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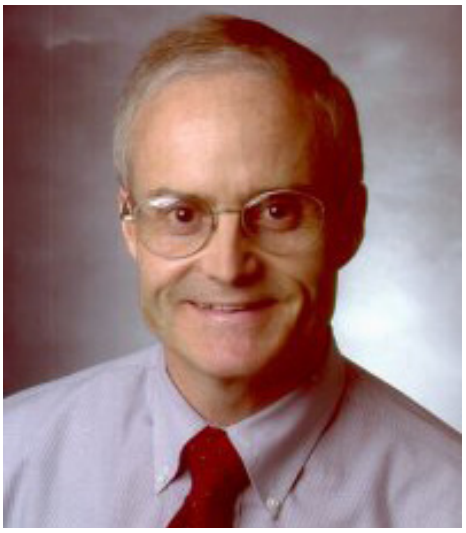
# FACULTY newsletter

CPMS Physical and Mathematical Sciences



ABOVE Dr. Greg Burton

## CPMS Appoints New Department Chairs

*The College of Physical and Mathematical Sciences recently announced the appointment of one new department chair and the reappointment of two others. The appointments went into effect on July 1st.*

**Chemistry and Biochemistry**

Dr. Greg Burton has accepted an appointment to serve as the Chair of the BYU Department of Chemistry and Biochemistry. Burton received Bachelor's degrees in Mathematics and Medical Technology from the University of Utah and a Master's degree in Microbiology from Brigham Young University. He completed his Ph.D in Microbiology and Immunology at Virginia Commonwealth University in 1989. Burton has previously taught at Virginia Commonwealth University and has been a faculty member at BYU since coming to Provo in 1997. Burton's academic research focuses on the molecular interactions of HIV with susceptible target cells.

Burton replaces the outgoing Paul Farnsworth, who served two three-year terms as chair. Dr. Steve Goates will continue on as Associate Chair, while Dr. Adam Wooley has been appointed to replace Dr. Paul Savage as a new Associate Chair.

"Although somewhat overwhelmed with this new responsibility, Steve Goates, Adam Woolley and I are committed to working together to continue to build upon the strong foundation established by the past and present members of the Department of Chemistry and Biochemistry. We acknowledge the excellent leadership of Paul Farnsworth, Paul Savage and Steve Goates, who previously served in the positions that we now occupy. We look forward to working together to serve our students, staff, faculty and alumni," Burton said.

**Physics and Astronomy**

Dr. Ross L. Spencer has been reappointed to serve as the Chair of the Department of Physics and Astronomy, with Dr. Harold Stokes continuing as Associate Chair. Spencer was first appointed as Chair in 2007.

**Geological Sciences**

Dr. Scott Ritter has been reappointed to serve as the Chair of the Department of Geological Sciences, with Dr. John McBride continuing as Associate Chair. Ritter was first appointed as Chair in 2007.

by: Steve Pierce

ABOVE Dr. Eric Ringger

## Professors Teach Computers Ancient Language

Computers may seem like cold, data-processing machines, but in the Natural Language Processing (NLP) and Applied Machine Learning (AML) Labs, Eric Ringger, Kevin Seppi, and their students are pioneering budget-conscious technology that is connecting linguists and Syriac scholars across the globe to facilitate the understanding of early forms of Christianity in the Near East.

Ringger, a faculty member in the Department of Computer Science, began by searching for meaningful projects at BYU to which he and his students could contribute. He was connected with Kristian Heal, Director of the Center for the Preservation of Religious Texts (CPART) at the BYU Maxwell Institute for Religious Scholarship, and the NLP Lab became involved in CPART's efforts to build a comprehensive electronic corpus of Syriac texts.

