ESSAY REVIEW

LITANIES, MANTRAS AND FATAL FLAWS: Bjorn Lomborg's Perpetual Motion Machine

An Essay Review of THE SKEPTICAL ENVIRONMENTALIST: Measuring the Real State of the World *by Bjorn Lomborg. 2001. Cambridge University Press, 515 p.*

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Imagine the world as a perpetual motion machine, unconstrained by the laws of thermodynamics, inhabited by a dominant organism forever immune to the negative feedback of the struggle for survival, and with a human economy totally separate from the biosphere, and set to expand forever. This is precisely the world that Bjorn Lomborg has depicted in his controversial book. In this essay I will dispute his view of the world. A comprehensive critique will not be attempted – it would require a book as long as the original. Instead, I will briefly examine Lomborg's intentions and methodology, then look at a few areas an earth scientist might usefully comment upon.

Lomborg calls the debate stirred up by *The Skeptical Environmentalist* a 'firestorm'. Actually, it's more of an old fashioned donnybrook between C.P. Snow's 'Two Cultures'. Lomborg comes out swinging from the non-scientific corner, strongly supported by the general and business press. Most scientists fight from the other side of the ring, aided and abetted by *Scientific American*, *Science*, and *Nature*. Two scientists who write in support of Lomborg are quoted on the back cover of the book as follows: "At last a book that gives the environment the scientific analysis it deserves" (Lewis Wolpert) and "A brilliant and powerful book" (Matt Ridley). However, the general tenor of the argument is more accurately conveyed by the following quotations. *The Economist* believes that "fair minded readers will find that most of the concerns they had about the future of the planet have given way to fury at the army of dissembling environmentalists who have dedicated themselves to stirring up panic by concealing the truth".

On the other hand, Paul Ehrlich (who with David Pimentel and Lester Brown appears in Lomborg's text as a representative "dissembler") says that the book "is packed with nonsense, old and new." Lomborg's websites at http://www.lomborg.com/biograph.htm and http://www.lomborg.com/books.htm are a convenient source of published critical comments of this kind, together with his responses.

Lomborg's subtitle reveals that his intention is to discover the 'Real State of the World'. That phrase is one of many digs at Lester Brown and his Worldwatch Institute's annual publication *The State of the World*. I applaud his objective even so. It is, after all, the fundamental agenda of science. What Lomborg says and what Lomborg does however, lie on opposite sides of a kind of behavioural transform fault. He says that we should avoid rhetoric, yet immediately introduces a rhetorical device of his own, which he calls "The Litany". He then uses the word throughout the book as code for the beliefs of the "dissembling environmentalists" – a usage which has been gleefully appropriated by the business press. If you can brand your opponents views with a label like the Litany, you don't need lessons in rhetoric. He also says that we should proceed by sound analysis, then fails to perform any objective evaluation of the quality of his data, nor of its significance to a finite world. He appears to have been highly selective, which would have been fine had he shown that the selection was representative of the whole. As an antidote, check Pimm (2001) to see how an ecologist uses much the same data, from much the same sources, clearly recognizes its shortcomings, and clearly states the implications for a finite biosphere. Pimm's comments on the quality of international data (p. 251-252) are particularly noteworthy in the present context.

What Lomborg (p. 4) calls the Litany is actually his caricature of reasonable environmental concerns that reads: "Our resources are running out. The population is ever growing, leaving less and less to eat. The air and the water are becoming ever more polluted. The planet's species are becoming extinct in vast numbers – we kill off more than 40,000 each year. The forests are disappearing, fish stocks are collapsing and the coral reefs are dying. We are defiling our Earth, the fertile topsoil is disappearing, we are paving over nature, destroying the wilderness, decimating the biosphere, and will end up killing ourselves in the process. The world's ecosystem is breaking down. We are fast approaching the absolute limit of viability, and the limits of growth are becoming apparent".

The problem says Lomborg (p. 4), is that the Litany "does not seem to be backed up by the available evidence".

Lomborg's reading of the runes is much more comforting, and to continue his liturgical metaphor I call it the

"Lomborg Mantra", a palliative concoction that can be summarized as follows: don't become prey to "unproductive worries" (p. xxiii), we are not overexploiting our renewable resources, the forests have not been eradicated – forest cover has remained constant, water is plentiful and renewable, there don't seem to be any serious problems with non-renewable resources such as energy and raw materials, and future generations will have ever more options (Chapter 14). That "ever more" is a muted echo of the infinitely expandable future foreseen by one of Lomborg's heroes, the late economist Julian Simon, who in a BBC Horizon documentary entitled Doomsday (produced by Claire Walmsley in 1992) said "the entire history of civilization is an increase in population, therefore increased problems, people responding to these problems with ingenuity and having an ever better standard of living ..... Forever."

