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# The Long-Term Outcome of Geo-Engineering

Ted Kaczynski

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In 2009, a correspondent asked me whether I thought nuclear weapons were the most dangerous aspect of modern technology. What follows is my reply, heavily rewritten. The most dangerous aspect of modern technology probably is not nuclear weapons. It could plausibly be argued that the remedies for global warming that are likely to be adopted constitute the most dangerous aspect of modern technology.

Nations have a strong incentive to avoid using nuclear weapons, at least on any large scale, because such use would probably be suicidal. This doesn't mean that nuclear war can never happen. On the contrary, the risk of it is very real. But a major nuclear war at least is not a strong probability for the foreseeable future.

On the other hand, it is virtually certain that nations will fail to reduce their emissions of carbon dioxide sufficiently and in time to prevent global warming from becoming disastrous. Instead, global warming will be kept in check through "geo-engineering." This means that the Earth's climate will be artificially managed to keep it within acceptable limits. Of the many

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tools that have been proposed for management of the Earth's climate, three examples may be mentioned here:

- i. Powdered iron can be dumped into the oceans to stimulate the growth of plankton that will absorb carbon dioxide from the atmosphere.
- ii. Microbes or other organisms may be genetically engineered to consume atmospheric carbon dioxide.
- iii. Carbon dioxide may be pumped into underground reservoirs for permanent storage there.

Any attempt at geo-engineering will entail a grave risk of immediate catastrophe. "Geo-engineering makes the problem of ballistic-missile defense look easy. It has to work the first time, and just right." Novel technological solutions usually have to be corrected repeatedly through trial and error; rarely do they work "the first time, and just right," and that's why people "quite rightly see [geo-engineering] as a scary thing."

But let's assume that geo-engineering does work the first time and just right. Even so, there is every reason to expect that the longer-term consequences will be catastrophic.

First: Attempts to meddle with the environment almost always have unforeseen, undesirable consequences. In order to correct the undesirable consequences, further meddling with the environment is required. This in turn has other unforeseen consequences ... and so forth. In trying to solve our problems by tinkering with the environment we just get ourselves deeper and deeper into trouble.

Second: For hundreds of millions of years, natural processes have kept the Earth's climate and the composition of its atmosphere within limits that have allowed the survival and evolution of complex forms of life. Sometimes during this period the climate has varied enough to cause the extinction of numerous species, but it has not become so extreme as to wipe out

all of the most complex organisms. When human beings have taken over the management of the Earth's climate, the natural processes that have kept the climate within livable limits will lose their capacity to perform that function. The climate will then be entirely dependent on human management. Since the Earth's climate is a worldwide phenomenon, it cannot be managed by independent local groups; its management will have to be organized on a worldwide basis and therefore will require rapid, worldwide communication. For this reason among others, management of the Earth's climate will be dependent on technological civilization. Every past civilization has broken down eventually, and modern technological civilization likewise will break down sooner or later. When that happens, the system of human climate-management necessarily will break down too. Because the natural processes that kept the climate within certain limits will be defunct, the Earth's climate can be expected to go haywire. In all probability the Earth will become too hot or too cold for the survival of complex life-forms, or the percentage of oxygen in the atmosphere will sink too low, or the atmosphere will become contaminated with toxic gasses, or some other atmospheric disaster will occur.

Third: When the Earth has a managed climate, maintenance of the technological system will be considered essential for survival because, as has just been pointed out, the breakdown of the technological system will probably lead to radical and fatal disruption of the climate. The elimination of the technological system, through revolution or by any other means, would be almost equivalent to suicide. Because the system will be seen as indispensable for survival, it will be virtually immune to challenge. The elite of our society-the scientists and engineers, the corporation executives, the government officials and the politicians-are afraid of nuclear war because it would lead to their own destruction. But they will be delighted to see the system that gives them their power and their status become indispensable and therefore immune to any serious challenge.

Consequently, while they will make every effort to avoid nuclear war, they will be quite pleased to undertake management of the Earth's climate.