Searching such a corpus is difficult due to the ambiguity of this Semitic language, since it, like Hebrew and Arabic, is written using only consonants and forms words in non-trivial ways. Seeing this need, Ringger's lab decided to apply machine learning methods to the problem. Deryle Lonsdale of the BYU Linguistics Department brought his expertise in morphology, the study of word

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ABOVE Dr. Kevin Seppi

# COLLEGE PUBLICATIONS

## Chemistry and Biochemistry

Wang, J., Harrison, R.G., Lamb, J.D., Journal of Inclusion Phenomena & Macrocyclic Chemistry, 2010, *67*, 55-61. Anion Binding by a Zinc Containing Tetratopic Cyclen-Resorcinarene.

Jiang, G., Rivera, F., Kanyal, S.S., Davis, R.C., Vanfleet, R., Lunt, B.M., Linford, M.R., Proc. SPIE, 2010, *7730*, 77301N. Analysis of the Plastic Substrates, the Reflective Layers, and the Adhesives of Today's Archival-Grade DVD's.

Watt, R.K., Hilton, R.J., Graff, D.M., Biochimica et Biophysica Acta, 2010, 1800, *745-759*. Oxido-reduction is not the only mechanism allowing ions to traverse the ferritin protein shell.

Holcombe, J.A., Farnsworth, P.B., In: Lindon, J., Tranter, G., Koppenaal, D., editors, Encyclopedia of Spectroscopy and Spectrometry, 2nd ed., Oxford: Elsevier, 2010, 1, 63-69. Atomic Emission and Fluorescence Theory.

Sanz-Garcia, E., Stewart, A.B., Belnap, D.M., J. Struct. Biol., 2010, 171, 216-222. The random-model method enables ab initio three-dimensional reconstruction of asymmetric particles and determination of particle symmetry.

Banerjee, B., Litvinov, D.N., Kang, J., Bettale, J.D., Castle, S.L., Organic Letters, 2010, 12, 11, 2650-2652. Stereoselective Additions of Thiyl Radicals to Terminal Ynamides.

Wang, J., Lamb, J.D., Hansen, L.D., Harrison, R.G., J. Incl. Phenom Macrocycl Chem, 2010, *67*, 55-61. Multiple anion binding by a zinc-containing tetratopic cyclen-resorcinarene.

Continued on page 4

## Ringger/Seppi *continued*

formation, to the table. Seppi joined the project soon thereafter, and together with their students they came up with the idea of cost-conscious active learning.

"Our project is innovative because it's one of the first real applications of active learning to text annotation," Ringger said of the technology. "It's been done elsewhere, but it's been kept in-house, and not to the degree we're doing it. We're trying to help others by sharing the tools and the technology. I'd love for people to never do text annotation again from the beginning of the corpus to the end. It will transform the way people do scholarship in Syriac."

In current machine-learning approaches, the computer processes volumes of existing labeled data to learn patterns and then independently annotates other data sets. Ringger observed that this approach can be very expensive and incomplete in scope. This led him to apply active learning, a concept adapted from education.

"We can't annotate everything," Ringger said of this dilemma. "It would be a waste of time. So we ask: What would happen if the computer asked the questions instead?"

The group realized this approach could be made even more cost-conscious. The machine learning can continue at a more effective pace if the computer asks the best questions in a way that is not only sensitive to the amount of information to be garnered from the answer but is also sensitive to the amount of effort required to come up with the answer. This way both the computer and the expert gain more for less.

"The computer begins looking at data we give it," he said, "and asks of the expert: 'What is this? Tell me more about this. And I know these; they're similar to these, but what about this?' It can then fill in the blanks. We don't have to tell it everything."

Through grant funding, everyone, including undergraduate students, is benefiting.

"We have students involved who care about language, machine learning, web services, and those who just love to program," he said. "Though the methodology is totally machine-driven, we are solving a human language problem."

Beyond the students, many scholars can benefit from the building of a corpus. There are approximately ten million words of classical Syriac texts, spanning over 18 centuries. Many of these texts provide a previously unknown perspective on eastern Christianity.

"When you have [a full-corpus], you can ask questions that you couldn't ask before," said Ringger. "Such as: what was the evolution of this word, or what was the influence of Greek philosophy on eastern Christianity? These questions require the big view. You have to have all the information."

