The Mathematics of Novelties and Innovations

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Our lives are filled with encounters with novelty. Whether it's reading a new word or learning some new facts, these kinds of experiences are what makes life interesting. And often, these encounters lead us to find other new things; ever looked up one thing on Wikipedia and then discovered over an hour has passed as you have clicked from article to article, having fallen down the Wikipedia rabbit hole?

Well, are there mathematical regularities behind how we encounter novelties? And are these encounters similar to how we encounter innovations more generally?

Recently, a team of applied researchers (including Steven Strogatz, my graduate school advisor) set out to examine this. Their paper is very engaging and well-written so I really just recommend you go check out the whole thing, but here are some excerpts:

> The notion that one new thing sometimes triggers another is, of course, commonsensical. But it has never been documented quantitatively, to the best of our knowledge. In the world before the Internet, our encounters with mundane novelties, and the possible correlations between them, rarely left a trace. Now, however, with the availability of extensive longitudinal records of human activity online, it has become possible to test whether everyday novelties crop up by chance alone, or whether one truly does pave the way for another.
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> The larger significance of these ideas has to do with their connection to Kauffman's theoretical concept of the "adjacent possible", which he originally discussed in his investigations of molecular and biological evolution, and which has also been applied to the study of innovation and technological evolution. Loosely speaking, the adjacent possible consists of all those things (depending on the context, these could be ideas, molecules, genomes, technological products, etc.) that are one step away from what actually exists, and hence can arise from incremental modifications and recombinations of existing material. Whenever something new is created in this way, part of the formerly adjacent possible becomes actualized, and is therefore bounded in turn by a fresh adjacent possible. In this sense, every time a novelty occurs, the adjacent possible expands. This is Kauffman's vision of how one new thing can ultimately lead to another. Unfortunately, it has not been clear how to extract testable predictions from it.

They conclude that the statistical features of the datasets that they look at are consistent with the idea of the continually expanding adjacent possible:

> All four of our datasets displayed the same statistical patterns, both for the rates at which novel events occur and for the statistical signatures of triggering events. Two of the data sets involved innovations (the creation of brand new pages in Wikipedia and the introduction of brand new tags in del.icio.us), while the other two involved novelties that do not qualify as innovations (the first appearance of a word in a text, or the first time a user listens to an existing song). The fact that we observe the same statistical signatures for novelties and innovations strengthens the hypothesis that they could be two sides of the same coin, namely, manifestations of correlations generated by the expansion of the adjacent possible.