

Built on failure: The value of what we can't comprehend

by [Kathleen L. Housley](#) in the [May 14, 2014](#) issue



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Retractions of scientific papers have soared in the past decade—up tenfold, according to a 2011 report in the journal *Nature*. At first glance, that fact might be taken as a sign of an increase in conscience among scientists who have discovered errors and omissions in previous work. Unfortunately, that is not the case. A study published in the *Proceedings of the National Academy of Sciences* in September 2012 concluded that misconduct, not error, was the reason for the majority of the retractions.

Furthermore, the uncovering of misconduct was due not to heightened editorial vigilance on the part of the scientific publications but to the prevalence of computer software that can detect data manipulation, plagiarism, and faked images. The study also showed that the problem is global.

Several factors are fueling malfeasance. The first is extreme competition for fewer jobs and diminishing grant money, leading to huge pressures on desperate scientists (especially young ones) to publish as fast and as often as possible. If they don't, they may end up being forced out of the profession. One prominent scientist has described it as a winner-take-all culture that encourages cheating.

A second factor is the commercialization of academic research, with its heavy emphasis on spin-off potential and profitability, which incentivizes the elimination of negative research data and the publication of positive results only. It is no surprise

that clinical trials with positive results are twice as likely to be published as those with negative results.

In science, when negative data is not reported, the result is a silence that silences, leading to the potential that a life-saving drug is withheld, an ineffective treatment is used, or a valuable lead to a new discovery is missed or dangerously misinterpreted. There is no way for true scientific understanding to be built on what is not there.

An example is a case reported in the *New York Times* (“A Clash over a Spine Treatment,” September 6, 2012) about a neurosurgeon who had an agreement with a device manufacturer to report on the progress of patients six months after undergoing a new spinal treatment. At six months, the results were encouraging, but beyond that point, several patients began experiencing significant problems. The neurosurgeon felt he had an ethical duty to his patients to report both positive and negative findings, regardless of time frame. When he did so, the device manufacturer filed a complaint with his university accusing him of scientific misconduct for following his patients beyond the agreed six months. According to Dr. Eugene J. Carragee, a spine expert at Stanford University and editor of *The Spine Journal*, this case is an egregious example of the pressure to push positive findings beyond their scientific merit while ignoring negative findings.

The publishing of scientific articles based on fake data is relatively rare. More common are papers in which positive data is valorized over negative. In these, the data is accurate as far as it goes, but it doesn't go far enough. Some of the reasons are rooted in human nature: there is a preference for positive results and novel findings, which in turn leads to a subtle bias in the design and analysis of experiments. Even with the best of ethical intentions, it is easy for a scientist to choose too narrowly from the mass of data at hand. The reason is simple but rarely recognized outside the laboratory—research is inherently messy and unpredictable; equipment fails; reagents vary in formulation or quality; technicians come and go; and anomalies appear at the most inconvenient times in the most inconvenient spots. Plus, there is much in nature that is beyond comprehension until new technology comes along.

For example, advances in gene sequencing have revealed that the vast majority of the genome, ignominiously and erroneously dubbed junk DNA back in the 1970s, is anything but. It plays an extensive role in regulating gene expression. The ENCODE project (Encyclopedia of DNA Elements) has found in the great complexity of

genetics vast new avenues for research, thereby showing the fallacy of judging things as limited in value—junk—when what is limited is our ability to comprehend.

In an interview in *Scientific American* (September 18, 2012), Ewan Birney of the European Bioinformatics Institute, who led the ENCODE team of 400 scientists, said, “I get this strong feeling that previously I was ignorant of my own ignorance, and now I understand my ignorance.” He sees the work of ENCODE as foundational—not an ending but a starting point for years and years of research. “We are complex creatures. We should expect that it’s complex out there. But I think we should be happy about that and maybe even proud of it.”

It would be unrealistic to demand that scientists must have more integrity. There is plenty of integrity, the neurosurgeon’s actions and Birney’s comments being indicative. It would also be unrealistic to demand that the winner-take-all culture of science be changed, although it needs to be. So how do we seek answers to the problem of deletion of negative data? One way to begin is to take a look at deletion from outside of science—specifically, how scholars handled problematic passages of scripture.

Consider the figure of Elihu in the book of Job. Scholars have long wondered whether Elihu is an editorial insertion who doesn’t belong in the text. He suddenly appears in chapter 32 and disappears after chapter 37. Job doesn’t respond to Elihu’s arguments, and he is not listed among the friends who are ultimately forgiven. Whereas Maimonides in the 12th century stated in *Guide for the Perplexed* that, of Job’s friends, Elihu presented the strongest arguments, Robert Alter in the 21st century considers him an interpolation by a misguided editor. Despite differing viewpoints among scholars separated by vast stretches of time, Judaism retains the idea that the inability of scholars to understand any text indicates their intellectual limitations, not a problem in the text. Nor are intellectual limitations cause for discouragement: if scholars were able to understand *all things*, then *all things* must be very small and probably not worth the effort.

Unfortunately, some recent translators have felt no such compunction and have deleted Elihu. One of those is the translator and poet Stephen Mitchell. On reading his version of the book of Job several years ago, I had a vague sense that something was missing, but there were no chapter and verse numbers to reveal what it was. Then, with a jolt, I realized there were only three friends debating with Job, not four. Elihu was gone!

