

# Nanotechnology and environmental ethics

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## SUMMARY

It seems that the relation between human and nature is not direct, but mediated by the technology. Therefore, it seems that characteristics of the technology defines the relation. If this is true, the problem is whether new technology always makes new relation or not.

In this paper, I take a brief look at the relation between technology in general and the environmental crisis from the ethical perspective. And then, I investigate the concept of responsible development and the principle of stewardship that is adopted in two reports concerning nanotechnologies. Through these explorations, an ethical stance on the application of nanotechnology is proposed.

**Key-words:** Nanotechnology, Science, Technology, Environment, Risks and benefits, Responsibility, Japan.

## RÉSUMÉ

### *LA NANOTECHNOLOGIE ET L'ÉTHIQUE DE L'ENVIRONNEMENT*

*Il semble que la relation entre l'humain et la nature n'est pas directe, mais arbitrée par la technologie. Par conséquent, il semble que les caractéristiques de la technologie définissent la relation. Si ceci est vrai, le problème est de savoir si la nouvelle technologie établit toujours une nouvelle relation ou non.*

*Dans cet article, je regarde rapidement la relation entre la technologie en général et la crise environnementale d'un point de vue éthique. Ensuite, j'examine le concept du développement responsable et le principe de gestion qui est adopté dans deux rapports concernant les nanotechnologies. A travers ces explorations, une position éthique sur l'application de la nanotechnologie est proposée.*

**Mots-clés :** Nanotechnologie, Science, Technologie, Environnement, Risque bénéfice, Responsabilité, Japon.

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This paper explores the relation between human and nature through nanotechnology. Technology is often blamed for environmental destruction. Modern technology is particularly powerful and can lead to irreversible changes in the natural world. As new technologies emerge, new ethical principles are required to mediate the relation between human and nature.

First, the relation between the technology and the environmental crisis is discussed from an ethical perspective, considering human as steward of nature. Second, I consider guidelines on the development of nanotechnology and its application to environmental problems, in addition to these the ethical implications considered. Third, the ethical approach to nanotechnologies in the US is presented based on reports published by the Environmental Protection Agency (EPA) and the National Nanotechnology Initiative (NNI). Based on these investigations, an ethical stance on the application of nanotechnology is proposed.

## 1. TECHNOLOGY AND THE ENVIRONMENTAL CRISIS

Before considering the relation between nanotechnology and the environment, the relation between the technology and the environmental crisis is discussed from an ethical perspective. Science and technology is often blamed for environmental destruction. For example, modern technology consumes exhaustible resources, and CO<sub>2</sub> emissions are causing global warming. The effects of modern technology have become so enormous that nature is unable to repair itself and degradation of the environment occurs.

It is also said that the anthropocentric character of science and technology is the cause of the environmental crisis. Among the issues concerning the roots of the present environmental problem, Lynn White Jr., a historian of agriculture technology of medieval Europe, criticizes Christianity for its anthropocentric approach. He describes an agricultural technique that

became established in the 7<sup>th</sup> century and its consequences. In those days, peasants in Northern Europe used a new kind of plow:

certain northern peasants were using an entirely new kind of plow, equipped with a vertical knife to cut the line of the furrow, a horizontal share to slice under the sod, and a moldboard to turn it over. The friction of this plow with the soil was so great that it normally required not two but eight oxen. It attacked the land with such violence that cross-plowing was not needed, and fields tended to be shaped in long strips.<sup>1</sup>

The emergence of this new plow gave rise to changes:

distribution of land was based no longer on the needs of a family but, rather, on the capacity of a power machine to till the earth. Man's relation to the soil was profoundly changed. Formerly man had been part of nature; now he was the exploiter of nature.<sup>2</sup>

Namely, the emergence of new technology changes the relation between humans and nature. He concludes that these technologies and Christianity as an anthropocentric religion combine to precipitate environmental degradation.

