Climate Consensus and 'Misinformation': A Rejoinder to *Agnotology, Scientific Consensus, and the Teaching and Learning of Climate Change*

Abstract

Agnotology is the study of how ignorance arises via circulation of misinformation calculated to mislead. Legates et al. (Sci Educ. doi:10.1007/s11191-013-9588-3, 2013) had questioned the applicability of agnotology to politically-charged debates. In their reply, Bedford and Cook (Sci Educ. doi:10.1007/s11191-013-9608-3, 2013), seeking to apply agnotology to climate science, asserted that fossil-fuel interests had promoted doubt about a climate consensus. Their definition of climate 'misinformation' was contingent upon the post-modernist assumptions that scientific truth is discernible by measuring a consensus among experts, and that a near unanimous consensus exists. However, inspection of a claim by Cook et al. (Env. Res. Let. doi:10.1088/1748-9326/8/2/024024, 2013) of 97.1% consensus, heavily relied upon by Bedford and Cook, shows just 0.3% endorsement of the standard definition of consensus: that most warming since 1950 is anthropogenic. Agnotology, then, is a two-edged sword since either side in a debate may claim that general ignorance arises from misinformation allegedly circulated by the other. Significant questions about anthropogenic influences on climate remain. Therefore, Legates et al. appropriately asserted that partisan presentations of controversies stifle debate and have no place in education.

Key Words: *Agnotology, Climate Change, Consensus Science, Critical Thinking, Misinformation*

"Science is the belief in the ignorance of experts."

Feynman (1969)

Introduction

Agnotology is the study of general or even systemic ignorance and its cultural production arising from a basic lack of knowledge, from selective choice, and from an intentional attempt to deceive (Proctor 2008). In the context of this paper, the focus will be on misinformation said to have arisen not through inadvertence, nor through any limitation in the state of knowledge, nor through any defect in teaching or learning, but through the self-interested determination of some sufficiently influential faction to circulate misinformation calculated to sow doubt, to conceal a truth, or to promote falsehoods.

Bedford (2010), seeking to apply agnotology to climate science education, asserted that vested interests had promoted doubt and ignorance about what he maintained was a consensus about the implicit effect that anthropogenic influences on the climate were potentially so damaging as to require urgent implementation of policies to abate them. Legates *et al*. (2013) added to that discussion with a paper raising questions about the legitimacy of attempting to apply agnotology to the politically-charged climate debate. In the rejoinder by Bedford and Cook (2013), it is evident that the claim of "misinformation" that the fossil-fuel industry is said to be circulating is contingent upon the post-modernist assumption that the truths that are the end and object of scientific inquiry are discernible by reference to the existence of a consensus among climate scientists, and upon the further assumption that such a consensus exists.

Bedford and Cook (2013), in agreement with Bedford (2010), outline their position as follows:

1) "There is an overwhelming consensus within the scientific community [that] …the Earth's global average temperature is increasing, and human emissions of greenhouse gases, especially carbon dioxide, are the main cause" (p. 2020),
2) "Despite this very strong consensus, the general public, especially in the United States of America, perceives substantial disagreement among scientists on these fundamentals" (p.2020),
3) "A campaign of obfuscation regarding climate change science has been undertaken since the late 1980s, funded in part by the fossil fuels industry" (p. 2020), and
4) "A careful examination of the claims made in popular literature or films regarding human-induced climate change could be a useful critical thinking exercise and test of content knowledge for students" (pp. 2020-2021).

The climate consensus in (1) is the standard definition – which, significantly, does not explicitly encompass the notion that any policy action should be taken to mitigate our influence on the climate. However, the literature does not evidence a "very strong" consensus as defined by (2). There is, however, general agreement among scientists that there is a greenhouse effect; that our emissions of carbon dioxide and other greenhouse gases enhance it; and that some consequent warming may be expected. The general public correctly perceives these basic climatological tenets, which are tenets not because there is a consensus about them but because they have been demonstrated by measurement and experiment.

If the definition of agnotology is accepted, then *a priori* either faction in a polarized scientific debate may be guilty of circulating misinformation calculated to obfuscate or to mislead. Just as the fossil fuel industry has a vested interest in questioning whether consensus stands part of the scientific method, whether there is a consensus, and whether – even if there

were a consensus – there are more cost-effective methods to mitigate global warming today than to adapt to any net-adverse consequences tomorrow, so too do the environmental lobby and large sections of the academic community have a vested interest in maintaining that argument from consensus is scientific, that there is an overwhelming consensus, and that we must act to mitigate climate change regardless of the cost. These considerations underpin the original concern of Legates et al. (2013) that agnotology has the strong potential for misuse whereby a 'manufactured' consensus view can be used to stifle discussion, debate, and critical thinking.

Though we are grateful to Bedford and Cook for their commentary, and though we agree with them on points such as (4) above, a substantive rebuttal of points (1) to (3) follows. These significant areas of disagreement require further discussion.

Climate or Climate Change?

Climatology is the study of the climate of the Earth – its causes, interactions, variability, and feedbacks. It is subdivided into a number of major areas of study (Landsberg and Oliver (2005) including physical climatology (mass or energy exchanges at the Earth's surface), dynamic and synoptic climatology (atmospheric motion and its concomitant thermodynamics), regional climatology (why climate varies over space), and applied climatology (use of climate science to solve agricultural, transportation, and design issues, for example). Climate change transcends all four of these subdivisions in that virtually all climatologists agree that climate is never stationary; but rather, is in a constant state of change on time-scales ranging from hours to eons.

Unfortunately, more time is spent in teaching about climate change than about the Earth's climate. Students are taught as early as the first grade that carbon dioxide causes temperatures to rise; so much emphasis is put on the transfer of energy by electromagnetic radiation that students

are often unaware that more energy is transferred to the atmosphere by latent heat than by longwave radiation. The effect of failing to teach climate science is that climate merely becomes *average weather* and climate change is the dynamics of how carbon dioxide will change this average or *normal* condition. Moreover, it also leads to a misunderstanding – whether innocent or intentional – of how questions are viewed by scientists and other respondents. The question "Do you believe in climate change?" for example, can yield a biased picture if the scientist uses the strict scientific definition of climate change while the questioner often views 'climate change' as being synonymous with 'anthropogenic global warming.'

A Scientific Basis for an Uncertain Science

The first tenet posited by Bedford and Cook (2013, p. 2021) is that the

> "…basic science is defined as the findings that greenhouse gas concentrations have been rising since the Industrial Revolution; this has occurred largely, though not exclusively, due to the burning of fossil fuels; and this increase in greenhouse gas concentrations is the main cause of an observed increase in Earth's global average temperature over the period of instrumental record (generally since the mid-late nineteenth Century)."