Forever – that's great news; we need fear no extinction for *Homo sapiens* then, or even a decline in the status quo.

Lomborg justifies the Mantra in terms of averages of grain production, mineral extraction, fossil fuel reserves, and so on, from the World Bank, International Monetary Fund, Food and Agriculture Organization (FAO), World Trade Organization, United States Department of Agriculture and other global and national agencies. He attempts no formal analysis of sampling techniques nor of the statistical significance of the trends he divines – strange for a man who (p. xix-xx) counters his admission of a lack of expertise "as regards environmental problems", with the claim that his skills "consist in knowing how to handle international statistics". Handle, I suppose, is a loaded word and perhaps Lomborg's stated preference for "fluency over cumbersome accuracy" (p. xxi) provides a revealing indication of his tendency to cut corners. Probing of the quality of data only occurs when the effect is to discredit opponents of the Mantra. Nobody comes in for more criticism in this regard than Lester Brown, who is castigated for making reckless predictions that don't fit well with Lomborg's Panglossian view of the world. Brown (1995), for example, suggests that feeding China may someday become a problem. No way, says Lomborg and the boys down at "Resources for the Future" (p. 102-104).

The problem of feeding people is worth looking at more closely, because it is indeed a major problem on a planet with more than six billion human inhabitants, more than a billion of whom will go to bed hungry tonight. The FAO, one of Lomborg's main sources of information, reported for instance that bad harvests in Africa, Western Europe and Australia put the planet within a few weeks of a general famine in 1995. When Lomborg cherry-picks his data, he ignores items of that kind.

The food supply depends to an immense degree on geological resources – soil, water, energy and fertilizer raw materials, among the most obvious. Lomborg, like a cornucopian James Hutton, sees no prospect of an end to the resource supply, and in spite of the fact that he recognizes that some resources are non-renewable, he writes as if our resource base is infinite e.g. "when we do not find even more deposits even faster it is because searching costs money" (p. 146). In other words, he sees "good economics, and not ecology" (p. 15) as the determining factor, and believes that we can always increase our reserves by increasing efficiency of extraction, of use, and by recycling. Regarding the latter, he says: "it is important to point out that metals, in contrast to energy, do not perish but only change form and location with use" (p. 147) – a characteristically sloppy sentence that denies the first law of thermodynamics (energy doesn't "perish") while ignoring the implications of the second (with use, materials typically "waste" to higher entropy forms, energetically expensive to recycle).

In sustaining civilization, soil is the most important part of the solid earth. By cultivating crops we have been mining the soil for nutrients and exploiting its biological resources since agriculture was invented some 10,000 years ago. How fast soil forms depends on a number of factors including the nature of the geological substratum (the soil parent material), climate, hydrodynamics, vegetation and so on. Typically, it takes between 10^3 to 10^4 years to produce a mature soil profile. For the biosphere, in the absence of human intervention, soil is a renewable component. On the scale of a human lifetime it isn't, though commonly we treat it as such. This is a major reason why our record of soil conservation from the early agriculture of the Neolithic, to the high-input farming of today, is dismal.

Cultivating a soil, except where such techniques as "no tillage" farming are practiced, involves exposing the surface to erosion by wind and water. Although avoiding tillage certainly cuts down on erosion, it requires the farmer to spread pesticides and other chemicals on the landscape in order for the crop to produce high yields. Figuratively speaking, it's an agent-orange approach to farming, with crop varieties selectively bred to withstand the biocides designed to eliminate all competition – a new twist on the survival of the fittest: the survival of the genetically engineered.
In regular farming – that is to say where tillage is practiced – the solum (soil horizons A and B), the part of the soil richest in both organic matter and available nutrients, tends to be carried away. Thanks to the current (albeit ephemeral) availability of oil and gas for the manufacture of artificial fertilizer, it is relatively cheap to replace the lost fertility with the stuff you buy in bags at the farmers' co-op. From this Lomborg, following Crosson (1995), reaches the conclusion that it doesn't pay to worry about soil erosion or the downstream problems it causes (p. 104-106). To the ecologist, this is a dangerously short-term view that considers soil solely in terms of immediate profit, and ignores its many functions within the totality of an ecosystem. But, out of sight, out of mind – the long-term consequences will be for our progeny to deal with in the post-oil and gas future. The really frightening thing is that people may be hard-wired to seek short-term profit (Brooks 2002), and I suppose that that

will be the lawyer's plea when Lomborg, Crosson, Simon and economists of similar stripe, are rounded up and called to account when Gabriel blows his horn.

