A Nobel Honor

Caltech added another win to its Nobel scorecard in 2014, bringing to 33 the tally of Caltech alumni and faculty laureates, who have won a total of 34 Nobel Prizes.

Eric Betzig (BS ’83), a group leader at the Howard Hughes Medical Institute’s Janelia Farm Research Campus in Ashburn, Virginia, was awarded the 2014 Nobel Prize in Chemistry along with Stefan W. Hell of the Max Planck Institute for Biophysical Chemistry and William E. Moerner of Stanford University. He is the second Caltech alum in two years to be awarded the prize; Martin Karplus (PhD ’54) received the Chemistry Prize in 2013.

The three were honored “for the development of super-resolved fluorescence microscopy,” a method that allows for the creation of “super-images” with a resolution on the order of nanometers, or billionths of a meter. In essence, the work turns microscopy into “nanoscopy.”

The technique developed by the trio overcomes the so-called Abbe diffraction limit, which describes a physical restriction on the sizes of the structures that can be resolved using optical microscopy. Essentially, the limit shows that nothing smaller than one-half the wavelength of light, or about 0.2 microns, can be discerned by optical scopes. The result of the Abbe limit is that only the larger structures within cells—organelles like mitochondria, for example—can be resolved and studied with regular microscopes; individual proteins or even viruses cannot. The restriction is akin to being able to observe the buildings that make up a city but not the city’s inhabitants and their activities.

Betzig, who was a physics major from Ruddock House during his time at Caltech, built on earlier work by Hell and Moerner to find that it was possible to work around the Abbe limit to create very-high-resolution images of a sample, such as a developing embryo, by using fluorescent proteins that glow when illuminated with a weak pulse of light. Each time the sample is illuminated, a different, sparsely distributed subpopulation of fluorescent proteins will light up and, because the glowing molecules are spaced farther apart than the Abbe diffraction limit, a standard microscope would be able to capture them.

Still, each of the images produced in this way has relatively low resolution—that is, the images are blurry. Betzig realized, however, that by superimposing many such images, he would be able to obtain a sharp super-image, in which nanoscale structures are clearly visible. The new technique was first described in a 2006 paper published in the journal *Science*. *—KS*