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MARGARET WERTHEIM

We all know the dismal statistics: Our children's test scores on international assessments of math and science literacy are plummeting; the number of PhD students in science and engineering is at a 40-year low; we are desperately short of science teachers; intelligent design is spreading like kudzu; and most of our citizens believe in ESP, angels, or alien abductions. There is much public hand-wringing, and those of us who love science have good reason to worry. The question we face is how to respond. As someone who has been writing about science for the general public for more than 20 years, I would like to suggest that some radical changes are called for in our strategies for communicating science.

The very verb we are dealing with points to the nub of the problem. Unlike speaking and writing, "communicating" supposes an active engagement on the part of an audience. For something to be communicated, it has to be not only transmitted but also *received.* Yet in discussions about how to improve the public's understanding of science—of which there are an escalating number—it seems that only one side of this channel is addressed. We ask: How can we better transmit the findings of science? As a journalist, I wrestle with this daily and feel thrilled when I have managed to coin an elegant article on the ecology of a termite's gut or the mechanics of a spider's eye. But there is another question that has, I think, been factored too little into our discussions: Who is on the receiving end of our missives? In short: Who are we writing *for?*

The primary public resources about science are popular science magazines. It is worth asking, Who buys them? Who reads them? The answers surprise many scientists—and many professional science communicators, too.

Eight top-selling science magazines—*Scientific American, Discover, Popular Science, Wired, Natural History, Science News, Astronomy,* and *Science*—collectively sell about 4.5 million copies a month. In all, they claim around 17 million readers. In magazine-world parlance, a "reader" is someone who spends at least half an hour with an issue. Reader numbers are quoted to attract advertisers and are notoriously optimistic, but let us give the benefit of the doubt here and say that 17 million Americans are looking at some science magazine each month.

Who are they? In a nutshell, they are overwhelmingly well-educated men over 40 in the upper socioeconomic brackets. I gathered the statistics as an exercise a few years ago when the latest figures available were for 2002, but I very much doubt they have changed significantly in the intervening years. These are the facts: In 2002, the median age of *Scientific American* subscribers was 49; for readers, it was 46. The median age of *Discover* readers was 41; of *Popular Science* readers, 43; and of *Science News* subscribers, 49. Of *Scientific American*'s subscribers, 87 percent were men and 13 percent were women. *Wired*'s subscribers were 85 percent male, 15 percent female; *Science News* subscribers were 72 percent male. A representative at *Popular Science,* by far the biggest selling, laughed when I asked for a gender breakdown and said I could safely assume the vast majority were men. Of *Scientific American*'s subscribers, 85 percent had college degrees and 58 percent had graduate degrees. For *Science News* the figures were 78 percent and 46 percent. The median salary of subscribers to *Scientific American* was $87,600; to *Wired,* $90,800; and to *Natural History,* $74,000. Age also provides a window: Two-thirds of the audience of *Popular Science* and *Discover*—which together accounted for 2.5 million copies per month—were over 35 years old. For *Scientific American* and *Science News,* almost 80 percent of subscribers were over 35. Of all subscribers, 22 percent were women. Most of the magazines did not break down their numbers by race.

According to the Census Bureau, the current US population is 299 million. This means that more than 280 million people are not reading any science magazines. Women, people under 35, and those in the lower socioeconomic brackets are barely being touched by the canonical channels of science communication.

Let me introduce, then, another set of numbers. At the same time that I researched statistics on science publications, I also looked at women's magazines. Again I chose eight top sellers—*Vogue, Elle, Glamour, Cosmopolitan, Self, Redbook, In Style,* and *Good Housekeeping.* In 2002, these magazines collectively sold 17.5 million copies a month. *Good Housekeeping* alone sold more copies than all eight science magazines combined (at

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4.7 million a month), and none of the eight sold less than a million. With sales this huge, the women's magazine world does not always bother to collect reader statistics, but if we assume the number of readers per copy is similar to that claimed by the science publications, then close to 70 million people are reading a women's magazine each month.

It is perhaps a sad fact, but ineluctably a true one, that most women do not go near science magazines. It seems to me that if we are serious about improving the public understanding of science, we have to start looking at where the public *is*—and if the mountain is not coming to us, then we must go to it. It is for this reason that for many years, in my native Australia, I wrote columns about science for women's magazines such as *Vogue* and *Elle*. I considered this my missionary work.

Writing for the hairdo and hemlines set carries no cachet in the science world—and little in the science communication world, either—but I consider this some of the most difficult (and serious) work I have done. Believe me, it is harder to explain genetic engineering or big bang cosmology in the context of *Vogue* than in the infinitely more prestigious pages of the *New York Times*'s Science section, for which I also write. The most difficult work I have done by a long shot was writing a television science series aimed at teenage girls, made for ABC Australia.

In May I was presented with the Print Media Award by AIBS for a pair of articles I wrote for the *LA Weekly,* sister paper to the *Village Voice.* As the flagship of alternative newspapers, the *LA Weekly* is known for its arts, culture, and political coverage; before me, they had never had a science writer, and it took me five years to convince them to let me do a science column. It has been an honor and a pleasure and also a challenge. I have to assume my readers know nothing whatever about science and that even the most basic concepts must somehow be conveyed without seeming teacherly. I have had the support of a wonderful editor, Tom Christie, who goes through my pieces with a fine-toothed comb, an open mind, and a naïf's questions. I am sometimes staggered at the things Tom doesn't know, but I remind myself that if he doesn't know, then 99 percent of our readers won't, either. Yet ours is an educated and literate audience.

Scientists often think that science writers dumb down their work, skimping on details and eliding over subtle distinctions. But most science writers—myself included—also love to write long pieces that convey the intricacies of a subject. It is these stories that meet with the approval of scientists (whose approval we journalists naturally desire) and that generally win awards. But the stark reality of our dollar-driven age is that print space is a precious commodity, and we are increasingly lucky to have *any* column inches for science. It is frustrating to have only 900 words, as I did for my columns in the Australian *Vogue,* or 1200, as I do now in the *LA Weekly,* to describe something as complicated as bioremediation or the physics of freezing; but 900 words are better than no words, and in the context of improving the public's understanding of science, every one of them is precious.

Scientists, by training, are experts; the public, by default, are not—and the gap between these two domains is getting wider. It will not do to sit around and bemoan this fact and hope that one morning we will wake up and find that everyone is reading *Science,* or even *Popular Science.* They will not. We may not like the creationists, but there is one thing we could learn from them: the power and the *value* of grassroots proselytizing. In short, those of us who love science are called upon to be missionaries.

It is time to get off our high horses and go out to the people.