

THE COSMIC HABITAT FOR EARTH-LIFE AND THE ISSUE OF SUSTAINABLE DEVELOPMENT

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ABSTRACT: The subjects under consideration here are the philosophical consequences arising as the cosmic dimension to ecology is taken into account. If the habitat for Earth-life is a part of the cosmic environment, then cosmology and astrophysics become a part of ecology. The human species is furthermore a participant in a vast process of cosmic evolution, with sustainable-development strategy thus defining the conditions for – and time needed to achieve – a technological civilisation allowing Earth-life to be evacuated to another part of the galaxy as and when the further existence of life on this planet becomes (or threatens to become) an impossibility. In the context of such a cosmic perspective, the value ascribable to our scientific and technological civilisation (and future versions thereof) changes, given that only this kind of civilisation offers a chance for Earth-life to persist in an extra-terrestrial environment.

KEY WORDS: cosmic evolution, sustainable development, scientific and technical civilisation, construction of an “interstellar ark”.

INTRODUCTION

Here my considerations will relate to the analysis and justification of the claim that implementation of postulates included in the UN’s report *Our Common Future* (otherwise known as the Brundtland Report, 1987) depend, not only on sustainable development of the human world in harmony with the biosphere, but also on conditions

holding sway in the wider cosmic environment that our planet occupies. This *inter alia* reflects my conviction that the main goal contained in the relevant declaration is to put in place conditions allowing for the ongoing survival of Earth-life (including our own species) over into an evolutionary timescale. The declaration relates to our common future in our common home, which in this context has its location in a wider, cosmic environment for life.

In a broad understanding, ecology, i.e. the science considering the habitat (*oikos*) sustaining Earth life, must also encompass the space environment, to the extent that cosmology and astrophysics might also be seen as elements of ecology. Some even claim that Cosmology is the best science about the environment (Rees 2001, 187). Dealing with things from the point of view of the universe, we are active and we further our knowledge in such a manner that we might be its future inhabitants, as well as merely residing in our own locality. However, at this point it needs to be stressed that our maturation into our awareness on the universal scale needs to be a steady process, since it requires such a radical change in our common intuition, most especially (though not solely) adjustment to utterly different temporal and spatial scales.

Seen from this new perspective, the human species is only a small part of our own planetary community of life, while also being a participant in an unimaginably broad process of cosmic evolution. Step by step, consideration can be given to:

- the influence of the cosmic environment on the emergence, maintenance and development of life on Earth;
- sustainable development strategy as a programme indirectly allowing for the evacuation of the human species to another region of the galaxy, as and when life on Earth becomes untenable;
- a new look at the value of our technological civilisation and at the role of the human species in the evolution of life.

When set against ecology taking account of the cosmic environment for life, traditional ecology confining itself to our local environment on Earth is limited in the same way as geocentric astronomy was limited in comparison with heliocentric astronomy. A second key change associated with a more cosmos-related point of view is the possibility it offers for modified cultural evaluations. An achievement of anthropology of recent years has been the claim that no culture can be seen as higher than any other, in the sense that different cultural systems are of the same value as means of organising human existence. Different they may be, but not better or worse. The same principle applied in the valuation of the species participating in the evolution of Earth-life in turn inclines a person towards accepting biocentrism.

In contrast, the new cosmic perspective offers a clear rationale for seeing the human species and its technical civilisation as outstanding.

EARTH-LIFE'S COSMIC ENVIRONMENT

A recognition that the cosmos represents an environment for Earth-life is one that changes environmental science radically, given that it requires, not only a new way of conceptualising our relationship with the universe, not only entirely new temporal and spatial scales, but also changes of intuition where feelings of responsibility, and indeed answerability, are concerned. Of course, this must not denote that we feel responsible for events ongoing in the cosmos upon which we have no influence whatever. But what it can engender is a sense that we ought to be held accountable for actions whose consequences may be separated by aeons of time in the way that they influence the course of evolution.

