Bringing Balance, Disclosure and Due Diligence into Science-based Policymaking*

Ross McKitrick
Department of Economics
University of Guelph

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Abstract

I look at three settings in which complex, uncertain information must be used to support a decision that will have institutional implications and may thereby impinge on others in society: court trials, business prospectuses and science-based policymaking. In the first two one can identify formally-coded rules that ensure balance, full disclosure and due diligence occurs, thereby putting the decision on the most secure footings possible in terms of truthfulness and fairness. In the policymaking case, there is little evidence that these principles apply in a systematic way, and with respect to the climate change issue they are conspicuously absent. I suggest some mechanisms for reforming the policy process that would bring public sector decision-making up to standards approaching those in the courts and the private sector.

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1 Introduction

The questions posed to this conference refer to the science guiding public policy as 'Public Science.' Chris Essex and I, in our book *Taken By Storm*[1] used the term 'Official Science' to mean much the same thing. These terms are new, but the situation is not—the underlying problem of incorporating esoteric advice into public policy is as old as society itself. Recall, for instance, the story from Genesis ch. 41 about Pharaoh and his ominous dreams. Seven dying cows appear and eat seven fat cows; then seven shriveled heads of grain swallow up seven plump heads of grain. The assembled prophets and fortune-tellers could make nothing of these dreams, but Joseph, the Hebrew seer, warned Pharaoh that it signified a coming famine. Seven abundant years would be followed by seven years of drought, and (said Joseph) the king must therefore immediately impose a twenty percent tax on agricultural output, with the proceeds used to store up food. Pharaoh followed this plan, perhaps encountering protests along the way from the taxpaying public who were not privy to the dreams; but the famine came as predicted and the country was spared ruin. Of course the hero in the story is Joseph, but Pharaoh also deserves credit for making good use of advice from a source whose reliability was not easy to assess.

Individuals in positions of responsibility often have to look at uncertain information and make decisions that will have institutional force and thereby impinge upon the lives of many others. In a democracy those decisions should, at some level, receive the consent of those affected. Since the scientific information supporting the decision may be very specialized or technical, the people affected will typically not be in a position to agree or disagree with it and thereby offer informed consent to the policy. Hence it is understandable that scientific input to a democratic decision-making process will at times cause tension between the desire for the best information—however complex—and the desire for informed, voluntary consent by those being governed.

The need to adjudicate uncertain information in support of institutional decisions arises in many contexts, but I would like to compare three situations that are prominent in our time: court trials, business prospectuses and government expert panels. My argument is that of these three, the latter

[1] Christopher Essex and Ross McKitrick. *Taken By Storm: The Troubled Science, Policy and Politics of Global Warming*. Toronto: Key Porter Books, 2002.

is the most important, in terms of consequences for peoples' lives, but also the least systematic. I will focus especially on the mechanisms for bringing information to bear on environmental policymaking, arguing that the other two mechanisms provide ready-made models for improving decision mechanisms in the public sector. I will develop this argument in the Section Three before turning in the fourth section to the three questions posed by the conference organizers.

2 Trials, Finance and Science Panels

2.1 Adversary proceedings in court

Consider, first, a court trial. A man is charged with murder and faces life in prison. He claims he is innocent. An eyewitness saw him enter the building just before the murder. His fingerprint was on the knife, and there is fiber evidence the prosecution says can tie him to the murder scene. The defence says the eyewitness is wrong, the accused was in fact at home; that he used the knife when he visited the victim—an old friend—for dinner the week before, and the fiber could be from anyone who happens to have a light blue cardigan. What will the court do? The jury (or judge) must make a decision in the face of uncertain information that will either consign a man to prison or set him free. And in the process they may establish precedent for handling certain types of evidence or procedural disputes that could affect hundreds of trials in the future.

We all know what the basic shape of the process will be. The court will ensure that both the prosecution and the defence are adequately represented. Any idea that only the prosecution should present its case would be dismissed as a horrifying throwback to an earlier, tyrannical age. There will be a preliminary stage in which the prosecution must reveal its evidence and allow the defence to prepare a response. Both sides will describe their expert witnesses and the court must approve their appearance before the jury, as well as approve the evidence that will be brought out in court. When the trial gets underway, the prosecution will bring in its witnesses, who will go over the evidence point-by-point. Every expert and every witness will be cross-examined by the defence attorney whose aim will be to expose any weakness in the case. There will be no pretense that the prosecutor or the defence are 'balanced'—each side is there to make its own argument as strongly as possible. Then the defence will present its case, subject in turn to cross-examination by the prosecution. Witnesses will stay on the stand for as long as it takes to complete each cross-examination, and every inconsistency or hearsay utterance can be probed until it is either straightened out or demolished. Evidence will be presented in such a way as to ensure that everybody in the room agrees on what it is. There may be disputes about what it means but everyone has to agree—including the judge—that the exhibits are admissible as evidence, and the jury must be given the opportunity to see exactly what each one is. Finally both sides will sum up, and the court will render a verdict. But even then the process is not over, because the losing side can launch an appeal if they find new evidence or if they dispute the fairness of the first trial.

Courts can and do make mistakes. But it must be admitted that the process ensures that the decision draws in both sides of the story. This is a key point. The attorney on each side is there to present the case only for his or her side. If it turned out the defence lawyer was also spending a significant part of his time assisting the prosecution he could be disbarred for unethical conduct. Ultimately what we care about is that the *process* is balanced, not the individual participants. *Indeed it is necessary for the individual lawyers to be one-sided for the process itself to be balanced.* One reason is that there is often a public stigma attached to one side or the other. Sometimes the prosecution is considered a heel for pressing charges and going to trial. Sometimes the defence is seen as trying to get rotten criminals off on cheap technicalities. The court cannot let these perceptions interfere with its function. Both sides must have vigorous representation for the process to work, and if the court is not satisfied that each side is properly represented the trial may not proceed, or the decision may be subject to later overturning on appeal.