Note that Bedford and Cook have mixed the 'basic science' of climatology with their definition of climate change. The authors go on to question our belief in what they call 'basic science':

> "Legates et al.'s (2013, p. 9) statement that 'The science is indeed uncertain owing to incomplete and complicated observational evidence' is therefore too imprecise to be helpful. To which aspects of the science of human-induced

> climate change are they referring? Are they proposing that it is unclear whether carbon dioxide is a greenhouse gas? Or that the concentration of carbon dioxide in the atmosphere has increased since direct measurements began in 1958? Or that global average temperatures in 2012 are greater than they were in 1900? If so, it would be intriguing to discover the basis for these claims of uncertainty. While some measure of uncertainty applies to any scientific finding, Legates et al. (2013) appear to be arguing that even these basic points are too uncertain to be taught in a science classroom without some alternative viewpoint to provide 'balance'. An overwhelming body of evidence indicates that this is not the case." (p. 2023)

This remark conflates the discussion of climate science with climate change and illuminates an errant linear thought process. The logical *fallacy of false cause* here arises from the premises (1) that carbon dioxide is a greenhouse gas, (2) that atmospheric concentrations of it have been increasing since 1958, and (3) that global average temperatures have increased since 1900. But the conclusion that rising global temperatures must be chiefly attributable to increasing carbon dioxide concentrations does not necessarily follow. The issues have always been whether and to what extent changes in the climate are caused by changes in greenhouse gas concentrations and whether there is a causal, not simply correlative, link. For mere correlation (to the extent that it exists) does not necessarily entail causation. Thus, Legates et al.'s (2013) assertion that the science [of climate change] is indeed uncertain owing to incomplete and complicated observational evidence is true.

Given that Bedford and Cook (2013) confuse climate science with anthropogenic climate change arguments, it is useful here to discuss three broad themes that underlie scientific

skepticism about anthropogenic global warming, so as to provide a proper scientific context for our subsequent discussion. First, scientific skepticism arises because of the continued failure of direct evidence for detailed spectral studies of electromagnetic radiation related to the greenhouse effects of atmospheric carbon dioxide (Huang et al. 2007; Huang and Ramaswamy 2008). This is related to an inaccurate representation of the effects and impacts of enhanced greenhouse warming from increased atmospheric carbon dioxide in simulations which often disagree with observations. Even where there might be some apparent agreements, the results are known to derive from large compensating errors in different spectral bands and regions (see e.g., Brindley and Allan 2003; Huang et al. 2007; Huang and Ramaswamy 2008).

A second reason is the extensive empirical evidence from paleoclimatic and geologic perspectives that casts doubt on whether atmospheric carbon dioxide has a predominant role as the driver of weather and climate (e.g., Soon et al. 2003; Kukla and Gavin 2004, 2005; Soon 2007; Akasofu 2010). Paleoclimatic data show that over time, climate varies naturally on local, regional, and global spatial scales with a very large range of warming-cooling, wetting-drying, and glacial-interglacial cycle amplitudes. Yet at no point in the >11,000 years since the abrupt termination of the Younger Dryas cooling event brought the last Ice Age to an end has absolute global mean surface temperature departed from the mean by much more than 3°C. Higher-resolution paleoclimatic temperature and hydrological proxies demonstrate that variations on the pertinent timescales of decades to centuries are entirely plausible even in the absence of any apparent influence by changing levels of atmospheric carbon dioxide. This point may come as a surprise,[1] but it has recently been noted that even during the dramatic 100 kyr glacial-interglacial

[1] This point is highlighted to stress the difficulties in ascertaining the actual causal role and impact of changing atmospheric carbon dioxide content on weather statistics and climate change over long time scales. We are aware of an opposing conclusion reached by Alley (2009), for example, where atmospheric carbon dioxide

cycles of the last 800,000 years or so, the role of atmospheric carbon dioxide can hardly be qualified as a primary driver (e.g., Soon 2007). Furthermore, the sensitivity and dependence of the regional climates of the Arctic and of China on solar radiation at multi-decadal to centennial timescales has been emphasized by Soon (2009) and Soon et al. (2011). Alternate hypotheses such as unforced variations from internal oscillations of the coupled ocean-atmosphere system must be comprehensively examined and quantified before any firm conclusion can be reached as to the magnitude of anthropogenic influences on global temperature.

Our third reason for scientific skepticism about whether atmospheric carbon dioxide is the primary driver of climate change is related to the over-reliance on climate model outputs which exhibit a strong exaggeration in their results even when narrowly adopting atmospheric carbon dioxide as the sole driver of climate responses. Lindzen and Choi (2011) and Choi (2011) recently documented that general circulation models, such as those cited in the *Assessment Reports* of the United Nations Intergovernmental Panel on Climate Change (IPCC), have consistently overestimated the climate sensitivity to rising atmospheric carbon dioxide. The current generation of models is still unable to represent properly the real-world oceanic and atmospheric processes.

The existence of these and many other well-evidenced scientific uncertainties demonstrates that teaching students about the climate *must* include discussions of how complicated the Earth's climate system is and of why we cannot possibly have all the answers to every question about how and why climate changes. In particular, fundamental problems related

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content is said to be quintessential for the presence of climate change on all timescales. Dr. Alley's presentation is at http://agu.org/meetings/fm09/lectures/lecture_videos/A23A.shtml.

to the parameterization of climate components with complex and potentially unknown interactions – notably forcings and feedbacks, especially those concerning clouds and the oceans – remain unsolved and are likely to remain so for the foreseeable future (Essex 1986; Essex 1991; Soon et al. 2001; Lindzen 2007; Koutsoyiannis et al. 2009). Owing to difficulties in simulating Arctic clouds (Walsh et al. 2009), climate models also have failed to simulate the surface shortwave and longwave radiation budgets in the Arctic by a very large margin when compared to the relatively minor effect of rising carbon dioxide in the scenarios posited. For example, Zhu et al. (2007) discussed the important biases in simulating low marine clouds in the tropics and emphasized that a correct determination of sea surface temperatures and above-inversion atmospheric stability remains two serious hurdles for any climate model.

Understanding the oceans too is essential to understanding the causes of climate change because they interact dynamically with the atmosphere and pose problems that simplistic modeling of ocean mass flows and wind-assisted circulation cannot address (Ghil et al. 2008; Wunsch 2002, 2010). Specifically, Wunsch (2002, 242-243) said:

> "The history of oceanography is littered with appealing, simplifying ideas, that had ultimately, to be painfully dislodged. The problem is further compounded by the fact that models have become so sophisticated and interesting, it is tempting to assume they must be skillful. This is a very dangerous belief! … It is not uncommon to see published calculations of future climate states obtained using ocean models with a spatial resolution as coarse as 4° [in longitude and latitude]. Although the writers of such papers would undoubtedly deny that they are producing "forecasts", the reader is usually given little or no guidance as to the actual expected skill of such models. Is it plausible that a 4° or even 1° ocean

model can be integrated with skill for 1000 years? If there is real skill, then the modeling community has solved one of the most difficult of all problems in turbulence: that of a rotating, stratified fluid in a complex geometry. What is the evidence for its truth?"

