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Employing Geoethics to Avoid Negative Nanotechnology Scenarios in Undeveloped Countries

Guido David Núñez-Mujica
**Parasite Enzimology Laboratory, Center of Genetic Engineering, Faculty of Sciences, University of the Andes, Mérida, Venezuela*

Abstract

Intensifying the current trends of using fewer raw materials per unit of manufactured consumer goods will eventually lead to fewer mining extractions and the preservation of natural resources. Nanotechnology-based recycling will improve today's efficiency rates and allow for extracting materials from sources that are currently impossible, making an almost perfect recycling system feasible. Integrating these trends within undeveloped countries with trends of slight or negative growth with the industrialized Western countries, could decrease their import needs to almost zero. New technologies could render junkyards and landfills a good source of raw materials. In discussing the crucial role of geoethics within such a scenario, several measures must be taken to ensure the economic, environmental, and social welfare of affected Third World, undeveloped countries, especially those affected by a loss of their foreign trade.

INTRODUCTION – DEMATERIALIZATION, RECYCLING, AND SUSTAINABLE DEVELOPMENT

Despite the astounding growth of world's economy, its physical impact has not grown at the same pace. In fact, thanks to new technologies, new materials, and smaller components, the volume of manufactured goods is steadily shrinking. This trend is called dematerialization and is defined as: "the absolute or relative reduction in the quantity of materials required to serve economic functions" [7]. Replacing heavier and scarce materials in industry with lighter and more abundantly available materials has been a constant practice within industrial Research & Development (R+D), which has led to the astonishing saving of resources. A heavy old coaxial cable made of copper carries far less data traffic than an optical fiber cable made of silicon, a cheaper and more ubiquitous material. Plastics and resins have replaced much of the metal in cars, leading to a decreased net weight. The importance of a given material in the economy can be measured by dividing its consumption by the Gross Domestic Product. Employing this analysis makes it possible to see the dramatic decrease in materials such as timber, steel, copper, and lead since 1900; almost in an exponential fashion. This does not means that the net consumption has dropped. On the contrary, it has grown, but not at the same pace as the economy [6]. Regarding certain materials, some of the incremental consumption is supported by high recycling rates, specifically for lead and steel.

To achieve sustainable development, recycling has been encouraged and shall be pursued as a responsible and environmentally friendly practice. Recycling rates have increased over the years and for certain items, more than 50% of the amount used in industry comes from recycling. In terms of energy, recycling can be more efficient than extracting raw materials when compared to the huge amount of work and energy needed for mining ores, and waste management is an equally important issue. The profitability of recycling a given resource and its impact on dematerialization is dependant upon three factors: 1) the ease of its isolation amidst a huge amount of waste, 2) the availability of the material in large amounts in a uniform fashion, rather than being mixed with other materials, and 3) the intrinsic value of the material [6].

NOW ADD NANOASSEMBLY!

Dematerialization and recycling are two pillars of the potentially sustainable use of resources. Given the contemporary state of technology, this remains just a possibility; however, given certain state of the art developments it is possible to envisage scenarios where this possibility may become a reality and provide more efficient recycling and even greater dematerialization. One of the necessary elements for a better and truly sustainable use of resources would be advanced nanotechnology; the ability to manipulate matter at the molecular level. As proposed by Eric Drexler of the Foresight Institute [3], nanoassemblers would make the manufacturing of almost every commodity feasible (from food to solar panels, including clothes and tools, from raw materials), molecule by molecule, making an almost perfect recycling system possible. Even if these nanoassemblers prove impossible to create, nanotechnology remains promising for incremental achievements in dematerialization and recycling rates. Carbon nanotubes are being regarded as the fundamental building blocks of new technologies ranging from energy storing to microprocessors. Once it’s possible to manufacture and manipulate nanotubes on a commercial scale, the substitution of heavier and scarce materials with nanotube-based materials will boost dematerialization. Nanotube construction, purported to be incredibly strong and durable, may replace many metals.

Looking closely at the pattern of the materials’ importance, we recognize that the logarithmic plot and its apparent lineal trends are in fact exponential, including the decreasing importance of certain materials. This fact may be due to the exponential growth of other sectors of the economy responsible for the bulk of the growth of the Gross Domestic Product (GDP). Although greater data is necessary to form a more accurate projection, this trend can be analyzed with Kurzweil’s Law of Accelerating Returns, the acceleration of the pace of the exponential growth of the products of an evolutionary process. [5]

GEOSTRATEGIC IMPACTS

The environmental effects of nanotechnology do not end with greater dematerialization and better recycling, which lead to less mining. New techniques in energy efficient nanosolar panels are projected to produce a great energy savings as they will create less of a dependency on oil and other non-renewable energy sources as coal and natural gas, thus, ending the dependence of developed countries on their traditional energy suppliers, most of them undeveloped countries. This change in the patterns of energy consumption will have a great impact upon many countries, because oil is their main trading commodity, and many others depend heavily on the exportation of raw materials and agricultural products as primary commerce activities.

