Why Scientists Behave Scientifically

In the midst of all the debunking of science that is currently fashionable, we tend to lose sight of the fact that science has been and continues to be more successful than any other social institution in fulfilling its stated goals. Of course, science does not have to work all that well to be more successful than any other social institution (such as Congress) in attaining its stated goals. But much more can be said on behalf of science. If the primary goal of science is to increase our knowledge of the natural world, it has been successful beyond anyone's wildest dreams. I admit that very little of this knowledge has found its way into the consciousness of very many human beings. Only a tiny proportion of the human race understands relativity theory, let alone quantum theory, and most people who think that they understand evolutionary theory profoundly misunderstand it. Even so, within its limited domain, science has been extremely successful. The question then becomes, how come?

In 1953 Charles E. Wilson, the President of General Motors, became famous for saying that what is good for General Motors is good for the country.[1] His contemporaries can be excused for being a bit suspicious of such a self-serving claim. But science is fortunate that science is so organized that, by and large, what is good for the individual scientist is good for science. Scientists want credit for their contributions. They want other scientists not only to notice their work but also to use it, preferably with a few generous citations. One of the peculiarities of science is that the first person who publishes a view (or more accurately gets the earliest submission date) gets all the credit, even though several other scientists may have been almost there. As incredible as it may seem, the winner-takes-all convention in science arose in the 17th century in order to force scientists to publish. *Force* scientists to publish! Scientists would like to keep their discoveries under wraps long enough to milk them for their most obvious consequences, but if they withhold them from publication for too long, they are likely to get scooped and get no credit at all. The legacy of this early convention today is an unseemly rush to publish.

However, a system of citation has also arisen that holds in check this rush to be the first to make a view public. Scientists cite the work of other scientists in part to give credit where credit is due but also in part to gain support for their own views. Thus, scientists are caught in a bind. They want their work to be accepted, but they also want it to appear as original as possible. Showing that it flows naturally from the well-established work of one's contemporaries is likely to increase the likelihood that it will be accepted, but such a practice automatically detracts from its originality. Conversely, omitting any references to the work of others makes one's own contributions look highly original but also decreases the likelihood that one's fellow scientists will take it seriously enough to incorporate it into their own work. In general, if a scientist is sparing in citing the work of others, these other scientists are likely to return the compliment. In short, scientists trade credit for support and vice versa. For each opportunity to cite, a scientist can have one or the other, but not both.

Of course, mutual citation can be found in a variety of professional institutions, but what distinguishes science from other professions in this regard is that scientists operate with a notion of truth that is much easier to apply within science than outside it. In fact, one of the defining characteristics of science is the ability to test one's views about the natural world in a reasonably direct way. Although scientists do not test each other's results as often as some naive commentators seem to think that they should, replication does occur in science. One of the strengths of science is that not all results need to be tested. Scientists amass lots of data, some of it fairly isolated, but they also devise theories which organize data and entail all sorts of conclusions about what should be the case. Any error fed into the system is very likely to produce erroneous results elsewhere.

If scientists had to check each and every result before they incorporated it into their own work, science would slow to a crawl. Instead, scientists tend to trust the results produced by others. However, not every scientist engenders the same amount of confidence. Some have the reputation of publishing work that is too fast and dirty, while others produce results that may not be all that exciting but at least you can depend on them. Scientists are constantly enjoined to adhere to the strictest canons of good scientific practice. Such invocations may have some positive effect on how scientists behave, but in other areas of human endeavor, comparable calls to do one's duty hardly seem sufficient to bring about the stated goals of the discipline. For example, physicians who own their own CAT scan machines find that their patients need double the number of such procedures as do physicians who have no financial interest in such machines.

Calls to do one's duty to the larger group certainly have some effect, but it always helps if individuals do not have to sacrifice their individual goals for the good of the group. Social systems work much better when virtue and self-interest go hand in hand. Once again scientists are in a bind. They would like to conduct their research as quickly as possible, to get their results out there sooner than anyone else so that they can get the credit for their discoveries. But the chief credit in science, the currency that really matters, is *use*. Scientists use each other's results, almost always without testing them. However, if something starts going wrong with their own research, scientists begin searching to see what went wrong and why. If the error can be traced back to your work, you are in real trouble. Citations may well give credit where credit is due, but they also leave paper trails for assigning blame as well. With the possibility of credit comes the possibility of *dis*credit.

Because scientists are invested in their own work, they are not all that good at discovering errors in their own pet hypotheses, but other scientists are more than happy to fill the gap. If anything, the sort of testing that goes on in science can be too rigorous. Scientists get very little credit for replicating other scientists' experiments, but they do get credit for discovering mistakes in the work of others, especially if this research is taking place in one of the "hot" areas of science. The rush to publish, when properly constrained, increases the pace of science. The monitor on this pace is the punishment meted out to those scientists who produce unreliable work. Some errors are more understandable, more excusable than others, but any error impedes the research of anyone who uses it. Failure to include appropriate citations hurts the careers of the scientists who are not cited. Erroneous results hurt the careers of everyone who uses them, and they are very likely to retaliate.

Thus, science can be viewed as a self-policing system of mutual exploitation—or cooperation if one prefers. It works only when individual and group interest coincide. As scientists are increasingly able to make money off their discoveries, the same sorts of financial impropriety that characterizes all other professions will increasingly characterize science.[2] Whenever scientists serve two masters, compromises will be made, whether these masters are government, industry, or mammon. Throughout most of the history of modern science, scientists have behaved extremely well as far as determining truth is concerned,[3] not because scientists are inherently superior beings, but because it has been of their own best self-interest to do so. Many scientists may be excellent candidates for sainthood, but one reason why science has worked so well is that scientists need not be saints to contribute to it. As the fathers of our country noted, the "best security for the fidelity of mankind, is to make interest coincide with duty."[4]

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1. For a fuller discussion of this quotation, see D. Dennett, *Darwin's Dangerous Idea* (Simon & Schuster, New York, 1995) p. 324.

2. Fred Grinnell, "Industrial Sponsors and the Scientist," *Journal of NIH Research*, Vol. **V** (June 24, 1993) p. 50.

3. As the frequency and bitterness with which priority disputes are fought amply shows, scientists are not so virtuous when it comes to assigning credit. Scientists are also not quite as concerned with the good of humankind as numerous public declarations would have us believe.

4. *The Federalist Papers* (1788:452).