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KEVIN KELLY AND STEVEN JOHNSON ON WHERE IDEAS COME FROM

Illustration: Jason Holley

SAY THE WORD "inventor" and most people think of a solitary genius toiling in a basement. But two ambitious new books on the history of innovation—by Steven Johnson and Kevin Kelly, both longtime wired contributors—argue that great discoveries typically spring not from individual minds but from the hive mind. In Where Good Ideas Come From: The Natural History of Innovation, Johnson draws on seven centuries of scientific and technological progress, from Gutenberg to GPS, to show what sorts of environments nurture ingenuity. He finds that great creative milieus, whether MIT or Los Alamos, New York City or the World Wide Web, are like coral reefs—teeming, diverse colonies of creators who interact with and influence one another.

Seven centuries are an eyeblink in the scope of Kelly's book, What Technology Wants, which looks back over some 50,000 years of history and peers nearly that far into the future. His argument is similarly sweeping: Technology, Kelly believes, can be seen as a sort of autonomous life-form, with intrinsic goals toward which it gropes over the course of its long development. Those goals, he says, are much like the tendencies of biological life, which over time diversifies, specializes, and (eventually) becomes more sentient.

Wired brought these two big brains together in New York, and the result was a conversation that covered everything from technological evolution to retweets to the value of Internet crap.

Steven Johnson: We share a fascination with the long history of simultaneous invention: cases where several people come up with the same idea at almost exactly

the same time. Calculus, the electrical battery, the telephone, the steam engine, the radio—all these groundbreaking innovations were hit upon by multiple inventors working in parallel with no knowledge of one another.

Kevin Kelly: Our books are another case in point. We independently came up with not just similar ideas but a lot of the same examples.

Johnson: Actually, I just hacked into your computer. [Laughs]

Kelly: It's amazing that the myth of the lone genius has persisted for so long, since simultaneous invention has always been the norm, not the exception. Anthropologists have shown that the same inventions tended to crop up in prehistory at roughly similar times, in roughly the same order, among cultures on different continents that couldn't possibly have contacted one another.

Johnson: Also, there's a related myth—that innovation comes primarily from the profit motive, from the competitive pressures of a market society. If you look at history, innovation doesn't come just from giving people incentives; it comes from creating environments where their ideas can connect.

Kelly: The musician Brian Eno invented a wonderful word to describe this phenomenon: scenius. We normally think of innovators as independent geniuses, but Eno's point is that innovation comes from social scenes,from passionate and connected groups of people.

Johnson: At the end of my book, I try to look at that phenomenon systematically. I took roughly 200 crucial innovations from the post-Gutenberg era and figured out how many of them came from individual entrepreneurs or private companies and

how many from collaborative networks working outside the market. It turns out that the lone genius entrepreneur has always been a rarity—there's far more innovation coming out of open, nonmarket networks than we tend to assume.

Kelly: Really, we should think of ideas as connections,in our brains and among people. Ideas aren't self-contained things; they're more like ecologies and networks. They travel in clusters.

Johnson: Exactly. And that, by the way, is also a fantastic example of how ideas work. After you'd read a galley of my book, you emailed me and wrote, "It's a book about why ideas are networks." And even though that line is in my book somewhere, I had never really framed it that way in my mind. But ever since then, when people ask me about the book, I've been using that concept to explain it. You had come to my work with fresh eyes and pointed out a really lovely way of expressing the main thesis that had completely escaped me. That's the way breakthrough ideas happen. They don't come from contemplative geniuses sitting alone in their studies, trying to think new thoughts.

Kelly: In part, that's because ideas that leap too far ahead are almost never implemented—they aren't even valuable. People can absorb only one advance, one small hop, at a time. Gregor Mendel's ideas about genetics, for example: He formulated them in 1865, but they were ignored for 35 years because they were too advanced. Nobody could incorporate them. Then, when the collective mind was ready and his idea was only one hop away, three different scientists independently rediscovered his work within roughly a year of one another.

Johnson: Charles Babbage is another great case study. His "analytical engine," which

he started designing in the 1830s, was an incredibly detailed vision of what would become the modern computer, with a CPU, RAM, and so on. But it couldn't possibly have been built at the time, and his ideas had to be rediscovered a hundred years later.

Kelly: I think there are a lot of ideas today that are ahead of their time. Human cloning, autopilot cars, patent-free law—all are close technically but too many steps ahead culturally. Innovating is about more than just having the idea yourself; you also have to bring everyone else to where your idea is. And that becomes really difficult if you're too many steps ahead.

Johnson: The scientist Stuart Kauffman calls this the "adjacent possible." At any given moment in evolution—of life, of natural systems, or of cultural systems—there's a space of possibility that surrounds any current configuration of things. Change happens when you take that configuration and arrange it in a new way. But there are limits to how much you can change in a single move.