We will consider some contrasts with the policymaking process later, but for the moment a particularly noteworthy point is the *Principle of Balance*: for a process to be balanced does not require that each participant be neutral, it requires that the contrasting points of view be deliberately sought out and presented to each one's best advantage.

2.2 Financing a public corporation

Consider, second, an investment prospectus. To be specific, suppose it is a proposed mining operation. The main backer is a large established mining company with publicly traded shares. It is preparing a public prospectus in advance of issuing new shares in a subsidiary company that will mine for gold in the forests of, say, Venezuela. They claim that their prospectors have established the likely presence of about one million recoverable ounces, making the deposit worth about $300 million. They would like the subsidiary shares to trade on a public stock exchange.

A prospectus must contain audited financial statements. Auditing is carried out by specialized and highly paid professionals and, for large corporations, the audit is virtually a full time occupation. A company issuing an exploration prospectus must provide a qualifying report on its geological properties by an independent geological professional. The geologist must be truly independent of the issuing firm, and would not begin to conduct the analysis unless he or she had inspected the physical cores and verified independently all data used to summarize their contents. Standard due diligence involves traveling to the site and obtaining new core samples by drillers who are also independent of the issuing company. Both the auditor and the independent geologist must approve the relevant language in the prospectus and provide signed consent letters to the securities commission. The prospectus itself is reviewed by two sets of securities lawyers – one for the issuing corporation and one for the underwriter or broker acting as agent (note the implicit Principle of Balance). Then the prospectus is reviewed a third time by the securities commission. Any errors identified by or concerns of the securities commission must be dealt with, regardless of whether it is material to the results. The process is expensive and painstaking. After all this, the officers and directors of the corporation have to sign a form certifying that they have made "full, true and plain" disclosure, which means not only certifying that everything in the prospectus is

true to the best of their knowledge, but also that they have not omitted anything from the prospectus which is material. These steps are required no matter how small the dollar amounts involved in the stock issuance.

Despite the multiple layers of due diligence for prospectuses, frauds still occur. One of the most famous cases recently was the 1997 scandal involving Bre-X, in which millions of dollars were lost over a phony gold mine in Indonesia. In this case there were lapses in due diligence. The drill core was never made available for inspection. During its main boom, Bre-X never issued a prospectus. When it listed on the Toronto Stock Exchange, it filed an ore reserves study by a well-respected engineering firm which contained the caveat that the ore reserve calculation relied on company information and that no examination of drill core or verification were carried out. The fraud was only exposed when, at a late stage in arranging the buyout of the company by a larger consortium, due diligence was finally undertaken in the form of a third party drilling new core samples. When it turned out there was no gold in them the entire scheme came crashing down—as did Bre-X's chief geologist, who threw himself out of a helicopter.

At this point it will be useful to summarize two additional principles that are manifest in both court proceedings and in the rules governing issuance of a prospectus. First, the *Principle of Disclosure* is that a party asking others to invest their resources on the basis of some factual or technical information must make full, true and plain disclosure concerning the information, including the exact origin of the data and the exact form of any computational analysis applied to it. Second, the *Principle of Due Diligence* states that anyone conveying information with the expectation that readers will act upon it (including investing their own or others' money in response to it) has verified, and can personally attest to, the truthfulness of the information.

Thus we see three principles at work in other decision-making contexts: Balance, Disclosure and Due Diligence. I now look at the use of scientific information in public policy formation, and ask whether these principles are upheld therein.

2.3 Science-based public policy formation

This topic requires more discussion than the others as there is no formally-codified process to be described: the situation is to some extent a free-for-all. To narrow the discussion I will primarily be referring to environmental policy, which can range from local issues (i.e. whether cities should ban cosmetic pesticides on lawns) to global issues (i.e. should nations implement the Kyoto Protocol). In each case some complex science must be reviewed to provide a basis of information for a policy decision.

The policy process specific to environmental issues has an extra strike against it: the enormous apparatus of activist lobbying. Table 1 lists some of the best known environmental and conservation groups in the world, along with their annual revenues for the most recent year available (as of summer 2003 when I got the list together). All figures are converted into $US. Worldwide these groups raise about $1.6 *billion* each year. By far the most successful fundraiser is the Nature Conservancy, with revenues of over $900 million and assets of $2.7 billion. Annual

expenses at the Nature Conservancy just on administration and fundraising as of June 2001 were $99.2 million US dollars (www.charitynavigator.org).

Group	Revenue	End of Fiscal Year	Source
Nature Conservancy	$923,010,000	30-Jun-02	Group's annual report
Natural Resources Defense Council	$46,442,001	2002	Group's annual report
The Trust for Public Land	$126,797,000	31-Mar-02	Group's annual report
Environmental Defense	$43,841,405	30-Sep-02	Group's annual report
Sierra Foundation	$73,112,136	31-Dec-01	charitynavigator.org
Sierra Club	$75,441,137	31-Dec-01	charitynavigator.org
Greenpeace Worldwide	$179,181,280	31-Dec-01	Group's annual report
Worldwide Fund for Nature (WWF)	$117,800,000	2002	Group's annual report
David Suzuki Foundation	$3,760,314	2002	Group's annual report
Friends of the Earth USA	$4,391,503	Jun-01	Group's annual report
TOTAL	**$1,593,776,776**		

Table 1: Annual revenue for fiscal year shown of some top environmental groups in North America and Europe.

