MILLER INSTITUTE NEWSLETTER

Winter 2008

Miller Fellow Focus: Tessa Burch-Smith

Tessa (left) and her Miller host professor, Patricia Zambryski (right).

First year Miller Fellow Tessa Burch-Smith is from Castries, St. Lucia. Where? If you look really closely at a world map, you will find St. Lucia nestled in the eastern Caribbean. By all measurements, St. Lucia is a small country: 238 miles in area and a population of 160, 000. But these constraints do not limit the imaginations and ambitions of its citizens, and Tessa is no exception. After completing her undergraduate studies at the University of the West Indies, she decided to pursue further study in the biological sciences.

Tessa received her Ph. D. from Yale University under the mentorship of S. P. Dinesh-Kumar. Her thesis work in plant innate immunity concerned how tobacco cells were able to detect, and respond to, the presence of a component of the Tobacco mosaic virus. She found that the plant cells have receptor proteins that carry a TIR domain, highly similar to those found in mammalian immunity molecules, for interaction with the viral protein. After detection of the pathogen, infected cells and their neighbors mount a highly coordinated defense response to eliminate the virus. Part of this defense response is the death of infected cells and their neighbors. But this response must be tightly controlled if the plant is to prevent the launch of a suicidal program. This research cultivated her interest in how cells within an organism, especially plants, can communicate their physiological and developmental state to adjacent cells in order to grow, develop and survive environmental fluctuations.

One unique feature of plant cells is they are surrounded by cell walls containing cellulose. Cell walls form the skeleton of plants, and as individual cells exist under relatively high turgor pressure, walls are critical to keep cells from losing their contents. While small molecules like water and ions can freely cross the cellulose and polysaccharide fibers that constitute the cell wall, the passage of larger molecules is severely restricted. This means that each cell is effectively isolated from its neighbors. This is in marked contrast to animal cells that are in direct contact with each other. This raises the intriguing question: How do plant cells communicate with each other to coordinate growth, development and responses to changing environmental conditions?

Animal cells use a variety of mechanisms for cell-to-cell communication. These include the secretion of small peptides and molecules like hormones into the extracellular environment for detection by cell-surface receptors localized to the plasma membrane. Animal cells may also display ligands at their surfaces that can be detected by specific receptors on neighboring cells. Plant cells also use plasma membrane receptors to detect ligands secreted by neighboring cells or generated by pathogen infection. However, these communication routes are limited in plants and most intercellular communication is accomplished via plasma membrane-

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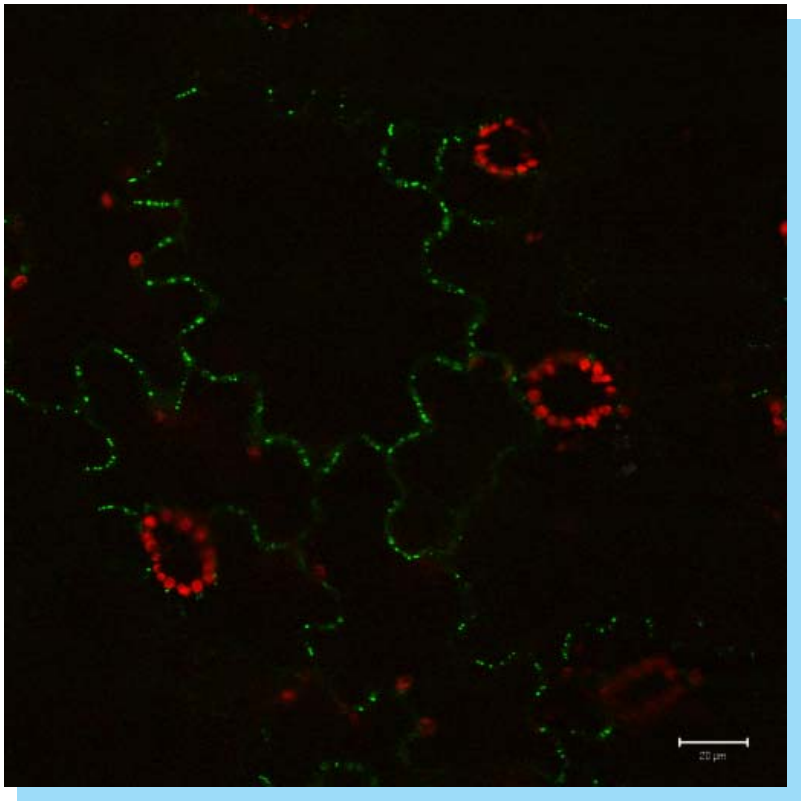
lined cytoplasmic channels called plasmodesmata (PD).

