



Humility

As the product of St. Mary Grade School and High School, I was informed at an early age and for many years thereafter that I should be humble. It was last on the list of the seven virtues taught me by the nuns, the virtue that curbs the sin of pride. For grade school students, many of whom, like myself, were the sons and daughters of immigrants, there wasn't much occasion to be prideful. So, we were encouraged to be self-effacing and modest. Quite a contrast to the self-esteem programs that overlay much education these days. In the fourth grade I remember running for class president, but voting for the other guy out of humility.

Then I got into science. My early notions of the selfless scientist toiling in his laboratory didn't fit with the claims of novelty and priority that marked accomplishment in science. The idea of one's self worth was closer to that found outside in the schoolyard, where we played "King of the Hill" and where claims of "I'm first" were common. It became clear that if you wanted to be heard and appreciated for your research, staying in your lab wouldn't cut it. You had to go out and talk to others about your ideas and work. As it turns out, it is also valuable to talk to others about their work.

While I was writing my textbook, *Elements of Optical Design*, I had a master's student, Steve Weinreich, who commented on the various drafts as I finished them. Steve was an optics student under Father Frank Pedrotti at Marquette. At times, we would also discuss our Catholic education and how it has affected us as scientists. After Steve graduated from Tech, he went west to seek his fortune, before landing a Ball Aerospace job in Colorado in the mid-80s. We saw each other at an optics conference one year and he chided me that I hadn't sent him a copy of *Elements*. So at our next meeting I presented Steve with a copy inscribed, "Despite what sister says, humility is a highly overrated virtue."

In many cases, protestations of humility are highly suspect. For example, I have never believed Isaac Newton's statement that "to myself, I seem to have been only like a

boy playing on the seashore, diverting myself now and then finding a smoother pebble or a prettier shell than the ordinary, whilst the great ocean of truth lay all undiscovered before me." The ingenuity of his work, his efforts to establish his ideas, and the trouble he took to defend his priorities belie the phrase "diverting himself." More to the point and closer to the truth is the comment in a letter to Robert Hooke, his nemesis at the Royal Society: "If I have seen further it is by standing on the shoulders of Giants." Considering that most of the concepts and development of mechanics and optics derived from the mind and experiments of Newton, it would seem to be an odd expression of humility. Because Hooke was short, the comment was more likely a sly insult.

But if researchers show little or no humility in descriptions of their work, there is one aspect of their profession where it is absolutely required, the work itself. Recently, Vice President Al Gore testified before the U. S. Congress on the topic of global warming, having just won an Academy Award for the documentary, "An Inconvenient Truth," which was based on a slide show that he had been presenting for many years. The Democrats liked what he said and praised him for his vision. The Republicans chided him for his alarmism. But even environmental scientists have their concerns. In an analysis of Gore's Capitol Hill testimony by Richard Harris of National Public Radio (<http://www.npr.org/templates/story/story.php?storyId=9072304>), Harris described a talk that Gore gave before the American Geophysical Union meeting in San Francisco last December. Harris said that the talk was applauded, but some scientists expressed concerns about the speech. They felt that while the overall message was correct, Gore got some of the underlying science wrong. This might be traced to the nature of political rhetoric in Washington these days, where controversial issues are described in black and white with no shades of gray. But any scientist knows that is rarely the case.

When pressed to describe the limitations of his or her research, a good researcher will provide caveats and areas of applicability. It is the honest thing to do, but it makes it easy for anyone in the media to enhance or diminish a threat by asking the investigator if they are certain that the consequences of the research will lead inevitably to a horrible conclusion. Of course, the researchers refuse to say so and the threat is vanquished. But it can't be otherwise. If we are true scientists and engineers, however vain we might be, we have to deny certainty. We must have humility about what we know and how well we know it. Doubt is what moves us to satisfy our curiosity. Because we know the limits of knowledge of our field, it is doubt that keeps us humble. And this humility toward our work makes us the scientists and engineers we are.

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