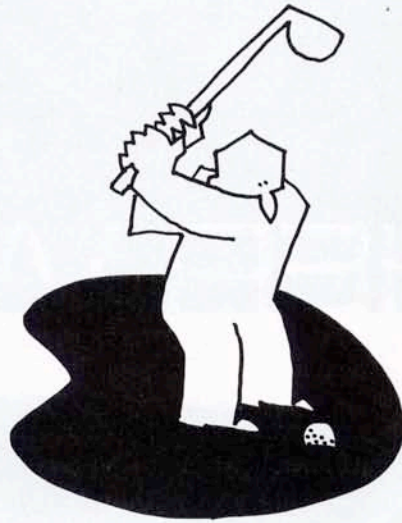


This methodological advance—it's known as multiple electrode recording—allowed Miller to ask a completely new kind of scientific question. For the first time, it was possible to see how cells in different brain areas interacted. Miller was most interested in the interactions of the prefrontal cortex. "You name the brain area, and the prefrontal cortex is almost certainly linked to it," he said. It took more than five years of painstaking probing, as Miller recorded from cells in the monkey brain, but he was eventually able to show that the prefrontal cortex wasn't simply an aggregator of information. Instead, it was like the conductor of an orchestra, waving its baton and directing the players. This is known as "top-down processing," since the prefrontal cortex (the "top" of the brain) is directly modulating the activity of other areas. This is why, during the focussing phase of the insight process, Jung-Beeman and Kounios saw activity in the prefrontal cortex and the neighboring anterior cingulate cortex. They were watching the conductor at work.

In 2001, Miller and Jonathan Cohen, a neuroscientist at Princeton, published an influential paper that laid out their theory of how, exactly, the prefrontal cortex controls the rest of the brain. According to Miller and Cohen, this brain area is responsible not only for focussing on the task at hand but for figuring out what other areas need to be engaged in order to solve a problem. One implication of this is that if we're trying to solve a verbal puzzle the prefrontal cortex will selectively activate the specific brain areas involved with verbal processing. If it decides to turn on parts of the right hemisphere, then we might end up with an insight; if it decides to restrict its search to the left hemisphere, we'll probably arrive at a solution incrementally or not at all.

This "integrative" theory of the prefrontal cortex suggests why we can instantly recognize the insight, even when it seems surprising: the brain has been concertedly pursuing the answer; we just didn't know it. "Your consciousness is very limited in capacity," Miller said, "and that's why your prefrontal cortex makes all these plans without telling you about it." When that obscure circuit in the right hemisphere finally generates the necessary association, the prefrontal cortex is able to identify it instantly, and the insight erupts



*"Better use the ink wedge."*

into awareness. We suddenly notice the music that has been playing all along.

Because Miller can eavesdrop on neurons, he's been able to see how these insights operate at the cellular level. One of his current experiments involves showing monkeys different arrangements of dots and asking them to sort the arrangements into various categories that they have been taught. The monkeys guess randomly at first, learning from trial and error. "But then, at a certain point, the monkey just gets it," Miller said. "They just start being able to categorize arrangements of dots that they've never seen before. That's the moment of categorical insight." This primate epiphany registers as a new pattern of neural activity in the prefrontal cortex. The brain cells have been altered by the breakthrough. "An insight is a restructuring of information—it's seeing the same old thing in a completely new way," Miller said. "Once that restructuring occurs, you never go back."

And yet even this detailed explanation doesn't fully demystify insight. It remains unclear how simple cells recognize what the conscious mind cannot, or how they are able to filter through the chaos of bad ideas to produce the epiphany. "This mental process will always be a little unknowable, which is why it's so interesting

to study," Jung-Beeman said. "At a certain point, you just have to admit that your brain knows much more than you do." An insight is a fleeting glimpse of the brain's huge store of unknown knowledge. The cortex is sharing one of its secrets.

So it was for Wag Dodge. After the fire crossed the river, all the other smoke jumpers were fixated on reaching the ridge. Panic had narrowed their thoughts, so that beating the flames up the slope was their sole goal. But, because Dodge realized that the fire would beat them to the top, his prefrontal cortex started frantically searching for an alternative. It was able to look past his fear and expand the possibilities of his thought process, as he considered remote mental associations that he'd never contemplated before. (As Miller says, "That Dodge guy had some really high prefrontal function.") And then, just as the blaze started to suck the oxygen out of the air, some remote bit of his brain realized that he could cheat death by starting his own fire. This unprecedented idea, a flicker of electricity somewhere in the right hemisphere, was immediately recognized as the solution the prefrontal cortex had been searching for. And so Dodge stopped running. He stood still as the wall of flame raced toward him. Then he lit the match. ♦