REAL SCIENCE ISN'T NEWS

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Henry H. Bauer, Professor of Chemistry & Science Studies
Virginia Polytechnic Institute & State University, Blacksburg, VA 24061-0247
hhbauer@vt.edu

If there's one single thing wrong with media coverage of science, it's that the latest article or announcement from a lab is treated as though it were "science". But such ***frontier*** "science" has none of the reliability that bestowed on science proper its high prestige and status. Frontier "science" changes all the time, and believing what it says at any given time can be harmful to our health (as well as to our understanding and our pocket-books).

One reason for taking the latest stuff as science is if you believe that science gets done and gets guaranteed reliable by "the scientific method". But that isn't so. The "scientific method" doesn't actually explain anything about science, let alone anything interesting – not only that frontier science is unreliable and textbook science very reliable, but also what the 17th-century Scientific Revolution was all about, and why the greatest scientists don't make all the worthwhile discoveries, and why scientists differ so much in so many ways, and what pseudo-science is, and how distinguished scientists surprisingly often come to commit pseudo-science, and why more and faster research is not necessarily a good thing, and why ethical practice is so vital to the soundness of science.

What's most wrong with media coverage of science is treating the latest article or announcement from a lab as though it were "science".

To almost everyone, "science" is synonymous with "reliable", maybe even with "true". If you want to present evidence that something is true, you might say, "tests have shown this works"; but if you want to be completely sure you'll be believed, you'd say, "***scientific*** test have shown it works".

It got that way some time late in the 19th century and because of the tremendous achievements – much greater by now, of course – that fill the textbooks of science. But why is this "textbook science" so reliable? Because it's been tested and modified and improved continually, ***for quite a long time***.

The latest news from a lab isn't that sort of science. It's "frontier science", and it doesn't have much reliability. It's probably as trustworthy, and illuminating for non-scientists, as the daily polls that announce which politicians are going to win six months from now: it'll change umpteen times before the facts are finally in.

There are a number of reasons, of course, for publicizing the latest stuff. It's "news", by definition. The discoverers and their sponsors and institutions ***love*** to have it publicized and try hard to get you to do it. It's exciting, and may get some people interested who wouldn't glance at something less newsy about scientific matters. It sells, in several different ways. But still it's wrong to do it, I think, without adding – not in fine print but in very large print – a ***caveat emptor***, let the buyer beware: believing this may be harmful to your health.

How many times in the last 20 years, say, have recommendations about healthy diet been changed, turned back-to-front, upside-down, opposite to before? Like margarine is better than butter – no, it's worse than butter. Like being underweight is healthier – no, overweight is healthier – no, underweight indeed is healthier – except for women.

When I left hospital after by-pass surgery, I was given several xeroxed sheets of dietary recommendations – and some of them had been altered by pen; even on the way back from the copying machine, apparently, word had come in that shellfish are cholesterol-good and not cholesterol-bad.

And, a few years later and after bringing my blood cholesterol down by strict diet, I read that low cholesterol may cause depression in old age; or, a couple of years after that, that low cholesterol induces violence… (***1***).

Ten years before my by-pass operation, I'd been found to have one severely narrowed coronary artery. I'd been lucky enough to be accepted into a trial, at the National Institutes of Health, of the technique of angioplasty: a deflated balloon is inserted into the constricted artery and inflated. Far, far better than open-heart surgery; the morning following angioplasty, I felt more energetic than for a long time. But when, ten years later, I experienced angina pains, an angiogram showed that deposits had built up at the branching points of all the coronary arteries – hence the need for the quintuple by-pass operation. A couple of years later, I read that it had been discovered that friction inside arteries, as for example when angioplasty is performed, stimulates later formation of deposits. I recalled that my narrowed artery had been in a particularly inaccessible spot and that the surgeon had tried all sorts of ways of getting the balloon into the right place. So my angioplasty had probably made necessary the later by-pass; angioplasty is not quite the advance that it had seemed at first (though I would still cheerfully have one every year rather than a by-pass every ten years).

Some of that sort of thing, continual advance of knowledge and modification of treatments, mightn't actually matter very much. But how many people's hopes have been ***seriously*** and quite unjustifiably aroused by blurbs about gene therapy, cancer cures, AIDS drugs?

How many successful trials of gene therapy have there been? Does anyone know?

In 1995, "the clinical trials conducted over the past 5 years have yielded very few published results … [even though] 567 patients are involved in 106 RAC-approved experiments.… Only a small fraction of these … are aimed at correcting defective genes" (***2***). "'Clinical efficiency has not been definitively demonstrated at this time in any gene therapy protocol' … 'despite anecdotal claims of successful therapy' and despite NIH's approval of more than 100 human studies" (***3***).

Yet how many people's hopes have been seriously ***and quite unjustifiably*** aroused by "news" of "advances" in gene therapy? Elisa Segrave wrote: "I eagerly raced through the first half of *Breakthrough: The Quest to Isolate the Gene for Hereditary Breast Cancer* …. It will attract many readers who, like me, have had breast cancer … [and] fearful women whose mothers or sisters have had breast cancer, and who are avid for information.… The authors conclude that someday a cure for hereditary breast cancer will be found, using gene therapy. But, until that happens, the 'breakthrough' of the title remains an academic one. As the search for the cure stretches indefinitely into the future, I will not be alone in feeling a little let down" (***4***).

