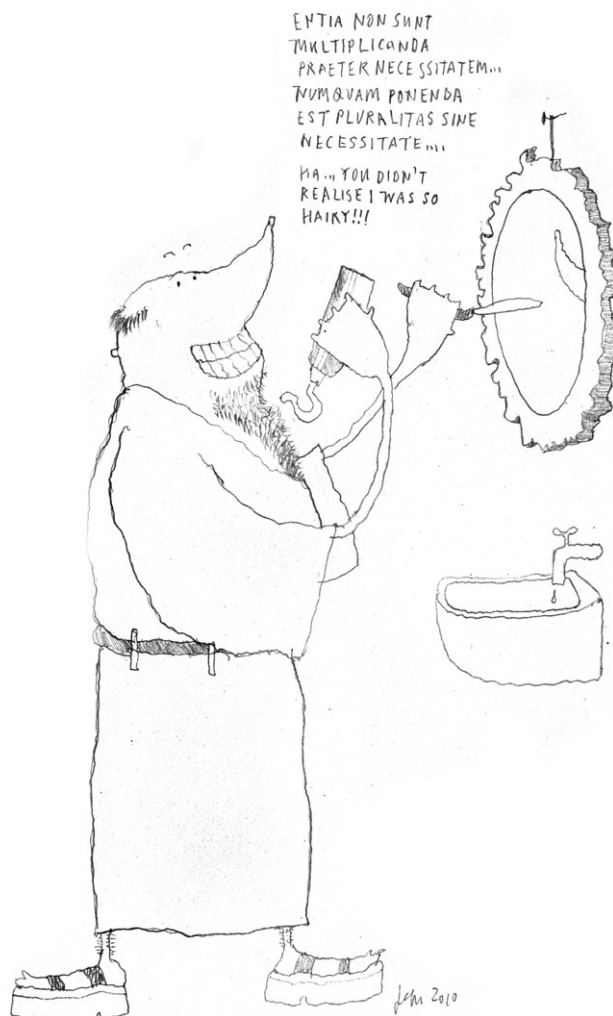


An occasional column, in which Mole and other characters share their views on various aspects of life-science research. Messages for Mole can be sent to mole@biologists.com.

Any correspondence may be published in forthcoming issues.



The Razor

Ouch. Another nick in the wall. Bit of tissue to staunch the flow and... ouch! Oh, I do hate to shave, which might explain why I do it so rarely. But today, it's worse than usual, because I'm shaving with a very dull razor I got from William of Ockham. Nasty, unwieldy thing, but I thought I should use it. Ouch again.

Now and then, the subject of Occam's famous razor comes up, especially in the context of our mad pursuit of the understanding of biomedical phenomena. Just in case you don't know (and I'm sure you do), the 14th century logician and Franciscan friar, W of O, stated it like this: "*entia non sunt multiplicanda præter necessitatem*". That is, "don't make things complicated". Okay, what this really means is: "entities should not be multiplied unnecessarily". This is the Razor. He actually said it better like this: "*numquam ponenda est pluralitas sine necessitate*" – "plurality ought never be posited without necessity". We scientists generally interpret this to mean that we

should always go with the simplest explanation of the available data and, when someone suggests otherwise, we slash at them with our shiny blade.

Bill didn't actually come up with this idea and didn't claim to, but he generally gets the credit, because Alhazen's Razor (see http://en.wikipedia.org/wiki/Ibn_al-Haytham) doesn't roll off the tongue the same way. But before I cut myself again, it's worth looking at the context of this maxim.

Before the 20th century, it was a generally accepted idea that the natural world is elegant, beautiful, logical and, above all, simple. Fabulously complex models of the universe, placing the earth dead center, crumbled in the face of Copernican simplicity. Fibonacci came up with a wonderful, simple series that explained, among many other things, the spacing of branches on a flower stem. And a triumph of the approach (from my very narrow view) was in the laws of genetics, rediscovered as the century dawned. Simple is beautiful. Thomas Aquinas, almost a hundred years before

Ockham, said, “if a thing can be done adequately by means of one, it is superfluous to do it by means of several; for we observe that nature does not employ two instruments where one suffices”.

But most of us know that things aren't very simple. Nature regularly uses two instruments where one suffices. Redundancy abounds, as does complexity. Biology (at least) is not 'built' elegantly, but is cobbled together with bits and pieces and glue that somehow work, and if the result turns out to survive in the mess and tumble, we're stuck with it.

We can be pretty sure that Mendel, in his little garden, chose traits that gave him simple and elegant results, and tossed aside those that didn't fit. By doing so, he was able to come up with his laws of segregation and independent assortment, the cornerstones of his theories (even if he was cited only three times over the next thirty years, he was right). But then he went on to apply his laws to other species, with mixed success. For a variety of reasons, based on the intellectual climate, he felt that recognition would depend on studies in hawkweed and, because of technical problems, everything fell apart. He turned to his growing administrative duties and left his garden to run wild.