The diminishing need for raw materials and non-renewable energy sources will create threats to developing world economies as their consumption decreases. If a developing country has nothing to trade, how will they be able to afford nanotechnology and even the most basic items needed for a modern society? A developing country with nothing of intrinsic value to trade would bring about environmental catastrophes. Maslow’s pyramid of priorities (or hierarchy of needs) [1] suggests that people would rape the environment due to a lack of resources, because the conservation of the environment is less important than satisfying their physiological needs. Despite the criticism of Maslow’s theory, there are surveys that show that in fact the rise of the GDP of a society is related to the improvement of certain environmental indicators, including decreased pollution. Primitive agriculture would devastate the rainforests at a much larger scale than at present, due to its low efficiency, if these countries lose their income sources.

GEOETHICS

There will be a need for global regulation regarding nanotechnology if we are to avoid the promise of recycling and conservation turning into increased poverty and environmental degradation. Recognizing the necessity for regulation is not a new issue concerning nanotechnology. In fact, almost since the birth of the concept, nanotechnology has been accompanied by the Foresight Institute Guidelines [4] which are updated continuously. These guidelines deal with many of the potential risks or misguided applications of nanotechnology; mostly with the effects of awry self-replicators, direct environmental damage, and nanotech-based weapons. They also deal with ethical aspects of nanotechnology applications and their use for improving living standards in undeveloped countries. “Poverty, disease, and natural disasters kill thousands, in some cases millions annually, and the potential to ameliorate their effects significantly should not be relinquished lightly, particularly by those least affected.” [4] In regard to the previously stated consequences on the biosphere, these guidelines do not explicitly state actions that could be taken to achieve this, nor an encouragement to do so. At the time this paper was written, the former scenario was not contemplated in any consulted visions of the risks of nanotechnology.

According to Jamais Cascio, geoethics is “the set of guidelines pertaining to human behaviours that can affect larger planetary geophysical systems, including atmospheric, oceanic, geological, and plant/animal ecosystems. These guidelines are most relevant when the behaviours can result in long-term, widespread and/or hard-to-reverse changes in planetary systems.”[2] This definition is based upon the definition given by Treder: “Geoethical means widely agreed-upon principles for guiding the application of technologies that can have a general environmental (including people) impact, much like bioethical principles (autonomy, beneficence, nonfeasance, justice) guide the application of curative technologies that specifically impact one or more patients.” [7] Geoethics and its principles (see Table 1) can support an approach for a rational regulation of nanotechnology that prevents environmental disaster from happening due to the crash of the economies of undeveloped countries. Concerning this issue, the principles of Integration, Diversity, and Interconnectedness, have special importance in application to human populations as a key element in the global processes. That is, human populations do affect the ecosystems and do not exist in isolation. When choices are given, they become diverse, technologically proficient and more adaptable to changes; therefore, their needs must be fulfilled to achieve a more steady-state, environmentally sound economy.

There are already ethical dilemmas concerning the wealth distribution. Some figures claim that there is enough food for meeting the world’s needs but is not well distributed. Others point out that “The three richest people in the world control more wealth than all 600 million people living in the world's poorest countries.” [9] Currently, however, the allocation of resources is expensive and resources themselves are scarce. In the future the abundance of such resources, thanks to nanoassemblers building them from scratch, will make the current dilemmas even tougher, because resources could be given to the needy people almost for free, but surely, for “security reasons,” a developed nation wouldn’t just give away the nanotechnology, as more motives could be argued for keeping a monopoly over this technology and its fruits. How do we avoid such environmental tragedies? How do we deal with rogue or deceitful states? A compelling ethical, economic, and ecological framework must be built to ensure that an orderly, rational and safe distribution of nanotechnology and its products is attained worldwide. In the next section, some measures for facing these dilemmas and meeting requirements of safety and welfare are proposed.

Principle	Definition
Interconnectedness	Planetary systems do not exist in isolation, and changes made to one system will have implications for other systems.
Diversity	On balance, a diverse ecosystem is more resilient and flexible, better able to adapt to natural changes.
Foresight	Consideration of effects of changes should embrace the planetary pace, not the human pace.
Integration	As human societies are part of the Earth's systems, changes made should take into consideration effects on human communities, and the needs of human communities should not be discounted or dismissed when considering overall impacts.
Expansion of Options	On balance, choices made should increase the number of options and opportunities for future generations, not reduce them.
Reversibility	Changes made to planetary systems should be done in a way that allows for reconsideration if unintended and unexpected consequences arise.

