

The Mother of all Positive Feedback Loops?

John Cairns, Jr.

Department of Biological Sciences, Virginia Polytechnic Institute and State University,
Blacksburg, Virginia 24061, USA

Saving civilization is not a spectator sport.

Lester Brown

Well it had to happen! Humankind knew that “business as usual” would reach a tipping point after which climate change would be beyond human control. “New U.S. government data estimates that worldwide emissions of carbon dioxide have gone up 38% since 1992 . . . The Kyoto Protocol, which industrialized nations other than the United States have agreed to adhere to, aims to reduce emissions in those countries 5% *below* 1990 levels by 2012” (Shapely 2008). No robust evidence indicates that this goal will be reached. As a consequence, Earth’s assimilative capacity for greenhouse gases will continue to be exceeded, and humankind will move the climate closer to major, irreversible tipping points.

“British scientists have discovered hundreds more methane ‘plumes’ bubbling up from the Arctic seabed, in an area to the west of the Norwegian island of Svalbard . . . It is likely that methane emissions off Svalbard have been continuous for about 15,000 years – since the last ice age – but as yet no one knows whether recent climatic shifts in the Arctic have begun to accelerate . . . climate change” (Connor 2008a) and “. . . details of preliminary findings suggesting that massive deposits of sub-sea methane are bubbling to the surface as the Arctic region becomes warmer and ice retreats” (Connor 2008b). Global carbon dioxide anthropogenic emissions last year (2007) outpaced the most dire predictions of international scientists (Eilperin 2008). “In 2007, carbon released from burning fossil fuels and producing cement increased 2.9 percent over that released in 2006, to a total of 8.47 gigatons, or billions of metric tons, according to the Australia-based Global Carbon Project . . . It is unclear how much industrialized countries will be able to reduce their carbon output in years to come,” (Eilperin 2008) if at all, but, even if they do, increased emissions from third-world countries will probably cancel any reductions and still add to the global atmospheric carbon total. Carbon “sinks” such as oceans and forests “have absorbed 54 percent of carbon dioxide emissions since 2000, a drop of 3 percent compared with the period between 1959 and 2000” (Eilperin 2008). In short, Earth’s ability to assimilate greenhouse gases is declining while greenhouse gas input into the atmosphere is increasing.

In addition to these increased anthropogenic emissions, emissions from formerly sequestered carbon, in the form of methane, appears to be increasing in the Arctic and probably elsewhere on the planet. These emissions will increase the rate of warming and result in increased release of carbon now sequestered in wetlands, tundra, permafrost, and frozen hydrated methane in the depths of the oceans and, thus, accelerate the rate of global climate change. More important, the essential point is that climate change is getting beyond humankind’s control. The feedback loops did not seem to be at current levels of activity at 350 ppm carbon dioxide and were presumably essentially inactive at the pre-industrial atmospheric carbon dioxide level of 280 ppm. Humankind probably has warmed the planet sufficiently to activate the release of stored carbon from a variety of sources. Various parts of the planet have effects on other, sometimes quite distant, areas of the planet (e.g., Tierney et al. 2008). These sources of carbon sequestered by nature at rates difficult to estimate or measure are clearly now emitted at rates significantly above the recent past. Nearly a year ago, the Intergovernmental Panel on Climate Change (IPCC) “issued its strongest call for immediate action to save humanity from the deadly consequences of unrestrained greenhouse gas emissions” (Romm 2008). Instead, greenhouse gas emissions increased last year, setting a course that could push beyond the worst case scenario of leading scientists (Times Wire Services 2008).

Nobel Laureate Svante Arrhenius noted the greenhouse effect of carbon dioxide in 1896, so the science is not new. The preponderance of scientific evidence demonstrates that anthropogenic greenhouse gases have a major effect on climate change, and no credible scientific evidence shows that they do not have effects. Of course, deniers are active, but they are usually persons with few or no scientific credentials and lacking publications in peer-reviewed, scientific literature. Vocal deniers in the US Congress and administration have delayed reaching agreement on treaties to set quantitative goals on greenhouse gas emission reduction. In

some cases, these actions go beyond global climate change to anti-science. The Union of Concerned Scientists has documented many cases in which the US government has changed, altered, or falsified science.

Uncertainty

Science is always a probabilistic determination based on evidence. Some uncertainties are characteristic of all scientific research. Furthermore, all scientists are responsible for continually probing for any weakness in scientific data and hypotheses. This quality control is essential to a robust, credible, scientific process. Regrettably, the general public, possibly strongly influenced by the news media, views these actions as scientific confusion rather than quality control. In global climate change, the preponderance of evidence that anthropogenic greenhouse gases play a major role is now awesome.

