much
We like to tell ourselves
stories of power
how we lost it
how we can reclaim it
We tell ourselves
the cries we hear may be those of labor
the pain we feel may yet be that of birth

Starhawk, a practitioner of goddess predicated spirituality – an unburned 'witch', an un-hemlocked philosopher – might be considered by many to be an inappropriate 'authority' with whom to end this paper. Yet, note how similar it is to the following poem, 'On the Pulse of the Morning', by another feminist writer, Maya Angelou (1993):

A Rock, A River, A Tree
Hosts to species long since departed,
Marked the mastodon,
The dinosaur, who left dried tokens
Of their sojourn here

THE EMPEROR HAS NO CLOTHES…

On our planet floor,
Any broad alarm of their hastening doom
Is lost in the gloom of dust and ages.
But today, the Rock cries out to us, clearly, forcefully....
You ... have lain too long
Face down in ignorance.
Your mouths spilling words
Armed for slaughter ... do not hide your face...
Your armed struggles for profit
Have left collars of waste upon
My shore, currents of debris upon my breast.
Yet today I call you to my riverside,
If you will study war no more. Come,
Clad in peace, and I will sing the songs
The Creator gave to me when I and the
Tree and the rock were one...
So say the Asian, the Hispanic, the Jew
The African, the Native American....
They all hear
The Speaking of the Tree...
I, the Rock, I, the River, I, the Tree
I am yours - your passages have been paid.
Lift up your faces ... for this bright morning dawning for you...
Here, on the pulse of this new day
You may have the grace to look up and out
And into your sister's eyes, into
Your brother's face, your country
And say simply
Very simply
With hope
Good Morning.

The occasion of this work's first reading was globally televised; the poem universally syndicated. It set in train a new surge of interest in poetics, having been commissioned as it was for the Clinton and Gore presidential inauguration at the White House.

Perhaps, for our science to be complete, we need poetics to complement mathematical and literal truth with metaphoric truth (White 1992). Science is generally a way of knowing reality from the outside probing in, whilst poetics knows, spiritually, from the inside out (Wink, op. cit.). We need both for a holistic epistemology. Both unite if we treat our object, nature, with reverence as subject; even as extended self.

And who knows ... perhaps as claimed in the title of the school textbook on which many of us were reared, 'Physics is Fun'. Or as Plato put it, 'splendid entertainment'.

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