While annual revenues like this would not quite get Big Green onto the Fortune 500 list, it is still a surprising amount of money.

By way of comparison, think about monetary policy for a moment. It is a highly technical area of economics, involving complex institutions and specialized theory. There are many ongoing debates within the profession over methodology, theory and practical policy. Decisions in this area can have large effects on millions of lives for generations. Policy debates are vigorous but are conducted at a cordial, professional level. There is very little public activism and media treatment tends to be routine and low-key, focusing on such things as daily stock tables or reports of speeches by central bankers.

Environmental policy is also highly technical, involving many branches of science as well as law and government. And there are many ongoing professional debates over methodology, theory and practical policy, where decisions can affect peoples' lives for years to come. But unlike monetary policy, there is massive public activism to contend with, debates are often acrimonious even in professional circles and media treatment leans heavily towards an alarmist interpretation of events.

It is the activism in particular that makes environmental science and policy such a difficult area. There is nothing remotely like Environmental Defense, Greenpeace or the Sierra Club hanging over monetary policy. People do not chain themselves to bank machines and agitate for higher reserve requirements; movie stars do not campaign for fixed exchange rates; there are no publicity stunts to raise awareness about the bond yield curve. "Activism" takes the form of think-tanks releasing studies on, say, international monetary policy coordination or bank mergers. "Activism" is professional, technically-informed and courteous, befitting the topic.

The puzzle is not why activists are so quiet on financial issues but why they are so noisy on environmental issues, which are not intrinsically more important than financial issues. Part of the explanation though is that some people do believe environmental issues are intrinsically more important, supremely important perhaps, though public opinion polls do not reflect this. Another part of the explanation is that many people seem to feel it is OK to hold and voice strong opinions on environmental issues on the basis of good intentions but little technical understanding, whereas in other areas people would want to have both in hand before becoming publicly active.

It is in the context of this unique storm of public activism that environmental policies are deliberated. A problem for the policymaker is that deciding on a contentious issue requires greater understanding of the science than the politician typically possesses. So an administrative layer has to be established to convey the science into the policymaking process.

In *Taken By Storm* we call this administrative layer "Official Science." We pointed out that Official Science is not, itself, science, even though it is typically assumed that it speaks for science. Its membership is somewhat open. There are individuals who are appointed, such as advisors to cabinet ministers and leaders of UN panels like the Intergovernmental Panel on Climate Change (IPCC), but others insinuate themselves into the role, like editors of popular science journal like *Nature* and *Science*, journalists for magazines like *National Geographic* and *Discovery*, chairs of committees at Royal Societies and National Academies, and so forth.

Official Science is a necessary function, but it can easily find itself trying to perform an impossible task. Nature does not easily yield up its mysteries. As Albert Einstein put it:

> "In the realm of the seekers after truth there is no human authority. Whomever attempts to play the magistrate there founders on the laughter of the Gods."

Often when reading the overconfident tone of government and IPCC publications on climate change I wish the would-be magistrates who write these documents had heeded this gentle caution.

The reality that many scientific questions are unanswerable runs up against the political constraint that Official Science is called upon, not to convey information per se, but to create an impression of *certainty*. This may seem like an unfair judgment, but recall Truman's famous lament about needing a one-handed economist. Official Science acts as an agent to principals (namely politicians) who must go out in public to defend a contentious decision, and they want to be able to point to solid science as their support. For such a purpose the Official Science doesn't have to be *right*, but it does have to appear certain. That the subject might be fundamentally uncertain is no obstacle—after all the long range prediction of climate is not possible, but that doesn't stop world leaders from making decisions on the assumption that it is routinely and accurately accomplished.

Lest that last statement strike the reader as controversial, I should offer a supporting citation, viz:

> In climate research and modeling, we should recognize that we are dealing with a coupled non-linear chaotic system, and therefore that the long-term prediction of future climate states is not possible. The most we can expect to achieve is the prediction of the probability distribution of the system's future possible states by the generation of ensembles of model solutions.
>
> IPCC Third Assessment Report, Chapter 14.2.2.2

Not only are long term predictions of climate states impossible, but even short term prediction is effectively impossible. In the winter of 2004 Environment Canada predicted that summer 2004 would be exceptionally hot and dry.[2] It turned out to be unusually cold and wet. This provoked little public reaction, because no one expects computer models to be able to forecast the weather months in advance. The problems of predicting the climate years or decades in advance are even more intractable, not less: as we detailed in *Taken By Storm* there is less of a theoretical basis for understanding the state and dynamics on the climate scale than there is for observable weather. Yet the public accepts long-term climate forecasts at face value, based on endorsement by Official Science. In this respect Official Science has done its job well on the climate file, though the amputation of one hand from the body of expert opinion was not without some bloodshed.

That Official Science (in particular the IPCC) is geared towards providing certainty rather than information can be illustrated by the conspicuous change to the widely-quoted "conclusion" of the 2001 IPCC Third Assessment Report. The draft version released in April 2000, at the close of the scientific review process, read as follows:

- *From the body of evidence since IPCC (1996), we conclude that there has been a discernible human influence on global climate*. Studies are beginning to separate the contributions to observed climate change attributable to individual external influences, both anthropogenic and natural. This work suggests that anthropogenic greenhouse gases are a substantial contributor to the observed warming, especially over the past 30 years. However, the accuracy of these estimates continues to be limited by uncertainties in estimates of internal variability, natural and anthropogenic forcing, and the climate response to external forcing.

