Comment

The Rosetta Stone

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Aristotle, who got almost everything about science wrong, got quite a lot about writing and oratory right. (Perhaps the moral of this is that we might be better off if many scientists became literary critics instead... but I digress.) One of his comments seems to me particularly relevant to big science in general and genomics in particular: he asserted that the most important thing is to find the correct metaphor.

Few things can cause so much trouble, especially in scientific discourse, as metaphor. The world is full of nitpickers and literalists who take perverse delight in pointing out inconsistencies between some obscure or trivial aspect of the metaphor and its counterpart. Reminding them that it is only a metaphor, and therefore not meant to be taken literally, accomplishes nothing: in addition to taking the metaphor too seriously, such people have an unfortunate tendency to take themselves too seriously as well. Yet we persist in using metaphor, particularly when we try to explain or justify scientific research to the general public, because the power of metaphor is so great. Metaphors allow us to bypass jargon and connect what we do with the everyday experience of the public who pay for our research and trust that what we do will help, not harm them. Get the metaphor right and we can mobilize public support even for the biggest and most expensive projects.

But if the metaphor is wrong, the consequences can be disastrous. Take the United States' "War on Cancer", announced by the Nixon Administration in the 1970s with all the fanfare that normally accompanies the dispatching of troops. Good intentions, on the part of both politicians and scientists, were behind this project, but as we all know, the road to hell is paved with those. War seemed to be the right metaphor for the anti-cancer project: it was, after all, a matter of life and death, and cancer had long been viewed with all the fear and hostility normally accorded an enemy. But I think it was the wrong metaphor, and in this case tragically wrong. Wars are perceived as having definite end-points, and usually must be won totally or else are deemed lost. This was never possible for the War on Cancer. Cancer is not a single disease. Every cancer has its own peculiarities, and the causes and treatments for it usually do not apply to most other cancers. This fact alone made a clear-cut victory in the war impossible. It also made a rapid victory even in a few key battles improbable. Thus, the metaphor of a war raised expectations that could never be met.

True, the research that the cancer war spawned in the 1970s is now paying off with new approaches to cancer diagnosis and treatment thirty years later, but lay people do not connect today's breakthroughs with investigations that began so far back. Three decades is too long for a war. And yet the right metaphor would not only have avoided the disappointments that the war analogy produced, it would also, I think, have allowed that long-term connection to be understood. Suppose we had called it the Cancer Campaign, for example - that metaphor conveys a very different image, of a process that evolves over time and has many stages. Or the Cancer Initiative. I sincerely doubt that either of these metaphors would have been less effective than war in securing the funding increase that was obtained; the importance of the project spoke for itself.

When the human genome sequencing project was started, a number of different metaphors were used to galvanize public and private support. The most common was that the sequence would represent a blueprint for building a human being. Another popular one likened the sequence to an encyclopedia. These metaphors were, I believe, very badly chosen. They convey the impression that the genome sequence can be understood easily and used readily. As we know, nothing could be farther from the truth. And now we have a gaggle of 'me too' big-science projects in its wake, which are being sold on the basis of their value in drug design (The Structural Genomics Project) or gene therapy (The Functional Genomics Project), or other immediate

needs. Science isn't really like that. No one project can take us smoothly to improvements in human health. Even the biggest and best provide but a few pieces of the puzzle.

This argument suggests what I think is the best metaphor for the genome project and its progeny. Arguably the greatest pure puzzle ever solved by human ingenuity was the decipherment of Egyptian hieroglyphics by Thomas Young and Jean-Francois Champollion. After all, the language of one person is completely meaningless to someone who has not been taught its alphabet, rules of grammar and vocabulary. It would thus seem impossible to decipher a 'lost' language, yet that is precisely what was done for hieroglyphics by Young and Champollion.

The key to solving the puzzle was, as every schoolchild knows, the discovery of the Rosetta Stone. Unearthed in 1799 when a group of French soldiers at Fort Julien in the town of Rosetta in the Nile delta were demolishing an ancient wall, the stone contained the same text inscribed in three different languages: hieroglyphics, demotic (a script replacement for hieroglyphics that evolved in Egypt around 600 BC and which was equally obscure), and Greek, which any scholar of that era could read. The Greek text represented the key to deciphering the other two languages, but because hieroglyphics turned out to be a phonetic language after all (not a pure picture language as was commonly assumed) it was a far from trivial task. (There's a wonderful chapter on how it was done in Simon Singh's marvelous *The Code Book* (1999), a history of cryptography from ancient Egypt to the present day.)

If we imagine that understanding human biology and using that understanding to cure disease and improve the quality of life is a task every bit as difficult as being able to decipher hieroglyphics (our first metaphor), then scientists are modern versions of Young and Champollion (second metaphor); the results of scientific research constitute the Rosetta Stone that will eventually enable us to solve the mystery (third and most important metaphor), and the genome sequence is one script on the tablet (fourth metaphor). Proteomics would provide another inscription, as would the three-dimensional structures of all the gene products, and so forth. Just as any one of the inscriptions would not have been enough, any one project - even the genome project - is not enough on its own; we need a number of different approaches, and the data from all of them. Individual 'small science' projects can aid in deciphering individual words or letters; the goal of each of the 'big science' genome-wide projects is to provide entire blocks of text in different languages that can, ultimately, all be put together to crack the code.

I like this metaphor because it seems to me to evoke many of the actual characteristics of the scientific endeavor. It enables anyone to realize that no single project can provide the single answer. It suggests the difficulty of the task and the long struggle that may be required. And it also conveys some of the excitement and romance of the challenge. Best of all, the metaphor is elastic: we can continue to use it to explain each new effort and to help the public chart our progress.

The wrong metaphor oversells what we do and raises hopes unfairly in people who trust us to make their lives better. The right metaphor helps them understand the torturous path between basic scientific discoveries and medicines or products, without robbing them of the hope that such a path will eventually be traversed. Maybe Aristotle had something useful to offer science after all.