

Witness : Robert M Carter
For : Claimant
Number : 2
Dated : 22 August 2007

IN THE HIGH COURT OF JUSTICE

Claim CO/3615/2007

QUEEN'S BENCH DIVISION

ADMINISTRATIVE COURT

B E T W E E N :

STUART ANDREW DIMMOCK

Claimant

- and -

**THE SECRETARY OF STATE FOR
EDUCATION AND SKILLS**

Defendant

**SECOND WITNESS STATEMENT OF
PROFESSOR ROBERT MERLIN CARTER**

I, Robert Merlin Carter of James Cook University, Townsville, Queensland 4811, Australia, will further say as follows:

Introduction

1. In my first witness statement, I said in my conclusion that I had undertaken preliminary consideration of a non-exhaustive list of some 20 separate departures in

the film *An Inconvenient Truth* (“AIT”) from the scientific consensus, each of which errs in the alarmist direction. I have now completed this exercise and I set out these errors below.

2. I have been provided with the Defendant’s Revised Summary Grounds bundle comprising the Revised Summary Grounds document and the witness statements of Ms Julie Bramman; Dr Peter Stott from the Hadley Centre; and the brief statement of Professor John Francis Brake Mitchell, together with their extensive exhibits.
3. In his evidence, Dr Stott comments that I am not an atmospheric scientist. The statement is correct, but the implication that only atmospheric scientists are qualified to hold an expert opinion on climate change is nonsensical. There are many sub-disciplines of research relevant to climate change, including meteorology, climatology, atmospheric chemistry and physics, geology, palaeoceanography, quaternary science, mathematics-statistics and modelling. My own expertise lies within the areas of geology-palaeoceanography-quaternary science and is just as relevant to making considered judgements on climate change as is Dr. Stott’s own expertise.
4. Dr Stott comments further that my views on climate change are those of a sceptic who lies “*well outside the scientific mainstream*”. Of course, as a scientist I am indeed a trained sceptic, as I hope is Dr Stott. Whether my views lie outside the mainstream is both difficult to judge and irrelevant to the present case. As I have said in my first witness statement (paragraph 21), the IPCC claims to represent the consensus of the leading scientists in climate and related fields throughout the world and Dr Stott, at paragraph 8 of his witness statement says that “*the task of identifying the consensus view among scientists is easier in the field of climate change than in some other field of scientific enquiry because of the existence of ...the IPCC.*” It is important to point out that the IPCC is itself an arm of the UN and therefore part of a political organization. Its panel members are selected by politicians and it has an agenda of its own. Several polls of professional opinion indicate that widespread

scientific scepticism exists with the IPCC orthodoxy. As I have said in my first witness statement, the published science that the IPCC draws upon to make its recommendations is mostly authoritative and widely accepted but, at the same time, many distinguished and well qualified scientists, including myself, disagree with some of its findings.

5. Nevertheless, and regardless of whether the IPCC can be said to represent any kind of “master” scientific consensus, it is important to note that the errors in the film that I discuss below are not significantly controversial and nor do they lie “outside the scientific mainstream.” As I seek to illustrate, major parts of the film AIT are at odds with many of the findings of the IPCC, as they are also with the considered views of many independent expert scientists.
6. The AIT film and its accompanying book have provoked a worldwide reaction of bipolar nature. Those persons and organizations already committed to the alarmist view of climate change welcomed the film and its message. Other, more independent, scientists and commentators derided the film as an inaccurate polemic. As is often the case, the reality lies between these two extremes, though in my view towards the polemic end of the argument.
7. Nowhere does Mr. Gore tell his audience or readers that all of the phenomena described in AIT fall within the natural range of previous environmental change on our planet. Nor does he present any evidence that climate during the 20th century departed discernibly from its historical pattern of constant change. This is not surprising, for no such evidence has been identified. Nor – remarkably, in view of its importance to his overall thesis - does Mr. Gore mention that global average temperature shows no greenhouse warming at the earth’s surface since at least 1998, and none in the lower atmosphere since 1979. Because of such egregious selectivity, AIT presents as propaganda for a global warming cause rather than as a balanced and well-made documentary about climate science reality.

8. In essence, Mr. Gore's film exhibits three major flaws:
 - i. It provides no tests of the greenhouse hypothesis, but instead adopts a reverse null hypothesis that change is human-caused unless and until it can be demonstrated otherwise.
 - ii. It comprises a catalogue of circumstantial and anecdotal evidence that is remorselessly cherry-picked to exemplify worst-case warming scenarios; at the same time, Mr. Gore neglects altogether the undoubtedly real risks of future climatic cooling.
 - iii. It selectively omits discussion of aspects of the climate system that do not reinforce the villainization of human-produced greenhouse gases; for example both the major source of climate energy and variation (solar) and the major atmospheric greenhouse gas (water vapour) are ignored.
9. In my opinion, these flaws make AIT particularly unsuited for use in school science teaching. First, because the film presents in itself a biased account of climate change science. Second, and perhaps even more importantly, because the film epitomizes bad scientific practice. Science is about the dispassionate collection of facts, and the conduct of experiments, towards the end of hypothesis testing, not about deploying partial facts and circumstantial evidence towards a predetermined conclusion.
10. These are sweeping criticisms, and to develop them in full would require a book-length rebuttal of Mr. Gore's thesis. A fuller critique of the film is given by Lewis (2007), and more detailed discussions of the many misconceptions that it perpetrates are covered by Khandekar *et al.* (2005), Carter *et al.* (2006, 2007), Lomborg (2007) and Carter (2007). In the space available here, I provide for the Court a list of 20 selected major errors and imbalances in AIT, accompanied by brief explanatory comments for each.