Table 1: Principles of Geoethics, (Cascio, 2005)

NANOTECH MANAGEMENT

The Guidelines of the Foresight Institute offer an excellent approach to nanotechnology regulation, but they are not suited for dealing with the environmental dangers posed in this work or for avoiding the economic collapse of non-developed economies. However, the necessary measures for that goal can be contemplated within these guidelines. The measures that shall be applied in the case of this scenario becoming reality must be a trade-off between assistance to the undeveloped world (to avoid the catastrophe of economic collapse) and safety, as many of these societies are not democratic or lack the ability for a proper management of nanotechnology (because of non-transparent governments and extensive corruption that could result in the sale of nanotechnology to independent actors or its use as a weapon in inner conflicts), and geoethical principles should be considered in designing these measures.

Some of the possible measures that could be used are:

- Not giving the technology away without the supervision of trained personnel from the West to instruct on its use or without the training of the local personnel in a Western developed country by people from all around the world. This training would involve not only technical but also ethical issues. This would expose the people in charge to a Western ethics model of world-unity and abundance.
- Ensuring the use of inherently safe replicators [3], which must be regarded as a priority and remain as one of the main technical measures to prevent nanotechnology misuse.
- Restricting the distribution of the assemblers to rogue states or nations while permitting them to acquire nanotechnology products. Thus, nanofactories *near* these states would provide the necessary commodities to their populations. However, even this distribution would have to be carefully planned to avoid the oppression of ethnic or political factions by totalitarian rulers. This distribution could take place in international waters or via a nearby friendly country.
- Giving away assemblers that are satellite controlled by an international organization and that are incapable of certain actions. If a link is broken or hacked, the assembler would destroy itself and send signals to the regulatory organizations.

- Trading nanoassemblers for improvements in human rights, women's conditions, and democracy. This could lead to a more sound global society grounded on Western values, thereby reducing the current threats of terrorism and the global dissatisfaction with the governments of developed countries that provide international help. However, this approach would not be enforceable against militarily powerful countries with weapons. Signing international treaties for the destruction of atomic weapons and transcontinental missiles in exchange for the products of replicators or the replicators themselves seems a viable option.

The aforementioned regulatory actions are grounded on geoethics and therefore must be discussed with the potentially affected people for achieving truly agreed-upon effective measures to cope with the possible environmental disaster. It should therefore be a priority to check the real plausibility of this scenario, discuss it widely, and incorporate it into the mainstream dialog on the risks of nanotechnology. We suggest that the measures developed for dealing with the proposed scenario, whether those proposed herein or others developed by experts in the field, be incorporated into the main set of measures proposed to cope with risk of nanotechnology, such as the Foresight Institute Guidelines.

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*Born in 1983, **Guido David Núñez-Mujica** is an undergraduate student of biology and computational physics in Los Andes University, in Mérida, Venezuela. In addition, he is an amateur writer on subjects of scientific divulgation, in which he has been involved for the last six years. Currently he is*

doing his thesis work on the subject of mathematical modeling of biochemical systems. Among his current projects are the creation of an Open Source community for pharmaceutical development against Chagas' Disease, a parasitic infection that affects 20 million people in the Americas, and further writing on the effects of new technologies on undeveloped countries. Based on his writings on future studies and ethics of new technologies, he has recently received awards form the World Future Society Venezuela and from the World Transhumanist Association.

POINTS FOR THE CLASSROOM *(send comments to forum@futuretakes.org):*

- *Identify other benefits and consequences of nanotechnology to international trade.*

- *Nanotechnology can potentially provide all of the necessities of life – and perhaps even some luxuries – to large numbers of people at low cost, thereby eliminating poverty. As nanotechnology becomes more common, will it "lift all boats" (that is, benefit all people), or will it widen the gap between "haves" and "have-nots"? In addition to the author's observations, what are the other potential impacts of nanotechnology on demographics including population levels?*

- *The article refers to "a more sound global society grounded on western values, thereby reducing the current threats of terrorism and the current global dissatisfaction with the governments of developed countries that provide international help." Are there any non-western value systems in existence that can mitigate dissatisfaction and strife – and if so, which ones?*

- *The article draws a scenario where the value of raw materials drops to almost zero. What are the consequences of this, and can you suggest a name for that scenario?*

- *The article discusses a possible diminishing need for raw materials and non-renewable energy sources. As nanotechnology enables progressively more local manufacture, with possible consequences to international and even inter-state and inter-province trade, what will be the impact on the economy, on industry (beyond the nanotechnology-enabled manufacturers), on international relations, and on communities?*