

Comment

The wisdom, and madness, of crowds

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In reading the history of nations, we find that, like individuals, they have their whims and their peculiarities; their seasons of excitement and recklessness, when they care not what they do. We find that whole communities suddenly fix their minds upon one object, and go mad in its pursuit; that millions of people become simultaneously impressed with one delusion, and run after it, till their attention is caught by some new folly more captivating than the first...Money, again, has often been a cause of the delusion of multitudes. Sober nations have all at once become desperate gamblers, and risked almost their existence upon the turn of a piece of paper... Men, it has been well said, think in herds; it will be seen that they go mad in herds, while they only recover their senses slowly, and one by one.

Charles Mackay, *L.L.D.*

This quotation comes from a book first published in 1841. In the 167 years since, it has never been out of print. Its author was a Scottish poet, journalist and songwriter, yet many have called it, after *The Wealth of Nations* by Adam Smith (a fellow Scot - there really was something to the Enlightenment, you know), the second greatest economics treatise ever written.

The book is *Extraordinary Popular Delusions and the Madness of Crowds*, by Charles Mackay. The quotation is taken from its preface. If it sounds amazingly relevant to our current economic crisis, it's because it is. It may be the most relevant book you will ever read.

Though published over time in two volumes, it is the first volume, and in particular, the first three chapters, on what Mackay called money mania and what we call economic bubbles, that have given the book, which I shall refer to as *EPD&MOC* for convenience, its well-deserved reputation. The economist, and popular writer about personal finance,

Andrew Tobias, who contributed the Forward to the edition I own, had this to say about it: "Once upon a time, there was an emperor with no clothes. For the longest time no one noticed. As you will read in this marvelous book, there have been many naked emperors since. There will doubtless be many more... As with any true classic, once it is read it is hard to imagine not having known of it - and there is the compulsion to recommend it to others."

My favorite chapter is the third, on tulipomania. For those unfamiliar with this psychological illness, which once affected the entire country of Holland in the mid-seventeenth century, and spread to some people in other nations of Europe as well, the term refers to a maniacal desire to possess rare tulip bulbs. Fervor for collecting, and trading, these essentially worthless botanical objects reached such a peak, that at around 1635, the average price of a tulip bulb exceeded its weight in gold, and a single rare bulb might easily trade for more than \$50,000 in today's money. "A trader at Harlaem," writes Mackay, "was known to pay one-half of his fortune for a single root - not with the design of selling it again at a profit, but to keep in his own conservatory for the admiration of his acquaintance... In 1634, the rage among the Dutch to possess them was so great that the ordinary industry of the country was neglected, and the population, even to its lowest dregs, embarked in the tulip trade. As the mania increased, prices augmented, until, in the year 1635, many persons were known to invest a fortune of 100,000 florins in the purchase of forty roots."

My favorite story from this bubble is so well-told by Mackay that I will quote it rather than summarizing it:

"People who had been absent from Holland, and whose chance it was to return when this folly was at its maximum, were sometimes led into awkward dilemmas by their ignorance... A wealthy merchant, who prided himself not a little on his rare tulips, received upon one occasion a very valuable consignment of merchandise from the Levant.

Intelligence of its arrival was brought him by a sailor, who presented himself for that purpose at the counting-house, among bales of goods of every description. The merchant, to reward him for his news, munificently made him a present of a fine red herring for his breakfast. The sailor had, it appears, a great partiality for onions, and seeing a bulb very like an onion lying upon the counter of this liberal trader, and thinking it, no doubt, very much out of its place among silks and velvets, he slyly seized an opportunity and slipped it into his pocket, as a relish for his herring. He got clear off with his prize, and proceeded to the quay to eat his breakfast. Hardly was his back turned when the merchant missed his valuable *Semper Augustus*, worth three thousand florins, or about 280 pounds sterling. The whole establishment was instantly in an uproar; search was everywhere made for the precious root, but it was not to be found. Great was the merchant's distress of mind. The search was renewed, but again without success. At last some one thought of the sailor. The unhappy merchant sprang into the street at the bare suggestion. His alarmed household followed him. The sailor (a simple soul!) had not thought of concealment. He was found quietly sitting on a coil of ropes, masticating the last morsel of his "onion". Little did he dream that he had been eating a breakfast whose cost might have regaled a whole ship's crew for a twelve months; or, as the plundered merchant himself expressed it, 'might have sumptuously feasted the Prince of Orange and the whole court of the Stadtholder.'

