The Spice of Life

AN INTERVIEW WITH STEPHEN JAY GOULD

Few scientists have reached a wider audience than Stephen Jay Gould. Passionate intellectual, best-selling author, and devoted baseball fan, Gould finds inspiration far beyond his lifelong study of paleontology. In his acclaimed Full House, *for instance, he combines evolutionary science, statistics, and professional sports to explain the nature of randomness, diversity, and variation in all living systems—themes that have struck a chord with many organizational thinkers. He spoke recently with managing editor Paul Cohen on what biology has to do with management.*

Leader to Leader: **In recent years, biology has had a huge influence on organizational theory. The phrase "complex adaptive systems" may occur as often in business journals as in scientific ones. Do these principles legitimately apply to management?**

Stephen Jay Gould: Often when these kinds of analogical comparisons are made it's far-fetched, or merely metaphorical. This is one of these cases where it may not be. Businesses are natural complex systems, and species are complex systems, so there ought to be some similarities. It is not a question of misapplying biological truths to human systems; it is a case of looking at principles which apply to both biology and human systems. Both are composed of large numbers of interacting components in which small changes in one can have cascading implications throughout.

On the other hand, the attempt to apply natural selection theory—the adaptation of a species to changing local environments—to the business world is wrong in principle. The mechanics of change in human cultural institutions are quite different from those in nature. For one thing, the inheritance of human institutions is Lamarckian—that is, it is an application of the theory (which is incorrect in nature) that acquired characteristics can be passed on to the next generation. But fortunately that happens all the time in human culture. It is called learning. So the analogy to natural evolution

doesn't work. But complexity theory actually has a potential common basis.

L2L: What do you think we can learn from complexity theory?

SJG: I think it can help us to understand why prediction is so difficult. For one thing, management is not a science like physics or astronomy where you have complete predictability. I can tell you to the minute when the next eclipse is going to occur, because it's a simple system with limited interactions. I can't tell you where human evolution is going. Also, the mathematical analysis of complex systems—systems composed of multiple, independent parts—shows that a small perturbation can produce profound effects, because of the way it cascades through the nonlinear interactions of the system. If you then add a little bit of randomness you get profound and unpredictable effects.

It's just natural—not only in business, but in any human endeavor—to think that we can figure out how we want a system to change, study the laws of change, and do our best to make it happen. But often you don't know what the optimal or better adapted system might be. Sometimes allowing a degree of randomness to operate in systems is the best strategy—especially if you don't know where things ought to be going. Just let the system float in a Darwinian world; it will probably find its best locally adaptive form. Those will be the survivors.

L2L: That does not sound like a clearly defined strategy for change.

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SJG: To operate under Darwinian principles—to put out a lot of variation and see where it goes—sounds brutal and inefficient, and it is. In fact, Darwin himself recognized how inefficient the system of natural selection is. In a famous letter he wrote to his friend Joseph Hooker in the 1840s, Darwin said, "what a work a Devil's chaplain would make of the miserable, low blundering and inefficient ways of nature."

Natural selection is not a very efficient system because it works by elimination. You get to goodness by eliminating the bad. Why don't you just go to good? The problem is, you don't know what good is. You have to let a system operate and find itself. That kind of modeling is counterintuitive to the way in which humans generally try to run their institutions. It may not always work—but it's had some success in medicine, for example. If you don't know what drug combination is going to work, why not just try a lot—not on people, obviously.

L2L: We know that evolution is not a matter of continuous, gradual improvement but one of fits and starts or "punctuated equilibrium." Similar patterns hold for entire industries through history. What does that suggest about how to manage change?

SJG: The world is too complex to be in continuous flux in all its parts. If you have continuous flux in every part of a system, how are you ever going to get integrated, complex systems? Lester Thurow, in his book *The Future of Capitalism,* identifies punctuated equilibrium as one of the three or four notions in the sciences that work well to describe the history of economic change. His message is that, at the

very least, we have to be sensitive to rapid shifts in the business and political environment.