The poor fit of current climate models results to the historical and recent air temperature records (e.g., Soon et al. 2003; Koutsoyiannis et al. 2008; Akasofu 2010, Anagnostopoulos et al. 2010) shows that while they may be of heuristic value (e.g., Soon et al. 2001), they simply cannot predict future climates (Green et al. 2009). For example, climate models cannot model historical climate fluctuations where atmospheric carbon dioxide lags air temperature because model prognostications of regional surface temperatures, or even of global mean surface air temperature, are inherently dependent on carbon dioxide levels under the current paradigm of climate forcings and feedbacks. Pielke et al. (2009) raise important criticisms of models' treatment of atmospheric carbon dioxide as if it were the only (or at least the dominant) climate forcing. An objective analysis must consider not only all other anthropogenic climate forcings but also naturally-caused climate changes as well as the limits to predictability of the climate system (Essex et al. 2007; Ghil et al. 2008; Koutsoyiannis 2010).

Notwithstanding the dominance of uncertainty in climate change science, Bedford and Cook (2013) argue for a strong scientific consensus on climate change. While they, and Bedford (2010), do admit there is ample room for disagreement, they assert that the "basic science of human-induced climate change" (p. 2021) – that since carbon dioxide is a greenhouse gas and its atmospheric concentration has been increasing since 1958 concomitant with a rise in global average air temperature, there must be a causal link – defines a scientific consensus. Despite their basic assertion, global air temperatures have not been rising at all since the dawn of this

Millennium (since January 2001) and, in fact, for several years before that (Figure 1). This raises the question of what natural or anthropogenic influences have offset any global warming since 2001 caused by carbon dioxide. Many suggestions have been posited, but the absence of global warming for more than 16 years indicates that influences with a signal at least as strong as the impact of increasing concentrations of atmospheric carbon dioxide have also affected the global air temperature record. This is why uncertainty still remains and cannot be dismissed.

Whither Scientific Consensus?

The crux of the argument in Bedford and Cook (2013) for an overwhelming scientific consensus is that several surveys examining the peer-reviewed literature "demonstrate that [while] it is possible to find peer-reviewed publications that explicitly reject the scientific consensus on human-induced climate change, …such publications represent a vanishingly small minority of the scientific community's output on the subject" (p. 2021-2022). Several articles are cited (Oreskes 2004, Doran and Zimmerman 2009, Anderegg et al. 2010) but the article that the authors define as "the most thorough assessment of the peer-reviewed literature on human-induced climate change to date" (p. 2021) is Cook et al. (2013). Since Bedford and Cook (2013) assign considerable importance to this article, who lead author is also an author of Bedford and Cook (2013), a more thorough discussion of it is warranted.

As Legates et al. (2013) had argued, the philosophy of science allows no role for head-count statistics. Aristotle's *Sophistical Refutations*, (circa 350 B.C.), codified the argument from consensus, later labeled by the medieval schoolmen as the *argumentum ad populum* or head-count fallacy, as one of the dozen commonest logical fallacies in human discourse. Al-Haytham,

the 11th-century philosopher of science who is credited as the father of the scientific method, wrote that "the seeker after 'truth'" (i.e., the scientist) places no faith in mere consensus, however venerable. The English biologist Thomas Henry Huxley (1866) wrote "The improver of natural knowledge absolutely refuses to acknowledge authority, as such…For him, skepticism is the highest of duties, blind faith the one unpardonable sin."

Popper (1934) formalized the scientific method as an iterative algorithm by which scientists advance new tentative theories to address a general problem, which is modified to the extent that these new hypotheses survive error-elimination by other scientists. The most likely outcome, especially in the physical sciences, is that error elimination will fail either to demonstrate or to disprove the hypothesis, in which case it gains credibility not because a consensus supports it but because it has not (yet) been demonstrated to be false. By this process, which may continue *ad infinitum*, science iteratively converges upon the truth. In Popper's definition, consensus plays no role. Science is not a belief system.

A new scientific paradigm, however, seeks to replace the scientific method with *expert* assessments, particularly in highly important areas where uncertainty and a lack of knowledge exist but where immediate decisions are needed. *Post-normal science* (see Funtowicz and Ravetz 1993) seeks, therefore, to create an *extended peer community* that weighs in on the topic and generates a body of knowledge through consensus. Thus, the quest to produce a *scientific consensus* that agrees with a prescribed set of facts and coordinates a response strategy is essential in post-normal science, a radical departure from the classical scientific method. Thus, Bedford and Cook (2013) have tacitly replaced the scientific method with this new consensus-driven paradigm (see also Saloranta 2001).

The problem, of course, is that consensus-building is difficult. Scientists will agree to the basic facts that experiment and measurement have established (e.g., carbon dioxide absorbs energy in the thermal infrared portion of the electromagnetic spectrum, and more energy is transferred from the surface to the atmosphere through latent heat than long-wave radiation). However, many of the important areas are still in doubt (e.g., the overall effect of clouds and their feedbacks, and the climate sensitivity to radiatively-active gases). It is of immense importance, therefore, that the proper question be asked and its answer interpreted correctly. The question "Do you believe in global warming?" can be answered in numerous ways, since "global warming" is not properly defined. Does it refer to "anthropogenic global warming" or to a warming of the globe at some unspecified time-scale? Thus, scientists who disagree strongly on the anthropogenic contribution of climate change may answer 'Yes' to the imprecise question "Do you believe in global warming?".

It is essential that rigorously precise terms be used in defining the consensus, if a consensus truly exists. These terms must be quantitatively expressed and must be sufficiently rigorous to be testable. Yet Cook et al. (2013) do not restrict their questions to a single definition of the hypothesis to which their consensus is said to adhere. They deploy three definitions of consensus interchangeably:

The unquantified definition: "The consensus position that humans are causing global warming" (p. 1),

The standard definition: The "scientific consensus that human activity is very likely causing most of the current …anthropogenic global warming…" (p. 2), and

> *The catastrophist definition:* That our enhancement of the greenhouse effect will be dangerous enough to be 'catastrophic' (i.e., "explicit rejection" of the consensus view "provides little support for the catastrophic view of the greenhouse effect", p. 3).

Note that in *the unquantified definition*, it is asserted that humans cause global warming, whereas in *the standard definition*, the level of agreement is only "very likely." Moreover, *the catastrophist definition* extends the warming to *catastrophic* consequences not encompassed in *the unquantified or standard definitions*; *the catastrophist definition* is also implicit in the Introduction of Bedford and Cook (2013, p. 1):

> "An accurate perception of the degree of scientific consensus is an essential element to public support for climate policy (Ding *et al*. 2011). Communicating the scientific consensus also increases people's acceptance that climate change (CC) is happening (Lewandowsky et al. 2012)."

The catastrophist definition is implicit in this passage because it demands that people accept that 'climate change is happening', implying that a climate policy response resulting from catastrophic consequences of anthropogenic global warming will be essential.

