Science- Friend or Foe to an Earth Charter?

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Online Conference on Global Ethics, Sustainable Development and the Earth Charter
April 1999

INTRODUCTION

This paper examines the role of science in the development of an Earth Charter. Specifically, I am concerned with those sciences that investigate Earth's ecology and the impact of human perturbations on Earth's environment.

Why is it that some people are concerned about environmental degradation and others are not? How is it that some people dedicate their lives to environmental protection while others do not see a problem. Indeed we can ask ourselves this very question. What was it in your life that made you think about the environment? Was it a particular incident or disaster that first turned your attention to the environment was it something based in your own experience or rather something your were taught or learnt from other people's experiences?

For many people, their attention is only focused on the environment, that is to say, the environment only becomes a matter of priority for them, when they experience deterioration in their immediate environment, or when something they greatly valued is lost or destroyed. This was certainly the experience of many people in England during the industrial revolution. By the mid-1800s the industrial revolution had transformed the English environment with disastrous results. The climatologist Douglas Hoyt (Hoyt and Schatten, 1997) quoted the following passage from the poet John Rushkin's response to the rapid deterioration in the quality of life the industrial revolution brought to many people:

"It is the first of July and I sit down to write by the dismallest light ever yet I wrote. For the sky is covered with grey clouds; not a rain cloud but a dry black veil, which no ray of sunshine can pierce. And everywhere the leaves of the trees are shaking fitfully enough to show the passing to and fro of a strange, bitter, blighting wind. It is a new thing to me and a dreadful one."

The poet was clearly disturbed by the environmental degradation he had witnessed over his lifetime. Today many people have experienced similar degradation in their local environments or are forced to live in degraded environments they know are unhealthy for them. Increasingly however, especially in North America, Western Europe and parts of Asia, people's local environments are OK and they are far removed from the environmental degradation that is occurring and that their life styles are contributing to. In these circumstance, people do not have a direct experience to draw upon. Indeed for wealthy people, their local environments may well have improved over their life times.

Many environmental problems are of a large scale or are a kind of phenomena that is simply not readily apparent at any one location, and hence do not fall within a person's

daily experiences. Many of our globally-scaled problems, such as greenhouse and the ozone hole, fall into this category. The average person on a day to day basis has no way or knowing or experiencing these problems as they involve the long term accumulated impact of small actions by many millions of people.

A further complication is that so much of Earth's environment is in a constant state of flux. It is not always apparent as to when a change is due to human perturbation and when it is natural. Nor is it always apparent when a change is within the natural range of variability versus representing a significant deviation due to human perturbation.

Here then is a set of reasons why science is a critical factor in the growing universal concern for the environment. Science provides the means of monitoring Earth's environment far beyond that possible by human senses and personal experience. From these investigations we can learn about global and local ecological life support systems, and are able to measure changes and determine significant deviations. Of course, our capacity is still very limited, but we should not underestimate the impact that scientific knowledge has had on our perception of the state of Earth's environment.

It is inevitable that as our understanding of Earth's environment grows, to some degree our value systems will change to reflect this new knowledge. From this perspective, environmental education has a critical role to play in the development of Earth ethics to promote sustainable development. On this basis, it can be argue that science has a vital function in the formulation of our value systems and the construction of an Earth Charter.

IS A TECHNO-DEPENDENT WORLD POSSIBLE?

However there is an alternative view that we should now consider. Humans are of course a highly adaptable species and our history as a species has involved the use of ever more complex technology to modify our environment in meeting our needs, demands and whims. To a large extent, our economic development to date has occurred, either directly or indirectly, at the expense of nature. Increasingly we become less dependent on nature to provide us with the things we need in life, and more dependent on technology to provide us with food, fiber, shelter, entertainment and the many other material things we enjoy. So far at last, the story of human development has meant a corresponding increase in the destruction of nature.

It can be argued that this is an inevitable situation and is in fact nothing to worry about on the basis that there is no limit to technological substitution. Rather we can rely on the scientific and technological ingenuity of humans to build machines that will replace the goods and services we currently derive from natural systems. At a local scale this is already happening with cities relying on major engineering works for their water supply and to treat their effluent rather than relying on the regulation of water supply and water quality by natural water sheds. Similarly, humans are now increasingly dependent on modern agricultural systems for their food.

A technological optimist would further argue that if necessary we could build machines that provide humanity with a totally artificially supported environment to replace even

the globally scaled ecological life-support systems. If so, then there would be no need to worry about global warming or the ozone hole as if necessary we could all live in artificially supported cities. Imagine then if Earth's environment was to become so degraded that the atmosphere became unfit for macro life. Now I admit that it is hard to imagine an artificial sky ever being built but what if we were to redefine how humanity lived and indeed what constituted humanity. For example, imagine that the human population was reduced so that there were only 100 million people, and these people lived in 10 cities each with a population of 10 million; and each city was like a moon base a domed city where all goods and services were generated by technology. Figure 1 illustrates this idea being my home town!, Sydney of course would have to be one of the selected 10 ten cities!

