



## **GEOETHICAL RULES FOR NANOTECHNOLOGICAL ADVANCES**

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Dr. Martine Rothblatt illustrates the principles of Geoethics toward the safe guidance of advances in nanotechnology on earth, as well as outer space.

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By definition, the types of technology I would group under nanotechnological advances include manufacturing at sub-micron sizes and self-replicating, sub-micron machines, which could be a subset of manufacturing. This fairly wide range lends to biotechnological machines (as most of these operate at sub-micron sizes), synthetic genomics, biotechnological medicines and molecular computing. What is common to almost all of these is that the technology that is implemented in one place has a very high likelihood of having dispersive effects over a wide geographic area.

There are two basic principles of Geoethics, the Principle of Consent and the Principle of Compliance. The Principle of Consent is to obtain prior terms of consent from those, or their representatives, who may foreseeably be materially and adversely effected by one's actions. The Principle of Compliance is to act in accordance with independent assurance of one's compliance. In other words, the Principle of Consent in plain language is not to affect someone else in an adverse way without their permission. The Principle of Compliance is to have an independent third party decide whether or not you are complying with their consent.

Geoethics is culturally universal among humans; there are four separate arguments for this. One is that Geoethics comes down to what is called fundamental fairness or equal protection. It is the notion that in every society similar things should be treated similarly. What happens in human societies is that they quickly find even slight differences in similar things and decide that

such differences are justification for differential treatment. Sometimes that's wise and sometimes that can be horrible.

A second reason why Geoethics is culturally universal is that there seems to be an evolutionary tendency toward categorization. People and animals that tended to react to similar things similarly had a higher likelihood of passing on their genes than those that didn't. If something that looked like a threat was reacted to before it pounced on us, we were more likely to pass that ability on through our genes. This concept of treating similar things similarly is not just an intellectual idea in each culture, but has an evolutionary backdrop.

A third argument for the universality of Geoethics resides in the nature of consciousness. There is a great deal of confusing literature written on consciousness, but one thing that is consistent across all writers is that it involves placing one's self somewhat outside oneself and seeing the self as others would see you. Even primates other than humans have this ability to guess what another member of the group is likely to be doing and react accordingly. This idea of treating others as one would like to be treated has this grounding in consciousness theory.

A fourth and final argument for the cultural universality of Geoethics is Darwinian Group Selection<sup>1</sup>. This is somewhat summarized in Sir Francis Bacon's quote, "if we do not maintain justice then justice will not maintain us"<sup>2</sup>. In other words, societies that tend to last longer and self-perpetuate themselves are societies that do not tend to end up in some form or another of self-immolation. These four different arguments for the cultural universality of Geoethics are a useful tool for managing dispersive nanotechnology.

We can differentiate Geoethics from Bioethics. Bioethics is based on the concepts of autonomy, beneficence, non-maleficence and justice. Bioethics does not seem to be enough when we come to geographically dispersive technology such as self-replicating nanotechnology. With regard to autonomy, if we are treating individual patients, we can ask them if they want to be treated, but if we were causing an effect on populations far removed from the center of activity, whom would we ask? It is because Bioethics is so limited to an individual patient or a small group of research subjects that we are driven beyond the borders of Bioethics when we start talking about dispersive nanotechnology.

In talking about the practicality of Geoethics, we'll start with Consent and then move into Compliance. Some of the components of the Principle of Consent are that consent is needed only if somebody will be materially and adversely affected. So, who is going to decide whether or not somebody is foreseeably materially and adversely affected? The best we can do is a scientific determination of who may be materially and adversely affected. It may not always be

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<sup>1</sup> Darwin, C. (1871), *The Descent of Man, and Selection in Relation to Sex* (1st ed.), London: John Murray. Retrieved from, van Wyhe, J. (ed. 2002). *The Complete Work of Charles Darwin Online* <http://darwin-online.org.uk/>

<sup>2</sup> Bacon, F. (1615). Speech for prosecution, as Attorney General, in the Overbury Murder Scandal (1615-1616). Retrieved from [http://www.earlystuartlibels.net/htdocs/overbury\\_murder\\_section/H0.html](http://www.earlystuartlibels.net/htdocs/overbury_murder_section/H0.html)

accurate. Sometimes it may be catastrophically wrong, but it's better than the nanotechnology actor deciding for themselves who would be materially and adversely affected. Based on detailed proposals, it would be possible to make a good scientific determination of who would be foreseeably materially and adversely affected most of the time if not almost all of the time.