11. The inaccuracies and errors that I list have been widely commented on, and I believe that they would be generally agreed amongst disinterested scientists. I would be surprised if they were not accepted as such by Dr Stott.

12. In each case, I have taken a quote from AIT and then attempted to summarise how it differs from established scientific opinion. Where the IPCC have specifically addressed an issue raised in the film, I have quoted their findings. As I have said above, I do this notwithstanding the fact that many other scientists besides me do not agree with individual findings of the IPCC, and also that many independent scientists would challenge whether the IPCC can be meaningfully said to represent a unique or “master” consensus of scientific opinion on climate change. I have adopted the IPCC “consensus” view where I can identify it for the purposes of this review in order to contrast how at odds AIT is with even that organization. Because the IPCC is silent in relation to some specific examples of the effects of AGW given in the film, I have in these instances assessed the AIT assertions against the latest authoritative peer-reviewed literature.

Error 1: The Earth’s temperature is increasing dangerously

13. *“...These are actual measurements of atmospheric temperature since our civil war. In any given year it might look like it’s going down, but the overall trend is extremely clear. In recent years, it is uninterrupted and it is intensifying. In fact, if you look at the hottest years ever measured in this atmospheric record, they have all occurred in the last 14 years. The hottest of all was 2005”* (AIT film, voiceover).

14. The implication that dangerous warming is occurring is untrue. World average ground temperature has not increased for 8 years since 1998 (Climate Research Unit, University of East Anglia; Carter, 2007), as recently conceded even by the Hadley Centre in a new modelling study (Smith et al., 2007). World average lower atmospheric temperature shows no greenhouse warming since at least 1979 (Gray,

2006). World average ocean temperature has not increased between 2003 and 2005 (Lyman *et al.*, 2006).

15. That hot years cluster around the end of the 20th century is irrelevant because of the limited context provided by considering only 150 years worth of data. 150 years is a short and climatically almost meaningless period. Statistics regarding clustering of abnormally hot or cold years only make sense in the context of Earth's known temperature cyclicality on time scales both longer and shorter than this. It is well established that the late 20th century warming represents a peak on a documented 1500-year temperature cycle of probable solar origin (e.g., Bond *et al.*, 2001). It is therefore utterly unsurprising should 11 out of the last 12 years rank among the 12 warmest years since 1860. It is similarly insignificant that in the northern hemisphere the majority of the warmest days in each year occur between June and August.

Error 2: Atmospheric CO₂ has not recently exceeded 300 parts per million

16. “*In all of this time, 650,000 years, the [atmospheric] CO₂ level has never gone above 300 parts per million*” (AIT film, voiceover).
17. This statement, which is based on the CO₂ content of gas bubbles in ice cores, is at best unproven and more likely incorrect.
18. First, because CO₂ determinations from ice core bubbles represent values that are averaged over decades to millennia (Petit *et al.*, 1999), instantaneous peaks having been, of course, both higher and lower. And, second, because other means of estimating past atmospheric carbon dioxide values by direct chemical measurement or from fossil plant stomata indicate *prima facie* that natural values of at least 400 parts per million (ppm) have been attained in the last few thousand years (Beck, 2007; Wagner *et al.*, 2002; Kouwenberg *et al.*, 2005).

Error 3: Exaggeration of the degree to which increasing CO₂ levels will cause dangerous warming

19. “*The relationship [between CO₂ and temperature] is very complicated. But there is one relationship that is more powerful than all the others and it is this. When there is more CO₂, the temperature gets warmer, because it traps more heat from the sun....*”; and “*This [100ppmv of CO₂ concentration] is the difference between a nice day and having a mile of ice above your head*” (AIT film, voiceover).
20. In the context of the parallel fluctuations in temperature and CO₂ from ice cores that Mr. Gore is describing, this statement implies that the increases in temperature observed are the *result* of increasing CO₂. This is incorrect, as is the further implication that higher CO₂ levels will necessarily cause dangerous warming, which misapprehension is fostered throughout AIT.
21. It is well established and uncontroversial that changes in ice core CO₂ content in the paleoclimate have followed 800-2000 years *behind* their parallel changes in temperature, which they therefore cannot cause (Muddelsee, 2000; Caillon *et al.*, 2003). In addition, atmospheric CO₂ has attained levels of one thousand ppm and more in earlier geological times without known adverse environmental effects (e.g., Lowenstein & Demicco, 2006).
22. Mr. Gore’s statements also completely ignore the warming effect of the established logarithmic relationship between increasing CO₂ and increasing temperature (IPCC, 2001). The 280 ppm of CO₂ in the pre-industrial atmosphere was responsible for a warming of around 6 deg. C. However, one important result of the logarithmic relationship between CO₂ and increasing temperature is that a doubling of CO₂ from the presumed pre-industrial level of 280 ppm will in the first instance produce only about 1 deg. C of warming, as widely calculated theoretically and recently supported on empirical grounds by Schwartz (2007). Note that these recent results contrast with the higher estimates made by IPCC (2007), which, for a doubling of CO₂, predicts a temperature increase of “*2 to 4.5 K with a best estimate of about 3 K and ... very unlikely to be less than 1.5 K*”. These IPCC estimates involve unproven assumptions

about the magnitude of various feedback effects, especially that of water vapour. Nevertheless, even using the IPCC estimates as a benchmark, it is clear that Mr. Gore has strongly overstated the likely effect of human increases in atmospheric CO₂.