Tangl first described these intercellular channels in 1879, and Strasburger conferred the name 'plasmodesmata' in 1901. PD have been studied intensively for over 100 years. Most of these studies have been limited to structural studies under different growth conditions and developmental stages. PD arise de novo during cell division, when bits of the cortical endoplasmic reticulum (ER) become trapped within the forming cell plate. Cell wall material is deposited and the plasma membrane extends to surround the captured ER membranes. This produces a channel with a central strand of modified ER that is continuous between contiguous cells. The space between the ER and the plasma membrane forms the PD channel consisting of shared cytoplasm between adjacent cells. In younger tissues that are "sinks" for photosynthates (think of the newly forming small leaves at the end of a branch), PD are simple and usually consist of a single, straight channel while those of mature tissues that are the "source" of photosynthates typically consist of multiple branches.

The last two decades have ushered in molecular tools for the analysis of PD function. Dr. Patricia Zambryski, Tessa's Miller host in the Department of Plant and Microbial Biology, is a pioneer in the application of theses new techniques to examining PD function. A major role for PD is the transport of developmentally important regulatory molecules. One group of such molecules consists of transcription factors that turn on expression of genes involved in specific processes like root development and flowering. Small RNAs are another important group of regulatory molecules that are trafficked via PD. The upper size limit of molecules that can cross the PD is called the size exclusion limit (SEL). The SEL, or aperture, of PD depends on the developmental state and the growth conditions of the cells. Work from Dr. Zambryski's lab, and others, has shown that PD of young tissues have larger SELs than those of mature tissues. PD SEL can also be manipulated by pathogens, especially viruses. The ability of viral movement proteins (MP) to alter the SEL of PD has been elegantly demonstrated using fluorescent molecules of various sizes. These fluorescent probes and viral MPs are now the standard tools for analysis of PD activity.

How are the movement of molecules through PD and the aperture (SEL) of PD regulated? This has proved to be a challenging question to plant biologists but it is also an intriguing problem that Tessa is examining as a Miller Fellow in the Zambryski lab. A typical approach to studying a biological process is to identify and then perturb the genes involved to determine what the function of the encoded proteins might be. This is not readily achieved for PD analysis since one imagine that altering or disrupting PD will have lethal consequences for a plant. The Zambryski lab has performed a clever analysis of mutant embryos from the model plant Arabidopsis thaliana to identify those with altered PD function as shown through their altered SEL. Fourteen independent mutants that show increased transport of fluorescent



Fluorescently Labelled Protein Localized to Plasmodesmata
Image taken by Solomon Stonebloom

Awards & Honors

December 14, 2007: **Maryam Modjaz** (Miller Fellow 2007 - 2010) received the overall conference-poster prize at the International Astronomical Union Symposium "Massive Stars as Cosmic Engines" in Hawaii.

November 14, 2007: **Sheila Patek** (Miller Fellow 2001 - 2004) is the winner of the 2008 George A. Bartholomew Award. This award, named in honor of George A. Bartholomew, president of the Society in 1980, is given annually by the Division of Comparative Physiology and Biochemistry to a young investigator for distinguished contributions to comparative physiology and biochemistry or to related fields of functional and integrative biology.

Nocwmbwe 13, 2007: **Adrian Bejan** (Miller Fellow 1976-1978) received the James P. Hartnett Award from the International Center of Heat and Mass Transfer.

October 26, 2007: **Nicholas Jewell** (Miller Professor Fall 1994), **Judith Klinman** (Miller Professor Fall 1992, Miller Professor 2003 - 2004), **Mimi Koehl** (Miller Professor 2000 - 2001), **James Chelikowsky** (Visiting Miller Professor Spring 1999), **Sandra Faber** (Visiting Miller Professor Spring 2005), **Steven Clarke** (Miller Fellow 1976 - 1978), and **Gang-yu Liu** (Miller Fellow 1992 - 1994) have been named fellows of the American Association for the Advancement of Science.

October 24, 2007: **Karl Pister** (Miller Professor 1962 - 1963) received the Clark Kerr Award from the Academic Senate for a career of service, leadership, and advancing higher education.

September 13, 2007: Associate Professor **Eileen Lacey** (Miller Fellow 1994 - 1996), who is also an Associate Curator at the Museum of Vertebrate Zoology, has been re-elected to the Board of Directors of the American Society of Mammologists at its annual meeting in June at the University of New Mexico. Dr. Lacey will serve another three-year term on the board assisting in the directing of the world's oldest and largest scientific organization devoted to mammals.

August 30, 2007: **Don Tilley** (Miller Professor 2004 - 2005) is the 2008 recipient of the Frederic Stanley Kipping Award in Silicon Chemistry.

August 16, 2007: **Alex Pines** (Miller Professor 1977 - 1978, 1998 - 1999, Spring 2000) was named one of R&D Magazine's top 100 innovators of the year for a development in the area of magnetic resonance imaging that could eliminate the need for powerful magnets.

June 20, 2007: **Sir David Read** (Visiting Miller Professor Fall 2002), University of Sheffield, UK, was knighted in the 2007 Queen's Birthday Honours for services to Biological Science.