The international reach continues with the publication of four recent papers. Ringger and Seppi and their students presented their work at two major conferences for language resources and computational linguistics. All of the papers are published in full in the conference proceedings.

"People attend [these conferences] from computer science, from linguistics, from humanities, and from philology," Ringger said. "They're coming to learn about tools for this kind of work. There are people building corpora all over the world. Everything from Syriac to dying aborigine languages. Some are using paper and pencil; some are using 3 by 5 cards in shoe-boxes; others are using regular text editors like Microsoft Word. These papers say, 'Here's what we're doing, why we're doing something new, and that there's a better way to solve these problems.'"

by: Katie Pitts

# IMPORTANT DATES TO REMEMBER

**Commencement**
August 12, 4:00 p.m.
Marriott Center

**College Convocation**
August 13, 8:00 a.m.
WSC Ballroom

**Annual University Conference**
August 23-27

**College Meeting**
August 25, 10:00 am
W-111 BNSN

ABOVE Dr. Jessica Purcell

# Purcell Explores Many Dimensions of Universe

*While it has been well-known for centuries that Earth is round, little is known regarding the shape of the universe. Jessica Purcell, a faculty member of the Department of Mathematics, is studying such questions using hyperbolic geometry.*

"Back in the Middle Ages, people thought the world was flat because if you're standing on the earth and look around, it looks flat like a two-dimensional plane," Purcell said. "But even though you've got all of these flat pieces, they all connect up to a sphere, which sits in three-dimensional space rather than two-dimensional."

Planes and spheres are examples of what mathematicians call a manifold. To someone standing within a manifold, it may appear to be a certain dimension. But once one steps out of it, like a person stepping off Earth's surface into space, the overall shape becomes clearer.

One may take this concept further by considering whether we truly see the universe as it really is, or whether we are confined to a narrower vision. Those in the Middle Ages saw the earth as a two-dimensional plane, but now we have been able to view it in its three-dimensional state.

"Maybe we envision the universe to continue forever like a three-dimensional plane, when it really connects back on itself, gluing up to form a three-dimensional sphere," Purcell explained. "If we're standing in our little space in the universe and we look around, it looks like everything is three-dimensional. You can go up, down, left, right, backward, and forward. But we still don't know what sort of a three-dimensional manifold the universe is. So what are we really standing in? Does it connect in a higher dimension?"

This question is hard to answer. While we may know how to escape the two-dimensional view of earth and enter outer space, we do not yet know how to exit our universe. Without this convenience, it is extremely difficult to determine which shape the universe should be.

"It's hard to explore the three-dimensional manifolds because almost all of them, even the simplest, connect up into a higher dimensional universe and we don't have any way of perceiving that," Purcell explained. "You can take a ball and be able to identify it as a sphere but you can't do that for a three-dimensional sphere which sits in four-dimensional space. So that's one thing that makes these complicated."

by: Natalie Wilson

ABOVE Dr. Shane Reese

# Summer Seminar Brings Statisticians Together

It started simply. The goal was to keep all faculty members of the Department of Statistics up to date with new methods and discoveries by inviting a statistician to bring his or her ideas to BYU campus. Now, the Summer Institute of Applied Statistics has grown into an event in which many of the top statisticians from around the world present their research to a group of about 40-60 participants from various backgrounds.

The Institute is held annually in June and spans three days. The schedule is full of classroom instruction, as well as a traditional barbecue at Rock Canyon Park in Provo and sometimes even a golf tournament. This year's program recently concluded and marked the Institute's 35th year of operation.

Shane Reese, a BYU faculty member, presented this year. Using innovative Bayesian methods, he has focused some of his research on nuclear weapons and ways to predict their outcomes upon detonation. Because nuclear testing is banned by treaty, Reese and his colleagues have developed techniques to accurately predict on paper what would happen.