By 1636, special markets for trading in tulip bulbs were established on the floor of the Stock Exchanges in Amsterdam and other towns. Many people grew suddenly rich, and others, not wishing to be left out, began speculating madly themselves. If this all sounds like the 'dotcom' bubble in the stock market at the end of the 1990s, or the subprime mortgage credit bubble of the past few years, it's because the same psychological factors that Mackay first dissected so brilliantly in 1841, and that were at work in Holland in the 1630s, were behind those follies as well: greed, stupidity, the herd instinct, and a reckless belief that the old rules of economics were somehow repealed in this instance.

Of course tulipomania couldn't last, and it didn't. Mackay again: "At last, however, the more prudent began to see that this folly could not last for ever... It was seen that somebody must lose fearfully in the end. As this conviction spread, prices fell, and never rose again. Confidence was destroyed, and a universal panic seized upon the dealers. A had agreed to purchase ten *Sempers Augustines* from B, at four thousand florins each, at six weeks after the signing of the contract. B was ready with the flowers at the appointed time; but the price had fallen to three or four hundred florins, and A refused either to pay the difference or receive the tulips. Defaulters were announced day after day in all the towns of Holland. Hundreds who, a few months previously, had begun to doubt that there was such a thing as poverty in the

land, suddenly found themselves the possessors of a few bulbs, which nobody would buy, even though they offered them at one quarter of the sums they had paid for them. Many who, for a brief season, had emerged from the humbler walks of life, were cast back into their original obscurity. Substantial merchants were reduced almost to beggary, and many a representative of a noble line saw the fortunes of his house ruined beyond redemption." Substitute 'mortgage contracts' or 'derivatives' for 'bulbs' in this description, and you have a perfect accounting of the events of the past few months of 2008. No wonder the book has never been out of print.

Mackay wrote to warn people of the foolishness of the collective mind. His warning seems to me to be particularly relevant now, and not solely for economic reasons. The central thesis of *EPD&MOC* is one we should at least consider as we examine a new movement that has swept the online publishing world and is beginning to creep into genomics: the collective encyclopaedia.

Everybody is probably familiar with the first, and best-known, manifestation of this phenomenon: Wikipedia. The name is a portmanteau of the words wiki (a technology for creating collaborative websites) and encyclopedia. Wikipedia is a multilingual encyclopedia project supported by the nonprofit Wikimedia Foundation. Wikipedia's 10 million articles have been written collaboratively by volunteers around the world, and almost all of its articles can be edited by anyone who can access the Wikipedia website. Launched in January 2001 by Jimmy Wales and Larry Sanger, it is currently the largest and most popular general reference work on the Internet.

The idea of a free encyclopedia encompassing all subjects, written not by a panel of chosen experts but by teams of people interested in the subjects and subsequently updated and amended by anybody has been wildly popular but has also attracted much criticism. Obviously, articles can, at least initially, have severe biases and inconsistencies. The question is whether in the end they get to the truth: does consensus produce something that is not just readable - most of the articles are pretty good in that regard - but reliable?