None of these three definitions is precise enough to be Popper-falsifiable. Worse, the three definitions are mutually exclusive. Not only do Cook et al. (2013) adopt them interchangeably, so that it is not clear which definition their survey is really testing, but each definition is imprecise and insufficiently quantified to allow rigorous falsification[2]. Moreover,

[2] Note that Cook et al. (2013) have apparently missed the key conclusions from three independent studies. First, Knight et al. (2009) have suggested that "The simulations rule out (at the 95% level) zero trends for intervals of 15 years or more, suggesting that an observed absence of warming of this duration is needed to create a

none of these definitions specifies the period to which it applies, or how much global warming was observed over that period, or whether the warming is continuing, or at what rate, or whether that or any rate (and, if so, what rate) is considered dangerous.

The standard definition, though it is quantitative in that it holds that at least 50% of all global warming since 1950 is anthropogenic, assigns no quantitative value to 'very likely'. *The unquantified and catastrophist definitions* do not specify what fraction of warming is considered anthropogenic. A hypothesis to the effect that humans cause some warming, or even that most current global warming is very likely to be anthropogenic, is not – and does not necessarily imply – a hypothesis to the effect that current warming, if continued over some unspecified period, might prove sufficiently damaging to justify any climate policy to address climate change, still less any public support for it. The implication of the cited remark in the Introduction of Cook et al. (2013) is that the authors of all abstracts expressing an explicit or implicit endorsement of *the unquantified and standard definitions*, which do not encompass catastrophism, also endorse *the catastrophist definition*.

Cook et al. (2013) also cite other papers whose authors adopt multiple imprecise and ill-quantified definitions of consensus. For example, Doran and Zimmerman (2009) sent a two-minute online survey to 10,257 Earth scientists at universities and government research agencies. Of the 3,146 respondents (a 31% return rate), only 5% identified themselves as climate scientists and only a mere 79 (2.5%) listed 'climate science' as their area of expertise, having published

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discrepancy with expected present-day warming rate" (p. S76). Santer et al. (2011), in adopting a slightly different metric, offered the conclusion: "Our results show that temperature records of at least 17 years in length are required for identifying human effects on global-mean tropospheric temperature" (p. 1). Finally, Huang (2013) provided an even more definitive detection and diagnostic of the carbon dioxide-global warming hypothesis by suggesting that "the most detectable secular trend signals appear in the CO_2 band and the time it takes to see these radiance changes is much less than 12 years" (p. 1711).

more than half their recent peer-reviewed papers on climate change. Of these 79 respondents, 98% believed human activity was a significant contributing factor in changing mean global temperatures. Furthermore, respondents were not asked whether they believed the anthropogenic contribution to global warming was or might become sufficient to warrant concern or the adoption of a 'climate policy'. The survey demonstrates nothing more than that 77 of 79 respondents believed the anthropogenic effect is non-zero. Moreover, no distinction was drawn between different human impacts; most notably, anthropogenic greenhouse gases versus anthropogenic changes in land use and land cover (see Mahmood et al. 2010).

From publication and citation data, Anderegg et al. (2010) selected 908 of 1372 climate researchers, defined as scientists who had published at least twenty climate papers and had either signed petitions opposing or supporting the IPCC's positions or had co-authored IPCC reports. Of these, 97-98% endorsed the standard definition that "anthropogenic greenhouse gases have been responsible for 'most' of the 'unequivocal' warming of the Earth's average global temperature over the second half of the 20th century" (p. 12107). The standard definition of the consensus in Anderegg et al. (2010) is less imprecise than that of Cook et al. (2013). Yet, like Cook et al. (2013), Anderegg et al. (2010) did not seek to determine how many researchers considered this global warming to be actually or potentially damaging enough to require a climate policy.

Such surveys are often cited as demonstrating a near-unanimous scientific consensus in favor of a climate policy, when they never ask any question about whether and to what extent the anthropogenic component in recent warming might be dangerous or about whether a "climate policy" should be adopted in attempted mitigation of future warming. Nevertheless, Cook et al. (2013), after a subjective review of only the abstracts of 11,944 papers on climate change which

"matched the topics 'global climate change' or 'global warming'" (p. 1), conclude that 97.1% of those that expressed an opinion endorsed the hypothesis as defined in their introduction (i.e., *the standard definition*). However, 66.4% percent of the abstracts had expressed no position. Thus, 32.6% of the remaining 33.6% (i.e., 97.1%) to whom they had ascribed a position were apparently in agreement with *the standard definition*. However, inspection of the author's own data file showed that they had themselves categorized only 64 abstracts, just 0.5% of the sample, as endorsing *the standard definition*. Inspection shows only 41 of the 64 papers, or 0.3% of the sample of 11,944 papers, actually endorsed that definition.

It is not possible to discern either from the paper or from the supplementary information what percentage of all abstracts the authors considered to have endorsed *the standard definition.* However, a file of raw data was supplied some weeks after publication. From this file, the abstracts allocated by Cook et al. (2013) to each level of endorsement were counted. No attempt was made to verify whether the allocation of each abstract to one of the specified levels of endorsement was appropriate. The results are given in Table 1. Of the 11,944 abstracts, 3896 (32.6%) were marked as explicitly or implicitly endorsing at least *the unquantified definition* that humans cause some warming. It was only by arbitrarily excluding those 7930 abstracts that expressed no opinion (but retaining forty abstracts expressing uncertainty) that Cook et al. (2013) were able to conclude that 97.1% endorsed 'consensus'. However, the authors' data file shows that they had marked only 64 abstracts (0.5% of the entire sample) as endorsing *the standard definition* of consensus. Inspection shows that 23 of these 64 do not, in fact, endorse that definition. Only 41 papers (0.3% of the sample) do so.

The conclusion of Cook et al. (2013, p. 1) as expressed in their Abstract, is "Among [4014] abstracts expressing a position on AGW [Anthropogenic Global Warming], 97.1%

endorsed the consensus position that humans are causing global warming." A 97% consensus is also asserted in the closing words of the paper: "Among [4014] papers expressing a position on AGW, an overwhelming percentage (97.2% based on self-ratings, 97.1% based on abstract ratings) endorses the scientific consensus on AGW" (p. 6). In the introduction to Cook et al. (2013), anthropogenic global warming is defined as the [standard] "scientific consensus that human activity is very likely causing most of the current GW (anthropogenic global warming, or AGW)" (p. 1). However, the authors' own analysis shows that only 0.5% of all 11,944 abstracts, and 1.6% of the 4014 abstracts expressing a position, endorsed anthropogenic global warming as they had defined it. But by taking into account that more than one-third of the 64 abstracts do not, in fact, endorse the quantitative hypothesis in Cook et al. (2013), the true percentages endorsing that hypothesis are 0.3% and 1.0%, respectively. Accordingly, their stated conclusion is incorrect.

Defects identified in the surveys of climate consensus by Cook et al. (2013) and by the authors of some of the papers they cite follow a recognizable and questionable pattern. Often a simple and limited question is posed (e.g., "Do you believe in global warming?") but it is assumed, on no evidence, that anyone who endorses *the unquantified definition* of consensus also endorses *the catastrophist* (or at least *the standard*) *definition.* In such surveys, whether deliberately or y inadvertence, it is not made clear which hypothesis is under test. Any head-count survey that is unclear about which definition is under test is scientifically valueless. *A fortiori,* a supposed consensus that exhibits multiple definitions of the consensus hypothesis and fails to state clearly the identity and definition of the hypothesis on the basis of which the survey was actually conducted must be rejected.

