

Going Beyond the Tipping Points

John Cairns Jr.

Department of Biological Sciences, Virginia Polytechnic
Institute and State University, Blacksburg, Virginia 24061, U.S.A.
E-mail: jcairns@vt.edu

Abstract

Tipping points may be passed when all appears well, and the changes that follow are likely to be swift and irreversible. A frequent analogy to passing tipping points is of passengers in an automobile driving rapidly through a dense fog toward a cliff an unknown distance away. Tipping elements are now beginning to receive some long overdue attention. This interest is essential because tipping points surely exist, even though people are unaware of them. Tipping points and tipping elements have received practically no political attention. However, the natural laws of physics, chemistry, and biology have been in operation for billions of years and ignorance of exceeding them affords no protection from them. Of course, much more research is needed. However, while research is proceeding, two major steps can be taken now: (1) a science information system for the news media, the general public, and politicians should be put into operation at once, (2) a science internet site operated by such organizations as the National Academy of Sciences should be established so that the general public can obtain the information personally whenever it chooses.

Keywords : Tipping points, Tipping elements, Anthropogenic forcing factors, Irreversible change, Natural laws, Earth system.

1. Introduction

“The term ‘tipping point’ commonly refers to a critical threshold at which a tiny perturbation can qualitatively alter the state or development of a system . . . ‘tipping element’ [is introduced] to describe large-scale components of the Earth system that may pass a tipping point” (Lenton et al. 2010). Along the same lines, “The Earth System (ES) is defined as the conglomerate formed by human civilization and its planetary matrix (i.e., all parts of the Earth that interact with the members and manifestations of our species)” (Schellnhuber 2010). The

term “biosphere” might have been used instead of “Earth System” in this definition, which would call attention to the biosphere’s rediversification following the five great extinctions. Each of the five resulting biospheres was markedly different from its predecessor.

2. Scientific Literacy

A major report issued in 2007 by the Organisation for Economic Cooperation and Development (OECD) found that 15-year olds in the United States ranked 29th in student literacy in science worldwide (Paulson 2007). Even if the general public

has a dramatic increase in scientific literacy, communication will be difficult because publications on global climate change and related topics are being generated at an unprecedented rate by a huge number of scientists. Scientists must learn to communicate more effectively with the general public, but the latter must meet scientists halfway by a broad public increase in scientific literacy.

Most people pay little attention to problems they perceive as distant in space (i.e., geography) and/or time (i.e., decades or more from now). Eight interactive global crises threaten humankind's biospheric life support system (Cairns 2010); however, unless people can understand that all global crises will affect their region, nation, or city, interest will be inadequate. Communicating risks to people will be of little use unless they can visualize the effect of global crises on them.

3. Ecosystem Services

Homo sapiens evolved and flourished in the present biosphere, which has maintained conditions favorable to humankind for millions of years. However, five different biospheres preceded the present one, so conditions were not always favorable for the human species. People assume that the present conditions will last "forever," but the preponderance of scientific evidence indicates that present conditions will not persist. The present biosphere consists of natural capital that provides ecosystem services essential to the survival of the human species and civilization, (e.g., Cairns 2009). However, ecosystem

services are not well understood by the general public, and some individuals are not even aware that they exist and are being threatened by anthropogenic forcing factors.

Understanding ecosystem services is essential for nurturing the present biosphere (Hassan et al. 2005, Daily and Ellison 2002). In the 2008 presidential election in the United States, a substantial portion of the population was chanting "Drill, baby, drill" as a solution to the energy crisis. Simplistic slogans will not enable citizens to comprehend complex issues such as tipping points and tipping elements.

4. Inevitable Obstacles

Every global crisis will probably involve special interest groups that will perceive some or all of the scientific evidence as a threat to their well being. Corporations attempt to discredit scientific evidence they regard as threatening, but, far worse, they attack the scientists who generate the data and the publications. In the long run, science usually triumphs — after all, people once believed Earth was flat! Scientists espousing the idea that Earth is round did not despair but were guided by robust evidence — may such a mind-set continue!

5. A Preliminary Communication Plan

Step 1 – Make a major effort to communicate how the scientific process works (<http://webstore.aibs.org/Understanding-Science-Flowchart-Poster/M/B002R1K00A.htm>). Keep the message simple and direct, but be sure to include how the scientific process

eliminates errors.

Step 2 – Laypersons must be shown how to distinguish between credentialed scientists with many publications in peer-reviewed scientific journals and “experts” with few or no scientific credentials. In the United States, a “balanced” debate in the media between a member of the National Academy of Sciences, who supports the evidence for global warming, and a person with few credentials, who represents the denial group, is presented as if the two are evenly matched scientifically. Being literate in science requires a significant investment of time. Laypersons can become scientifically literate more efficiently by requesting assistance from faculty in academic institutions. However, academe in the United States and elsewhere in the world has endured substantial budget cuts, and the end of these decreases is not yet in sight. Most faculty members have full schedules, and their speaking to a group requires additional time.

Step 3 – The scientific community must vigorously challenge flagrant distortions of the evidence — for example, Earth is not cooling, although the temperature does fluctuate, but the long-term trend is global warming.

6. Conclusions

Human activities are causing irreversible changes to the climate in which *Homo sapiens* evolved and flourished for 4 million years. These hazardous changes are the result of individual decisions by nearly 7 billion people. Even though these changes are often not reversible, future changes can

be avoided by individual actions of a substantial portion of the 7 billion. Making the appropriate lifestyle changes will require scientific information from reliable sources. Determining whether this information is sound requires scientific literacy that can only be achieved if individuals invest a significant amount of time – probably 5% or more for the average person.

Inevitably, complaints will arise about the cost of implementing measures to reduce risk, the time required for generating new scientific evidence to reduce risk, the cost of implementing protective measures, and the time required to become more scientifically literate. However, ignorance is expensive.

Mass improvement in environmental literacy is essential. Globalization and 21st century technology have damaged the biospheric life support system and driven many of its component species to extinction. Despite massive evidence that humankind is altering Earth’s climate, “business as usual” continues. Widespread improvement in environmental literacy may not change this situation, but it is worth a try. The impact of the universal laws of physics, chemistry, and biology cannot be altered by lobbyists, politicians, and wishful thinking.

Of course, selection still is operative at the individual level — a careless individual can still acquire AIDS or have a gun accident. Group selection was probably operative at the tribal level, but the loss of a tribe was not fatal — loss of *Homo sapiens* at the global level is very serious.

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