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The Replication Crisis[1]

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The replication crisis is a phenomenon widely accepted in major institutions of science (Ioannidis, 2005, 2014, Baker 2016). Roughly half of peer reviewed scientific literature is probably flawed or totally wrong. There are almost certainly problems in all fields of science. How did this problem develop? The inadequacies of the peer review system are largely to blame. The peer review process is a grossly deficient quality assurance process.

The peer review problem

Peer review as it works today:

- Peer review is a quick check by maybe a couple of "peers". It might take a just few hours.
- Peers never have time to do thorough checks or genuine replication of work.
- Peers might be the authors friends.
- The public is completely unaware of how pathetic the peer review process is, or its failure rate.
- Science institutions have deceived the public to think peer review is a far more robust and lengthy process than it actually is.
- Peer review makes group-think inevitable.

Examples of reliable science abound and are foundational to our civilization. It is massively replicated and often tested every day. Examples are Newtons laws of motion, Quantum Mechanics, Thermodynamics, Theory of Relativity, most of the medical sciences. You can stake your life on it. *In fact, you do so every day.*

Unfortunately, most of science is not replicated as much as it should be. This often does not matter, because most of this research is not used at all. For example, who cares about the feeding habits of an obscure insect? It has no consequences to anybody. If the research is wrong, it does not matter too much.

Science used for industry is at the other end of the spectrum. It is checked thoroughly before any production is started because it must work. We must rely on it (Figure 1). If it fails, people could die, or the company could go broke.

But not so for governments, especially if the consequence of the research is an anticipated problem decades in the future as is the case for many environmental issues. The problem is made worse if an element of ideology is involved. We may ask: What are the quality assurance processes in environmental science?

[1] The lecture can be watched at https://www.youtube.com/watch?v=nETKLfJyY9E (Recorded by Yngvar Engebretsen).

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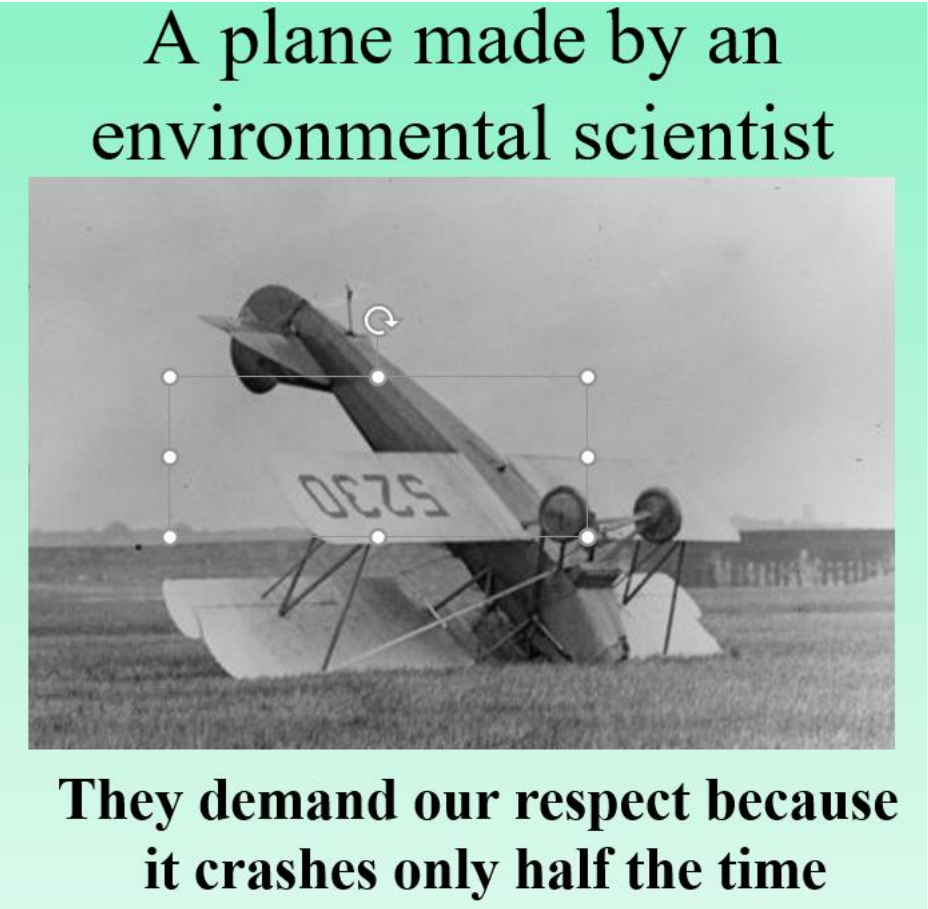

Figure 1: It would be disastrous if industry used the same quality assurance system as the environmental science with its 50 % rate of failure.