Furthermore, consensus hypotheses must be expressed quantitatively. Bias is sure to affect the results when qualitative definitions of a scientific hypothesis give the appearance of being more political than scientific. Most papers that attempt to define a climate change consensus are inherently political by nature.

The conclusion is that the quest for defining a climate change consensus is fraught with bias which is not often apparent. The non-disclosure in Cook et al. (2013) of the number of abstracts supporting each specified level of endorsement had the effect of not making available the fact that only 41 papers – 0.3% of all 11,944 abstracts or 1.0% of the 4014 expressing an opinion, and not 97.1% – had been found to endorse the standard or quantitative hypothesis, stated in the introduction to Cook et al. (2013) and akin to similar definitions in the literature), that "human activity is very likely causing most of the current GW (anthropogenic global warming, or AGW)" (p. 2).

Further demonstrating the flaws in Cook et al.'s (2013) assessment of a climate change consensus are the endorsement levels they incorrectly assigned to some of the learned papers whose abstracts they reviewed. Consider as an example the articles cited by two of the authors of this paper – DR Legates and W Soon. The inventory of abstracts surveyed by Cook et al. (2013) cited only three papers by DR Legates and only two by W Soon. Yet these two authors have written many more papers in the more than 20 years (January 1991 to May 2012) covered by Cook et al. (2013). All five selected papers, save one, are labeled as 'taking no position' or 'being uncertain.' Liu et al. (2009) is categorized as giving 'explicit endorsement to the anthropogenic global warming position without quantification' even though the paper suggests a Medieval Warm Period and a Little Ice Age exist and that variability in solar radiation due to solar forcing was evident even in the Industrial Age. Armstrong et al. (2008), of which W Soon

was a co-author, was listed by Cook et al. (2013) as 'being uncertain'. Armstrong et al. (2008) discuss articles on polar bear populations by Amstrup et al. (2007) and Hunter et al. (2007), both of whom link increases in greenhouse gases to decreases in polar bear populations. Far from being uncertain, however, Armstrong et al. (2008, p. 390) conclude, "However, the inconsistent long-term trends in the polar bear population suggest that it is best to assume no trend in the long-term", thereby undermining the anthropogenic climate change impact of diminished sea ice on polar bear populations suggested by Amstrup et al. (2007) and Hunter et al. (2007).

The restriction to the key words 'global warming' or 'global climate change' arbitrarily eliminates many relevant papers. Oreskes (2004) used only the search phrase 'global climate change'. DR Legates and W Soon have written numerous papers on the topic of climate change and its possible anthropogenic origins but these were not considered, apparently because the arbitrarily-chosen search phrases did not appear in those papers. A bias, therefore, arises in that those studies which demonstrate a natural cause for climate variability are far less likely to use the search phrases adopted by Oreskes (2004) and Cook et al. (2013). Accordingly, surveys that arbitrarily select some non-randomized subset of the available papers on climate change have little evidential value.

A better approach to determining an appropriate methodology to identify and quantify a consensus can be found in the work of Lefsrud and Meyer (2012). They argue that building a consensus "fundamentally depends upon expertise, ensconced in professional opinion" (p. 1478). Even here, a Classical purist might legitimately argue that appealing to the authority of experts, however well qualified, is the Aristotelian logical fallacy later labeled by the medieval schoolmen as the *argumentum ad verecundiam* – the argument from reputation. Experts can be unanimously wrong, as the case of the 100 German authors who opposed Einstein's theory of

relativity in the years leading to World War II. They were wrong because the regime demanded them to make scientific objectivity subservient to the racial politics of the regime.

Mutatis mutandis, another prejudice (though without the racial bias) appears to have exercised undue influence upon significant segments of the academic and scientific communities today. As a first step towards identifying any such prejudice, Lefsrud and Mayer, rather than asking open-ended questions to which the answers can be interpreted in a myriad of ways, deploy *frames* to identify not only the world views but also social identities of expert survey participants. The authors (p. 1484) define these frames as containing a problem demanding attention, a prognosis for a particular solution, and a rationale for action. Diagnosis, prognosis, or rationale may overlap, yielding frames with some similar and some diverse characteristics. On the question of climate consensus, they surveyed opinion among the Association of Professional Engineers and Geoscientists of Alberta, Canada, and concluded that five frames exist (with the extent of anthropogenic contribution in parentheses): (1) "Comply with Kyoto" (human impact, not normal), (2) "Regulation-Activists" (natural and human-caused, problem is complex), (3) "Fatalists" (natural with little human impact, problem is complex), (4) "Economic Responsibility" (natural and human-caused, no significant impact), and (5) "Nature is Overwhelming" (natural with little human impact). A sixth group did not provide enough information to be categorized. Only the "Comply with Kyoto" group felt that the debate was settled.

The results are surprising. While 99.4% of all experts felt that the climate is changing, only 36.3% felt the debate was settled ("Comply with Kyoto" group) while 41.4% felt that human impacts were small or insignificant (the "Fatalist" and "Nature is Overwhelming" groups). These results, though specific to the engineers and geoscientists of Alberta, indicate

that when questions are appropriately directed toward grouping individuals into specific categories based on their true beliefs, a different picture of the consensus can emerge.

Public Perception and the Contrived Consensus

It has been demonstrated that the attempt by Bedford and Cook (2013) to apply agnotology to climate science is based on an imagined-scientific consensus. Yet the authors lament that the public does not buy into the consensus story they have contrived. They blame "a deliberate effort to foster this [skeptical] view among the public" (pp. 2023-2024). In pursuit of the argument for a well-funded and well-organized disinformation campaign by 'climate deniers', they cite articles from the New York Times and from activist groups (e.g., Informed Citizens for the Environment) to support their claims.

However, the balance of opinion in the mainstream news media has tended to endorse the catastrophist position, and the funding by governments and environmental groups for that position is very likely to outweigh greatly the funding for skeptical groups. The United States Government alone had spent almost US$80 billion on climate-related policies in the twenty years from 1989 to 2008; carbon trading worldwide reached US$180 billion in 2011, though it is now declining; yet Exxon Mobil was criticized for having spent a total of US$23 million on skeptical groups. Through public pressure brought about by environmental groups, it now spends nothing on them.