This paragraph is suitably non-committal, and conveys the intrinsic uncertainty in the subject. For this reason, presumably, it was deemed to be unsuitable for publication during the subsequent "government review" phase, wherein it was re-written into the much more definitive form published 9 months later:

[2] See comparison of forecast to actual temperature anomaly fields at http://weatheroffice.ec.gc.ca/saisons/charts_e.html?season=jja&year=2004&type=t.

> In the light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely[7] to have been due to the increase in greenhouse gas concentrations.

There was no great advance of science in those 9 months to justify this amplification of certainty: some officials (never identified) simply stripped out the relevant uncertainties because, in effect, that was their job.

Another illustration of the drive for certainty in Official Science was brought to light by an article in *New Scientist* in September 2004, concerning the fact that newer, more complex climate models are not providing anticipated reductions in the range of future global warming scenarios.

> "Some climate scientists find these new figures disturbing not just for what they suggest about the atmosphere's sensitivity to greenhouse gases, but also because they undermine existing predictions. Uncertainty about those predictions is stopping politicians from acting to halt global warming. So, they argue, even suggesting that the model results are less certain could be politically dangerous.
>
> But other climate scientists fear creating a spurious certainty about climate change. Since we don't know what the future holds, they say, we shouldn't claim to know. These people see the predictions of climate models as less like a weather forecast and more like a bookmaker setting odds for a high-stakes horse race. There are no "dead certainties". They say that humanity has to act prudently and hedge its bets about future climate change in the absence of certainty. We will, they argue, never be able to see through the clouds, and politicians will just have to accept that."
>
> *New Scientist* September 2004.

The bind for regular scientists who might protest the intellectual compromises inherent in Official Science is that it is hard to speak out on behalf of a position of uncertainty. If someone with the ear of Pharaoh claims to know something that cannot be verified one way or the other (such as the state of the future climate), the critic's profession of ignorance hardly amounts to a compelling rebuttal, and it guarantees that politicians will be less inclined to seek his advice anyway. Early in the process of researching climate change, some regular scientists tried to warn the public about the peril created by this epistemological asymmetry. For instance, Craig Bohren, an atmospheric physicist at Penn State, had this to say in 1994 speech:

> The government's response to clamoring from an electorate frightened by global warmers to do something about global warming is to recklessly toss money to the wind, where it is eagerly grasped by various opportunists and porch-climbers… I have never understood

> Gresham's law in economics--bad money drives good money out of circulation--but I do understand this law applied to science. Incompetent, dishonest, opportunistic, porch-climbing scientists will provide certainty where none exists, thereby driving out of circulation those scientists who can only confess to honest ignorance and uncertainty.
>
> (Bohren 1994, quoted with permission in *Taken By Storm* page 301.)

In a policymaking setting, faced with the need for certainty to underpin a public decision, some form of Official Science panel is inevitable. Consider, for example, the debate over whether lawn chemicals are a threat to health in cities. A government wants advice on the science, and by some chain of rumour, acquaintance and political jockeying, Professor Bland is selected to form a panel and write a report. The Panel settles on a particular view. The Bland Report comes out, 1,000 pages long, dense with footnotes, all boiling down to a conclusion, which as it happens was precisely the view that Professor Bland and the other panelists held before writing the report.

So far so good. The problems begin when some other experts start to object. They say they weren't consulted, or that the Bland Panel overlooked important evidence. But by now the government has institutionalized the Bland Report, referring to it as the scientific basis for a contentious decision. The opponents are the "skeptics," the minority, the outsiders; industry hacks or environmental alarmists as the case may be. It doesn't matter how many of them there are, how big the errors are that they find in the Bland Report or how good their own arguments are. They do not have the institutional standing to produce a report of their own. Even if they sign joint letters of protest they are individuals speaking against an institution. To the extent they are politically embarrassing the government can easily deal with them by playing whack-a-mole.

So the expert critics get frustrated and drop out of the debate. While this solves the immediate political problem, the result is that their expertise gets lost just when it is most needed.

While the overall process seems to have little consistent structure, at least as compared to trials and prospectus audits, there are two elements of codification worth mentioning. First, Official Science often faces a formal requirement that the information on which the conclusions rest must be drawn from "peer-reviewed" journals. While this appears to be a constraint, in practice it is not, since a limitless variety of views can be supported with reference to peer-reviewed publications. Peer review is nothing like a jury trial or a financial audit, it is typically little more than an informal advice to an editor. An editor selects reviewers to provide anonymous advice about whether a paper ought to be published. Obviously an editor can (if he or she chooses) select reviewers who are known to be favourably or unfavourably disposed towards the paper, thus turning the process into a rubber stamp for foregone conclusions. Depending on the journal, the paper may go through a tough screening that weeds out error, but there are lots of journals publishing lots of papers of very inconsistent quality, and if someone is determined he or she can usually get published in a "peer reviewed" journal somewhere.

The "real" review is the later process of replication, challenge, critique and debate that goes on among specialists in a field after a paper has been published. This is a slower process, and can take years or decades to proceed. However if a study is particularly pertinent for a policy debate,

there is no reason in principle a science panel could not accelerate the process by hiring consultants to replicate it.