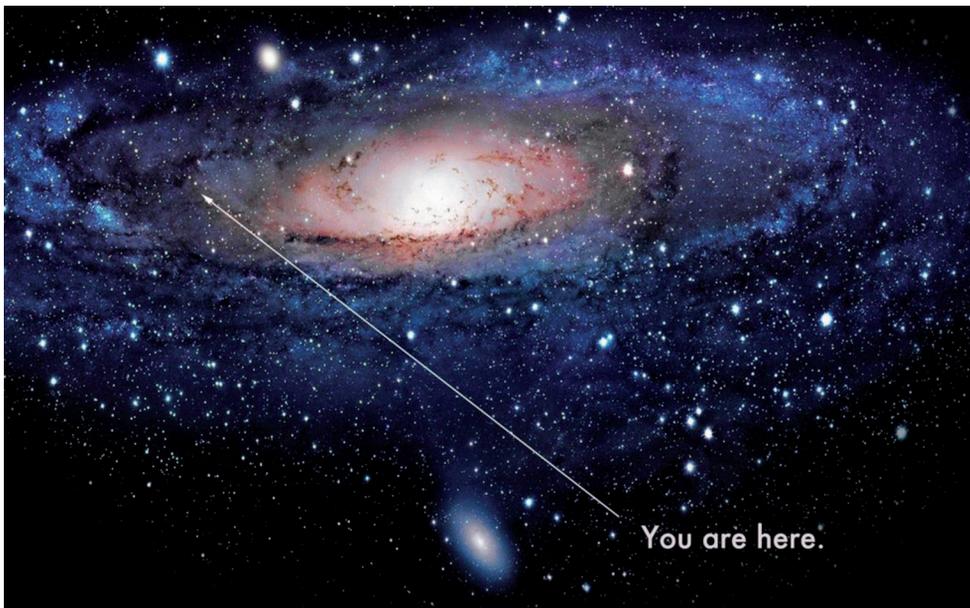


Figure 1. The location of the Solar System within the Milky Way Galaxy

Source: http://www.poorwilliam.net/pix/you_are_here.jpg

Intensive space research of the last 100 years makes it clear that the cosmos is unimaginably huge and dynamic, and is evolving in line with a rhythm played out over cosmic timescales. Perhaps contrary to first impressions, nothing in the universe is in fact permanent, indeed to the extent that the balance of forces is actually very delicate indeed, with processes of creation and destruction ongoing one after the other. Cosmic recycling for example entails stars being born in dust clouds and dying in supernova explosions – dust to dust, with gas and particles expelled into space, along with huge amounts of energy in the form of gamma-rays.

While the timescales involved here are indeed immense, observation and understanding justify the claim that conditions favourable to the evolution of Earth-life and terrestrial civilisation will not persist forever.

Given the pre-ordained size of this article, I shall focus my remarks here on just some of the conditions present in the cosmic ecosphere that have influenced the emergence and perpetuation of an environment for life here on Earth, but that also surely enough limit the amount of further time over which that life may persist. While the universe plays host to forces utterly beyond our control, we are already able to recognise the atypical sequence of events that led to the emergence of a Solar System located in a suitably safe zone of the galaxy; and then to the emergence of a planet at a more or less optimal distance from that System's star. In deploying the term "optimal", I am of course referring to a circumstance favourable to both the appearance, and the ongoing evolution, of life. There are many factors and contingencies involved here, beginning with the aforesaid optimal Earth-Sun distance allowing water to exist in liquid form, and also including the orbit of our planet (near-circular and hence not subject to extreme seasonality of temperature), and the existence of a proportionally large Moon that helps stabilise the aforesaid orbit, while also exerting influences helping ocean waters to mix.

In turn, the Earth's magnetic field shields our surface from harmful cosmic rays and the Solar wind; while a relatively close Jupiter (whose diameter is 11 times that of the Earth, and whose volume is thus 1300 times greater) has strong enough gravity to act as a great protector, helping to intercept or expel asteroids, comets and even objects arriving from the wider cosmos. Many of these would otherwise collide with Earth, erasing life before it could even get started. Paradoxically, favourable as these conditions may be, our planet has sustained major cosmic catastrophe at least twice since life has been in existence, each time exterminating 2/3 of the species present (if – as it happens – not necessarily proving especially negative to life over the longer term).