The real reason why the public do not endorse catastrophism is that they are not convinced that every extreme event is linked, somehow, to anthropogenic climate change – a link

that even serious scientific journals have attempted, on no evidence, to make. For instance, the Editor-in-Chief of the journal *Science* made a similar accusation in a 2005 editorial:

> "As Katrina and two other hurricanes crossed the warm Gulf of Mexico, we watched them gain dramatically in strength. Papers by Kerry Emanuel in *Nature* and by Peter Webster in [*Science*] during the past year have shown that the average intensity of hurricanes has increased during the past 30 years as the oceans have gained heat from global warming…We know with confidence what has made the Gulf and other oceans warmer than they had been before: the emission of carbon dioxide and other greenhouse gases from human industrial activity, to which the United States has been a major contributor. That's a worldwide event, affecting all oceans…Not only is the New Orleans damage not an act of God; it shouldn't even be called a 'natural' disaster. These terms are excuses we use to let ourselves off the hook." (Kennedy 2005; p. 303)

Yet tropical cyclone activity as measured by the Accumulated Cyclone Energy index[3] (Maue 2009; 2011) is at a 35-year low and in three recent years (2006, 2009, and 2010), there were no hurricane landfalls in the United States[4]. In 2006, ten prominent hurricane scientists, including Emanuel and Webster, issued a statement[5] which said, in part, "The possibility that greenhouse gas induced global warming may have already caused a substantial increase in some tropical cyclone indices has been raised, but no consensus has been reached on this issue." And on the existence of trends in storm intensity, the scientists' statement indicates, "This is still a hotly

[3] See http://policlimate.com/tropical/
[4] Only five such years exist since 1950 – 2000, 2001, 2006, 2009, and 2010.
[5] http://wind.mit.edu/~emanuel/Hurricane_threat.htm

debated area for which we can provide no definitive conclusion." Seven years have passed since then, but there is still no definitive conclusion.

Bedford and Cook (2013, p. 2024) assert that

> "The rhetorical techniques employed by some works of misinformation extend to misquoting and gross distortions of source material, and such works have the appearance of attempting to persuade readers, viewers or listeners by fair means or foul. Thus, an awareness that some works are written with a view not to providing accurate reportage but to skewing public perception through misrepresentation becomes important background information."

Their tacit suggestion is that virtually everything that disagrees with their contrived consensus view is a misinformation campaign. The possibility that the opposite may be the case has not received their consideration (except possibly for the movie *The Day After Tomorrow*). Yet the authors concede they are in limited agreement with us when we wrote, "To the extent that such assertions [of misrepresentation] are true, they apply in spades to the presentations and writings of many scientists who support the IPCC's alarmist view of the situation" (Legates et al. 2013, p. 2010-2011).

Consider arguably the most-seen film on climate change, the movie that has done the most to proselytize for extreme anthropogenic climate change – *An Inconvenient Truth*. Al Gore won the Nobel Peace Prize (along with the IPCC) for this film. It is still shown to school children in science classes, social studies classes, and classes in the humanities even today. The film was, and continues to be, heralded by environmental activists and scientists alike for its apocalyptic view of a future climate thrown out of balance owing to increasing anthropogenic

carbon dioxide concentrations. A High Court judge in the United Kingdom[6] ruled that the movie contained nine key scientific errors and could only be distributed to schools in England if it were accompanied by 77 pages of corrective guidance notes to prevent 'political indoctrination'. Despite these factual errors and numerous other mistakes (see Legates 2007), scientists who applauded the film argued that the mistakes "were relatively small and did not detract from the film's central message." The judge disagreed and concluded, particularly in connection with Gore's claim that sea level would imminently rise by 20 feet, that the "Armageddon scenario that he [Gore] depicts is not based on any scientific view."

Or consider the book for children and used in schools to teach about global warming – *The Down-to-Earth Guide to Global Warming* (David and Gordon 2007). On page 18, the book declares "The more carbon dioxide in the atmosphere, the higher the temperature climbed. The less carbon dioxide in the atmosphere, the lower the temperature fell." Students are encouraged to raise a flap labeled, "Lift to see how well CO_2 and temperature go together." The chart shows a remarkable relationship where temperature follows carbon dioxide, except that the curves are mislabeled. The curve labeled "Climate Temperature" is really "CO_2 Concentration in the Atmosphere" and vice versa. In fact, the curve was taken from Fischer et al. (1999, p. 1712) who wrote, "high-resolution records from Antarctic ice cores show that carbon dioxide concentrations increased by 80 to 100 parts per million by volume 600 ± 400 years *after* the warming of the last three deglaciations" (emphasis added). But when confronted with this error and the fallacy that it spread – namely, that historically air temperature has been largely driven by carbon dioxide concentrations – Michael Oppenheimer noted

[6] See http://www.telegraph.co.uk/earth/earthnews/3310137/Al-Gores-nine-Inconvenient-Untruths.html and http://www.guardian.co.uk/environment/2007/oct/11/climatechange

> "I have reviewed the figure on page 18 of The Down-to-Earth Guide to Global Warming. It appears that the labeling of the axes has been reversed. As a result, the curve labeled 'carbon dioxide concentration' should be labeled 'climate temperature', and vice versa. However, the description of the figure in the accompanying text is accurate, and it fairly represents the current state of scientific knowledge, in terms that would be comprehensible to children 8 years of age or older."

So misinformation is allowed to spread simply because it agrees with the contrived consensus story.

These are but two examples of places where misinformation worthy of study by agnotologists exists in the classroom and there is little effort to set the record straight. Numerous other examples of extreme claims made by proponents of extreme anthropogenic global warming exist. This is one of the fundamental problems with agnotology in climate change as defined by Bedford (2010) and Bedford and Cook (2013) – that misinformation is always couched as a disagreement with the consensus view that the authors and others like them have contrived. But agnotology, though invented and near-exclusively deployed by a single narrow academic faction, is a two-edged sword. Misinformation has no place in our classroom, regardless of whether the misinformation is peddled by that narrow faction or by its opponents. Rather than spend valuable class time demonizing the opposition, academics would spend their own and their students' time more usefully on making sure that students are presented with factual material that is science-based, eradicating all advocacy science, particularly from the fabricators of the non-existent consensus.

For example, Lenzer (2013), discussing the idea of a contrived consensus in the medical profession, showed that a very high percentage of clinical policy committee chairs and co-chairs had financial conflicts. Unfortunately, such is the case with climate change. Climate change research translates into big money. Researchers buy into the climate change bandwagon and get large grants because it represents a way to appease the administration (with overhead rates sometimes exceeding 100%!). Those who comply garner an easier path to promotion and tenure. There is a strong impetus to fall in line with the contrived consensus to keep promotion, tenure, and the money lines flowing. Even professional societies feel the need to publish statements on climate change, often without consulting the membership, so as to keep the money flowing to their constituents. As Lenzer (2013, p. 3) concludes, "despite concerns about bias…'we like to stick within the standard of care, because when the shit hits the fan we all want to be able to say we were just doing what everyone else is doing – even if what everyone else is doing isn't very good'." Indeed, one of us (Legates) attended a meeting at the University of Oklahoma in 1990 where John Dutton of Penn State lamented that solid Earth geophysics and extragalactic astrophysics garnered the lion's share of the research money while atmospheric science was woefully underfunded. The then-new concern over anthropogenic climate change looked to change that dynamic. Dutton concluded to the effect that "We had better not kill the goose that will lay the golden egg."

Agnotology: Teaching Tool or Instrument of Indoctrination?