If continuing "business as usual" is likely to be catastrophic, precautionary measures are justified, even if scientific uncertainty exists in certain areas. For example, uncertainties involving the ebb and flow of continental ice sheets are unlikely to be resolved for many years. The exact greenhouse gas concentrations that will exceed major climate tipping points will probably never be known until they have been passed. The assumption that a new, dynamically stable biosphere will develop after major ecological disequilibrium will probably not be known for thousands of years – a time frame not commonly used in human decisions. Finally, Americans unused to US\$4/gallon gasoline want to "drill here, drill now, pay less," which might make more fossil fuel available at a low cost but will increase greenhouse gas emissions. Coal, which emits more greenhouse gases per unit of energy, is increasingly favored for electric power generation – this burning also vastly increases greenhouse gas emissions. In the year-long US presidential debates, global climate change was barely mentioned.

Are Catastrophic Climate Changes Needed for an Adequate Wake-up Call?

Even climate scientists are surprised at the present rate of climate change. Former US Vice-President Al Gore, although not a scientist, is so disturbed at the depth and rate of change that he made the following statement at the recent Clinton Global Initiative: ". . . we are at a point in our world's history, and in need of such immediate action, that if you are a young person it's time for civil disobedience. In particular, to bring coal plants to a halt" (Brewer 2008).

I have never felt civil disobedience has been productive, except in Ghandi's case, but I understand fully Gore's desperation at the failure to reduce greenhouse gas emissions when time is so short to take remedial action. If another major climatic tipping point is passed in the near future, which will probably happen if the positive climate feedback loops increase rates of activity, humanity might survive in areas of the world that remain habitable, but the quality of life will not be attractive. Regrettably, loss of human life could be in the billions. Most of humankind's societal infrastructures will probably not survive a worst case scenario, and resources to repair or replace them will most likely be scarce. All these events are possible, even probable, if the positive climate feedback loops escape human control.

Why Worry?

Earth has had conditions suitable for the genus *Homo* for over two million years, and no context exists with which to integrate present day events. However, ancestors in the genus *Homo* faced major challenges, such as leaving trees for the savannah, and survived, although the price was probably often horrendous. The present generations have a significant advantage over their ancestors – they have the power to reduce greenhouse gas emissions. At present, humankind only seems to lack the will.

Infectious Exuberance

The recent financial meltdown in the United States has some lessons that may be applicable to the global climate change crisis that has yet to evoke fear in the US citizenry and in much of the rest of the world, although, based on evidence available, climate change could easily kill and/or displace billions of people. Shiller (2008) notes that financial bubbles are like epidemics – both should be treated the same way. Most of the world, and the United States in particular, worships economic growth, and all that is needed to kill legislation to reduce greenhouse gas emissions is to suggest that the legislation might have adverse effects upon the economy. However, in the United States, citizens were not protected against a financial meltdown and are not being protected from adverse consequences of global climate change. "Many culprits have been fingered for the housing crisis we're in today: unscrupulous mortgage lenders, dishonest borrowers, underregulated financial institutions. And all of them played a role" (Shiller 2008, p. 19). However, too little attention has been paid to the most fundamental cause – the contagious optimism, seemingly impervious to facts, that often takes hold when prices are rising (Shiller 2008). Bubbles (e.g., financial, housing) are primarily social phenomena. Until society understands and addresses the psychology that fuels social phenomena, they are re going to keep forming. "Speculative bubbles are fueled by the social contagion of boom thinking, encouraged by rising prices.

Sooner or later, some factor boosts the transmission rate high enough above the rate for an optimistic view of the market to be widespread" (Shiller 2008, p.20).

Tipping Points Again

Clearly, very few, if any, people realized that a financial tipping point was being approached. Or, if they did, Secretary of the US Treasury Paulson issued no warning, nor did US President George Bush. The US Congress appears to have been caught unawares along with, of course, the major financial institutions and the general public. As of 4 October 2008, a US\$700 billion bailout was passed (+US\$150 billion in "pork" for congresspersons who otherwise might not have voted favorably on the bill) and rapidly signed by US President George Bush. Despite the large sum of money, the bailout might not work. The original bill submitted to the US Congress was three pages long; the final bill, the one signed into law, was reported to be 454 pages long – its size increased in just a few weeks. Surely, few people had adequate time to read the final, authorized bill carefully or systematically.

In short, no thoughtful approach was in place before the financial tipping point was passed. In fact, faith in the free market system was too encompassing and the free market ideologists disregarded common sense. In any case, perpetual growth of population, economics, resource use, and all non-cerebral growth cannot continue indefinitely on a finite planet.

Conclusions

Crossing a financial tipping point does not seem to have altered people's attitudes on population growth, ecological overshoot, global climate change, or even infectious exuberance, although all involve global tipping points. Perhaps enough time has not passed for reaction, although people should be asking what else could go wrong.

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