L2L: You write that evolution is "a full house of variation within a whole system" rather than a clear march of progress toward a higher life form . . .

SJG: Yes, bacteria still dominate the world, as they always will.

L2L: But does the role of variation and diversity have implications for those who manage human systems?

SJG: I can only tell you, as a personal example, that I live in SoHo in New York, and I love that there's the corner Korean grocery that's open 24 hours. It is one of many elements of a very rich environment. I realize that there are all sorts of pressures to standardization. But I think of another principle of evolution: diversity and regionalism. If you have a species that lives over a wide area, it's going to diversify into regional groups called subspecies. I value that in human society, and I hope we don't go to a model of universal maximal efficiency and only one way to do everything. In fact, ultimately that doesn't work, because of punctuated equilibrium and the nature of environmental change. If you do put your eggs in one basket, that basket's going to eventually collapse. And diversity gives you resiliency against catastrophe.

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L2L: You have shown how misleading it can be to rely on statistical averages for a true picture of reality. Can you explain why that is and what leaders should use as a more meaningful indicator of performance?

SJG: I'm not saying that the trend of either an average or an extreme value is never an appropriate measure. It might be, for certain kinds of questions. It's just that we do have a tendency, and a very erroneous one, to look at entire systems, which are highly variable, and then to abstract that variation in a single number which interests us. Then we use the trend of that single number to characterize the whole system. We can just make ridiculous errors by doing that. Yes, if you've got a few Bill Gateses in a country, some happy politician will say "the mean income has risen substantially." But when you look at the mode—that is, the most commonly occurring value—you may find that most people's income has actually fallen. If you don't look at the whole variation within a system, you'll get a very misleading view of the nature of things.

Often you can just plot the full range through time rather than worry about what is happening at a single moment, as expressed by an average or an extreme.

L2L: What are the sources of improvement, or continued change and adaptability, in a healthy system?

SJG: With Darwinian theory, as we discussed, there's no notion of general advance. There is adaptation to a changing environment. Darwinian theory is about constant local improvement, and since environments are always changing, especially given technological progress, there always has to be flexibility for adaptation—more so in human cultural systems. No matter how well

you're doing something, your environment may change. A travel agent offering the friendliest service in the business finds the next month that everybody's buying their tickets on-line. One answer is to remember that natural selection is about local adjustment, not about cosmic betterment.

L2L: Speaking of cosmic issues, you make the case in *Full House* that the disappearance of .400 hitting in baseball actually reflects an *improvement* in the game. In essence, everyone is getting better, so there is simply less room for an individual to tower above the rest. How do we manage in a context where all competitors are strong and the potential for great improvement is small?

SJG: In human technological history, we may reach that point in certain forms of human invention. When, for instance, you reach the limit in speed of communication, which, of course, is instantaneity, you're not going to get any faster. But I think in most of human technology, we're nowhere near those kinds of limits. The issue more often applies to the human body because we can get ourselves to the extreme of what a body can conceivably do. I suppose there are situations in the world of business where we're approaching the limit of what, in principle, a system could do. In those cases, I would think, you play to your strength, and look for other areas of improvement.

L2L: Does the fact that in 1998 both Mark McGwire and Sammy Sosa crushed a 37-year-old record and in 1999 came close to matching those records, change your view that modern players are nearing the limits of what is possible?

SJG: I wouldn't look at it that way. McGwire in 1998 was a man of destiny. You have to remember, he hit 49 in his rookie year. He's got great gifts of body, and that obsessiveness in training. He hit 58 the year before and missed two or three weeks. I've been saying for years, if he ever plays a full season he's definitely going to break the record. Sosa is the one who somewhat mystifies me. He is a wonderful player, but I don't know where his recent performance comes from—1998 was a replay of Maris and Mantle with reverse results. Mantle was the man of destiny in 1961. He didn't quite make it. Maris had never hit more than 39, came out of nowhere. But McGwire is the Ruth of this generation, and every once in a while someone's going to come along and do it.