What is lost on both Bedford (2010) and Bedford and Cook (2013) is that the use of agnotology as a teaching tool is based on the definition of 'misinformation'. They cite non-political and non-controversial areas in physics and psychology classes where preconceived notions and simple misinformation (e.g., 'old wives tales') can be can be used to make a specific point. One of us (Legates) has used that concept in seventh-grade hydrology lessons to teach that the intuitive idea that 'water flows downhill' is false. Gravity is indeed a strong force, but it is the gradient force (from Fick's First Law of Diffusion) that drives hydrologic flow. Does the water that transpires from plant leaves come from canopy interception? No, it comes from plant roots. But that requires water to flow uphill or upwards in the tree, doesn't it? And through osmotic pressure, indeed it does. See also the discussion of "carbon dioxide causes the Earth to warm like a greenhouse" and "carbon dioxide causes the Earth to warm like a blanket covering your bed" arguments from Legates et al. (2013) for examples where agnotology would be useful to dispel myths that are central to the anthropogenic global warming argument.

The problem arises when the use of agnotology is extended into politically-contentious areas. Whoever defines the consensus also defines what is 'misinformation'. That is why Bedford and Cook (2013) focus extensively on the importance of establishing the scientific consensus. Yet if strong disagreement exists, then it behooves us to present all sides of the issue. But Bedford and Cook (2013) argue for their contrived consensus, where viewpoints which substantially diverge from this view become *misinformation*.

Totalitarian regimes spread misinformation while demonizing their opposition. How is it different here? *Haud secus isti*. If it is as Michael Oppenheimer argued earlier – though the

figure is wrong, the discussion is useful because it agrees with the consensus – then misinformation is being used as *information* to support the consensus. In that instance, agnotology takes on an added connotation – it includes the study of how misinformation is spread as information by those espousing a contrived consensus to support one's cause. With politically-charged issues, those who spread misinformation are usually defined as those who disagree with the advocate. Thus, where there is not an appropriately defined 'consensus' view in politically-charged areas, let us be frank: we are all advocates of a given position. Thus, as Legates et al. (2013, p. 2011) posited as their main point, the use of agnotology in politically-charged contexts such as climate change "can be used to stifle debate and to require acceptance of a single scientific viewpoint."

Bedford (2010) and Bedford and Cook (2013) suggest the explicit use of non-peer reviewed sources – newspaper articles and books such as Michael Crichton's *State of Fear* – to show examples of misinformation on climate change. The problem with this approach is that many who write on climate change in the popular media have no scientific background or training. This includes the many authors who support varieties of catastrophism. The implication is that if one pundit makes a clearly erroneous statement, the pundit speaks for the group; and demonstration that this person spouts misinformation is tantamount to demonstrating that all people who disagree with the position we espouse are equally biased. The easy solution is to bisect the group into a polarized dichotomy of the 'environmentally conscious' and the 'climate change deniers' and thus debunking several of the extreme statements will suffice to undermine all of the opposition arguments. This, unfortunately, teaches our students to polarize all arguments and look on with disdain at the views spoken by those with whom we disagree. As Legates et al. (2013) wrote, this is *not* what our classrooms should become.

One wonders if Bedford and Cook would welcome discussions about agnotology leveled against those who follow the consensus. For example, the United Nations Environment Programme issued a statement in 2005[7] proclaiming 'fifty million climate refugees by 2010'. Those numbers, of course, never materialized. But in 2011, the UN was back[8] with another forecast: '60 million environmental refugees by 2020'. Examples like this are legion, largely because the popular press is overrun by articles which agree with the contrived consensus. Advocacy groups on all sides live in the non-peer reviewed world where scientific rules do not necessarily apply. Thus, advocacy materials must be introduced into the classroom only with extreme caution. Legates et al. (2013) cautioned about the use of newspaper accounts as sources of both information and misinformation in the classroom.

That is not to say that peer review guarantees factual presentations; far from it. While it is assumed that reviewers will be impartial, bias and other tendencies (both positive and negative) undermine the process, especially when hotly-debated subjects like climate change are considered. Hollander (2013) laments that the biggest threat to peer review lies in the prevailing orthodoxies (i.e., imagined consensus) that determine what gets published: "Deviating from the prevailing, apparent consensus or orthodoxies could be a major roadblock to publishing" (p. 149). Although Hollander argues that such biases have more influence in social sciences and humanities than on the physical sciences, the climate change issue has shown that such biases can impinge upon even scientific debate. Establishment of a consensus, no matter how badly contrived, is essential in defining misinformation which deviates from it. Editors, then, are predisposed, and even pressured, to select reviewers that will perpetuate the consensus. Even the

[7] From Norman Myers, "Environmental refugees. An emergent security issue". 13 Economic Forum, Prague, OSCE, May 2005; Millennium Ecosystem Assessment, 2005.
[8] http://phys.org/news/2011-02-million-environmental-refugees-experts.html

reviewers themselves "are likely to have internalized the prevalent, conventional, politically correct wisdom, and will be reluctant to approve of writings that appear to deviate from it" (Hollander 2013, p. 149).

Furthermore, the peer review process is manipulated when aided by complicit editors who can change the tenor of a given publication and can arbitrarily decide what viewpoints are published and which are not. Often, editors know which reviewers are likely to provide a positive review and which are likely to reject a submission. As Weissberg (2013, p. 158, emphasis in original) notes,

> "An editor can *honestly* therefore kill a piece that he dislikes for whatever reason, including ideological aversion, simply by forwarding it to an excessively demanding reviewer. A death sentence can also be given by facilitating an ideological mismatch: sending a submission that reaches a *conservative* conclusion to a referee famous for strident liberalism."

Though anonymity of referees should lead to a frank appraisal, often it invites irresponsibility (Weissberg 2013). Anonymity often allows reviewers to be make unsubstantiated claims or even to be openly hostile; the cloak of secrecy will prevent discovery or retaliation.

The 'Climategate' scandal uncovered many places where reviewers and editors conspired to stifle academic debate. For example, Thomas Wigley of the National Center for Atmospheric Research wrote to several friends,

> "Let me give you an example. There was a paper a few years ago by Legates and Davis in GRL [Legates and Davis 1997] that was nothing more than a direct and pointed criticism of some work by Santer and me – yet neither of us was asked to

review the paper. We complained, and GRL admitted it was poor judgment on the part of the editor. Eventually, (> 2 years later) we wrote a response."

Yet scientists do not possess the automatic right to review all papers that cite their work critically. If we were asked to review Bedford and Cook (2013) before publication, we might have written, "Do not publish." But would that have been because we truly believed their article did not merit publication or because we simply wished to stifle debate? Clearly, there must be an impartial third party to act as a reviewer. Incidentally, it has been argued that competent student reviewers would be more open and less biased than established scientists (Mendenhall 2013). This is an intriguing idea. But it appears that Legates and Davis's rebuttal to Wigley and Santer's response to our paper was rejected by the editor of *Geophysical Research Letters* because of an arrangement with the Tom Wigley and not on the merits of what we wrote. Real science invites debate and discussion; pseudo-science attempts to silence dissent.