Another component of the Principle of Consent is determining who is able to give consent. Individuals cannot always be trusted to give consent on their own behalf because they may lack capacity. They may lack mental capacity, they may lack medical capacity if they are seriously infirmed; they may be under oppression, they may be in prison. We talk about individuals or their representative within the Principle of Consent. It is not always clear that people who claim to be representatives for others actually are representatives. You can have totalitarian situations or manipulated populations. In addition to having a scientific determination of who is foreseeably materially and adversely affected we also must have a legal determination of whether or not adequate consent can be obtained and has been obtained for those cases where there are populations being materially and adversely affected. In summary the Principle of Consent is very proactionary without forsaking precaution.

The second half of Geoethics is the practicality of the Compliance Principle. The Compliance Principle requires independent assurance with the terms of any obtained consent. Here we need to have the legal determination of whether or not the assurance is, in fact, independent. It is important for legal personnel to determine transparency, lack of conflicts, and demonstrated expertise with regard to whichever party is being set up to assure compliance with any terms of consent. You could have a different body being responsible for compliance with many different nanotechnologies, a different body for each project or some bodies for multiple projects. Many hospitals have a single institutional review board insuring compliance with the terms of consent of patients undergoing medical procedures or experiments. Admittedly, lawyers cannot be one hundred percent certain that assurance is in fact independent. Lawyers can make mistakes, and lawyer's assessments can be undermined, but it is better than the nanotechnology actors themselves providing their own assurance. There must be a bona fide effort to ensure the independence really is independent. That is the training of lawyers, specialists in this area, to ensure that through transparency, lack of conflicts and demonstrated expertise, that independent assurance really is independent.

Bioethics is a subset of Geoethics. It is a subset of Geoethics when the place of action and the place of effect converge on the same body. When researchers do experiments on individuals, the place of the experiment and the place of the effect of the experiment is the same body; those research subjects are patients. With Geoethics, the place of the activity, the creation of some type of dispersive nanotechnology, and the place of the effects may be hundreds of thousands of miles apart. It turns out that the two principles of Geoethics subsume the four principles of Bioethics.

Why Wasn't Informed Consent Enough for Bioethics if Enough for Geoethics?	
<ul style="list-style-type: none"> <li>• <b>Bioethics</b> Obtains Consent from <b>Individuals</b>, Who Are <b>Weak &amp; Unable to Negotiate Terms</b></li> <li>• Requirements for Beneficence and Non-Maleficence Helped Make Up for Weak Individual Autonomy</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Geoethics</b> Obtains Consent from <b>Populations</b>, Not <b>Individuals</b>, <b>Providing Negotiating Strength</b></li> <li>• Aspects of Beneficence and Non-Maleficence Will Be Taken Into Account in Granting Geoethical Consent</li> </ul>

As you can see in the left hand column, while Bioethics obtains consent from individuals who are weak and unable to negotiate terms, Geoethics obtains consent from populations, not individuals, which provide greater negotiating strength. Requirements for beneficence and non-maleficence help make up for the weak autonomy of any one individual against a research enterprise. We don't need beneficence and non-maleficence for Geoethics because a population with independent scientific determination of whether there is foreseeable material and adverse harm and independent legal determination of the adequacy of consent render redundant the need for beneficence and non-maleficence requirements. If people want to take a chance on nanotechnology and they have the information in front of them, we don't need to second guess whether or not that nanotechnology is actually beneficent and non-maleficent as many things have aspects of both benefit and harm. If a population wants to take advantage of the benefits, they should have the authority to do so; with Geoethics, they do have the authority to do so.

Society for Accelerating Geoethical Advances in Nanotechnology (SAGAN)	
<ul style="list-style-type: none"> <li>• Formed by Treaty And Scientific Peer Pressure</li> <li>• Actions Involving Nanotech Must First Be Cleared by SAGAN</li> <li>• SAGAN Must Decide Within 100 Days if Proposed Nanotech "May Forseeably Materially &amp; Adversely Affect Others"</li> </ul>	


The graphic above presents an idea for the formation of a Society for Accelerating Geoethical Advances in Nanotechnology. I would call this group SAGAN as an acronym. It

would be formed by a treaty and/or scientific peer pressure. Scientific peer pressure is actually quite effective in getting other researchers to comply with what is considered to be a reasonable norm. People want to get their work published, they want to get their work known and scientists can agree, “Well you have to be working with SAGAN to get your research published, known, presented and so forth”. Actions involving nanotech would first have to be cleared by SAGAN, but SAGAN itself has to act in a very proactionary way. I’m suggesting that it must decide within one hundred days if the proposed nanotech “may foreseeably, materially and adversely effect others”. One hundred days is the clock used in Europe for governments making decisions on moving forward with numerous medicines from one stage to the next and since these medicines are life and death decisions for hundreds of thousands of people, it seems that if one hundred days is sufficient for that, it should be sufficient to make a decision on whether or not nanotech may foreseeably materially and adversely effect others.

