**Roots of Honor and Integrity in Science**
"The Ethical Basis of Science"
Bentley Glass

Glass challenges the view that science is nothing more than a non-ethical, objective report of observations of natural phenomena. He does this first by using evolution: he argues that man has evolved a set of moral values alongside his biological evolutionary advances (e.g., larger brain, growing food, living in communities etc). Man's sense of right and wrong (Ethics or "philosophy of morals") was originally derived and is continually questioned through his reason. In the same way science uses reason to arrive at conclusions. Not only that, but science has become a tool to help man adjust to his environment in more ways than those available to him through the slower process of evolution. Science is thus tied to man's social progress. Reason dictates then that the "right" thing to do with science is use it to improve social life, and not doing so would be "wrong."

Since science is a creation of man's reason, it can't be intrinsically objective. Our interpretations are colored by having only one outlook on the world, the human one. The only way for science to become objective is by agreement of different scientists on the data and interpretation of data.

Since science is subjective, and socially entwined, it must be ethical as well. The ethical issues that arise, leading to questions and definitions of "values," come from a conflict between duty of individuals to the society to which they belong and duty to themselves as free people (paraphrased from quote by J. Bronowski). If the freedom of science is the pursuit of truth, the concurrent duty involves allowing truth to be verified by others, whom we trust to value truth just as much.

So Glass proposes 4 "Commandments" as the ethical basis of science, each with their subparts:

1. Complete truthfulness that is scientific integrity. This is the only way that scientific progress can be made, as it must be, in a social environment of verification by others.
2. Related to truthfulness is refraining from stealing others' ideas/experiments. This covers plagiarism through unconscious "borrowing" of another's ideas. Glass finds referees of scientific journals most prone to fall into this latter trap, due to their exposure to work related to, and therefore in competition with, their own. He suggests using scientists who are no longer active in research in balance with younger referees to address this problem. Referees could also refuse to take those manuscripts related to their own work. Reviewers of grants are also in danger of idea "harvesting," perhaps more so than referees. Glass does not propose a solution for this particular scenario.
3. Defense of freedom of intellectual investigation, perhaps with ones life. This is the hardest one. But since science's "laws" are all relative and everything is subject to revision, and it is often impossible to predict beforehand the exact value a discovery may have, scientists must be free to pursue not only what is socially important and useful, but what is creative and interesting and beautiful. Of course there's a wide range of opinion on this, since so much of science is publicly funded. Individual scientists are charged with defending science's freedom from any dogma whether religious or political, to investigate and publish.

4. Lastly, full communication of findings through the following: detailed methods and results so they can be replicated; appropriate abstract/indexing so the work can be found; writing critical reviews that really synthesize data and ideas of a field into a coherent whole; informing the general public; and teaching the next generation.

These Commandments give rise to 3 main social and ethical responsibilities:

1. Proclaiming benefits
2. Warning of risks
3. Discussing dilemmas

The first is mostly about maintaining truthfulness. In the second, scientists must be careful when called to come before the public to distinguish between facts he states from knowledge as an expert in his particular field, and his opinion about what occurs in other fields, in which case he is no different than a layman. Glass uses nuclear warfare possibly resulting from advances in scientific technology as the example, that the scientists (Einstein et. al.), most acutely understanding the situation, thought that it might help negotiations among public officials by discussing the issue of the arms race objectively amongst themselves. As for future dilemmas, Glass hints at genetic engineering ("the control of man over his own biological evolution.").