Documenting a Neuroscientific Revolution in the Making

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We tend to think of science and religion as polar opposites, even antagonistic toward one another, and for good reason: The Catholic Church spent centuries persecuting any scientist who dared to challenge theological dogma, and many modern fundamentalist Christians still have no truck with such robust scientific ideas as Darwinian evolution.

But not all religions are so threatened. Buddhists embrace modern science, and none more so than the fourteenth Dalai Lama, Tibet's spiritual leader. Indeed, the Dalai Lama has gone so far as to say that if rigorous science were to disprove any tenet of Buddhism, then Buddhism must change. To that end, he has for the past two decades invited eminent scientists to Dharamsala, his Indian home-in-exile, to participate in a series of Mind and Life Conferences.

One of these gatherings, in October 2004, was devoted to the topic of neuroplasticity, the brain's ability to change. Noted science correspondent Sharon Begley (then with the *Wall Street Journal*, now at *Newsweek*) was at that Dharamsala conference, and she documents both the proceedings and the emerging field of neuroplasticity in her new book, *Train Your Mind, Change Your Brain* (Ballantine). It is a thorough and elegant snapshot of a neuroscientific revolution in the making.

The format of the Dharamsala conferences is simple. Each morning, one of the five invited scientists sits on the stage with the Dalai Lama and delivers a synopsis of his or her research findings. After lunch, the assembled Buddhist scholars in the audience react to the talks, draw connections with Buddhist teachings, and suggest further lines of inquiry. Begley structures her book around the five scientific presentations that made up the 2004 dialogue.

The received scientific wisdom about the brain has long been that it is basically immutable; that in early childhood the brain's 100 billion or so neurons are fixed into place like an intricate and finely tuned computer. The five psychologists and neuroscientists in Dharamsala, though from very different scientific backgrounds, are all out to challenge that dogma.

Fred Gage, of the Salk Institute in California, is arguably the most audacious in his challenge. A pillar of neuroscience is the notion that the brain cannot grow new cells. Unlike other cells, neurons do not divide, and what's more it's been believed that new neurons with new connections would throw off the brain's delicate balance. Gage has proved this wrong. In a series of animal experiments, he has shown indisputably that brains can and do sprout new cells, as a result of exercise and mental stimulation, and that these new cells not only integrate themselves into existing tissue but are fully functional. Preliminary evidence suggests that this is true of humans as well.

Helen Neville, University of Oregon, has taken a different tack in debunking neuroscientific tradition. Studying people who are blind or deaf, she has shown that "hardwired" brain functions such as sight and hearing are not nearly as hardwired as we once thought. The visual cortex, deprived of visual

stimulation, can adapt to process hearing, and vice versa. In other words, life's travails can sculpt the brain according to its needs.

All of the scientific work described here suggests that the brain is not a one-way street. The brain's computer does generate thoughts and emotions and behavior, but behavior and thought and emotion in turn have a powerful effect on the brain's shape and operation. Michael Meaney, McGill University, has proven that the way mothers treat their offspring determines which genes in the children's brains are turned on, making them shy or outgoing. Philip Shaver, University of California, Davis, has shown that a sense of safety and security in early childhood (or lack of it) determines adult relationships and attitudes and behavior toward others, including altruism.

Of the five scientists featured in Begley's book, Richard Davidson, University of Wisconsin, is the one most directly involved in studying Buddhist practice and belief. He has used brain scanning technology to study the brains of accomplished Buddhist meditators and has shown that positive emotions like compassion and joy are teachable. His work demonstrates, in effect, that disciplines such as meditation can alter the brain and mind in lasting ways — that we can willfully direct our emotions and attitudes. That's an optimistic view that goes way beyond the Buddhist adepts: It means that we all have the potential to sculpt our brains in ways that make us happier, more benevolent people.

In 1913, the Nobel Prize-winning neuroscientist Santiago Ramon y Cajal proclaimed that "the nerve pathways are something fixed, ended, and immutable." This was the reigning, and pessimistic, view of human potential. But he also added: "It is for the science of the future to change, if possible, this harsh decree." As Begley's fine study makes clear, the science of the future is here.