And he hadn't gone empty-handed: besides the six chapters in which he appears, he had absconded with chapter 28—the magnificent poem on searching for wisdom, described metaphorically as a miner dangling in the pitch black of a shaft he has cut deep into the earth, laying bare the roots of mountains. Mitchell had arrogated to himself the right to decide what was essential for readers.

I would have been less concerned about his choice had he been open about it, stating on the cover that the text was abridged instead of mentioning it only in an endnote. Had he done so, he would have alerted people to the necessity of reading the uncut version to make their own fair assessment.

Few Torah scholars, no matter how brilliant, would have dared to think that their knowledge was so encyclopedic as to endow them with the right to delete a portion of the text. Besides respecting the inviolability of scripture, they would reason that while a passage might be beyond their understanding, in the future someone might come along who has the ability to understand it, and for that person it must be preserved. Limited understanding, contradiction, and sharp disagreements, seen as positive attributes, point to a profound idea: there is not one meaning but an expanding infinity of meaning, and in that vastness is glimpsed the vastness of God.

To return to Elihu: he can be seen as a proto-scientist observing the darkening sky and the distant flashes of lightning. Prior to warning Job of the oncoming storm, he attempts to rebut what has been said by Job and his friends Eliphaz, Bildad, and Zophar. He is young and prideful, declaring insufferably that “one perfect in knowledge is with you.” Yet before we decide not to listen to him, we must remember that Job's entire argument about his innocence is predicated on his assertion that he is perfect in righteousness. Elihu asks Job if he can do the things that God can do, such as spread out the firmament like a molten mirror when the scorching south winds blow. Undercutting his own claim to perfect knowledge, Elihu states that God has no regard for those who consider themselves wise. To Job's demand that God answer him, Elihu points out that Job is not at the center of the universe and that God is beyond understanding and beyond reach but not beyond reverence (37: 23-24).

As important as what Elihu says is what he does. Like a perceptive naturalist, he notices what is going on in the world around him and is so frightened by what he sees that his heart “is leaping out of its place.” It is his observations that prepare the way for God's entry. As Elihu tries to gather his thoughts in the thickening darkness,

his bellicosity decreases. He had begun his speech in arrogance; he ends it in silent awe as the whirlwind touches down. Although Elihu is never heard from again, his silence is far different than the utter silence that is imposed by deleting him from the text.

What is lost by means of deletion cannot be corrected, because it cannot be found. In science, access to negative data and failed experiments must be maintained. A dramatic example: in 1964, a cancer researcher at Wayne State University in Detroit had a colossal experimental failure. Jerome P. Horwitz had sought to develop a unique strategy to stop the runaway growth of cancer cells by tricking them into incorporating a synthesized nucleoside into their DNA, causing them to be unable to replicate. One of his new compounds was azidothymidine (AZT). When he tried it in leukemic mice, however, the compound did not work. Horwitz was so disappointed he didn't even bother to patent his method.

Because Horwitz was working in academia, his data on AZT was maintained in the Wayne State archives, where it was available to other pharmaceutical researchers to explore. Occasionally AZT was tried with other diseases, but with no more success than against cancer.

Twenty years went by, during which time Horwitz never lost faith in AZT. He believed that the underlying theory was correct. "We had this very interesting set of compounds waiting for a disease to cure," he stated.

That disease turned out to be HIV/AIDS. AZT was one of the thousands of compounds that Burroughs Wellcome (now GlaxoSmithKline) screened, in conjunction with the National Cancer Institute. AZT was the first drug to treat HIV/AIDS successfully, though it did not cure it. Because he had never patented it, Horwitz didn't even learn that Burroughs Wellcome had been testing AZT against a form of AIDS-related pneumonia until 1985.

AZT's toxicity problems and its potential were both huge; so also was the subsequent acrimony over its exorbitant price and the enormous profits for Burroughs Wellcome. But at the time of his death in September 2012, Horowitz was not bitter. During all those years, he kept working on many projects, including reverse transcriptase inhibitors and drugs to treat solid tumors. He had wanted a career in which, as he said, he could "make a difference." His greatest failure turned out to be in his greatest success—it was a failure that eventually saved countless

lives and laid the foundation for antiviral therapy.

The word for truth in Hebrew is *emet*, made up of the first, middle, and last letters of the Hebrew alphabet. The word for falsehood is *sheker*, made up of letters huddled together near the end of the alphabet. Jewish sages interpreted this to mean that truth is broad and balanced because of the shape of the individual letters, whereas falsehood is narrow and unbalanced. Furthermore, *emet* has its root in the word for foundation or support, meaning that it can be built upon. A deletion in science cannot be built upon because it is not there. Neither can a deletion in scripture. Without Elihu, the book of Job becomes unstable.

When God finally speaks to Job in chapter 38, he asks who laid the foundations of the earth, who used the ruler and the plumb line, who anchored the support pillars, who set the cornerstone in place. To build wisdom and knowledge, a firm foundation is the one essential thing. That foundation is composed of the multitude of things understood and things yet to be understood.