Conclusion: The Lack of a Scientific Consensus and Its Impact on Agnotology

Legates et al. (2013), far from being an "aggressive critique" of Bedford (2010), focused not on that paper *per se* but on the issue of using misinformation (e.g., agnotology) to further the so-called *consensus* view of climate change. We thank the two authors for their discussion, which serves to show areas where we both agree and, in particular, to highlight areas where we strongly disagree.

The position taken by Bedford and Cook (2013) is not new. The authors argue that an "overwhelming consensus" exists among scientists but is not perceived by the public owing to "a

campaign of obfuscation" by the fossil fuel industry and its allies. Agnotology, the authors write, can be used in the classroom to identify this alleged campaign of misinformation and to teach students how to detect and learn from this misinformation (p. 2020). It has been demonstrated that the so-called consensus view is a fabrication, contrived by asking ill-defined questions, deploying multiple definitions of the consensus hypothesis interchangeably, or perusing abstracts identified by selective search terms and not necessarily interpreted with a clear and impartial eye. It is no less legitimate to argue that the environmental lobby and its many friends in academe have circulated misinformation, including misinformation about the existence and extent of a supposed scientific "consensus", as it is to argue – as Bedford and Cook argue – that the fossil fuel lobby has circulated misinformation calculated to minimize the anthropogenic influence on the evolution of the climate object. It is very likely that governments, the environmental lobby, academe and the news media have spent far more on information (and perhaps on misinformation) than the fossil fuel lobby.

Those who are financially dependent upon acquiescence in whatever governments may require have found it expedient, in the absence of definitive or even of adequate scientific data and results, to manufacture a *scientific consensus*, at all costs, so that the "misinformation" that is the focus of agnotological studies can be improperly defined as that which deviates from this consensus. Bedford and Cook (2013) make the need for the consensus very clear: for, without it, it is difficult – and perhaps impossible – to argue convincingly that those who question the magnitude and cost of the anthropogenic influences on the climate are guilty of purveying misinformation. In fact, however, there is a decided lack of consensus among scientists, and especially among those who are trained in climate science or have studied it extensively. The 97.1% consensus claimed by Cook et al. (2013) turns out upon inspection to be not 97.1% but

0.3%. Their claim of 97.1% consensus, therefore, is arguably one of the greatest items of misinformation that has been circulated on either side of the climate debate.

Whilst agnotology can be useful in many situations where 'old wives tales,' myths, and other incorrect ideas exist, the value of using agnotology in politically-charged discussions such as climate change is questionable. Since the definition of *misinformation* lies in the eye of the advocate of a particular viewpoint, there is a danger that agnotology may serve not to enhance discussion or learning but rather to stifle debate and silence critics. Thus, the conclusion of Legates et al. (2013, p. 2007) that demonizing any position that is at odds with a not necessarily soundly-derived conclusion in politically-charged discussions has no place in education (see also Weiss 2012) remains valid.

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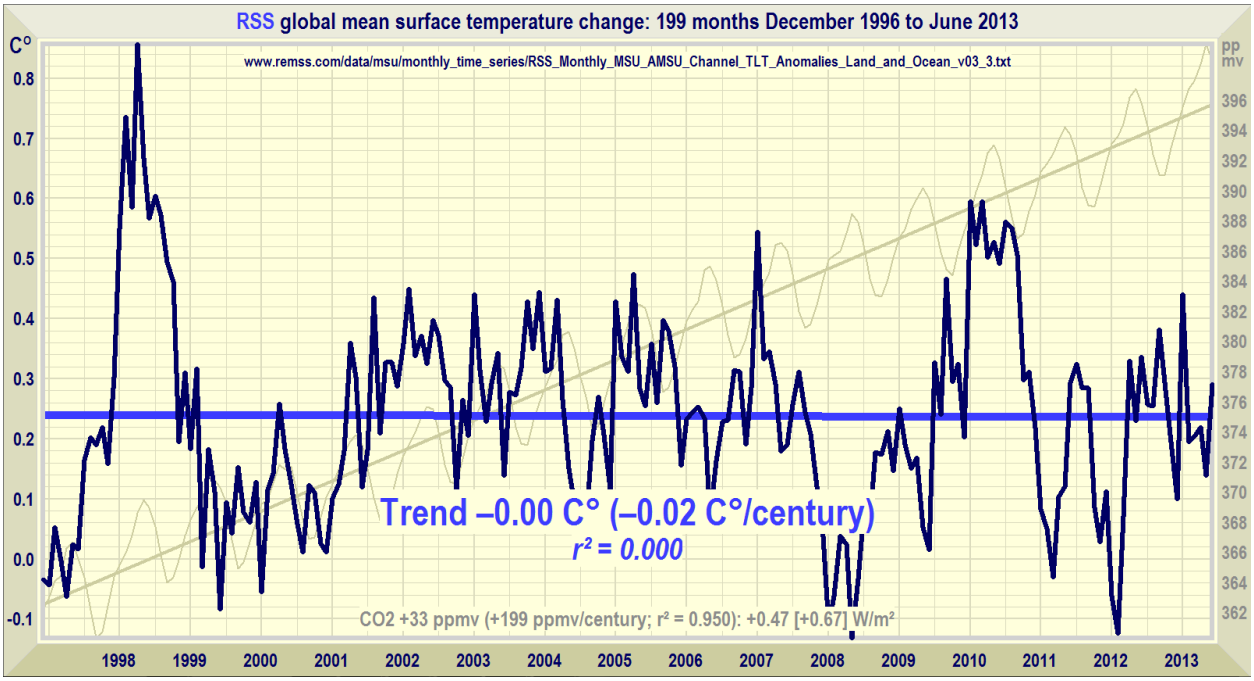

Figure 1: Monthly global mean surface air temperature anomalies, December 1996 to June 2013 (Remote Sensing Systems, Inc.), showing no trend over 16 years and 7 months (199 months), notwithstanding a rising trend in carbon dioxide concentrations at a rate equivalent to 199 μatm century^{-1} (NOAA 2013), implying a radiative forcing of 0.47 W m^{-2} from carbon dioxide alone or 0.67 W m^{-2} when the additional forcing from all other anthropogenic influences are taken into account.

Endorsement level		Abstracts	% of all abstracts	% of all abstracts expressing an opinion
1	Explicit, quantified endorsement (standard definition of consensus)	64	0.54%	1.59%
	Actually endorsing the standard definition upon inspection	**41**	**0.34%**	**1.02%**
2	Explicit, unquantified endorsement	922	7.72%	22.97%
3	Implicit endorsement	2910	24.36%	72.50%
4a	No position	7930	66.39%	
4b	Expression of uncertainty	40	0.33%	1.00%
5	Implicit rejection	54	0.45%	1.35%
6	Explicit, unquantified rejection	15	0.13%	0.37%
7	Explicit, quantified rejection	9	0.08%	0.22%
	TOTAL	**11,944**	**100%**	**100%**

Table 1: Data showing the breakdown of the abstracts reviewed by Cook et al. (2013) by level of endorsement of the climate consensus.