A revelation

One summer during the territory work, I took my PhD supervisor, Stan Cook, to see the system at Grizzly Lake. The morning after our long drive and our long hike in, I sat Stan down on a rock in one of the meadows, then sat just behind and above him, where I could look over his shoulder and direct his vision. Until they experience it for themselves, people tend to resist believing that it is possible to observe an individual wild hummingbird continuously for an entire day, but it is true and Stan was no different than anyone else in this respect. To engage this closely with a wild hummingbird requires not only the ability to ***see*** what happens, but to some extent to anticipate it correctly, and it takes a while to attune oneself to a meadow in this way. Anyone can do it, but it takes some getting used to and requires "thinking like a hummingbird".

Later, I encouraged my own students to think like hummingbirds: to project themselves so completely into hummingbird anatomy, hummingbird metabolism, hummingbird circumstances, and hummingbird time (fast) that they could imagine what could, would, and should happen next under various assumptions about how the world works. This imaginative exercise was the source of many experiments and theoretical advancements over the years because it generated so many interesting questions.

Sometime during Stan's acclimation to the meadow, while he was realizing that he "knew" what the bird we were watching was about to do but did not yet trust that he had any real reason to know it, he turned slowly toward me and said, "My God, Lee! Those stories you've been telling us for the last couple of years are all true!"

I had not known there had been any doubt about my stories, although I'm such a compulsive storyteller that I should have guessed. But the important part of this anecdote is not my stories but the fact that Stan's statement reinforced something I had been beginning to suspect about what I was learning. The suspicion was that the entire hummingbird system, including bird populations, flower populations, migration and all, was one grand web of tightly coupled functional relationships. Within that web, I sometimes risked imagining, I would be likely to find similarly tight relationships anywhere I looked, coupled by energy exchanges. That was exactly the way it turned out, as you will see if you continue reading, because it became the basis of an entire career in scientific research.

An important aspect of the anecdote is that it illustrates that some of the best, most influential things we receive from our teachers are not at all about the content. There was very little Stan Cook could have taught me about hummingbirds at that stage in my development, very little about ecological energetics or animal intelligence, or even about mountain meadows or how best to study them. That wasn't his field of expertise, and it wasn't his job as my research supervisor. He didn't know enough about those things, and Stan was wise enough not to pretend he did. But he did know his own experience, and he shared it with me that morning in a way that reinforced the deepest things I was trying to do. It significantly influenced the course of my life.

On the basis of his experience of living systems, Stan knew that the stories I told all during the winter sounded too good to be true. He also knew that what he was seeing in the meadow was shaking that experience to the core. He was realizing that the hummingbird system is more tightly organized than any other ecological system anyone

knew about at the time. When he turned around to face me, Stan shared one of the more valuable things a teacher can share with a student: the moment at which the teacher's own reality shifts as a result of something the student says or does. Because of the special relationship between teachers and students, that kind of sharing is supremely valuable.

For these reasons, that interaction in the meadow was pivotal not only in my life as a scientist, but in my life as a teacher. As a scientist, it lent me the strength, courage, and confidence to probe ever more deeply into the hummingbird system. As a teacher, I "paid Stan's gift forward" (to use a phrase from the movie, *Pay it Forward*) in working with my own graduate and undergraduate students for the next few decades. And now I am paying it forward to you. Thanks a lot, Stan!