It turns out I have an entry in Wikipedia (don't ask me who contributed it; I certainly didn't, and I haven't edited it either). If you do a Google search for my name, the Wikipedia article will be the second entry in the resulting list. Here's an excerpt: "Gregory A Petsko is an American biochemist and member of the National Academy of Sciences. He is currently the Gyula and Katica Tauber Professor of Biochemistry & Chemistry at Brandeis University... Petsko is co-author with Dagmar Ringe of *Protein Structure and Function*. He is also the author of a monthly column in *Genome Biology* modeled after an amusing column in *Current Biology* penned by Sydney

Brenner. Petsko is best known for using X-ray crystallography to solve important problems in protein function, including protein dynamics as a function of temperature and problems in mechanistic enzymology." All perfectly accurate, though Sydney may blanch at the thought that he's responsible for this.

In my experience, Wikipedia is often inaccurate when it comes to scientific facts, variable but occasionally quite good when it comes to topics in history or politics, and absolutely first-rate on any matter of popular culture. I suspect this reflects the interest of the Internet-savvy population as a whole, though I haven't done any surveys to find out. I do know that every teacher warns his or her students not to trust it as an unconfirmed source of facts for term papers or theses; it would appear that the wisdom of crowds is not trustworthy without independent checking.

What does this have to do with genomics? Well, one of the most highly accessed articles in recent issues of *Genome Biology* was a piece by Barend Mons *et al.* entitled 'Calling on a million minds for community annotation in WikiProteins' (Mons *et al.*: *Genome Biol* 2008, **9**:R89). WikiProteins, which is most conveniently accessed by entering keywords at the WikiProfessional portal [<http://www.wikiprofessional.org/portal/>], has pages for more than a million biomedical concepts, derived from authorities such as the Unified Medical Language System (UMLS), UniProtKB/Swiss-Prot, IntAct and the Gene Ontology (GO). By adding information to concepts in WikiProteins, scientists are invited to "expand an evolving knowledge base with facts, connections to other concepts, and reference information." In other words, the collective mind, scientifically speaking, is being called upon to annotate gene functions, connections to diseases, and other information relevant to functional and biomedical genomics. Ideally, WikiProteins, which is still in the beta-testing stage, should contain both reliable information from experts and potential connections among data that haven't previously been noticed, or explored.

Here's an example, called up by me by searching for 'triosephosphate isomerase', the name of an enzyme. I got a list of triosephosphate isomerases from many different organisms. Clicking on the one from *Escherichia coli* gave me the following functional information: "*isomerase activity* Definition: Catalysis of the geometric or structural changes within one molecule. Isomerase is the systematic name for any enzyme of EC class 5. [ISBN:0198506732 "Oxford Dictionary of Biochemistry and Molecular Biology"]." Perfectly accurate, though perhaps not ideally helpful. Doing a similar search for 'DJ-1', a gene involved in Parkinson's disease, produced (after leaving out the hyphen): "Acts as a positive regulator of androgen receptor-dependent transcription. May function as a redox-sensitive chaperone and as a sensor for oxidative stress. Prevents aggregation of SNCA. Protects neurons against oxidative stress and cell death.

Plays a role in fertilization. Has no proteolytic activity. Has cell-growth promoting activity and transforming activity. Interacts with: with DAXX (accepted by Swiss-Prot); with AR (accepted by Swiss-Prot)." Again, as far as I can tell, accurate, and probably more helpful. There are a bunch of links as well, only some of which I've explored, and the site provides the opportunity not only to edit any entry but to establish other links.

It is fairly well accepted that the functional and other annotations in the commonly used genome and protein sequence databases are at best accurate only about half the time (my guess would be closer to 25%), so there's real hope that this community-based project might improve that appalling figure. (It certainly would seem to have nowhere to go but up.) It's worth watching to see how WikiProteins does, and I hope genome biologists will try it out, and contribute to it. As an experiment in the wisdom of crowds, it's fascinating. But if you read Mackay (and I hope you all will; it just may save you a lot of money some day), you will know to take what's in WikiProteins, or WikiAnything, with a good dose of caution. Remember, 'the community' once thought tulip bulbs were worth a fortune.