And this underscores the problem. What data do we incorporate into our theories and what do we discard? One solution is that it is up to each of us to present only our most rigorous results and interpret those, but my most rigorous results might not be those of a reviewer. And these days, reviewers call the shots. My friend, the Beach Dweller, had this to say about what data are shown:

The golden age of data not shown (DNS) in the post-Gutenberg but pre-World Wide Web World was anything but golden. For a start, why was it DNS? Simple northern beach dweller that I am, I could never figure that out. Imagine you are lying in your burrow reading the latest Stieg Larsson thriller and, at a particularly exciting point, found he had decided that this book-writing thing was a bit hard and then simply told you who the murderer was (DNS). How you would snuffle and splutter with outrage!

More seriously, isn't the chain of evidence defined by the weakest link in any case? At least that is what an old biochemist once told me while babbling on about Occam's Razor. It is not a sign that editors or reviewers have done a proper job when the paper has lots of shown

data (SD) or DNS – in fact, it shows that they don't understand the central importance of Occam's Razor in modern scientific thought. What do I mean by that? Well, just as making a big pile of flotsam and jetsam in my back garden will definitely not help to sell my house, a large pile of SD should not sell a manuscript to reviewers, editors or readers. In fact, Occam's Razor tells us that we should prefer simple explanations over complex ones and therefore the more data we add to provide supporting arguments for a hypothesis, the more likely we are to be wrong. Oops, I now seem to have found a really big problem in all this SD stuff. To revisit Stieg Larsson's thrillers, do you want them to have SD listing all the discarded plot ideas he had while writing his thrillers? I doubt it.

*Yours in the North,
Beach Dweller.*

I agree with BD that making our case with 'Data Not Showable' is unacceptable. But I disagree with the idea that the problem he outlines is due to a misunderstanding of the Razor. I'll suggest that it is precisely because we understand and hold Bill's blade dear that we've gotten into something of a mess (but not a fatal one). In its simplest form, this is illustrated by a type of review we regularly see, viz, “the authors have clearly shown that pigs do not fly and their data appear to support their conclusion that this is because pigs do not have wings. However, Walrus and Carpenter (*J. Beach Dwellers*) discuss pigs with wings, and their findings on *Ostreidae* must be examined and explained in this context. Several dozen experiments are suggested below (following which the authors are free to eat the results).”

There are three ways to think about the Razor, one that is not useful, one a little bit useful and one we should (but generally don't) try. If we read Occam to suggest that explanations must be elegant and otherwise wrong (and force authors into this corner), we are discarding more than a century of experience that tells us that nature is very often *not* elegant and, at least in biology, it is our simple explanations that are most often faulty. However, if we read the Razor as saying we should not overextend our explanations beyond the available data, this has value. But only limited value at that.

Once upon a time, but not very long ago, it was perfectly acceptable to discuss the ideas that emerge from our data in the broader context of

the literature, noting where they might or might not explain other findings. In fact, the findings that challenged our ideas were often presented openly, with suggestions for how we might incorporate them into a larger view. We used to call this part of the paper the *Discussion*. But there has been a shift away from such speculation for fear that every noted counter example presents opportunities for a dyspeptic reviewer to insist that resolving the issue now is paramount and our papers risk lying fallow while we pick away at the additional experiments.

BD wisely notes the flotsam and jetsam that populate our flood of publications. How much of this is due to the flood, and how much is actually our need to share every bit of extraneous data within our papers to appease the demands placed on us and keep our little lab ships afloat? Okay, this is only flotsam (the floating stuff); the jetsam sticking up from the murky depths is our desperate attempt to keep something above water.

We can do something about this, at least, those of us who do spend our time reviewing papers. When you review a paper, ask whether the conclusions are, in principle, interesting. If not, say so and send the authors on their way. But if they are and you suggest an experiment, stop and think whether this experiment is truly required to support the interesting conclusions and, if it is not, then *don't ask for it*.

And for any editors who might be glancing at this? Consider insisting that the reviewers justify any additional data that are requested – if the justification isn't convincing (or forthcoming), discard it. Let's get back to publishing our findings and drawing our conclusions, so that others can read them and work to incorporate, disprove or extend them towards something that resembles understanding (for the moment).

This is the third, and possibly the most useful, interpretation of Occam's Razor: provide enough rigorous data to draw an interesting conclusion and no more. The conclusion might not be simple, the story will almost certainly be incomplete, but the result will be a publishable *unit* that we can build on. That is, *if* we can get the system to settle for this.

But first, I have to get my hands on a Stieg Larsson thriller.

Mole

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