Those skeptical of catastrophic anthropogenic climate change are generally excluded from major science institutions. It is dangerous to the career of a young researcher to challenge the conventional wisdom. However, the problems of peer review, which have contributed extensively to dubious conclusions about the role of carbon dioxide on climate, is completely accepted by the mainstream. In order to challenge the conventional wisdom about climate, the problems of peer review, and the lack of decent quality assurance protocols in much of science, must be highlighted.

Richard Horton, UK, the editor in chief of The Lancet stated (Horton, 2000):

> *"we know that the system of peer review is biased, unjust, unaccountable, incomplete, easily fixed, often insulting, usually ignorant, occasionally foolish, and frequently wrong."*

Although there is wide acceptance of the replication crisis, and the problems with peer review, institutions are largely in denial about the possible consequences of this to the scientific foundations of some elements of public policy.

The replication crisis

It is claimed that 50 per cent of the scientific literature in medicine is wrong. Prof John Ioannidis (Stanford University) wrote a famous paper: *"Why most published research findings are false*?" (Ioannidis, 2005). It is also claimed that 85 % of science resources are wasted, due to false or exaggerated findings in the literature (Chalmers and Glaszios, 2009). Funding bodies don't fund replication – even though it is fundamental to the scientific processes.

Another example is the experience of pharmaceutical companies. They routinely try to replicate original scientific published results. One company found that the science was wrong in 80 % of the time (Prinz et al, 2011).

In psychology there is an almost complete failure of replication of the scientific findings. There is definitively a confidence crisis (Wagenmakers 2012).

In marine science two very eminent scientists, Carlos Duarte and Howard Browman (Duarte et al, 2015; Browman, 2016) have posted a call for "organized skepticism" to improve the reliability of the environmental marine sciences: *"the scientific community concerned with problems in the marine ecosystem (should) undertake a rigorous and systematic audit of ocean calamities, with the aim of assessing their generality, severity, and immediacy. Such an audit of ocean calamities would involve a large contingent of scientists coordinated by a global program that assess ocean health."*

What happens to people that speak up against the wrongdoing of the system? They are silenced, expelled, or lose their jobs. In many cases they have to wait until retirement age to speak up. That is why there is a majority of grey heads in this audience.

The legal system vs the scientific system

The scientific system is missing an important component. Let us compare it with the quality assurance of the legal system. *The system is set up to guarantee a debate.* In a legal system there will always be a defense mounted against the prosecution. Regardless of how obviously guilty the defendant is. The defendant will be defended, and the case shall be decided by an independent jury.

In the Great Barrier Reef (GBR) or climate science, we have a jury like the Intergovernmental Panel on Climate Change (IPCC). They have been instructed about what they shall find: CO_2 emission has been guilty since the 1992 treaty was signed. All other scientific results must be silenced. In Great Barrier Reef science there is a consensus committee doing this job. They consist of the same people that will act as the prosecutors, "defense", judge and jury. We can have no trust in such a system. It must be changed.

A revision is needed

We need more Quality Assurance (QA) than peer review with its 50 % failure rate. We are not careful enough with QA in our sciences. We would not accept to fly airplanes that crash half the time? How can we respect a system that comes up with the wrong answer half the time?

And how did we arrive in this messy situation?

Before 1960, science was mostly done by the military or industry. It was generally well tested before put in use. The bomb must explode - the machine must work. Peer review was supplemented by the ultimate tests. Did it work? Then came the soft sciences and environmental sciences. We got predictions of doom in 30 years with no consequences for the scientists if the prediction turned out to be wrong: DDT, CFC-ozone, climate, diesel particle emission etc. How do we tell they are real? In most cases they turned out to be wrong or exaggerating the effects.

The proposed solution is to establish an Office of Science Quality Assurance (QSQA). Not under the Ministry of Science, but run through the Auditor General's office. They don't know science, but they know the meaning of independency. If a scientist produces junk-science, it should have an effect on the reputation of the scientist.

If there is a replication problem, with wrong results more than half the time, and government bodies follow these results, then it is inevitable there will be major consequences for public policy. The cost for people and environment can be excessive.

Conclusions

- The replication crisis was inevitable with a system that uses peer review. One group got control and excluded contradicting views.
- There is a deficiency in our scientific institutions and systems.
- Stop focusing too much on the details of climate science and concentrate on establishing a decent system of replication, checking, and testing the science.
- **Make science work as it should.**

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