



Central Coast Climate Science Education

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Essay 1: The Peer Review Tradition and the Volume of Climate Science Research

Science evolves by the continual refining and checking of ideas and results. Clearly some sort of 'quality control' is required, otherwise scientists would be totally overwhelmed by contributions which are undocumented and unsubstantiated. This is now more true than ever with the explosion of the internet.

As of today (March 21, 2010) I have just entered 'climate change' in Google: It returned 49,600,000 entries! For 'global warming' the result was 27,000,000. (These numbers change markedly from month to month for reasons known only to Google). Needless to say, some of these entries will contain more reliable information than others.

The Peer Review Process

Scientists have dealt with this issue by adopting the practice of 'peer review'. I will describe this process based upon my own experience in Astronomy, and although details will vary from one discipline to another, here is basically how it works:

- 1) An author (or much more commonly nowadays, a group of authors) carry out research on a particular topic, usually over many months or years. When they feel their results are ready for publication they write them up. There is a fairly standard format which nearly always includes: a) The full list of authors and their home institutions b) An 'abstract' which gives the essence of the publication in a paragraph or two c) The main body of the publication d) A summarizing discussion of the main results and their significance. e) A list of previously published papers which were referred to in the paper, giving the names of the authors of these publications and the name, year, volume and page numbers of the journals referred to.
- 2) The authors decide which professional journal they think is most appropriate for the research they have completed and submit it to the Editor of that journal. Most journals are administered under the auspices of the professional society dealing with the particular subject matter. (For example, in the United States, papers in Astronomy or Astrophysics are usually sent to one of two journals run under the auspices of the American Astronomical Society). However there are a few journals (notably the British journal NATURE and the American journal SCIENCE) which deal with a wide area of science--these general journals are most often used for publishing shorter 'hot off the press' results.
- 3) The Editor of the journal to which the paper was submitted (usually aided by an Editorial Board, responsible to the sponsoring professional society) will then examine the contents of the paper and will decide if the subject matter seems to be appropriate for that

particular journal. If so, then the paper is sent to at least one and usually two or even three 'Referees', deemed by the Editor and/or members of his Board to have expertise in the subject of the paper.

4) The Referees are then asked to carefully read the paper and make recommendations to the Editor. These usually fall into one of three categories: a) The paper should be published "as is". b) The paper is worthy of publication, but only after some modifications have been made. c) The paper suffers from such serious flaws that it should not be considered further for publication.

These 'Referee Reports' are sent back to the Editor who passes them back to the Authors, generally, but not always, with the Referees being anonymous as far as the Authors are concerned. (Of course the Authors always engage in a guessing game as to who the Referees were--sometimes correctly, sometimes not).

The Referees make their recommendations based on several criteria, including:

- a) Does the paper contain new results or confirm old results in a new way, and are these results significant or fairly trivial?
- b) Are the Authors aware of previous work bearing on their subject, and have they taken this work into account and referenced it?
- c) Are the conclusions drawn based upon reasonable data or analysis, and is the analysis and source of the data clearly spelled out so that readers familiar with the topic can follow it?
- d) Are there sections of the paper which are confusingly written and need to be clarified?

Of course, some subjectivity is always involved. Further, needless to say, breathes there an Author who has received a critical Referee's Report and whose immediate response has *not* been "The Referee is a Complete Idiot!"

(Often, if the Authors really feel that a Referee's Report was unfairly critical, they may request an additional Referee: This is up to the Editor to decide).

5) The Authors revise their paper in accordance with the Referee's Report(s) and send it back to the Editorial Board, which may decide to proceed with publication or send it back to the Referees to see if they are satisfied with the revision.

6) If the Editor and Referees are satisfied, the paper is then published in the Journal. It will appear with the date it was received by the Editor and the date(s) revised versions were submitted. The *vast* majority of research scientists are not motivated to do research for financial gain, but they *do* care about their reputation among their peers for carrying out reliable, original and important work. Having the date their work was submitted to the journal as a matter of public record is a way of ensuring that someone else will not claim that 'We did this before they did.'

There is an exception to the above fairly rigorous procedure: Often workshops or conferences are held on some specialized topic and the research results presented at them are then written up in 'Conference Proceedings'. These written summaries are generally reviewed by an Editor of the Conference Proceedings, but not necessarily passed through a formal review process.

Is the fact that a paper has been through the peer review process and was published in a reputable professional journal any guarantee that it is 'correct'? Of course not. Further

research may modify or even contradict previously published research. That's how science works.

Nor, on the other hand, should reports or postings be ignored out-of-hand if they have *not* been peer reviewed. In such cases, if the report is issued by a major research center (as in the case of the Copenhagen Diagnosis Report referenced in the Resources section of this website) and if the Authors themselves have solid credentials by extensive publications in the peer reviewed literature, then such reports may contain valuable and generally carefully researched information.

However, if none of these conditions apply and a report is simply posted on the internet **or** is issued by a private foundation whose funding sources you cannot establish **or** the Authors of the post or report do not have a solid record of peer-reviewed papers, then: *Let the Buyer Beware.*

(Nearly all climate scientists currently carrying out research have a 'home page' that you can find on the internet if you know the name and institution where they work. Generally, a list of their peer-reviewed publications will be provided.)

In summary, the peer review process is not perfect, but, to paraphrase Winston Churchill's famous remark about Democracy: "The peer review process is the worst way of insuring scientific quality there is--except for all the others."

The Volume of Climate Science Research

I suspect very few members of the general public have any idea of the enormous amount of climate science research currently being carried out. (I certainly did not when I first began to be interested in this subject). I will explore this in more detail in a subsequent essay on the IPCC. For the present, let me just give as an example the "Copenhagen Diagnosis" report mentioned above: The report was put together by 26 Authors covering the full spectrum of climate science. It runs about 50 pages, not counting the references and biographical background of the Authors (which provides a check on the expertise of the Authors). In this brief report there are references to 275 published papers, most of them appearing in about 40 different professional journals. I cannot provide an accurate count of the total number of authors cited in the references, but I would estimate there are about 1000 of them. They are located in many countries. They work in Government research labs or in Universities, both major and minor. This undoubtedly represents only a small fraction of the total amount of published research in the span of time covered by this report.