Favourable conditions also extend to the fact that the Sun is stable for a star of its type, continuing to represent a source of life-giving energy capable of being trapped by the processes of photosynthesis, and in this way fuelling metabolic channels throughout the biosphere. The Sun is one huge thermonuclear reactor in which hydrogen is burnt to generate helium and energy, which then makes its way to Earth as light radiation. The calculations of astrophysicists suggest that the Sun's fuel-supply will be exhausted around 5 billion years from now, leaving a barren Earth entirely unsuitable for life. This is a well-founded forecast that cannot be played down, notwithstanding the huge amount of time that still has to pass. It is the knowledge of the evolution of stars of the same type as the Sun that allows for the forecast regarding the final depletion of the Sun's reserves of hydrogen and commencement of the combustion of helium generating carbon and oxygen. That phase will be followed by nuclear fusion involving carbon and oxygen, with the result that atoms of iron are generated. That process will denote the onset of collapse or implosion by our star, which will contract, while its corona

expands outwards. At this point, the Sun will swell to red-giant proportions, meaning that it will be 20–30 times larger than at present, with a diameter that first extends beyond Mercury, then engulfs Venus.

The Earth is the next target to be swallowed up, assuming that it has not already been lost to space as solar gravity declines. In the next (final) phase of its evolution, the Sun will transform into a white dwarf. However, as the Sun achieves its red-giant stage, the temperature on Earth will rise to 1000°C, the oceans will evaporate off and there will be no conditions suitable for life on the planet. Thus, for Earth life to survive and go on, humankind will need to evacuate to some other friendly place in the Milky Way. And this description of what happens as the Solar System ages further is not in any way a science fiction story, but rather a well-understood fact from the world of astrophysics. The galaxy in fact has billions of stars ostensibly similar to the Sun, and astronomers (using spectroscopic analysis) are searching their environs for planets with conditions similar to those prevailing on Earth. There is now a rich literature devoted to the search for extra-terrestrial life, and most of all of course intelligent life-forms, elsewhere in the galaxy (Wabble 2007).

Notwithstanding the 5 billion years to its very end, the Sun will cease to be life-giving “just” 2 billion years from now, so we have that amount of time to shape a civilisation that will be capable of evacuating to another part of the galaxy. Astrophysicists with powerful telescopes thus search the Milky Way for worlds that might be friendly to life, i.e. planets located close to stable stars and having traces of carbon, oxygen and water. While some planet or other is discovered out there almost every week now, the majority of the finds are “hell planets” inimical to life, given the high temperatures present, the storms that must rage, or unfavourable conditions of many other kinds. Nevertheless, our galaxy does include “twins of Earth” on which conditions similar to ours hold sway. Needless to say, though, all of the places favourable and unfavourable for life are far beyond the Solar System. So a time-scale of perhaps a billion and a half years will also need to be used by the human species to achieve such a level of civilisational technology as not only facilitates the discovery of extra-terrestrial environments favourable to life, but also permits the actual colonisation of those worlds. To that end, ecology on the cosmic scale studies the conditions capable of allowing humankind to settle elsewhere, with the sustainable development strategy contained in *Our Common Future* setting out the conditions needing to be met for a civilisation open to the conditions out in space to take shape. Serious thought is now also being given to safeguarding the planet against certain threats originating out in the cosmos. NASA is for example monitoring near-Earth space to spot any stray asteroid that might pose a threat (in that it is more than a few metres long), as well as coming up with proposals for the prevention of impacts with the Earth’s surface.