Error 4: Carbon dioxide is the most important atmospheric greenhouse gas

23. *“But the problem is that this thin layer of atmosphere is being thickened by all of the global warming pollution that is being put up there. What that does is it thickens this layer of atmosphere. More of the outgoing infrared is trapped. So the atmosphere heats up worldwide.”* (AIT film, voiceover). Mr. Gore then immediately goes on to talk about the rise in CO₂ levels over the past 50 years and his “political journey” dedicated to cutting CO₂. Then he states: *“And now we’re beginning to see the impact in the real world. This is Mount Kilimanjaro...”*
24. Mr. Gore therefore clearly implies that CO₂ is the most important atmospheric greenhouse gas, and that its increase bears a direct relationship to the melting of glaciers on Mt. Kilimanjaro and the other effects he goes on to list.
25. An atmospheric greenhouse gas is one that absorbs space-bound infrared radiation, thereby increasing the energy available near the Earth’s surface for warming or increased evaporation (e.g., de Freitas, 2002). Though precise estimates differ amongst different authors, the most important greenhouse gases are, in order, water vapour (up to 70% of the total effect), carbon dioxide (up to 26%), methane (up to 9%) and ozone (up to 7%) (e.g., Kiehl, J. T. & Trenberth, K. E. 1997). IPCC downplays the relative importance of water vapour by treating it as a feedback rather than a forcing, but nonetheless concedes (IPCC, 2007, p. 12) that *“water vapour changes represent the largest feedback affecting climate sensitivity”*.
26. As discussed before (3, above), the logarithmic nature of the relationship between CO₂ and temperature means that further increases in CO₂ above 280 ppm will cause only minor additional warming. That CO₂ represents 80% of all human emissions and

is therefore dangerous, as argued by Mr. Gore, is simply irrelevant besides the constraints of the fundamental physics.

27. In summary, carbon dioxide is not the most important greenhouse gas, and neither are there grounds for asserting that further increases in its atmospheric concentration will cause dangerous global warming, let alone for claiming that dangerous AGW changes can be seen all around us.

Error 5: Carbon dioxide is a pollutant

28. *“But the problem is that this thin layer of atmosphere is being thickened by all of the global warming pollution that is being put up there”* (AIT film, voiceover).

29. The statement, in context, implies that CO₂ is a pollutant. This is incorrect. Rather, in scientific terms, CO₂ is a colourless, odourless natural gas that we breathe out every time we exhale, that is an essential constituent of plant growth, and that has been present in earth’s atmosphere through time in trace amounts ranging from a few hundred to many thousand ppm.

30. Enhanced levels of CO₂ have a beneficial effect on plant growth and water use efficiency (Eamus, 1996; Saxe *et al.*, 1998; Robinson *et al.*, 1998) and, at levels above 300 ppm, the mild warming that additional CO₂ may produce is more likely to be beneficial than harmful. For example, in 2003, scientists Dennis Bray and Hans von Storch surveyed 530 atmospheric scientists from 27 countries on topics related to global warming. Asked to what degree global warming might prove beneficial for some societies, a striking 34% of the scientists answered 1 or 2 (a great degree of benefit), and just 8.3% answered 6 or 7 (very little/no benefit).

Error 6: GCM computer models can provide accurate predictions of future climate change

31. The prediction of both regional and global climate events, as referred to on many occasions by Mr. Gore in AIT, depends upon the skill level of general circulation modelling. The prediction accuracy of GCMs is limited both in mathematical theory

and observed practice, so the attribution of regional climate events to anthropogenic “global warming” is uncertain. Indeed, tests show that the skill level of regional climate forecasting is no better than chance.

32. This uncertainty is acknowledged by the IPCC (2001, 2007), which deliberately uses the term “scenario” rather than “prediction” for its GCM-forecasted futures. Unfortunately, the press and public (including Mr. Gore) are not so careful, and generally treat IPCC scenarios as firmly predicted futures.

33. Modelling expert and IPCC lead author Dr. Kevin Trenberth recently wrote on Nature’s Climate Feedback that GCMs:

“... do not consider many things like the recovery of the ozone layer, for instance, or observed trends in forcing agents. None of the models used by IPCC is initialised to the observed state and none of the climate states in the models corresponds even remotely to the current observed climate”. In addition “the state of the oceans, sea ice and soil moisture has no relationship to the observed state at any recent time in any of the IPCC models”. Trenberth added that “... there are no (climate) predictions by IPCC at all. And there never have been”. Instead, there are only “what if” projections of future climate that correspond to certain emissions scenarios”.

34. These uncertainties of the computer models that the IPCC uses to “predict” future climate are unrepresented in Mr. Gore’s film.