The first SAGAN governing principle would be if there is no scientific evidence of foreseeable material and adverse harm, then SAGAN must authorize the proposed nanotech per the Proactionary Principle<sup>3</sup> of Max More. There is really no latitude to just sitting on something over hypothetical and non-demonstrated risks of foreseeable, material and adverse harm. On the other hand, if such harm is foreseeable, then SAGAN must seek prior consent from the affected population via their representatives. When SAGAN does see that there is a material risk of adverse harm that is foreseeably based on scientific data, then SAGAN has the authority to stop the dispersive nanotechnology from going forward until prior consent, consistent with legal overview, is obtained from the effected populations or their representatives.

### **SAGAN Consent Procedures**

- **National Processes, If Consistent with Respect for Autonomy**
- **Public Opinion Surveys if Consistent with Informed Consent**
- **Majority Is Good Enough Because Democracy Accepts That for Other Risks**
- **If Consent Cannot Be Obtained, Then the Nanotech Cannot Cause Risk in that Geography**



Let’s look at what these consent procedures might be. If national processes are available that would be great. We can’t have every single person independently agreeing to everything. Majority voting seems to be good enough for countries to send themselves to war and infer all

<sup>3</sup> More, Max. (2004). The Proactionary Principle. Retrieved from <http://www.maxmore.com/proactionary.htm>

sorts of other risks that are probably far greater than dispersive nanotechnology, so majority voting should be good enough for consenting to dispersive nanotech. If a place is not sufficiently democratic to provide assurance of representative consent, there are alternate options. Public consent surveys are conducted in many countries around the world that are not normally considered democracies. Public opinion surveys are considered scientific, plus or minus their margin of error. An actual vote is not always necessary. A more quickly implemented public opinion survey would be an adequate measure of consent.

If consent is not obtained however; the nanotech cannot cause risk in that geography because that would just not be fair; it would not be Geoethical. So what then? How can some nanotech that is promising but harmful to go forward? I'll get to that in a moment. Let me first talk about if consent is obtained; what would be the type of compliance procedure to ensure compliance to the terms of the consent? The consent may be, as an example, to this dispersive nanotech pouring over our borders we want there to be sampling stations erected at miscellaneous locations, serum sampling of the population, and such and such share in the benefits.

The effector of nanotech must provide independent funding of the means of compliance within the terms of consent. The SAGAN organization would ensure there is independent funding to obtain compliance to the terms of consent. That could be done through an endowment as part of the costs of the project, or through user fees. It should be remembered, even by technology advocates, that the compliance organization has to have the authority to terminate the nanotech operation if the terms of consent are violated.

Back to the question, how can really exciting dispersive nanotech go forward if it has a risk profile inconsistent with obtaining consent on the surface of the earth? That question was actually answered by Dr. Gerard K. O'Neill<sup>4</sup> back in the 1970s when he first asked his physics class at Princeton: "Is the surface of the earth the best place for a post-industrial civilization?" The answer was "No", after which he decided the best place to carry out research on some really crazy self-replicating technology was on the outer surface of orbiting space habitats. Ultimately, Geoethics will help to accelerate space industrialization because exciting nanotech that seems too dangerous to people to occur on the surface of the earth, would almost assuredly pass the scientific test of not foreseeably causing material harm if carried out in space. As one gets deeper into space, it would actually become safer as there is no risk of foreseeable adverse harm, so there would be no need to obtain consent from anybody. Not only does Geoethics allow proactionary use of nanotechnology on the earth and protect people on earth from unreasonable risk of harm, but also accelerates our ultimate move into outer space as a place for the wildest nanotech to run free.

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<sup>4</sup> Dyson, F. (1993). Life of Gerard K. O'Neill. Space Studies Institute. Retrieved from <http://ssi.org/the-life-of-gerard-k-oneill/>

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