As an aside, I would like to remind readers how, until recently, we had almost no knowledge at all of our links with the cosmos. Under Aristotelian cosmology, the heavenly sphere – or starry sky – above us was the seat of the Gods, and separated from the imperfect sublunary sphere. The centre of that sphere – and at the same time

of the universe as a whole – was occupied by the Earth. It was only within that sphere that the laws of physics held good. Furthermore, the idea was that these heterogeneous spheres could exert no impact at all on one another – hence a long-lasting dispute about where meteors came from, given that nothing (least of all rocks) could fall down from the heavens.

It was left to astrophysics to demystify the starry heavens above it, and to come to an appreciation of where the Earth is located within the cosmic ecosphere. Out of cosmological research came growing awareness of the conditioning of life on Earth deriving from the cosmic environment, as described above; as well as the discovery that human beings and living things here are children of the universe in a very real and tangible sense. After all, the Earth as a whole and our very bodies are built of stardust containing elements emerging in the fiery furnaces of supernovae.

It turns out that an early, pre-stellar and hence pre-light, stage of the evolution of the cosmos saw a universe of high-energy plasma generate the lightest elements – first hydrogen and then helium. And to this day, most matter in the universe is of these two elements. The Big Bang theory describing the birth of the universe (Singh 2007) holds that atomic fusion (i.e. the synthesis of all the heavier elements known from Mendeleev's table) is achieved in supernovae – whose conditions are a prerequisite for the formation process to take place. These conditions entail very high temperatures and pressures of the kinds not present in the universe's "Dark Ages" capable of generating the aforementioned hydrogen and helium, but not yet giving rise to stars. The thermonuclear reactors that are supernovae are exploding stars of masses more than 100 000 times that of the Sun. As they burst so spectacularly, these expel into space huge amounts of energy in the form of gamma rays, as well as clouds containing all the elements synthesised in the previously-existing core. A form of cosmic recycling thus gives rise to nebulae of dust and gas eventually capable of condensing down into new stars, planets ... and ourselves.

As I consider the evolution of the cosmos, I accept the postulate of objectivity as understood by Jacques Monod. I therefore eschew the operation of any anthropic principle, which is to say that (as with my understanding of the course of terrestrial evolution) I make no assumptions regarding goal or purpose. The universe is not there for us, and cares not what happens to us. But that also means – to a given extent at least – that our future is indeed in our own hands. Since the universe has generated beings intelligent enough to understand the laws holding sway across that immensity now, and also to look back to its very origins, then why should that species not also seek to do what it can to shape its own cosmological future?

SUSTAINABLE DEVELOPMENT AS A MECHANISM ALLOWING EARTH-LIFE AND THE HUMAN SPECIES TO COLONISE THE UNIVERSE

The (new ecology-based) recognition that the universe is a very dangerous place, and that even the environment on Earth will eventually disfavour life's further evolution, inclines intelligent and responsible human beings to act so as to put in place a technically-advanced civilisation capable of evacuating to other favourable parts of the galaxy should a threat arise (or more precisely, when it inevitably arises). For people to create such a civilisation, a very long period of time is required. Sustainable development (hereinafter SD) is to make this kind of achievement possible nonetheless. Thus the idea of permanently self-maintaining development is supposed to ensure the evolutionary future of the human species through ongoing survival of humankind in association with the biosphere, and thereafter via spread and evolution in other corners of the universe. In this way, the cosmic perspective to SD will see our descendants building a kind of "cosmic Noah's Ark".

Without going into a detailed discussion on the different ways in which SD may be understood, the concept may be said to relate to processes reconciling the economic, social and environmental orders, albeit with the said environment now considered to have its cosmic, as well as merely terrestrial, dimension. The many and various SD strategies support activities that have as their ultimate goal the building of a global civilisation in which the key, most fundamental organising principle of societies will come to be that involving protection of the environment. This obviously also denotes the encroachment of environmental and indeed pure-ecological issues into policy. For "green" policy requires people to learn new ways of cooperating as they seek to protect and safeguard the environment on an international scale. It was to this end, and also in this way, that birth was given to such whole-world forms of collaboration as the so-called "Earth Summits", at which agreement is or has been reached regarding postulates for the limitation of carbon dioxide emissions, a Convention on Biological Diversity, an order that technologies deployed should be environment-friendly and a directive enforcing the use of renewable energy sources, as well as many other valuable initiatives seeking to adjust the functioning of the anthroposphere to the natural capacity characterising the environment. These are of course great challenges for civilisation, which has thus far developed on the basis of unlimited exploitation of natural resources, with little or no account taken of the costs this imposes on the natural environment. As a result of such environmentally short-sighted and exploitative policies, a home-grown threat to life on Earth has arisen to supplement that posed by cosmic factors, such as the aforesaid exhaustion of the Sun's capacity to supply energy, or else a supernova explosion, in the form of the destructive actions of people equipped with instruments particularly effective at abusing and over-exploiting the resources of the environment.