Error 7: The European heatwave of 2003 was caused by AGW

35. *“A couple of years ago in Europe they had that massive heatwave that killed 35,000 people”; and “We have just ten years to avert a major catastrophe that could send our entire planet into a tail-spin of epic destruction involving extreme weather, floods, droughts, epidemics and killer heat waves beyond anything we have ever experienced”*(AIT film, voiceover).

36. The 2003 European heat wave was caused by an anticyclone becoming stationary over Europe, thus blocking the ingress of cooler air from the Atlantic and enhancing the influence of hot air from the Mediterranean and north Africa. This meteorological situation has occurred before, will occur again, and is not caused by AGW.
37. The statement about heat deaths is global warming alarmism at its most unbalanced. The 2,000 heat-related deaths that occurred in 2003 in the UK need to be viewed against the background of more than 25,000 UK cold deaths that occur annually. To give but one example, Keatinge & Donaldson (2004) estimate that a 2 deg. C increase in mean surface air temperature in the UK would cause 2,000 more deaths from heat, but 20,000 fewer deaths from cold.
38. There is no clear evidence that unusual weather conditions are becoming more common or more destructive, and nor can specific weather events (such as the 2003 heatwave or the recent UK rainfall and flooding) be attributed to human-caused global warming. The statement that we have ten years to avert a climate catastrophe is simply fanciful.

Error 8: Hurricane Katrina was caused by AGW

39. *“We have seen in the last couple of years, a lot of big hurricanes....And then of course came Katrina. It is worth remembering that when it hit Florida it was a Category 1, but it killed a lot of people and caused billions of dollars worth of damage. And then, what happened? Before it hit New Orleans, it went over warmer water”* (AIT film, voiceover).
40. Mr. Gore devotes a significant part of the film to showing pictures of the suffering in New Orleans caused by Hurricane Katrina, and names every hurricane that occurred in the unusually active 2005 storm season in USA. The implication throughout is that the frequency and intensity of these events are a result of human-caused global warming.

41. This implication is unwarranted, and conflicts with the consensus view of hurricane experts. Meeting recently under the banner of the UN World Meteorological Organization (one of the parent organizations of the IPCC), these experts said (WMO Workshop, 2006):

1. No conclusion can be drawn on whether there is a detectable anthropogenic signal in the tropical cyclone climate record;

2. No individual tropical cyclone can be directly attributed to climate change.

42. **Error 9: Hurricanes will become more numerous and more powerful because of AGW**

43. *“Of course, when the oceans get warmer, that causes stronger storms. We have seen in the last couple of years a lot of big hurricanes...And then of course came Katrina....There had been warnings that hurricanes would get stronger....And one question that we, as a people, need to decide is how we react when we hear warnings from the leading scientists in the world”* (AIT film, voiceover).

44. Research studies on possible future changes in hurricane frequency or power due to global warming “give such contradictory results as to suggest that the state of understanding of tropical cyclogenesis provides too poor a foundation to base any projections about the future” (Pielke et al., 2005). Specifically with respect to hurricane intensity, Landsea et al. (1999) and Chan & Liu (2004) found no significant secular trends during the decades of record that they judged to be reliable. Under assumed warming (which of course may not occur), and using a modelling approach, Knutson & Tuleya (2004) predicted only a marginal 5% increase in hurricane windspeeds by 2080; Michaels et al. (2005) concluded that even this small projection may be inflated by a factor of two.

45. It is clear that no scientific consensus exists regarding the effects of mild global warming on either the number or intensity of tropical storms.

Error 10: Higher insurance costs for weather disasters are a reflection of AGW

46. *“Over the last three decades, insurance companies have seen a 15-fold increase in the amount of money paid to victims of extreme weather. Hurricanes, floods, drought, tornadoes, wildfires, and other natural disasters have caused these losses. Many can be linked to factors that are worsened by global warming”* (AIT film, voiceover).
47. The first two sentences are factually correct, the third is not. All the listed phenomena are weather events that occur as part of earth’s normal dynamic behaviour and they have nothing necessarily to do with AGW.
48. The true reason why the cost of hurricane damage has increased in recent years is the rapid expansion of population and built infrastructure along coastlines where hurricanes make landfall (Pielke *et al.*, 2007 and the WMO Workshop 2006 referred to at **8** above). The increasing costs are compatible with demographic changes such as the increasing concentration of people in risk prone areas, and the increase in wealth which has outstripped inflation in developed countries.

Error 11: Sea-level rise of up to 20 feet [7 m] will be caused by melting of either West Antarctica or Greenland in the near future

49. *“I want to focus on West Antarctica, because it illustrates two factors about land-based ice and sea-based ice. It’s a little of both. It’s propped on tops of islands, but the ocean comes up underneath it. So if the ocean gets warmer, it has an impact on it. If this were to go, sea levels worldwide would go up 20 feet. They’ve measured disturbing changes on the underside of this ice sheet. It’s considered relatively more stable, however, than another big body of ice that is roughly the same size. Greenland”* (AIT film, voiceover).
50. A significant length of film is devoted to alarmist images of the flooding that a 20-foot sea-level rise would produce in coastal population centres in Florida, San Francisco, New York, Bangladesh, China and the Netherlands.