For most of human history, extending the area of cultivated soil has been the principal means by which we increased our food supply. Suitable soils for further expansion are now scarce, and a favourite answer to resource scarcity for the cornucopians is substitution. For soil there is no viable alternative, though there are those who argue that hydroponic systems offer a possible substitution. In his master's thesis Wada (1993) compared the productivity of high-tech heated hydroponic greenhouses with that of high-input conventional agriculture in the Lower Mainland of British Columbia. He concluded that in terms of all energy and material flows, the ecological footprint (Rees 2003) of a hydroponic tomato was 14 to 20 times larger than for the high-input field farm. Similarly, aquaculture is sometimes touted as a means of dealing with food shortages, and Lomborg states approvingly that the Norwegian salmon "with genetic enhancement and modern fish farming" (p. 63) has become twice as productive since the early 1970s. He doesn't tell you that for an output of one calorie, modern fish farming requires an input of up to 60 calories (Lavigne 2002). How sustainable is that?

A necessity, for which no conceivable substitution is possible, is water. The recently released World Water Development Report (UN 2003) states that a billion people lacked access to a clean water supply in the year 2000, and that estimates will soon rise to 4 billion. Similarly, water shortages mean that sanitation is a problem for 2.4 billion people. Lomborg, however, believes "basically we have sufficient water" (p. 149), and I guess that surfing pools in Las Vegas and the West Edmonton Mall, and the lush green golf courses maintained in the semi-deserts of the southwestern USA and the United Arab Emirates, might fool anyone into thinking that there is no shortage of water on Earth, but for "dissembling environmentalists" such usage is short-sighted waste. Lomborg states that globally we have gone from 1000L/person/day to twice that over the last century, and that this is particularly due to the increase in agricultural use that allows "irrigated farms to feed us better and to decrease the number of starving people" (p. 150). It also gives us salinization problems from the Aral Sea to California. A rigorous discussion of the water cycle would have helped in this context, though it is clear that Lomborg's grasp of such basics is rather tenuous. For example, on page 150 he appears to deny the principle of the conservation of mass when he talks of water being "irretrievably" lost through evaporation or transpiration. Not to worry, "Kuwait, Libya and Saudi Arabia all cover a large part of their water demand by exploiting the largest water resource of all – through desalination of sea water". Reasonable concerns about the energy demand are ignored because "these countries also have great energy resources". Energy is never a problem in Lomborg's world of no limits – he ignores thermodynamics and the finite nature of oil and gas resources, and concentrates on what is for him the all-important factor: economics. "We can have sufficient water, if we can pay for it" (p. 153) is Lomborg's Vivendi-friendly conclusion.

For economists in general, one of the great bogeymen is also one of their own: Thomas Malthus. His 1798 classic *An Essay on the Principle of Population* is available online at http://www.ac.wwu.edu/~stephan/malthus/malthus.0.html. Lomborg tells us that "many reputable scientists have fallen for" his theory. That must include Thomson (1998), who points out that Malthus's idea has never been falsified. Moreover if it ever is falsified, the theory of natural selection – in Darwin's words "the doctrine of Malthus, applied to the whole animal and vegetable kingdoms" – will bite the dust too. For most of us, the astounding success of "Darwin's Dangerous Idea" (see Dennett 1995) clinches the argument that Malthus was on to something.

Basically, Malthus says that population when unchecked, tends to increase exponentially, whereas food supply tends to increase arithmetically. This means that a population will eventually find itself banging up against a ceiling dictated by the food supply, and if case histories in support of the proposition are required, the literature of ecology provides many. Consider the fate of the population of Easter Island, as a specific instance from human ecology. The original islanders probably got there by chance, but once there, they were marooned. They flourished for a while, built up a complex society, then as their population outgrew the resources of the island and its immediate seas, lapsed into barbarism and even cannibalism (Diamond 1997).

Lomborg, however, believes that the well-established Malthusian collapse of Easter Island is a poor model for the planet as a whole. He states that out of 10,000 Pacific islands, only 12 underwent such a decline (p. 29). What he's missing here, is that Easter Island, unlike most Pacific islands, was essentially an isolated system. There were no nearby territories to provide help when indigenous resources grew scarce; nowhere for the islanders to extend their ecological footprint. And it's precisely this point that makes the fate of Easter Island germane to the fate of the Earth. We are isolated in the same sense – there are no nearby planet earths to overrun or trade with when we've degraded all the low-entropy resources on this one.