Indeed peer review can be perverted these days in even more insidious ways. In March 2004 a document was distributed via Canadian climate change research networks inviting participation in a multi-university consortium organized out of the UK. Entitled "Economic and technological dimensions of stabilising atmospheric CO_2 concentrations: An international and comparative analysis" the plan proposed a tight series of consultations with interested researchers on the economics of stabilising the carbon dioxide concentration in the atmosphere. It is taken for granted in the proposal that this would be, first, feasible, and second, desirable, and the proposal is to discuss modelling strategies for assessing the costs. There has been copious work on the costs of CO_2 emission cuts already, but the organizers have in mind new studies that build in rather fanciful assumptions about ambitious technological innovations that somehow could be induced by fiat, presumably reducing the projected costs of the policy. What makes the proposal disturbing is not so much its tendentiousness or the ill-posed set of questions motivating it, but the transparent plan to produce papers on a timetable to ensure they can be used by the IPCC in its next (Fourth) Assessment Report, due out in 2007, including purchasing a special issue of a "leading journal":

> Based upon preliminary consultations held in Potsdam, Utrecht and Milan, diverse modeling teams would undertake to generate results relating specifically to questions surrounding atmospheric stabilisation that would be of interest to, and on a timescale for, the IPCC Fourth Assessment. The final results would be written up as a series of papers from the different teams.. The results would then be collated and published as a Special Issue of a leading journal (see Umbrella Programme), in time for the results to be incorporated in the IPCC AR4.

The authors propose careful coordination with the IPCC at each step to ensure that the research work is "relevant" to their report.

Had this proposal come from, say, Exxon, the outcry would have been deafening. Suppose a major fossil energy corporation was soliciting participation in a series of studies based on vaguely-defined methodology with a predetermined set of conclusions in mind, and with sufficient budget in place to purchase a special issue of a leading journal so as to guarantee the results come out in a "peer-reviewed" forum in time to be used by the IPCC, which would have been involved along the way steering the research agenda. There would have, rightly, been considerable protest against the distorting of the peer-review process and the disingenuity of the IPCC steering research into print so that it could then cite it in its Assessment Report. That the funding is coming from governments does not make the situation any less disturbing.

Thus a stated reliance on the standard of "journal peer review" does not amount to much of a standard at all. The second codification is unique to the US, where the Federal Data Quality Act (FDQA) has been in force for three years. This act refers to the use of scientific information in

government documents disseminated to the public and referred to as support for government policy. It imposes requirements of "objectivity" (whether the disseminated information is presented in an *accurate, clear, complete* and *unbiased* manner and is as a matter of substance *accurate, reliable* and *unbiased*), and "utility" (referring to the *usefulness* of the information to the intended users). A study containing "influential scientific or statistical information", must also meet a "reproducibility" standard, setting forth transparency regarding data and methods of analysis, "as a quality standard above and beyond some peer review quality standards."

The FDQA is already having an impact on the kind of scientific work done in the US government, since the Act prohibits public money from being used to disseminate documents that fail to meet its standards. Perhaps the best known examples of its impact concerned the US National Assessment on Climate Change of 2000 and The Environmental Protection Agency (EPA) "Climate Action Report" of 2002. The Competitive Enterprise Institute (CEI, www.cei.org) sued the Administration in 2002 to prevent dissemination of the National Assessment on the grounds that it fails to meet the Act's standards. The Administration settled the lawsuit by adding a disclaimer to the National Assessment web site stating that the document was produced by an outside agency and was not subject to the requirements of the Act, effectively prohibiting its use for policymaking within the government.[3] The CEI then petitioned the EPA to cease dissemination of the Climate Action Report. The EPA rejected the petition, not because they dispute that the document fails to meet the FDQA standards but on the grounds that the EPA does not actively disseminate the report in question (the matter is under appeal).

I will conclude this section by offering a personal opinion on whether the process of connecting climate science to climate policy meets the tests implied by the Principles of Balance, Disclosure and Due Diligence. Considering the costs of implementing the Kyoto Protocol in Canada and elsewhere[4] as well as the enormous complexities of the underlying science(s), I hold that the standard should be set very high for the policymaking process, and these three principles do not represent an onerous or unusual burden. Yet I find the IPCC and Environment Canada fail to meet them.

That the IPCC advocates for only one point of view is no secret. In a February 2003 interview in *Le Monde*, Rajendra Pachauri, the chairman of the UN Intergovernmental Panel on Climate Change made the following comment:

> "…the fact is that our climate is changing and the consequences are very serious. Global warming demands dramatic behavioural changes on the part of individuals and societies, and we know that these changes are difficult to accept and to put into practice…. The Flat-Earth Society has only a handful of members today, and they continue to meet every

[3] http://www.usgcrp.gov/usgcrp/nacc/.

[4] See, for instance, McKitrick, Ross and Randall Wigle (2002), "The Kyoto Protocol: Canada's Risky Rush to Judgment", C.D. Howe Commentary, October 2002, available at http://www.uoguelph.ca/~rmckitri/research/papers.html; McKitrick, Ross (2003) "Budget 2003 and the Kyoto Process" in *The 2003 Federal Budget: Conflicting Tensions* edited by Charles Beach and Thomas Wilson, John Deutsch Institute, Queen's University.

> year, to assert that the earth is indeed a slice. It is the same with climate change - you may deny it, but it is a fact."

He conflates "climate change" (which is a permanent and natural state of the Earth's environment) with human-induced global warming, but this does not disguise his point that anyone disagreeing with his position on the science (and the policy agenda he assumes it necessitates) can be dismissed as a Flat-Earther. In saying this he is following an earlier IPCC tradition: in a widely-reported Reuters article of April 2001 his predecessor Robert Watson publicly dismissed the suggestion that there is a division of expert opinion on climate change: "I personally believe it's something like 98-2 or 99-1," referring to the proportion of scientists whom he said support the IPCC position.