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probes were identified, and two of the mutant genes have been cloned. These genes, ISE1 and ISE2, both encode RNA helicases, proteins with diverse, important roles in RNA metabolism. Intriguingly, the results imply that mutants with altered SEL play a role in the transport of RNA between cells. Tessa is now part of efforts to further characterize these RNA helicases. She is particularly interested in extending the analysis of these genes to other stages of development to determine what role, if any, they may play after embryogenesis. ise2 mutant embryos have a significant proportion of branched PD, while wild type embryos possess only simple PD. Tessa plans to use a number of proteomic approaches to examine the differences between wild type, simple PD and branched, ise2 PD. Defining altered PD components will provide critical insight into the structural and regulatory proteins essential for function of these important intercellular channels.

Tessa is very excited about her opportunity to pursue her research into this interesting biological question as a part of the Miller Institute. When not probing PD function, Tessa spends her free time reading, traveling and dreaming of the warm Caribbean sunshine!!

Miller Professorship Awards

The Miller Institute is happy to announce the awards for Miller Research Professorship terms during Academic Year 2008-2009. Recipients are released from teaching and administrative duties, allowing them to pursue their research, following promising leads as they develop.

Michael Jordan	Statistics
Adrian Lee	Physics
Michael Manga	Earth and Planetary Science
Thomas Powell	Integrative Biology
Theodore Slaman	Mathematics
Ashvin Vishwanath	Physics
Peidong Yang	Chemistry

Next Steps

The Miller Institute congratulates **Sasha Turchyn** (Miller Fellow 2005 - 2008) on her new position as Lecturer in the Department of Earth Sciences at the University of Cambridge in the United Kingdom.

Birth Announcements

Congratulations to **Marco Ziegler** (Miller Fellow 1998 - 2000) and Petra Ziegler on the birth of their daughter, Aquina. She was born December 23, 2007.

Congratulations to **Bojko Bakalov** (Miller Fellow 2000 - 2003) and Vesselina Bakalov on the birth of their twins, Nicolas and Daniel, born Aug 23, 2007. Bojko is currently an Assistant Professor of Mathematics at the University of North Carolina.

Congratulations to **Chris Fromme** (Miller Fellow 2004 - 2007) and Alison Fromme on the birth of their son, Nathan, born October 13th. Chris is continuing his postdoctoral work in the Department of Molecular and Cell Biology at UC Berkeley.

Visiting Miller Professorship Awards

The Miller Institute is pleased to announce the Visiting Miller Professorships granted during this year's competition. The purpose of the Visiting Professorship program is to bring promising or eminent scientists to the Berkeley campus for collaborative research interactions. The recipients will be on campus for terms during Academic Year 2008-2009.

Nalini Anantharaman *CNRS, Ecole Polytechnique, France*	Mathematics, sponsored by Maciej Zworski
Jim Bryan *University of British Columbia*	Mathematics/Physics, sponsored by Mina Aganagic
Sergio Ferrara *CERN, Geneva, Switzerland*	Physics, sponsored by Ori Ganor
Andrew Green *University of Saint Andrews, Fife, UK*	Physics, sponsored by Joel Moore
Michael Hochberg *University of Montpellier II, France*	ESPM, sponsored by Wayne M. Getz
Nicolas Mathevon *Université Jean Monnet* *& Institut Universitaire de France*	Psychology, sponsored by Federic Theunissen
Thomas Meade *Northwestern University*	Bioengineering, sponsored by Thomas F. Budinger
Lucy Pao *University of Colorado*	Mechanical Engineering, sponsored by Masayoshi Tomizuka
Leo Radzihovsky *University of Colorado*	Physics, sponsored by Ashvin Vishwanath
Thomas Russell *University of Massachusetts*	Chemistry, sponsored by A. Paul Alivisatos
Hermona Soreq *The Hebrew University of Jerusalem*	Helen Wills Neuroscience Institute, sponsored by William Jagust
Lena Ting *Emory University and Georgia Tech*	Integrative Biology, sponsored by Robert J. Full

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The Advisory Board

The Advisory Board of the Miller Institute met on November 30 to discuss policy and to select new Institute members. The Board is comprised of four advisors external to Berkeley: the newest member **Professor Elizabeth Blackburn** (UCSF), **Dr. Jennifer Chayes** (Microsoft Corporation), **Professor Michael Klein** (University of Pennsylvania), and **Professor Nancy Kopell** (Boston University); four internal Executive Committee members **Professor Jonathan Arons, Executive Director David Chandler, Professor Alberto Grunbaum, and Professor George Oster**. The Board is chaired by Berkeley's Chancellor, **Robert Birgeneau**. The Vice Chancellor for Research, **Beth Burnside**, also attends the meeting.

From the left: Jonathan Arons, Michael Klein, Elizabeth Blackburn, Alberto Grunbaum, Beth Burnside, and Jennifer Chayes. Backs to camera: David Chandler and George Oster.

Elizabeth Blackburn and David Chandler

The Miller Institute is "dedicated to the encouragement of creative thought and the conduct of research and investigation in the field of pure science and investigation in the field of applied science in so far as such research and investigation are deemed by the Advisory Board to offer a promising approach to fundamental problems."