The environmental crisis was first recognised in a report on the state of the planet delivered by Secretary-General U'Thant at the UN in 1969, under the portentous title

of *Problems of the Human Environment* (Thant... 1969). Cited in this as one of the main causes of the crisis recognised was the development of a technologically-based civilisation, allowing for exceptionally rapid (basically exponential) economic growth, as well as overexploitation of the environment for today's benefit with little or no thought given to the future.

The idea of sustainable development that the above approach gave way to (thanks to the 1987 report from Gro Harlem Brundtland) constituted a kind of project for a new, pro-environmental civilisation that would stem the growing crisis, at the same working to combat humankind's progress towards self-destruction, *inter alia* through the imposition of limits on the development of the technology-based civilisation, with attendant attempts to "get back to nature". In the wake of this discussion of the environmental crisis and SD, it would have been possible to leave with the impression that destruction of the environment is the primary (indeed the intended) use to which technological progress has been put! Numerous green organisations and bodies criticise the development of a technologically-advanced civilisation, drawing attention to the huge power to modify the environment this gives, without any concomitant development of the capacity to foresee (let alone limit) longer-term effects often separated from their causes by expanses of both time and space. Such a way of thinking was also subscribed to by Henryk Skolimowski, in his philosophy going back to 1999. One of the founders of ecophilosophy, Skolimowski offers a negative assessment of the technological civilisation, which sees it as not much less than a gift from the Devil by which people obtain the means to bring about their own end.

In contrast, Vaclav Klaus (2008) presents a more or less opposite view, tending to dismiss ideas to hold back civilisational development as manifestations of the hysteria characterising "a society now possessed by ecology". For Klaus, the postulates espoused by environmentalists have the *de facto* impact of attacking human freedoms and inciting people to return to an earlier state of barbarity.

In the context of such disputes, it is worth recalling how we have known – even since the time of Aristotle – that technology is ambivalent in nature and may be used for both irresponsible environmental destruction (threatening whole species and habitats with extinction) and in the recognition of threats and efforts to restore balance in the environment. Furthermore, as I argue above, it is advanced technology that may allow us to evacuate the human species and at least part of the biosphere to some other region of the galaxy, as and when the environment on Earth ceases to be life-friendly.

Thus, when considered in the context of a new ecology deeming the cosmos to be a suitable environment for Earth-life, a civilisation based around technology makes a much more positive impression, being the only one to permit the survival of that life beyond the Earth. If we discern that a key element of SD contained in the Brundtland Report is the postulate of inter-generational solidarity (whereby we must care for the interests of future generations), then one might with justification claim that the basic interest of our descendants (the possibility to live, including in an extra-terrestrial environment) coincides with activity in the name of the development of advanced

technology. In turn, the capacity of Earth-life to evolve defines in an open way the possibility of life going on in the environment of space, thereby corresponding with the imperative of Hans Jonas (1996, 38), who insists that we should always act in such a way that the effects of our actions can be reconciled with the continuity of authentic human life. I think that the ambivalence of the technique is well justified because, by developing the technique, people not only destroy the environment, but they can also protect and maintain it in a state of equilibrium by ensuring the imperative of the continuity of authentic human life.