There is nothing wrong with the IPCC holding a particular view on climate change, the problem is that it is an institution viewed by governments as a balanced adjudicator of the science, rather than as an advocate for one particular point of view. In fact there are many scientists who have published research that casts doubt on the IPCC conclusions, with more coming out all the time, and many have stated publicly that they disagree with the IPCC on professional grounds. What is frustrating to an observer and practitioner like me is that because the IPCC is a government institution whereas the critics—no matter how many or how competent—are individuals, there is a presumption that the institution must be right.

Environment Canada has also never sought to evaluate the arguments of scientists who dispute their position on global warming: indeed they do not seem to believe that there are any grounds for disputing their position. In their Action Plan 2000 they summarized the science with the statement "Our scientific understanding of climate change is sound and leaves no doubt that it is essential to take action now to reduce emissions." (Chapter 7: "Investing in Future Solutions."). Around the time this was published I attended a meeting on research funding with (among many others) a senior official at Environment Canada. In discussing climate change he lamented that he didn't know of any experts who could present counterpoints to the dominant views he was hearing within his Ministry. I promptly took out a piece of paper and wrote down the names of at least a dozen scientists at universities, and the topics they could specifically address. I suggested he find the money to put on a workshop where these experts could come in and discuss their research. He was initially quite positive on the suggestion, but after thinking about it he handed me the list back and said that while he'd love to see it happen, he could not do it himself. His explanation was worded roughly like this: "The Minister has spoken and the Prime Minister has spoken. If I spend government money on an event that openly contradicts their views I would lose my job."

This was a career civil servant, with considerable seniority, and he was unwilling to serve as a conduit for a balancing perspective out of fear of being fired. So, of course, no such consultation ever took place. Not every ministry is as unbalanced as Environment Canada, but listening to the utterances of Former Environment Minister David Anderson it is clear he only ever got one type of information, with the certainty quotient running extremely high. In response to my written suggestion in 2001 that he meet some of his skeptics he wrote back about having "conclusive proof that the climate has changed and that this is the result of human activities" thereby

dismissing the need to hear from others (quoted in *Taken By Storm* p. 56). More recently (February 2004) he spoke in Toronto where he castigated the suggestion that there is any uncertainty on global warming:

> Sir David King, the chief scientific advisor to the Government of the United Kingdom puts it bluntly. "Climate change is real." Full stop. Not, 'maybe'. Not, 'sort of'. *Real.*

Here again he conflates climate change with anthropogenic global warming, but the context of the speech made it clear he means the latter. This aggressive claim of certainty would be remarkable for any area of science, but for a topic like climate change it is demented. In any case the point is that there is no balance to the treatment of the subject in Environment Canada or the IPCC, because no contrasting points of view are sought out.

As for the Principles of Disclosure and Due Diligence, I have been involved in an ongoing effort to replicate one of the central aspects of the IPCC case for global warming, the so-called "hockey stick" graph[5] of Mann, Bradley and Hughes, purporting to show that the climate of the late 20th century is unusually warm compared to the past thousand years. Full details are available on my web site[6] as well as in a forthcoming book chapter.[7] The episode sheds considerable light on the failure of the IPCC, Environment Canada and other agencies that promote the global warming scare to implement either principle.

When my coauthor Stephen McIntyre first looked into replicating the Mann et al. result he immediately discovered that the data could not previously have been requisitioned by anyone, since it took some considerable digging by the originating author to come up with a useable version of the data. When we published a study[8] enumerating many errors in that dataset Professor Mann promptly disowned the file we had been sent, instead pointing to a new FTP source, the contents of which turned out to differ from what had been described in the original *Nature* publication. When we pointed this out to *Nature* they ordered publication of a Corrigendum.[9] In subsequent correspondence we have uncovered further discrepancies in the data identification and the methodological description, but *Nature* has effectively given up trying to resolve them.

The influence of the Mann et al. hockey stick on the IPCC conclusion cannot be overstated: it appears in Figures 2-20 and 2-21 in Chapter 2 of the 2001 IPCC Working Group 1 *Assessment Report*, Figure 1b in the Working Group 1 *Summary for Policymakers*, Figure 5 in the *Technical Summary*, and Figures 2-3 and 9-1B in the *Synthesis Report*. The IPCC *Summary for Policymakers* (p. 3) used this figure as the basis of its prominent claim that it is likely "that the

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[5] Based on Mann, M.E., Bradley, R.S. & Hughes, M.K. (1998) *Nature*, 392, 779-787 and Mann, M.E., Bradley, R.S. and Hughes, M.K., (1999). *Geophysical Research Letters*, 26, 759-762.
[6] http://www.uoguelph.ca/~rmckitri/research/trc.html.
[7] McKitrick, Ross (2004) "The Mann et al. Northern Hemisphere Climate Index: A Tale of 'Due Diligence.'" (Washington: Marshall Institute, forthcoming.)
[8] McIntyre, S. & McKitrick, R. (2003). *Environment and Energy* 14(6), 751-771.
[9] Mann, Bradley and Hughes (2004) Corrigendum, *Nature* July 1, 2004, page 105.

1990s has been the warmest decade and 1998 the warmest year of the millennium" for the Northern Hemisphere. The hockey stick graph has also been reprinted countless times and used by governments around the world, including Environment Canada. Yet none of these bodies made any attempt to verify the results or replicate the study. After publishing our first paper on the subject we were contacted by a scientist who had tried to warn the IPCC about its use of the hockey stick graph without proper evaluation:

> "…I was one of a myriad of "reviewers" of the IPCC 2000, prior to its publication. One of the major concerns I expressed was the high level of credence given to the Mann et al. temperature history, without it having been seriously subjected to testing. I strongly recommended that this had some dangerous implication, should the reliance upon that research prove premature…."