51. Both the main Antarctic and Greenland ice sheets are near to mass balance and exhibit declining interior temperatures and ice thickening (Doran *et al.*, 2004; Johannesen *et al.*, 2005; Zwally *et al.*, 2005). In addition the area of sea-ice around Antarctica has increased in recent years. Overall, with respect to polar-forced changes, Shepherd & Wingham (2007) conclude that ice-cap wastage is contributing to sea-level rise at a rate of 3.5 cm/century. As Ollier (2007) explains, the mechanics of glacial plateaux at high latitudes are such that more extensive melting of either the Greenland or Antarctic ice-sheets is extremely unlikely on any foreseeable scenario.
52. The IPCC (SPM 2007) states that: “*Antarctic sea ice extent continues to show interannual variability and localized changes but no statistically significant average trends, consistent with the lack of warming reflected in atmospheric temperatures averaged across the region.*” It goes on to state: “*Current global model studies project that the Antarctic Ice Sheet will remain too cold for widespread surface melting and is expected to gain in mass due to increased snowfall.*”
53. In relation to sea level rise, in its 2007 4th Assessment Report, the IPCC estimated that sea-level will rise between 18-59 cm (midpoint 38.5 cm) by 2100, which is a reduction from their earlier 2001 estimate of 9-88 cm (midpoint 48.5 cm). The 2007 Report predicted rates of rise overlap with the long-term historical rates of 1-2 mm/yr recorded by tide gauges. No acceleration of global sea-level rise is observed in long tide-gauge records in the late 20th century (e.g., Raicich, 2007), and a recent analysis documents rates of rise between 1920 and 1945 (2.5 mm/yr) that are comparable with those between 1993 and 2000 (2.4 mm/yr) (Jevrejeva *et al.*, 2006). Sea level rises of the magnitude shown in AIT could, according to the IPCC, only happen were global warming of 1.9 to 4.6 deg C to be sustained for millennia.
54. Short-term flooding caused by 20 feet of sea-level rise is a figment of Mr. Gore’s imagination, and exists only as a product of speculative computer models.

Error 12: Low-lying inhabited Pacific atolls are being inundated because of AGW

55. *“There’s a difference between floating ice and land-based ice. It’s like the difference between an ice cube floating in a glass of water, which when it melts doesn’t raise the level of water in the glass, and a cube sitting atop a stack of ice cubes, which melts and flows over the edge. That’s why the citizens of these Pacific nations had all had to evacuate to New Zealand”* (AIT film, voiceover).

56. Mr. Gore is here suggesting that the loss of ice from the land masses of Greenland and Antarctica has raised sea level so much that already the island nations of the Pacific are being compelled to relocate their populations. This suggestion is in threefold error.

57. First, problematic sea-level rise is not expected to be engendered by polar glacial melt (11, above). Second, records from the Pacific Islands, including Tuvalu, show no recent changes in sea-level that lie outside of normal natural variation (Khandekar *et al.*, 2005). And third, the people of Tuvalu have not been forced to emigrate to New Zealand for safety. Mr. Gore is alleged to have been informed of this latter fact during a recent visit to New Zealand, but his erroneous statement remains on the record uncorrected.

Error 13: Coral reef bleaching and species loss is being exacerbated by AGW

58. *“Coral reefs all over the world because of global warming and other factors are bleaching and they end up like this. All the fish species that depend on the coral reef are also in jeopardy as a result. Overall species loss is now occurring at a rate 1000 times greater than the natural background rate”* (AIT film, voiceover).

59. Coral bleaching is a natural phenomenon that has undoubtedly occurred many times in many places prior to the late 20th century, ever since corals with algal zooxanthellae first evolved. A study by Hendy *et al.* (2003) documented two hiatuses in coral skeletal growth from the Great Barrier Reef (“GBR”) that were reliably dated

to 1782-85 and 1817 AD, both times of El Nino conditions similar to those that caused extensive modern GBR bleaching in 1998.

60. The existence of the GBR and other coral reefs today is testament to the fact that, however great may be the “instantaneous” damage wrought on a reef ecosystem by bleaching, recovery occurs in due course. Furthermore, no significant evidence is advanced in the AIT film for the dramatic claim that enhanced coral reef species extinction is occurring at the present day.

Error 14: Mt. Kilimanjaro and other mountain glaciers are being melted by AGW

61. *“And now we’re beginning to see the impact in the real world. This is Mount Kilimanjaro more than 30 years ago, and more recently. And a friend of mine just came back from Kilimanjaro with a picture he took a couple of months ago. Another friend of mine, Lonnie Thompson, studies glaciers. Here’s Lonnie with a sliver of a once mighty glacier. Within the decade there will be no more snows of Kilimanjaro”* (AIT film, voiceover).

62. It is well established that modern glacier recession on Kilimanjaro is not caused by AGW. Rather, glacier retreat began around 1880 as part of the Earth’s recovery from the cold conditions of the Little Ice Age. The Kilimanjaro retreat occurred in parallel with the shrinkage of other mountain glaciers in equatorial East Africa, and is attributed to declining regional precipitation and changes in cloud cover rather than to atmospheric warming (Hastenrath, 2001; Molg *et al.*, 2003).

