

An occasional column, in which Mole, Caveman and other troglodytes involved in cell science emerge to share their views on various aspects of life-science research. Messages for Caveman and other contributors can be left at mole@biologists.com.

Any correspondence may be published in forthcoming issues.

BUT OF COURSE SCIENCE IS CONSENSUAL, DAMN IT, SONNY BOY!! IT TOOK 'EM FORTY ODD YEARS TO ACCEPT M'CLINTOCK'S WORK ON THE MAIZE GENOME - FORTY ODD YEARS FOR THE CONSENSUS TO BECOME A LITTLE LESS CONSENSUAL, - THEN M'CLINTOCK WON HER NOBEL PRIZE, AND EVERYTHING BECAME CONSENSUAL ONCE MORE... NOW YOU CAN'T GET MORE CONSENSUAL THAN THAT, SONNY BOY!!!



How we know III: taking the bull by the horns

When I was a wee Mole-let, and a terror to my science teachers (woe was he who misordered the planets of the solar system), I was regularly confused by a simple misconception shared by all my friends and seemingly the world at large: that dinosaurs and people had not only co-existed but regularly battled to the death – comic books, cartoons and lasting images of Raquel Welch being swept up in the talons of an enormous pterodon had firmly planted the idea in our deepest psyches. If science were consensus, then people hid while dinosaurs roared. (This isn't just Mole-ish reminiscence: a park in middle-America recently opened to promote this idea to those unfortunate children who missed *The Flintstones* and *One Million Years BC*, and whose parents might wish to shield them from knowledge of a planet rich in deep-time.)

This terribly democratic idea, that

science can be done by consensus, is just stupid. Isn't it? We don't *vote* to determine when dinosaurs and people lived; we use sophisticated methods to place these organisms in their appropriate time periods. So we know more or less when dinosaurs walked the earth. And we're pretty certain people weren't around. How certain? I'd say with more or less the same certainty that we know the sun will come up in the morning. (Of course I *mean* that the earth will revolve to the point that the sun will strike its surface at those times when people at those locations drink their morning beverages of choice.) We also *know* a fair bit more, which we figured out by doing good science, in a scientific way, for a good long time. It wouldn't matter if there were a huge popular vote that concluded that water contracts as it freezes. Ice would still float, and we'd still be able to skate on it (which, of course, wouldn't happen if it *did* contract as it froze).

For those of you just joining us, we have been walking, like the Walrus and the

Carpenter, on a beach (where the sea is wet as wet can be, and the sand is dry as dry), and (figuratively) on thin ice, talking about nonsense and how dangerous it can be to think that we *know* things we learn by the application of the scientific method. I'd taken the position that, despite our best efforts, we really don't *know* what we think we know – and then gone and admitted that we *do* know lots of things. And you've said "Mole! Make up your mind!" And I said, "Exactly!"

Exactly. (There, I've said it). Science *is*, to a great extent, done by consensus – not by a public vote, but a consensus of those who practise science, who read and review the technical literature, who decide on how grant money will be allocated and, ultimately, who decide what to teach. Yes, there are a number of examples of individual scientists who bucked the system, sometimes for years, but we've only come to hear about them when enough other scientists decided, finally, that they were *right*. If this is the case then what is true, what is right, what we *know*, changes. Often in small, sometimes in grand, ways. We *do*, in a sense, vote on the 'truth'. And if we are completely honest (despite our best efforts to get things right), we admit that this is a 'truth' that we don't really *know*, but represents a best guess (a best guess that is often very good, except, as in the case of eugenics, when it is very poor).

But science is a serious business, and truly important decisions rest on our ability to get things right. So we make statements (as a collective scientific community) and we stick to them. We know that they *might* not be correct, but it's what we've got until something comes along to convince us to change our minds. Don't get me wrong here; we aren't lying. According to St Augustine (perhaps the best authority on lying, since he wrote *On Lying*), there are eight sorts of lie. Among these are falsehoods ("we *know* global warming is absolutely and objectively true") told to attain a certain goal ("so we should stop emitting massive amounts of carbon dioxide"), and if this goal is viewed as indispensable ("or else the ice caps will melt"), then these are not strictly lies. The alternative ("it is only to the best of our knowledge, and we're pretty darned smart, that the ice caps are going to melt") doesn't carry the

punch we need to get things done, as can readily be seen by how little actually gets done. It's *important* that we take stands based on our best evaluations of available evidence, because we are uniquely positioned (and often empowered) to make the assessments and take these stands. This is not lying (according to St Augustine – and he was a *Saint*).

But it may be bullstuff, according to the philosopher H. G. Frankfurt, who wrote the brilliant *best-selling* essay *On Bull*—. Frankfurt rigorously analyzed and ultimately defined bullstuff and why it is so prevalent. He asserts that, when one knows that a statement one makes is not currently verifiable as definitively true or false (in the formal sense), then one has a choice: do not make any assertions at all about the alleged facts, or continue to make assertions that purport to describe the way things are. The first option is ineffectual and generally unacceptable. The second is, by his definition, the very stuff of bullstuff, and the reason there is so much of it around. Science, therefore, leads inevitably to bullstuff.

What can we do? If we back-pedal and admit that we can't really *know* anything by doing science, then it becomes an empty exercise and not worth the enormous amounts of money and attention that we receive. But if we assert that we *do* know, then we are bullstuffing.

The answer, I contend, does not come from science, per se, but from the broader realm of the human quest for understanding, specifically those disciplines we often lump together as the 'humanities'. In science, there is little or no room for the approaches elaborated by these disciplines. We regard any attempt to derive answers to scientific problems based on non-scientific methods as bullstuff, and correctly so. No amount of philosophy, history or art will inform us about the molecular processes of the cell or the mechanisms of disease. I am proud to be a card-holding member of this way of thinking, but that isn't what I'm suggesting.

What the humanities *can* teach us is how society, opinion and bias enter the way we do science and affect our ability to draw meaningful conclusions. It was historians, not scientists, who realized

that we regularly rewrite the past to make it seem that there has been a steady march leading to the present – progress – and that this Whig view (so called because this now vanished political group were famous for taking such revision to outrageous heights) pervades human intellectual thinking, including that of scientists. Many of us still think like this (just read a text book or review article), not only because it's convenient (why do we want to learn about things that turned out to be wrong?) but also because we *believe* it. But it isn't true. And it goes deeper. For example, many of us reason in terms of increasing complexity over evolutionary time, imagining progress from simple organisms, like yeast and worms, to us. We incorporate this into our experiments and conclusions and, as a consequence, we can't see where we go wrong.

Perhaps most importantly, it is in the realms of the humanities that many of the personal and social choices that affect our lives really reside. We can provide observation, interpretation and advice but, ultimately, it is in the subtle, complex and complicated interactions between humans, with all of our emotional baggage, that decisions and policy are made, and we scientists have little to contribute in this regard. We need help if we are to know what we *know*, despite all the bullstuff, and use it to affect the way we live. We embarrass ourselves with claims that sequencing the human genome will end social problems (scientists have really said this), instead of admitting that our endeavours are only one way to approximate knowing. We should not teach literature in science classes (even if people vote that such literature is valid science), but neither should we suggest that the study of literature holds no value for understanding the world. That *would* be bullstuff.

So, Walrus (or am I the Walrus?), while you're busy reading journal PDFs hot off the printer, consider directing some of that reading to those other ways to approximate knowing. There is much to learn – cabbages, kings, and pigs with wings notwithstanding.

Mole