Another scientist commented in print some time later that his own, similar misgivings about the graph had prompted him to remove it from the paleoclimatology text he was then authoring.[10] Clearly the IPCC does not perceive its duty to include due diligence in any form that would be recognizable in a private sector setting.

The duty of disclosure is closely related in this instance. After Steve McIntyre and I published our preliminary work, we were criticized by Mann et al. for not using the "right" data or the "right" methods, though we had used what was then available and requests for further details had been refused. In the aftermath of our publication we were able to work out some more specifics of the methodology and data, but to this day some important details remain undisclosed. We were unable to convince *Nature* to force release of these details even though they had published the original article and relied on some undisclosed computations in their subsequent refusal to publish a critique we submitted. We unsuccessfully petitioned the US National Science Foundation (NSF), which funded the research, to enforce its own policies on grant recipients by requiring Mann et al. to disclose their computer code and computations; the NSF argued these were the personal property of the authors. We spent an enormous amount of time in 2003-2004 extracting some of the information behind the Mann et al. 1998 paper, but eventually it became clear the institutions involved had no willingness to enforce their existing disclosure requirements on published authors. Much less have the IPCC or Environment Canada ever verified the information behind the conclusions they publish, in particular those based on the studies of Mann et al. We know they have never sought disclosure of this information, let alone felt an obligation to provide such disclosure to those readers in government and the general public whom they feel are obliged to take their position seriously.

3. A Better Mechanism for Official Science

It should not be surprising at this stage of the argument that I would like to see Official Science placed under an obligation to meet the three principles I have outlined above: Balance, Disclosure and Due Diligence. If these are deemed too onerous for the government to meet when proposing policies that will cost the taxpayers tens of billions of dollars, how then does the government justify requiring the courts and the private sector to meet them in situations where much smaller

[10] Muller, Richard (2003). "Medieval Global Warming." *MIT Technology Review* December 17, 2003.

amounts of money are usually at stake? There is no justification for any such double standard. The principles could be implemented as follows.

The Principle of Balance.

In *Taken By Storm* Chris Essex and I spelled out a detailed proposal for introducing balance into settings where scientific information is used to decide major policies. Suppose a municipality is trying to decide whether to ban lawn pesticides. Rather than forming one panel, a city should form two: one would be asked to produce the strongest possible case for the ban and the other the strongest possible case against. Then each team would be asked to write a rebuttal to the other's. The final report would consist of all four documents, and would not contain an executive summary.

Does this sound strange? Two teams? Handpicked so they hold foregone conclusions? Sure. Let them be as biased as they like. Let them self-select their members and tilt together into their preferred position. Remember that for the *process* to be balanced does not require that the individuals involved be neutral, only that the contrasting points of view be well-represented. In the end the two teams' reports will be set side by side. If they are evenly matched, so be it. That is the honest message of the science. And any process that fails to convey it is perpetrating a fraud on the public.

In the case of climate change, the day is far spent and it may seem like a pipe dream to hope for a balanced process, but then again the issue is going to be here for a long time and there is no reason to settle for the flawed institutions currently dominating the discussion. There are opposing views, and it is not obvious which is correct on any particular question. Governments ought to form two groups with equal funding and adequate membership in each. One group could be called Heads and the other group Tails. The job of the Heads group would be to produce a report making as strong a case as possible that human activity is causing a significant climate change that will have harmful consequences. The Tails group would have the job of making as strong a case as possible to the contrary.

Since we would have done away with the artificial labels of "mainstream" and "marginal," a wider range of participants would likely come forward, especially on what today is maligned as the "skeptical" side.

Each group would be asked to produce, say, a 300-page report, as well as, later, a 100-page rebuttal to the other group. The complete 800-page document would be released without a summary, but with an index. It would be submitted to the world's governments without either panel being asked to render a decision on which team's report is stronger.

Each government then would have to decide for itself. They could, if they like, consult internal and external experts for their opinions. But even if one government made the mistake of setting up a national Official Science group to render a verdict and write a summary, it would not bind on any other country.

The Principle of Disclosure

In addition to the above mechanism I would like to see rules established (akin to the FDQA in the US) governing what kind of science can be invoked for public policy. For a study to be referred to in a policy-relevant assessment it is not enough that it have passed journal peer review. It must meet a standard of disclosure in which the data and computational methods used to derive the results are either freely available, or in the case of proprietary data, has been supplied on request to an independent third party who have certified the reproducibility of the results. Many academic journals are toughening up their disclosure rules. The *American Economic Review*, for instance, late in 2003 adopted a rigid new policy that any paper being published in the journal, as a precondition of publication must supply the data and computational code for archiving on the journal web site. This came about as a result of a project in which two authors were unable to reproduce a majority of the results in a recent edition of the *Review*, mostly because of unavailability of the data or the obscurity of the methods. The rule I have in mind would stipulate that in cases where full, true and plain disclosure of data and methods cannot be verified, a study cannot be referred to in assessment documents which will be cited in support of a policy decision.

The Principle of Due Diligence

In many policy settings there are a few studies which are of identifiably pivotal importance. In air pollution policy, for example, there are a handful of very influential studies looking at the correlation between pollution levels and health effects or mortality. In climate change there are a handful of papers (including the Mann et al. papers cited above) that strongly influence the conclusions of the IPCC, and in turn groups like Environment Canada. A requirement of due diligence would require that the expert staff at government ministries or specialized bodies like the IPCC must verify that they can reproduce these results starting from scratch in another computer package. This would follow on from disclosure, but would also ensure that the analytical methodology was accurately stated and the process of re-doing the results would bring to light any errors in methodology. I envision either specialized statistical consulting firms would emerge to do this replication work, or there would be a buildup of more technically sophisticated staff in government bureaucracies. It would also force researchers who want their work to be influential on policy to be more conscientious in publishing their data, methods and code in easily accessible formats.