63. Mr. Gore also subscribes to the widespread misapprehension that mountain glaciers throughout the world are (i) controlled only by temperature, and (ii) uniformly in retreat because of human-caused warming. In the film, for example, he says: *“This is happening in Glacier National Park....Within 15 years this will be the park formerly known as Glacier...Here is what has been happening year by year to the Columbia Glacier. It just retreats more and more every year...People who go up to see them, here is what they are seeing every day now [pictures of ice breaking off]”*

64. The claim that these changes can be attributed to human-caused warming is false. In the first instance, glacial advance or retreat is governed by the mass balance for a particular glacier, which factor in turn depends upon a complex of environmental factors of which temperature, precipitation and albedo (reflectivity of the sun's rays) are among the most important (e.g., Ollier, 2007). Second, the retreat of many alpine glaciers commenced with the ending of the Little Ice Age around 1860, a warming that far predated modern voluminous increases in industrial gases (IPCC, 2001; Fig. 2.18). And third, today some glaciers are advancing (e.g. Engabreen, Norway; Franz Josef, New Zealand) at the same time that others (and perhaps a majority) are in retreat. It is therefore both a gross oversimplification, and also an unsupportable assertion, to say or imply that the modern changes in mountain glaciers are due to human-caused global warming.

Error 15: Polar bears are threatened by Arctic warming

65. *".... there is a faster build up of heat here at the North Pole in the Arctic Ocean and the Arctic generally than anywhere else on the planet. That's not good for creatures like polar bears that depend on the ice. A new scientific study shows that for the first time they're finding polar bears that have actually drowned, swimming long distances up to 60 miles to find the ice. They did not find that before"* (AIT film, voiceover).

66. This quotation, and other related AIT text and commentary, implies that the Arctic region is warmer today than it has been at any previous time. In fact, temperature records demonstrate that the Arctic was warmer around 1940 than it is today (Przybylak, 2000; Briffa *et al.*, 2004). In addition, Soon (2005) has shown that Arctic temperature rhythms over the past 125 years are more closely correlated with measured changes in solar activity than they are with the monotonic increase in atmospheric CO₂ concentration.

67. Regarding polar bears, it is simply untrue that their numbers are in overall decline. Taylor (2006) has shown that at 11 of the 13 main bear locations in Canada

populations are thriving, some having more than doubled since 1940. And in a study of bears in Hudson Bay, Dyck *et al.* (2007) concluded as follows:

“We found that spring air temperatures around the Hudson Bay basin for the past 70 years (1932-2002) show no significant warming trend and are more likely identified with the large-amplitude, natural climatic variability that is characteristic of the Arctic. Any role of external forcing by anthropogenic greenhouse gases remains difficult to identify. We argue, therefore, that the extrapolation of polar bear disappearance is highly premature”.

“Climate models are simply not skilful for the projection of regional sea-ice changes in Hudson Bay or the whole Arctic. Alternative factors, such as increased human-bear interaction, must be taken into account in a more realistic study and explanation of the population ecology of western Hudson Bay polar bears. Both scientific papers and public discussion that continue to fail to recognize the inherent complexity in the adaptive interaction of polar bears with both humankind and nature will not be likely to offer any useful, science-based, preservation and management strategies for the species.”

68. Like the panda, the polar bear is an iconic species and hence scaremongering about its extinction due to AGW is a highly effective way of creating public alarm. The reality is that there is no factual evidence that warrants alarm about polar bears because of climatic warming.

Error 16: Lake Chad dried out because of AGW

69. *“This is Lake Chad, once one of the largest lakes in the world. It has dried up over the last few decades to almost nothing. That has been complicating the other problems that they also have. The second reason why this is a paradox: Global warming creates more evaporation of the ocean that seeds the clouds, but it also sucks moisture out of the soil. Soil evaporation increases dramatically with higher temperatures”* (AIT film, voiceover).

70. The attribution of the evaporation of Lake Chad to anthropogenic global warming is incorrect. After prolonged investigation, NASA scientists concluded that the drying out was caused by local increases in water use (especially diversions for agriculture), by changed grazing patterns, and by increases in nearby populations (Foley & Coe, 2001).

Error 17: Drought in the Sahara has been caused by AGW

71. *“Focus most of all on this part of Africa just on the edge of the Sahara..... One of the factors that has been compounding this is the lack of rainfall and the increasing drought. ... Global warming creates more evaporation of the ocean that seeds the clouds, but it also sucks moisture out of the soil. Soil evaporation increases dramatically with higher temperatures”* (AIT film, voiceover).

72. As discussed under 7 above, it is not possible to attribute regional effects to global climatic causes. Also, it is a matter of fact that rather than enlarging the Sahara Desert has actually shrunk by about 300,000 square kilometers in recent decades, as vegetation has been able to re-establish itself in a moister atmosphere (Nicholson, 2001).

Error 18: Ocean thermohaline circulation will be deleteriously affected by AGW

73. *“America. The Great Lakes are the remnants of that huge lake. An ice dam on the eastern border formed, and one day it broke. All that fresh water came rushing out, ripping open the St. Lawrence, there. It diluted the salty dense cold water, made it fresher and lighter so it stopped sinking. And that pump shut off and the heat transfer stopped, and Europe went back into an ice age for another 900 or 1000 years. The change from conditions we have here today to an ice age took place in perhaps as little as 10 years’ time. That is a sudden jump. Of course that’s not going to happen again, because the glaciers of North America are not there. Is there any big chunk of*

ice anywhere near there? Oh yeah [pointing at Greenland]. We'll come back to that one" (AIT film, voiceover).