Anyway, Lomborg assures us that we are not going to starve. We constantly use our ingenuity to ratchet up the linear increase in food production predicted by Malthus. This is a valid observation: we have been able to ratchet up the base level of the Malthusian increase in food supply a number of times over the last 500 years or so. It doesn't falsify Malthus – it just means that if populations and consumption continue to grow, the crunch is postponed. Moreover, a less cursory analysis of the situation shows that we have done it by two unrepeatable strokes of luck more than by ingenuity.

The first astonishing piece of good fortune, assuming you are not Amerindian, was the European encounter with the Americas. This is the supreme example in modern history of the use of conquest to increase

carrying capacity. It really paid off when the steam locomotive opened up the grasslands of Canada and the USA to the markets and bellies of the Old World. Catton (1980), incidentally, considers that this event began an "age of exuberance" which sparked the kind of optimism that Lomborg displays – an age which he now sees as drawing to an end.

As a second stroke of luck, we have inherited a vast capital pool of energy from earlier versions of the biosphere – the fossil sunlight of coal, gas and oil. It is a truism of ecological as opposed to economic commentary on the subject that our material civilization is precariously dependent on gas and oil. Take the "Green Revolution" for example. Here is a case where human ingenuity did indeed ratchet-up the food supply. On the whole, it didn't work in Africa, and it only worked in Asia until the population increase nullified the gain (as Malthus predicts). High-yielding varieties of staple crops were bred, and with an elaborate husbandry, irrigation systems and liberal doses of pesticides and fertilizers, the new breeds of plant were used to replace indigenous agricultural crops and techniques. The whole syndrome of this type of agriculture is energy intensive, and the heavy applications of nitrogen fertilizers the new crops were developed to exploit accounts for a large component of the energy input. Essentially all fertilizer-nitrogen comes from the industrial fixation of atmospheric N_2, a process kept affordable, yet again, by the biggest agricultural subsidy of all, the ancient sunlight represented by the diminishing resource of natural gas. Since the energetics of a process are never seriously analyzed by Lomborg, he feels free to make the ludicrous statement that since "air contains about 78% nitrogen, there are no limits to consumption" (p. 144). The phrase "no limits" should be added to the Lomborg Mantra.

Phrases such as "no limits" are symptomatic of one of the fatal flaws in Lomborg's thinking - belief in an infinitely expandable economy. Lomborg's "don't worry, be happy" message, depends entirely upon this belief, though he would no doubt counter any criticism by pointing to perfunctory genuflections towards a finite view of the world that occur scattered throughout the book like exotic blooms in a wasteland. Clearly, he knows that some resources are non-renewable, and as he says "in principle exhaustible" (p. 159). "In principle" is an inspired piece of obfuscation designed to camouflage the stark word exhaustible. Yet he still feels able to say "that we have more and more oil left, not less and less" because "we explore new areas and find new oil" (p. 125).

On this matter it is worth stating that oil *discoveries* in the USA peaked about 1930, while *extraction* peaked in the 1970s. The USA now imports 55% of its petroleum needs. Globally, discovery peaked in the early 1960s and the extraction peak is expected to be within the next decade. Campbell (2001) published an estimate that in the year 2000 total oil discovery was 11.2 Gb - less than half the consumption, and what he (p. 3) finds inexplicable is: "our great reluctance to look reality in the face and at least make some plans for what promises to be one of the greatest economic and political discontinuities of all time."

Again, Lomborg says "if we continued to use resources with no change in technology, we would eventually run out. But the fact that this chapter [Chapter 14] can conclude that significant scarcities are unlikely is because we continuously find new resources, use them more efficiently, and are able to recycle them and to substitute them" (p. 148). Faith (and faith is what it is) in the technological fix, is integral to this belief in an essentially infinite economy. Optimism is justified by an uncritical Micawber-like assurance that something will always turn up.

It is a viewpoint that is only possible if the human economy is considered in some way divorced from the biosphere that contains it, whereas the truth is that the economy squats like an overfed cuckoo in a nest from which all other occupants are in danger of being excluded. This deception enables cornucopians like Lomborg, to deny that the *only* material way that the economy grows is at the expense of the biosphere. Undoubtedly, the biosphere defines the absolute limit on earth to the imperial ambitions of our species, and it is reasonable to think that long before we achieve a complete takeover, we can expect to suffer a global version of Easter Island's collapse – unless of course, we find a new planet Earth to annex.