4. Public Science in Liberal Democracy: Three Questions

To conclude I turn to the very stimulating questions posed by the conference organizers, which I hope the foregoing has laid some groundwork for answering.

1. Can science retain independence and objectivity in the face of demands to meet commercial and public policy objectives?

At the risk of sounding trite I must object that *science* is a thing, not a person, and as such is trivially independent, objective and impersonal. It always will be these things, as will the stars above and potted plant in the corner, and this is nothing special one way or the other. *Scientists* however, as human beings, are neither independent nor entirely objective. I have been influenced

in my (admittedly limited) thinking about the nature of scientific knowledge by Michael Polanyi's fascinating book *Personal Knowledge*.[11] The richness and extent of his insights are not done justice by the one essay of his ("The Republic of Science") included the conference reading package: indeed my answer to the question could be skipped in favour of reading the two-page preface to his book.

As to objectivity, knowing is a skillful act involving a personal commitment to what one believes to be true, coupled with an awareness of one's capacity to be wrong, and consequently is inherently subjective in the sense that all knowledge must be "somebody's" knowledge. Yet, as Polanyi emphasizes, knowledge is not subjective, since objective truth is the external reality of which the knower is focally aware. Skills, including particular elements of an intellectual framework, must be indwelt at an uncritical and precognitive level for them to support knowledge of the real, and as such any serious scientific training must cultivate a deep personal commitment to a field and its assumptions. Hence, as to 'independence,' let's ask: independent of what? The scientist only acquires training by subordinating his or her judgment to a community of expert practitioners—a scientist attempting to be independent of the scholarly community would never acquire the knowledge nor indwell the tools of analysis sufficiently to get started in the field. Nor is a scientist independent of the interested public. The long effort required to acquire advanced scientific knowledge is motivated by a passionate interest in the subject and this inevitably brings the academic scientist into repeated contact with people who share that interest, including members of the public. We would think of someone who tried to avoid all such interaction as being eccentric, if not senile.

Can scientists be independent and objective? No, nor would we want them to be. They are interdependent on one another and on the communities in which they live, and their knowledge reflects the unavoidable personal commitment to the skills subordinated in the act of comprehending the objective reality hidden from the casual observer. We do ask that scientists be honest and suppress any preferences they may hold as to the outcome of analyses or experiments in favour of letting the data speak transparently. But users of the knowledge for the purpose of political or institutional decision-making have a fiduciary duty to establish processes that do not rely for their validity on the voluntary honesty and balance of the participants, any more than we rely on the honesty and balance of the prosecutor in a trial, even though we might consider her honest and fair—yet still insist on independent counsel for the defence. Hence the process by which scientific information is conveyed into a policy process can best be made independent and objective by imposing mechanisms to ensure balance, disclosure and due diligence, just as is routinely done in other decision-making contexts.

2. In what ways is scientific discourse privileged in the formation of public policy? Can there be a genuine public discourse if one party is privileged?

If the concern is that scientists get inordinate sway over policy formation, I'd say scientific discourse has not been privileged. As an economist I lament the absence of economic reasoning in many policy settings where economics has direct bearing. I realize there are non-economists who lament the perceived extent of economics influence in policy formation, but this lament is

[11] Polanyi, Michael. *Personal Knowledge*. Chicago: University of Chicago Press, 1958.

overstated. Policy is driven by polling data, and technical arguments are at a disadvantage in this setting, since activists can use rhetoric and demagogy to persuade the public to support worthless and costly measures. When the counterargument requires careful construction and cannot be communicated in soundbites then any technically dense communication is at a disadvantage.

But scientific discourse has been privileged in one sense: by being held to a much lower standard in terms of balance, disclosure and due diligence. Academic research, even when being used to drive multibillion dollar public investments, is done to standards that would never be acceptable in the business sector. This is not necessarily a problem for the academic purpose being served, since researchers have to have considerable leeway to make their mistakes in public in order to ensure scholarly communication remains open and important topics are probed through. The problem arises when governments assume journal peer review amounts to a standard of verification similar to what would be applied in a business setting or a trial procedure. This is a disastrous assumption.

3. How can scientific knowledge and scientific methodology be made compatible with the interdisciplinarity and integration required of public policy discourse and formation?

I have set out suggestions in the previous section that would address these issues, at least to some extent. But let me reverse the question: how can the interdisciplinary bodies involved in public policymaking (e.g. the civil service and the interested academic sector) be convinced of the need to grapple with the scientific knowledge and methodologies relevant to understanding the issues at hand? There is an onus on both sides. The users of the knowledge have to meet the producers of the knowledge halfway. It is not necessary for politicians to be scientists, or even for all their bureaucrats and advisors to be scientists. But they have to be prepared to do the hard work of learning some of the science, including the mathematical foundations.

I have, on several occasions, addressed audiences of influential bureaucrats on technical issues relating to climate change science and policy. While there are many intelligent and well-trained government staffmembers and elected officials who genuinely want to grapple with the technicalities, I have also encountered more than a few who are intellectually lazy, expecting to have complex mathematical ideas reduced to a thin, sweet milk then spoon-fed into them. But many of the important scientific issues of the day just cannot be reduced this way without fundamentally misrepresenting them. There are people who are happy to present their message in snappy soundbites, because their message is simplistic and shallow. But if we want sound policy we have to have a mechanism for communicating honest, complex, deep science into the policymaking process, without distorting or stripping down the content along the way. My suggestions, as laid out in the previous section, are aimed at doing just this.