74. In this passage, and related commentary, Mr. Gore advances the possibility that the Gulf Stream, and indeed the entire thermohaline ocean circulation, may be disrupted as a result of Greenland fresh melt water created by anthropogenic "global warming".
75. I have shown already (11, above) that the chance of substantial melting of Greenland is vanishingly small. It is estimated that Greenland today yields an estimated 224 cu km of melt water annually. For comparison, the rupture of a North American ice dam that may have caused a perturbation in ocean circulation just after the last glaciation added more than 100,000 cu km of meltwater to the North Atlantic (Stephens & Keeling, 2000).
76. A recent review by Latif *et al.* (2006) concluded that modern changes in the strength of the thermohaline current system fall within the envelope of previous natural variations. Cunningham *et al.* (2007) have recently published accurate short-term records of variation in the Atlantic thermohaline system; these show wide intra-annual flow variations between 4.4 and 35.3 Sv which destroys earlier arguments that potentially dangerous short term flow trends had been identified. Finally, regarding the Gulf Stream, in a letter to *Nature* in 2004, Professor Carl Wunsch (MIT) - the scientist referred to at paragraph 12 of Professor Stott's statement who claimed that his views in the Channel 4 documentary, *The Great Global Warming Swindle*, had been misrepresented - commented:

"European readers should be reassured that the Gulf Stream's existence is a consequence of the large-scale wind system over the North Atlantic Ocean, and of the nature of fluid motion on a rotating planet. The only way to produce an ocean circulation without a Gulf Stream is either to turn off the wind system, or to stop the Earth's rotation, or both. Real questions exist about conceivable changes in the ocean circulation and its climate consequences. However, such discussions are not helped by hyperbole and alarmism. The occurrence of a climate state

without the Gulf Stream any time soon — within tens of millions of years — has a probability of little more than zero”.

Error 19: Malaria and other tropical diseases are being exacerbated by AGW

77. “*Mosquitoes are profoundly affected by global warming. There are cities that were originally located just above the mosquito line, which used to mark the altitude above which mosquitoes would not venture. Nairobi, Kenya, and Harare, Zimbabwe, are two such cities. Now, with global warming, the mosquitoes are climbing to higher altitudes*” (AIT book, p. 173).

78. The implication is that these cities were founded in their particular location specifically in order to avoid the threat of mosquitoes. In fact, Professor Reiter, one of the world’s foremost experts on the malaria mosquito, says that Nairobi was founded during the construction of the railway from Mombasa to Dar es Salaam, and its location, at a point where the line falls from the Kikuyu escarpment to the Rift Valley, was determined not by the altitude but by the presence of water there, making it suitable as a rail depot. It is also a documented fact that malaria epidemics occurred many times in Nairobi prior to the 1950s (Hay *et al.*, 2002; Shanks *et al.*, 2000).

79. Furthermore, malaria is not necessarily a tropical disease, and the *anopheles* mosquito does not select its habitat primarily by reference to temperature (Reiter, 2000). Indeed Ottawa (Canada) was once a danger zone for malaria, which was previously prevalent also in Europe. Malaria is still endemic in Siberia, where ambient temperature is seldom tropical; and an epidemic in Soviet Russia in the 1920s and 1930s extended right through Siberia, and killed tens of thousands even as far north as Arkhangelsk.

Error 20 - AIT ignores the influence on climate of the two vitally important forcing agents - water vapour and solar variation

80. Throughout the film, there appears to be only one significant statement about the main source of energy for Earth's climate system: *"The Sun's radiation comes in the form of light waves and heats up the Earth. Some of the radiation that is absorbed and warms the Earth is re-radiated back into space in the form of infrared radiation. Some of the outgoing infrared radiation is trapped inside the atmosphere. That is a good thing because it keeps the temperature of the Earth within certain boundaries, keeps it relatively constant and liveable."*
81. Gore then goes on to say that: *"the problem is that this thin layer of atmosphere is being thickened by all of the global warming pollution that is being put up there."*
82. As covered in 4 above, "other" greenhouse gases include the dominant factor of water vapour, which is nowhere discussed adequately by Mr. Gore and, besides which, additional increments of CO₂ constitute only a minor effect on climate. Second, use of rhetorical language such as "thickened" to describe an increase in atmospheric CO₂ from 0.028% to 0.038% is clearly aimed at inducing an emotional response from the viewer rather than with conveying a neutral scientific fact.
83. The effects that solar variations have on Earth's climate are not yet fully described or understood. Nonetheless, it is undeniable that climatic cycles of many different time-spans are linked to solar causes (Beer *et al.*, 2000; Veizer, 2005). Solar rhythmicity includes the fluctuating radiation intensity of the 11 year-long sunspot cycle (including a relationship between the precise cycle length and temperature; Abdussamatov, 2004), periodic changes in the solar magnetic field on a time scale of 22 years (Mackey, 2007), including links to rainfall patterns (Alexander *et al.*, 2007), and other signals at time periods of 60-80 (Klyashtorin & Lyubushin, 2003), 180-205 (Beer *et al.*, 2000), 1500 (Singer & Avery, 2006) years and longer (Solanki *et al.*, 2005). Finally, several studies have established that solar variations are better able to explain climate change than are changing CO₂ concentrations (e.g., Soon, 2005; Camp & Tung, 2007).