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L2L: You have said that we've developed a cult of innovation in which we honor the new over the enduring. And yet innovation is by definition the way forward. Can one assess the quality of an idea in order to avoid what others have called an infatuation with mindless change?

SJG: Indeed, one can. Of course, I'm a paleontologist so I revere the past in ways that not everyone does. If you consider the aesthetic and the ethical dimension, then you're not going to always worship innovation. Sometimes we do things in ways that may not be maximally efficient because they have human value. What amuses me is how often people will go for complex technologies that automate things—which in general I'm in favor of—at the expense of simplicity. For example, old-fashioned photographic slide technology works pretty well because it's not complicated. A human being presses a button and you get the slide you

want. It very rarely fails and if it does you have a person right there to fix it.

Now you've got portable computers. Someday they'll work flawlessly, and then I'll switch to them. But for the moment, I've never seen one that works reliably. And their results, even when they do work, aren't much better than a set of conventional slides. That's a case where I think you really don't need it.

L2L: As science and technology play an increasing role in society, do you see a global leadership role for scientists? Should they be more involved in articulating a vision for the future?

SJG: I think so, and I think that we do insofar as we can and that people listen. I don't think scientists have any superior political sense, nor can we predict the future any better than any pundit in politics or history or sociology. But we do have technical knowledge that's enormously important—the understanding of how all these devices work. I don't think it gives us any moral compass; but since science can be politicized, we want scientists to be speaking out on these issues.

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L2L: The human genome project makes it likely that in a generation or two, humans will be able to plan their own genetic development. Again, at the risk of getting cosmic, will that change our view of our place in the universe?

SJG: That's a little broad. It certainly changes a lot of things about human culture. The scope of the change will depend first on how much regulation we impose upon it, and I think we'll impose a lot. Second, of course, most of the traits we really want are not coded in the genes. You will be able to choose blue eyes versus brown eyes; that is simple. And you will be able to select for sex, which raises serious ethical concerns. But you're not going to be able to choose intelligence—I don't doubt there are lots of genes that influence intelligence—but there isn't a "smart gene." With such a complex interaction of thousands of genes with environmental factors, there is not going to be a simple menu for the things we really care about.

L2L: Finally, given all the analogies and imposed models that you see—what actual lessons does natural evolution offer for society and organizations?

SJG: I think rather limited ones. And that's an important point. There are meaningful analogies, we've been talking about some of them, but the main error people make is to take a well-articulated and well-confirmed mechanism of Darwinian change, that is, natural selection, and think it ought to describe cultural change in humans as well. It really doesn't in principle. Those are the errors of 19th-century social Darwinism.

The entire mechanics of change is so different in cultural versus natural systems. In cultural systems change is Lamarckian—acquired characteristics can be inherited. Whatever we learn or invent in one generation we teach directly to the next generation. That gives cultural change a powerful driving force.

That's why the speed of cultural change works at orders of magnitude greater than anything possible with natural selection. And why natural selection has almost become irrelevant in human evolution. There's been no biological change in humans in 40,000 or 50,000 years. Everything we call culture and civilization we've built with the same body and brain.

The other major difference is that in natural biological evolution once a lineage becomes separate, it's separate forever. It interacts with others ecologically but it can't join with them to create something new. But in human culture you do that all the time. A traveler to a distant land sees a wheel, goes back home and changes his culture forever—so you have constant cross-penetration. Which again makes things unpredictable and wildly variable and fast moving.

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I think the only thing that evolutionary theory suggests that's analogical is that genetic variability is a good thing, so therefore flexibility, different strategies, ability to change, variation, ability to consider lots of alternatives are also good—the only constancy is change and you need flexibility for adaptation. Species that are very rigidly committed to one way of life don't last very long. ■