Kelly: Which is why the great inventions are usually those that take the smallest possible step to unleash the most change. That was the difference between Tim Berners-Lee's successful HTML code and Ted Nelson's abortive Xanadu project. Both tried to jump into the same general space—a networked hypertext—but Tim's approach did it with a dumb half-step, while Ted's earlier, more elegant design required that everyone take five steps all at once.

Johnson: Also, the steps have to be taken in the right order. You can't invent the Internet and then the digital computer. This is true of life as well. The building blocks of DNA had to be in place before evolution could build more complex things. One of the key ideas I've gotten from you, by the way—when I read your book Out of Control in grad school—is this continuity between biological and technological systems.

Kelly: Both of us have written books on this idea, on the primacy of the evolutionary model for understanding the world. But in What Technology Wants, I've actually gone a bit further and come to see technology as an alternative great story, as a different source for understanding where we are in the cosmos. I think technology is

something that can give meaning to our lives, particularly in a secular world.

Johnson: One thing I love about your book is that by the end, you've moved from discussions of cutting-edge technology to this amazingly grand vista of life and human creation. It's very rare to have a book about technology that is moving in that way—that has this almost spiritual component to it. Really, it's kind of the anti-Unabomber manifesto.

Kelly: [Laughs] That's a great blurb.

Johnson: No, seriously! He had this bleak, soul-sucking vision of technology as an autonomous force for evil. You also present technology as a sort of autonomous force—as wanting something, over the long course of its evolution—but it's a more balanced and ultimately positive vision, which I find much more appealing than the alternative.

Kelly: As I started thinking about the history of technology, there did seem to be a sense in which, during any given period, lots of innovations were in the air, as it were. They came simultaneously. It appeared as if theywanted to happen. I should hasten to add that it's not a conscious agency; it's a lower form, something like the way an organism or bacterium can be said to have certain tendencies, certain trends, certain urges. But it's an agency nevertheless.

Johnson: I was particularly taken with your idea that technology wants increasing diversity—which is what I think also happens in biological systems, as the adjacent possible becomes larger with each innovation. As tech critics, I think we have to keep this in mind, because when you expand the diversity of a system, that leads to an

increase in great things and an increase in crap.

Kelly: Right. This is a big theme in your book, too—the idea that the most creative environments allow for repeated failure.

Johnson: And for wastes of time and resources. If you knew nothing about the Internet and were trying to figure it out from the data, you would reasonably conclude that it was designed for the transmission of spam and porn. And yet at the same time, there's more amazing stuff available to us than ever before, thanks to the Internet.

Kelly: Ten years ago, I was arguing that the problem with TV was that there wasn't enough bad TV. Making TV was so expensive that accountants prevented it from becoming really crappy—or really great. It was all mediocre. But that was before YouTube. Now there is great TV!

Johnson: Yeah.

Kelly: To create something great, you need the means to make a lot of really bad crap. Another example is spectrum. One reason we have this great explosion of innovation in wireless right now is that the US deregulated spectrum. Before that, spectrum was something too precious to be wasted on silliness. But when you deregulate—and say, OK, now waste it—then you get Wi-Fi.

Johnson: This is another idea with a clear evolutionary parallel, right? If we didn't have genetic mutations, we wouldn't have us. You need error to open the door to the adjacent possible.

Kelly: In your book, you use this marvelous image of the coral reef as a metaphor for where innovation comes from. So what, today, are some of the most reeflike places in the technological realm?

Johnson: I have two answers to that. One, not surprisingly, is Twitter—not to see what people are having for breakfast, of course, but to see what people are talking about, the links to articles and posts that they're passing along.

Kelly: The retweets.

Johnson: Exactly. But my second example of an information coral reef, and maybe the less predictable one, is the university system. As much as we sometimes roll our eyes at the ivory-tower isolation of universities, they continue to serve as remarkable engines of innovation.

Kelly: In my book, I quote the astrophysicist Paul Davies, who asks whether the laws of nature are "rigged in favor of life." For my part, I think the laws of nature are rigged in favor of innovation.

Johnson: Life seems to gravitate toward these complex states where there's just enough disorder to create new things. There's a rate of mutation just high enough to let interesting new innovations happen, but not so many mutations that every new generation dies off immediately.

Kelly: In this way and many others, technology is an extension of life. Both life and technology are faces of the same larger system.

Johnson: So what I want to know is this: I started thinking about the connection between biological and cultural systems from your first book, but where did you learn it from?

Kelly: One big influence for me was Douglas Hofstadter's book Gödel, Escher, Bach, published back in 1979.

Johnson: So where'd he get the idea from?

Kelly: [Laughs] He was a genius!