84. Counterbalanced against these wide-ranging studies, the authors of one recent and widely publicized paper have argued against a significant solar influence on contemporary climate change (Lockwood & Frolich, 2007). Indeed, the Royal Society greeted this paper with the remarkable and unjustifiable comment that "*The sun is not a factor in recent climate change.*" Regrettably, the Lockwood & Frolich paper is known to be flawed in at least five separate ways, as explained at <http://scienceandpublicpolicy.org/images/stories/papers/originals/UnrulySunne/SPPI_07_aug8_finalLockwoodpaper.pdf>.
85. It is also certain that as well as direct effects, solar activity modulates the intensity of galactic cosmic rays received by the Earth and thereby influences climate in other, indirect ways (Neff *et al.*, 2001; Svensmark, 2007).
86. Given these facts, the uncertainty of our knowledge, and the large amount of solar research that is underway, the fact that the film makes no reference to these issues is a serious omission. For instance, a recent empirical study by Pinker *et al.* (2005) showed that between 1983 and 2001 the solar radiation received at the earth's surface increased at a rate of 0.16 W/m²/yr. The total increase of about 3 W/m² exceeds by an order of magnitude the 0.3 W/m² estimated for human CO₂ forcing over the same time period.
87. In his film, Mr. Gore ignores the climatic effects of both solar variation and water vapour, and concentrates instead on the theoretical (modelled) future effects of the minor greenhouse gas CO₂. There is very little discussion of natural climate change. Above all other errors, it is this blatant and unbalanced partiality that reveals *An Inconvenient Truth* to be a political polemic rather than a serious contribution to science or education.

Overall Comment - The issue of scientific consensus

88. Towards the end of AIT, Mr. Gore displays the numbers from 1 to 928 on a large screen and tells the audience that between 1993 and 2003 there were 928 scientific

papers on climate change, not one of which apparently challenged the “consensus” view of climate change advanced by Mr. Gore (who at this point replaces the numbers 1 to 928 on the board with the single digit “0”). What Mr. Gore does not reveal is that the “consensus” referred to, as defined in a *Science* essay of Dr. Naomi Oreskes (2004), is a strictly limited one. Dr. Oreskes’ definition assumed that more than half of the observed warming of the past half-century was anthropogenic. Further, her definition did not consider such controversial issues as whether a variation of only 100 ppm in the atmospheric concentration of CO₂ has caused the 6 deg. C difference between global temperatures during the Ice Ages and global temperatures during the interglacial periods (such as the present), nor whether the melting of the Greenland and Antarctic ice-sheets might imminently cause global sea level to rise by 20 feet, nor many other similar, contested issues that Mr. Gore presents in his film.

89. In my opinion, the failure by Mr. Gore to state clearly the limited extent of the peer-reviewed consensus defined and identified by Dr. Oreskes is highly misleading, in that the implication of Mr. Gore’s claim is that the “consensus” endorses all the major claims which he has previously made during the film. For the reasons which I have given, this is not the case.

90. Finally, it is important to note that the idea of “consensus” is only ever invoked in science regarding matters for which deep uncertainties exist. Scientists never say that there is a consensus about Boyle’s gas law, nor that there is a consensus that the sun will rise tomorrow; rather, they point to the established scientific laws or theories that underpin the *predictable* behaviour of gases and celestial bodies, respectively. Because there is no established law (let alone adequate computer model) that allows climate change to be predicted, many different and equally legitimate scientific views - consensus and otherwise - exist regarding its deeply uncertain future path.

CONCLUDING COMMENTS

- 91. I have outlined 20 selected deficiencies of *An Inconvenient Truth* which exemplify the misleading picture that Mr. Gore’s film paints of modern climate science. Overall, the film ignores compelling evidence regarding the established temperature records, overemphasizes the importance of CO₂ as a climate change agent, ignores the probability of future climatic coolings, prodigiously exaggerates and/or misrepresents the consensus of scientific opinion and advocates unsuitable public climate policies.
- 92. In contrast to Mr. Gore’s preoccupation with cutting atmospheric CO₂ levels, the proper task of a modern climate policy is to ensure society’s capability to react appropriately to the full range of natural weather events, and to prepare adaptive plans equally for both future climatic warmings and the much more dangerous coolings.
- 93. School pupils need to be appraised of such a balanced view of the climate change issue and taught to judge the scientific evidence on its merits, rather than being indoctrinated with the alarmist AGW viewpoint epitomized by Mr. Gore’s film.
- 94. I confirm that I understand my duty is to the Court rather than the party that instructed me and I confirm that I have complied with that duty. I confirm that I have read the CPR Part 35 Practice Direction and the Protocol and in particular the nature of my duty at paragraphs 1.1 to 1.6 of the Practice Direction, and paragraphs 4.1 to 4.7 of the Protocol.

Statement of Truth

- 95. I confirm that insofar as the facts stated in my report are within my knowledge I have made clear which they are and I believe them to be true, and that the opinions I have expressed represent my true and complete professional opinion.

Signed Dated

Professor Robert Merlin Carter

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