Now of course there would be some problems with this solution. First, it would mean the death of billions of human being and how would we decide who would live and become one of the lucky 100 million? Would only the rich survive? Second, how many people would want to live such a life where there were no natural phenomena no forests, no sky, no sea, no landscapes, no wild animals. Nothing that was not manufactured by machines and technology. I suggest that for most of us this is not the kind of world we want.

Clearly then there are other values we hold that make this an unwanted vision. Within our value systems lies a deep concern for our fellow human being, for the larger community of life, and for a world where there is some kind of appropriate balance between technology and nature.

THE ECOLOGICAL BOTTOM LINE

Once we have decided that we do not want to proceed down the path of a technologically- dependent humanity, science has a critical role to play in informing us as to what path we are on and where it is likely to lead. Science should be able to identify an ecological bottom line, that is, the minimum amount of nature we have to protect in order to maintain Earth's environment in a condition fit for life (Mackey 1998, Gorshkov 1995). Science should be able to inform us what we have to do to maintain global and local ecological life support systems.

This idea is illustrated in Figure 2 which shows Earth in various stages of ecological degradation. Prior to the development of modern farming systems and the industrial revolution, global life support systems were in tact; humans had been around for a while with considerable impact; but this impact was not of sufficient magnitude to break the resilience of Earth's global ecological systems. However the last 200 years has seen the magnitude of human impact increase such that we are now affecting global systems, and presumably approaching the ecological bottom line.

We face the very real danger therefore of breaching some threshold beyond which if humanity is to survive then it will only be through cataclysmic changes and complete technological dependence humanity reduced to a handful of artificial domed cities. However at this point in time from a scientific perspective the problem is that we really

do not know precisely enough where the current state of Earth's environment is in relation to the Ecological Bottom Line.

At this point I would like to return to the quote from the English poet John Rushkin who further observed while lamenting the terrible state of his local atmosphere due to industrial pollution that

"The scientific men are busy as ants examining the sun, and the moon, and the seven stars, and can tell me all about them how they move and what they are made of. I do not care, for my part, two copper spangles, how they move nor what they are made of. But I would care much and give much, if I could be told where this bitter wind comes from, and what it is made of. For perhaps with forethought one might make it something else."

Here the poet expresses his exasperation at the fact that while England was full of great scientists, the terrible atmospheric pollution that was ruining the lives of so many people was not the focus of their scientific investigations. Rather their attention was focused on solving theoretical problems to do with the movement of celestial bodies far removed from Earth. Once again, this is something many people today can sympathize with, especially those who believe that Earth is in the midst of a great environmental crisis. Their grave concerns do not appear to be matched by the overwhelming majority of scientists and research institutions whose telescopes, microscopes, computers and laboratory dishes are focused elsewhere.

This is not to say there is no scientific response to our environmental problems. On the contrary, there are fortunately many networks of scientists actively engaged in these very questions. The International Geosphere Biosphere Programme (IGBP 1997) is one such example of an international network of researchers with the aim of understanding Earth-human interactions. However environmental science is only a very small piece of the science pie with by far the biggest slice going to military applications.

The situation is so serious that we need a new global agenda for science and technology. We need the great scientific institutions of the world to unite in recognition of this common research cause a scientific mission to help save planet Earth. We must take at least some of the one trillion US dollars spent on new weapons each year and invest that money into scientific investigation of the Earth system and the impact of human perturbations. An order of magnitude increase in our knowledge base is needed to ensure that our efforts at building a sustainable world have a solid foundation.

CONCLUDING COMMENTS

As a scientist I have increasing respect for the insight on our environmental situation that emerges from the experiences and common sense of members of the general public. For example, there is a very widespread concern amongst the average person at the deteriorating state of the world's forests. People feel a great loss is being suffered and a great wrong being committed. These concerns (often expressed in very emotional terms) are increasingly being supported by the findings of scientific investigations as we begin to learn more about the critical role forests play in maintaining Earth's Ecological Bottom

Line. There is increasing scientific evidence that forest ecosystems play a critical role in regulating the carbon content of the atmosphere over time periods of decades to centuries a critical time period in the context of human perturbations (Gorshkov 1995, Adams and Faure 1998).

Figure 3 shows a mature temperate forest in S.E. Australia (called Monga State Forest). In a single tree such as this one there can be 60 tonnes of carbon, and in one hectare of this forest as much as 600-1000 tonnes of carbon both in the vegetation and in the soils (unpublished data). Indeed, three quarters of the total amount of carbon held in terrestrial ecosystems is found in forests (Sedjo 1993)). Given the important function they perform in regulating atmospheric carbon, their on-going clearance and degradation is a matter of grave concern.

In our attitudes to forests then we find the complex mix of factors that comprise our value systems fundamental ideas about the kind of world we want to live in, the balance we seek between technology and nature, intertwined with the ever-growing information that scientific investigations provide about the state of our environment, and the compelling motivation for changes in our attitudes it offers.

However science cannot help us in this mission to save planet Earth if we care little for the larger community of life and the suffering of our fellow human beings, or if we do not want to find an appropriate balance between technology and nature - but once we have decided what path we want to be on and where we want to go, science can tell us what we have to do to get there. Ultimately, this is why we need an Earth Charter - to chart the path we wish to follow. Having done this, science then becomes an invaluable travelling companion.

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