This year's Institute attendees gathered to learn about Bayesian methods from Dr. Reese, but they came from many different fields, ranging from pharmaceutics to engineering. Some were sent to this workshop by their employers to sharpen their skills and receive training in the most cutting-edge statistical techniques. Participants noted that Reese took a genuine interest in everyone's learning and willingly deviated from his notes to explore questions and concerns posed by his listeners.

Thirty-five years after its initial session, the Institute continues to create an atmosphere of mutual learning among its attendees. It seems the original vision of the Summer Institute of Applied Statistics has been—and continues to be—realized.

by: Natalie Wilson

ABOVE Dr. Daniel Ess

# CPMS Welcomes Daniel Ess to Chem Faculty

The College of Physical and Mathematical Sciences would like to welcome Daniel Ess, a new faculty member in the Department of Chemistry and Biochemistry.

Ess obtained his Bachelor's degree from BYU in Biochemistry and continued to obtain his Ph.D. at the University of California in Los Angeles. He did postdoctoral work at both the California Institute of Technology and at The Scripps Research Institute in Florida. Having just worked at the University of North Carolina as an Energy Frontier Research Center Postdoctoral Fellow, Ess has already gained much experience and is ready to start teaching, researching, and producing results here at Brigham Young University.

Ess was born in southern California, the second of three children. He filled his childhood with sports, enjoying pick-up games of every kind, especially soccer and baseball. This passion for sports has continued—Ess recently opted to drive from North Carolina to Utah instead of flying in order to watch several ball-games along the way.

Ess met his wife, Emily, in a Physics class while still an undergraduate student in Provo. They currently have two children, Madison and Henry.

As a family, they enjoy traveling and have learned from many rich, diverse cultures. Emily is from Malaysia and served a mission in Taiwan. Ess served a mission in Portland, Ore., and due to job locations, he and his family have also traveled to or resided in Switzerland, France, Australia and Japan.

Despite all the unique, exotic foods Ess has tasted throughout his life, he still cherishes good old American barbeque as his favorite meal. But, he specified, it has to be from Texas or Georgia.

"It's good stuff," he smiled.

by: Natalie Wilson

# COLLEGE PUBLICATIONS *continued*

## Chemistry and Biochemistry

Chen, X., Tolley, H.D., Lee, M.L., Journal of Chromatography A, 2010, 1217, 3844-3854. Polymeric cation-exchange monolithic columns containing phosphoric acid functional groups for capillary liquid chromatography of peptides and proteins.

Truong, T.V., Nackos, A.N., Williams, J.R., VanDerwerken, D.N., Kimball, J.A., Murray, J.A., Hawkes, J.E., Harvey, D.J., Tolley, H.D., Robinson, R.A., Bartholomew, C.H., Lee, M.L., Analytical Methods, 2010, 2, 638-644. Differentiation of Bacillus endospore species from fatty acid methyl ester biomarkers.

## Mathematics

Xian-Jin Li, (2010). "A spectral interpretation for the explicit formula in the theory of prime numbers." Science China Mathematics 53, no. 3, pp. 791-812.

Zeng Lian and Kenning Lu, (2010). "Lyapunov Exponents and Invariant Manifolds for Random Dynamical Systems in a Banach Space", Memoirs of the American Mathematical Society 206, no. 967, p. 111.

Sebastian Acosta and Vianey Villamizar, "Coupling of Dirichlet-to-Neumann boundary condition and finite difference methods in curvilinear coordinates for multiple scattering", Journal of Computational Physics, Arts, & Letters 229, pp. 5498-5517

Jessica Purcell, "Hyperbolic geometry of multiply twisted knots," Communications in Analysis and Geometry 18, no. 1, pp. 101-120.

## Mathematics Education

Hendrickson, S., Hilton, S., & Bahr, D. (2010). The comprehensive mathematics instruction (Cmi) framework: A new lens for examining teaching and learning in the mathematics classroom. Impact Journal, 11, 13-16.