A general rejection of the notion of limits to growth must also account for Lomborg's uncritical belief in the fatally ambiguous concept of "sustainable development", perhaps the defining oxymoron of the late twentieth century. In fact, ambiguous is hardly adequate for a phrase that has as many definitions as Heinz has soups and salad dressings – see individual papers by Robinson, Lavigne, Clark and Brooks *in* Chesworth et al. (2002). When Lomborg states that the World Bank defines sustainable development as "development that lasts", and that "in this respect our society certainly seems to be sustainable" (p. 160), a little semantic exposition of the concept would not have come amiss. What we do know is that the palliative Mantra reflects a view of sustainability that pays close attention to the dollars and cents, while ignoring calories, the true currency of biospheric transactions.

A second and more fundamental flaw in Lomborg's interpretation of "The Real State of the World" is his disinclination to test his Mantra against certain important default positions of science. Consider that word real, for example. Too much of the "real" world of the economist is solipsistic, and as insubstantial as a stockmarket bubble. ENRON-type scams would hardly be possible otherwise. Most people, and that includes all scientists, believe that there is a real world outside our heads. We also believe that in spite of the strictures of deep thinkers from Plato to Popper, we can know something about it. Our scientific model of reality is built on foundations that go back at least 7000 years to the early hydraulic civilizations of Asia and Africa, and over the last two hundred and fifty years we have elaborated this view considerably. To judge by the astonishing technological achievements

of our species, the model now approximates material reality rather well, and we continue to refine it using the powerful, self-correcting mechanism called science. Some of the important clues we have picked up along the way include the fact that we cannot create something out of nothing, that when we use something up it does not become nothing, and that energy eventually drains into an ultimate sink from which it cannot be extracted to do useful work. We have also learned that we are animals, whose life-support system, the earth, is finite, and that together with all other species inhabiting the biosphere, we have been shaped by the implacable process of competition called natural selection. Any attempt we make to discover the 'real' nature of the world, including the 'real' nature of human society, must accord with these default positions or be judged wanting (see Hardin 1993, Chapter 19). Lomborg's model, where economics trumps ecology every time, is no match for science as a means of finding reliable answers to the tough environmental questions that face us.

Finally, some of Lomborg's reviewers have been mightily impressed by the masses of data and the pages of references and notes in *The Skeptical Environmentalist*. I have already given reasons for questioning his treatment of data, while others have criticized his heavy reliance on secondary sources (see http://www.lomborg.com/biograph.htm. But even if Lomborg's choice of data had been the best in the world, and even if he had treated it with impeccable rigour, his faith in an economy of virtually no limits would still lead him to an ideological position at odds with the ecology of a finite and isolated planet.

On January 7 2003, the Danish Committees on Scientific Dishonesty judged that in *The Skeptical Environmentalist* Lomborg was "systematically one-sided", and that "objectively speaking, the publication of the work under consideration is deemed to fall within the concept of scientific dishonesty". Two days later the *Economist* online at http://www.economist.com/science/displayStory.cfm?story_id=1522706 thundered back to ask why "is a panel with a name such as this investigating complaints against a book which makes no claim to be a scientific treatise? "The Skeptical Environmentalist" is explicitly not concerned with conducting scientific research. Rather, it measures the "litany" of environmental alarm that is constantly fed to the public against a range of largely uncontested data about the state of the planet. The litany comes off very badly from the comparison." Well it would, wouldn't it – a straw man isn't constructed to withstand a pounding, it's constructed (in harmony with the Danish Committees' judgment) to make the fight one-sided.

The *Economist* goes on:

"the environmental movement was right to find the book a severe embarrassment. But since the book was not conducting scientific research, what business is it of a panel concerned with scientific dishonesty?"

Here, the *Economist* seems to be saying that Lomborg, despite calling himself the "skeptical environmentalist", should be allowed to disarm scientific criticism by his incongruous admission that in fact, he lacked any expertise at all "as regards environmental problems" (p. xx).

A book need not be scientific to present a reasonable argument, but if your objective is to argue against a scientific position, your argument, unlike Lomborg's, must at least be logical, and must be based on a model of the world that the long history of human curiosity and experience tells us approximates reality. A deconstruction of all the *Economist's* huffing and puffing, leads inevitably to the damning conclusion that Lomborg, who replaced the parody he calls The Litany, with the feel-good Mantra of business as usual, has written a book that attempts to counter scientifically testable claims by inappropriate rhetorical means. His idea of the "real" state of the world is the ecological equivalent of a perpetual motion machine, set on a fantasy planet where the principle of the conservation of energy does not hold, entropy is of no consequence, and Charles Darwin was never born.

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