Criticisms of this critic of anthropocentrism appeared soon in environmental ethics. John Passmore states a representative idea among these criticisms in his *Man's Responsibility for Nature*<sup>3</sup>, the first systematic work concerning environmental ethics. His standpoint is an anthropocentric. But his view of human being is not exploiters of nature, but guardians of nature, in other words, stewards of nature. The prototype of this idea of human being can be found in Plato's *Republic*. In this book, "Trasymachus thought it self-evident that the ruler acts entirely in his own interests; Socrates denied this. As ruler, his responsibility, according to Socrates, is the welfare of those he governs"<sup>4</sup>. Humans are defined as rulers of this world in the Bible, but Passmore claims that this means a Socratic (or Platonic) governor, not a despotic governor. And he cites the Anglican Bishop Hugh Montefiore's word "Men hold their dominion over all nature as stewards

1. Lynn White Jr., The Historical Roots of Our Ecological Crisis, in *Science*, 155(3767), 1967, p. 1205.

2. Ibid.

3. John Passmore, *Man's Responsibility for Nature*, Duckworth, 1974.

4. Ibid., p.29.

and trustees for God'. And he insists that 'man's responsibility is to perfect nature by co-operating with it'. Since the word 'nature' is derived from the Latin word '*nascere*', nature is regarded as the potential or not yet. Therefore man as a steward has the responsibility to develop or to perfect nature.

This issue concerning anthropocentrism raises problems about the role of human in the nature and the rights of the nature etc. and forms the basis of environmental ethics in its early stages. In the background of these problems, not to be indicated explicitly, there is the problem of the relation between man and the nature (or the environment). When we investigate this relation, we cannot help exploring it without science and technology, that is the main tool connecting us to the environment. It is therefore self evident that the tool (science technology) becomes the cause of the environmental crisis.

## 2. RESPONSIBLE DEVELOPMENT OF NANOTECHNOLOGIES

Sustainable development is the indispensable idea for environmental protection. Although this idea is widespread, people continue to discuss what this idea means. Before this idea was presented, people were faced with either environmental protection or economic growth. After this idea appeared, the road that combines environmental protection with economic growth was opened. Therefore, we must consider how nanotechnology may contribute to or conflict with the idea of sustainable development.

In *Our Common Future* sustainable development is defined as follows:

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.<sup>6</sup>

Sustainable development includes two key concepts following this definition. One is the concept of need.

The concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given.<sup>7</sup>

And the other is the idea of limitations.

The idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.<sup>8</sup>

The latter idea is important for the problem of technology. According to these definitions, the idea of sustainable development is accompanied by limitations. However, limitations are imposed by the state of technology and of social organization. As the technology and social organization progress, the range of limitations changes with it. How about nanotechnologies?

Let us look at the possibility and limitations of nanotechnology are discussed in two reports published in the U. S. One is the *Nanotechnology White Paper* written by EPA in 2007 and the other is the *Strategy for Nanotechnology-Related Environmental, Health and Safety Research* written by NNI in 2008. At the beginning of this white paper, the application of nanotechnology to the environment is stated as follows:

Nanotechnology also has the potential to improve the environment, both through direct applications of nanomaterials to detect, prevent, and remove pollutants, as well as indirectly by using nanotechnology to design cleaner industrial processes and create environmentally responsible products. However, there are unanswered questions about the impacts of nanomaterials and nanoproducts on human health and the environment, and the U.S. Environmental Protection Agency (EPA or "the Agency") has the obligation to ensure that potential risks are adequately understood to protect human health and the environment.<sup>9</sup>

Naturally, there are benefits and risks, when nanotechnology is used in the environment. Remediation/Treatment and sensors are stated as benefits in the White Paper. And it is also said that 'Nanotechnology may be able to advance environmental

5. Ibid., p.32.

6. The World Commission on Environment and Development, *Our Common Future*, Oxford University Press, 1987, p.43.

7. Ibid., p.43.

8. Ibid.

9. U.S. Environmental Protection Agency, *Nanotechnology White Paper*, 2007, p.4 (<http://www.epa.gov/osa/pdfs/nanotech/epa-nanotechnology-whitepaper-0207.pdf>).

protection by addressing the long-term sustainability of resources and resource systems<sup>10</sup>. While nanotechnologies bring us benefits, we must note that they may also have risks. 'Uncertainties in health and environmental effects associated with exposure to engineered nanomaterials raise questions about potential risks from such exposures<sup>11</sup>'. Therefore, the white paper states that the National Nanotechnology Initiative (NNI) has a principle of responsible development as a strategy of the development of nanotechnology. One of the goals of NNI is as follows:

One of the stated goals of the National Nanotechnology Initiative is to support responsible development of nanotechnology. EPA administers a statutory framework laid out in this chapter that supports responsible development.<sup>12</sup>

Responsible development is defined in the *Strategy for Nanotechnology-Related Environmental, Health and Safety Research* as follows:

Responsible development of nanotechnology includes supporting fundamental discovery-based research as well as targeted research and other activities to understand potential risks associated with the manufacture and use of engineered nanoscale materials. Since the inception of the NNI, the participating agencies have supported research to safely develop and apply nanotechnology for societal benefit and economic growth, as well as research to better protect public health and the environment. By integrating the results of such research, the NNI aims to ensure the benefits of this new technology are maximized within a coordinated research framework that emphasizes understanding and prioritizing potential risks as well as the means to manage such risks.<sup>13</sup>

In addition to this responsible development, a principle of stewardship is stated in the white paper. It consists of the following principles:<sup>14</sup>

1. Exceeds required compliance
2. Protects natural systems and uses natural resources effectively and efficiently

3. Makes environment a key part of internal priorities, values and ethics, and leads by example
4. Holds oneself accountable
5. Believes in shared responsibility
6. Invests in the future.