It is worth stressing that not every transformation of the environment assumes the form of degradation. It may be that progress with genetic engineering will allow us to direct the evolution of our bodies in such a way that we can colonise planets with somewhat different environmental conditions. There are many cosmologists and astrophysicists who claim that we should prepare for our colonisation of space by establishing transitional bases around the Solar System that will serve as extra-terrestrial points of departure. First steps taken in this direction already exist, with the International Space Station, as well as the construction in the desert of experimental bases of the *Biosphere 2* type. On the other hand, there is an ongoing search for extra-terrestrial civilisations in the form of the SETI Project.

THE VALUE OF TECHNOLOGICAL CIVILISATION

The various sustainable-development strategies were introduced to counteract the negative consequences of the rape of nature's bounty, in other words the over-exploitation of the environment, which only intensified as a technological civilisation took shape. As I have noted, traditional ecology sees SD as a mechanism by which ongoing, near-permanent, self-sustaining cohabitation of humankind and the biosphere can take place. In essence, it could be deemed to safeguard the functioning of the biosphere and the persistence of life for just as long as the Earth is itself suitable for life. Beyond that, however, SD seen in the context of ecology on the cosmic scale is also to ensure the high level of advancement of a civilisation based around science and technology that provides, not only for the passive research into possible environments for life in the cosmos, but also ultimately for the colonisation thereof, and hence for the ongoing, perhaps even eternal, presence of Earth-life (at least) in the wider cosmic environment.

What needs stressing here is the fact that SD seen as a mechanism ensuring the survival of the human species in the cosmic environment necessitates change in the value assigned to cultural systems. The aforesaid civilisation based around science and technology gains added value because this and only this (as opposed to, say, tribal culture) can offer any real possibility of Earth-life going on beyond our planet. This is important, given that SD in the context of Earth alone sees tribal culture as of high value when it comes to maintaining the balance of nature. Alas, its value where

cosmic conditions are concerned is vanishingly small. Environmental ethics underline how Australian Aborigines, Kalahari Bushmen, various tribes of “Indians” and Inuit people all have cultural systems adapted (admittedly more or less) to the capacity of the environment they live in. *In extremis*, they do not even build permanent settlements, do not raise livestock or grow crops, while maintaining (apparently successful) traditions passed down the generations from ancient ancestors. We may even risk suggesting that such peoples use the environment in the same way as an elephant, lion or bear might do. Sadly, these tribes resemble elephants in having an equally endangered evolutionary future (Diamond 2005).

The new ecology that has assumed cosmic dimensions inevitably offers some kind of reevaluation of anthropocentrism. Even if microorganisms might conceivably travel through space by accident, humankind represents the only species on Earth among all those millions that may engage in the active evacuation of Earth-life into the wider cosmos, should such a need be recognised. In that perspective, our species regains its distinguished position among Terran life-forms, but simultaneously takes on the burden that the commitment to save (ensure the persistence of) Earth-life denotes. Thus cosmic ecology prizes technological civilisation for many of the same aspects that eco-philosophy decries or condemns it, within the conceptual framework of biosphere-based sustainable development.

CLOSING REMARKS

In summing up my musings, I would like to draw attention to two key facts. The first is that evolutionary knowledge of mechanisms underpinning life on Earth changes the way of looking at relationships between the human species and others participating in the evolution of the biosphere, while the second (of equal importance) concerns the way in which knowledge of the evolution of the universe provided by cosmologists and astrophysicists has changed radically the way we see humankind’s relationship with the cosmos. Along with the planet we inhabit, we are also participants in ongoing cosmic transformations, not merely passive observers of the starry heavens above us. Two fields of knowledge, which overlap and function as a palimpsest, generate change in both the value assigned to technological civilisation and the role of the human species in evolution. It is worth noting how the anthropocentrism invoked in cosmic ecology is of a different calibre from the traditional variety, but the development of this subject requires distinct considerations. The difference here lies in the fact that, in placing the intelligent human being within the group of intelligent life forms present in the universe, we do not know how favourably we will match up when some comparison is finally made. Likewise, we do not know what our allotted place may be, as we meet up with our “brothers in reason” and become members of the galactic community.

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