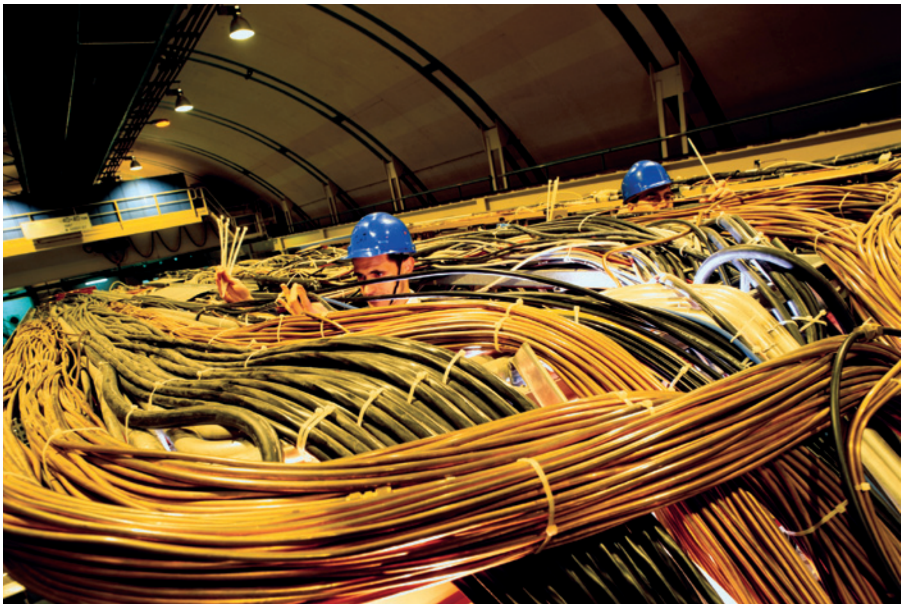


Supercomputers such as that at CERN in Switzerland are becoming faster at a predictable rate.

P. GINTER/SCIENCE FACTION/CORBIS

NETWORK THEORY

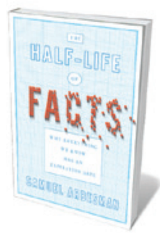
The regularities of facts

Carl Bergstrom assesses the power of scientometrics in predicting the shifts and shelf-life of knowledge.

How much of what you know today will be true tomorrow? In a week's time? In a decade? The weather forecast may change overnight; our estimate of the number of genes in the human genome may change in the coming months; our understanding of consciousness may be radically different a century from now.

Knowledge shifts over time, explains Sam Arbesman in *The Half-Life of Facts*, and it does so in predictable ways. The book takes us on a whirlwind tour of emerging fields of scientometrics, and undertakes a broader exploration of metaknowledge. Arbesman details how researchers beginning to focus the big-data lens back on science itself are uncovering quantitative laws and regularities in the way that scientific knowledge is constructed and modified over time.

Like the decay of atoms, individual discoveries may be difficult to predict, but in the aggregate, facts change in highly regular ways. To illustrate this point, Arbesman ranges widely through the scope of human knowledge, drawing on examples from physics and chemistry, technology and medicine, sociology and cultural studies, and even the arts and humanities. For example, over time there is a predictable regularity to how measurement errors get smaller, how computation and travel become faster, how innovations diffuse through social networks and how technological advances drive increases in human populations. Even the magnetic permeability of iron has increased in a consistent manner with changes in smelting technology.



The Half-Life of Facts: Why Everything We Know Has an Expiration Date
SAMUEL ARBESMAN
Current: 2012. 256 pp. $25.95, £18.99

Arbesman defines facts loosely, not as objective truths but as little pieces of knowledge, right or wrong. This casts a broad net over facts of many different kinds, at the risk of obscuring interesting and important distinctions.

Scientific 'facts' about the natural world — the nature of an electron or the evolutionary significance of a peacock's tail — change as science progresses and our explanatory frameworks shift. Statistics as facts — batting averages, gross national products, crime rates — change not because the body of knowledge around them changes, but because the world is changing beneath our feet and new events are transpiring.

So statistical facts need not be as interconnected as scientific facts; for example, Guinness World Records is a catalogue of independent assertions. In 2011, Zac the macaw set the record for the most basketballs slam-dunked by a parrot in one minute; meanwhile, the world record for the fastest 100-metre hurdles wearing diving fins remained unchanged at 14.8 seconds.

But in proper network-theorist fashion, Arbesman focuses more on the similarities than on the differences between these distinct types of fact and processes of change. Both kinds are generated at predictable rates, change in predictable ways and are subject to scientometric analysis.

One quibble I have with the book is that occasionally I feel Arbesman's enthusiasm gets the better of him, and he accepts the conclusions of sound-bite science without adequate scrutiny. For example, if approximately 80% of citations are copied from earlier citations of the same material (M. V. Simkin and V. P. Roychowdhury *Complex Sys.* **14,** 269–274; 2003), can we join Arbesman in the presumption that researchers read only 20% of what they cite? Or might this pattern arise because authors find it easier to compile their bibliographies from other reference lists — irrespective of whether they have read these papers?

Overall, however, Arbesman is a delightful guide to the territory, patently in love with this emerging field. He is also a skilled storyteller, and his wide-eyed reporting invigorates material that could have been dry and academic.

The chapter on hidden knowledge deserves particular note. It addresses one of the most pressing scientific problems we face: how to make vital new connections among ideas. In an era in which exhaustive reading is no longer possible and library-shelf browsing is infrequent, how can we design mechanisms that connect scholars with the ideas that they need to move forwards?

Arbesman hints at possible elements of a solution: innovation prizes, social tagging, systematic meta-analyses and automated discovery programs. Big changes are coming in the very near future, driven by the confluence of the digital revolution in publishing, the explosion of computational capacity and the accumulated strain of a 350-year-old system of scientific communication pushed to the breaking point in an exponentially larger world.

The current generation will solve these problems, and change how science as a social and communicative process is practised. Reading *The Half-Life of Facts*, I became excited about the prospect of living through — and perhaps even contributing to — this change. ■

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