It is necessary to observe these principles so that nanotechnology can be conducted responsibly.

### 3. DEVELOPMENT OF NANOTECHNOLOGY AND APPLICATION FOR THE ENVIRONMENT IN JAPAN

Next, let us look at the development and application of nanotechnology. The government has established the Science and Technology Basic Plan every five years since 1995 in Japan. The third basic plan is currently being executed. This plan is an extension of the second basic plan that stated:<sup>15</sup>

- (1) A nation that contributes to the world by creating and using scientific knowledge - creation of wisdom
- (2) An internationally competitive nation capable of sustainable development - vitality from wisdom
- (3) A safe, secure nation where people enjoy a high quality of life - enlightening society through wisdom

In the third basic plan, the Japanese government emphatically allocates the budget to four priority fields (Life-Science, IT, Nanotechnology, Materials) that contribute greatly to achieving the above three ideas. The ratio that is occupied by the 4 fields in the science and technology budget increased from 38% in FY2001 to 46% in FY2005.

Regarding ethical issues, it is worth noting that several items are stated under the title of S&T to Be Supported by Society and the Public.

10. Ibid., p.24.

11. Ibid., p.29. Dreher, 2004; Swiss Report Reinsurance Company, 2004; UK Royal Society Report, 2004; European Commission Report, 2004; European NanoSafe Report 2004; UK Health and Safety Executive, 2004.

12. Ibid., p.63.

13. National Nanotechnology Initiative, *Strategy for Nanotechnology-Related Environmental, Health and Safety Research*, 2008, p.3.

14. U.S. Environmental Agency, *Nanotechnology White Paper*, 2007, p.110.

15. [http://www8.cao.go.jp/cstp/english/basic/2nd-BasicPlan\\_01-05.html](http://www8.cao.go.jp/cstp/english/basic/2nd-BasicPlan_01-05.html)

1. Responsible measures to resolve ethical, legal, or social problems caused by S&T
2. Accountability relating to S&T and the improvement of information transmission
3. Improving the public awareness of S&T
4. Promoting proactive participation of the public in S&T.<sup>16</sup>

However, as there are no concrete description concerning these items, these issues have only now just been addressed.

Let us to focus on the application of nanotechnology to the environmental problem. The nanotechnology of Japan is used to conduct high level research in the material field. Therefore, there are high expectations of a major contribution being made to this field.

The development of materials brings great breakthrough in the field of environmental technology. Nanotechnology makes it possible to fabricate the shapes of materials at the molecular or atomic levels and to optimize the structure to manipulate composition. Combining this nanotechnology with conventional technology, the performance of conventional materials are improved, and new technological processes become possible. This is a major objective of nanotechnology.<sup>17</sup>

This report states the environmental importance of the development of materials. Also in this report, technical assignments are discussed in detail. However, there is no reference to the risks and the assessment of risks when nanotechnology is used to resolve environmental problems. Moreover, ethical, legal and social issues of nanotechnology are not mentioned at all, completely ignoring the risks of nanotechnology and its social acceptance.

## CONCLUSION

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Technology is a tool that mediates the relations between humans and nature. For this reason, the development and use of technologies is of great importance for both environmental problems and environmental ethics. This article introduces the idea of stewardship that is adopted by a US report. Although it admits that human beings have the right to rule other creatures, it is not a right to do anything, but it is appropriate that human beings have the responsibility to care for other creatures.

While the development of technologies enables us to fulfill our responsibility, we should recognize that such development might lead us to lose sight of our responsibility. ■

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16. Bureau of Science technology policy, Science and Technology Basic Plan, 2006, p.60-p.62 (<http://www8.cao.go.jp/cstp/english/basic/3rd-Basic-Plan-rev.pdf>).

17. Commission on the environmental technology, *Strategy for the research and development of the environmental technology using nanotechnology*, 2008, p.4.