I think it's a serious consequence of treating the latest stuff as "science", that people are seduced into becoming guinea pigs with almost no chance, if any at all, of personally benefiting. In my community there have been several drives to raise money in the last few years for people to get bone-marrow transplants. We were not told, however, that "in bone marrow transplants, even when donors and recipients are immunologically matched, the risk of developing a severe or lethal immune reaction … is 40%" (***5***).

I think the public needs to hear – ***deserves*** to hear – a ***balanced***, ***contextual*** view of newfangled ventures. Here are a few more instances where balance – or outright skepticism – would have been warranted:

⇒ Genes have been discovered that cause "or significantly influence" alcoholism, homosexuality, manic depression, "the search for new things", TV-watching, and divorce.

⇒ "Up to 3,000 … may have died prematurely before a nationwide trial discovered that two drugs designed to prevent irregular heart beats could actually cause heart attacks among specific types of patients …. Encainide and flecainide " (***6***)

⇒ Left-handers die younger – OOP's, no, the statistics were bad (***7***)
⇒ Anti-sense technology, *Science*'s 1992 Molecule of the Year; unexpected questions in attempts to use for therapy of cancer, AIDS, and other diseases; they don't work the way it was thought they did (***8***)
⇒ Combined use of 3 anti-AIDS drugs doesn't work after all (***9***)
⇒ An epilepsy "cure" by magnetic fields (***10***)

Of course, you might reasonably say that medicine isn't science, or that these are awfully complicated matters; and that in simpler cases, say in physics, you wouldn't find this constant chopping and changing about new discoveries. But you do. How many times in the last 20 years, say, have we read that the first planets outside the solar system have been discovered? How many times has the discovery been confirmed? And, by the way, how many times did the media follow up the original announcement with the appropriate retraction?

Do you remember

⇒ The incredible lightness of gyroscopes (***11***);
⇒ The heavy neutrinos (about 17 keV), observed by four independent groups between March 1991 and August 1992 (***12***)
⇒ Big astronomical "discovery" turns out to be interference signal from television (***13***)

I think that the fundamental reason for confusing the latest stuff with "science" is the widespread belief that science is what gets done by the scientific method; that it's the method that guarantees reliability; that scientists use the method, and therefore what they produce is reliable from the very beginning.

That method goes something like this:

1. Establish a hypothesis; that is, ***venture a guess*** about something that's not yet known.
2. Devise some experiments or observations that will test the hypothesis.
3. Make the observations or do the experiment.
4. If the results agree with the hypothesis, the belief that led to the hypothesis is confirmed; it becomes an established scientific theory. If the results go the other way, the hypothesis is disproved and a different hypothesis gets tested.

Now presumably you've all learned or are learning that getting experiments or observations right isn't so simple a matter. Still, what I want to say goes far beyond that. Even if you get the same answer ten times in a row, that isn't much guarantee that your result is right, much less the way you interpret it. There might be something systematically wrong with your apparatus or your materials. Anyway, something can't be said to be science until everyone knows about it. So you write up what you've found and publish it.

But a lot of what gets written up never gets published, because the editors and referees find something wrong with it. Why didn't those who wrote it up see the problems? Because it's human nature not easily to see something wrong with what we've done ourselves, others can see it much more easily.

Even with the critiques by editors and referees, the published research articles in the technical literature aren't ironclad true; John Ziman, for example, estimates that 90% of what's in the primary physics literature is wrong. That sort of estimate is underscored by the very short time for which most articles continue to be cited – and actually the overwhelming majority of articles never do get cited by anyone, they're either wrong or unimportant or irrelevant.

What's best in the research literature eventually gets into review articles and monographs – with a time lag of many months or several years; and still some of that never gets into textbooks because it gets modified or disproved within another few years or so.

If using the scientific method guaranteed getting it right, then recent science would be as reliable as old science. But it isn't. What ***has*** made science reliable is the cross-checking, critiquing, competing and cooperating that go on in the scientific community. So it is ***NOT*** that

we've got a knowledge explosion because so many scientists have been so busy using the scientific method: rather, we've got a lot of ***suggested*** scientific knowledge whose reliability we won't be able to judge properly for months or, more typically, several years or even longer, during which time that ***suggested*** knowledge gets ***filtered*** – the honest or deliberate errors removed and the inadequacies recognized by trying to make things happen and seeing whether the suggested stuff really ***works*** or not.

The unreliability of new, frontier "science" contrasted with the reliability of textbook science is one example of how misleading it is to think that science gets done by a scientific method. There are many more examples, many things about the actualities of science that can't be explained in terms of a scientific method. Those many things can, though, be very nicely explained by understanding science as a communal activity rather like putting together a jigsaw puzzle of knowledge about Nature, in which that communal knowledge gets refined as time goes by. For more about all this, about "the scientific method" as ***a knowledge filter***, please have a look at my book, *Scientific Literacy and the Myth of the Scientific Method*.

Citations

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