BIOTECH *at* VIRGINIA

The Newsletter of the University of Virginia Biotechnology Training Program
Volume 8, Number 2
Fall 2007

In the Spotlight:

Giorgio Carta: Separating from the Rest

By Timothy M. Pabst

GIORGIO Carta received his Ph.D. in chemical engineering from the University of Delaware in 1984. After leaving Newark, he came to the Department of Chemical Engineering at the University of Virginia to pursue his research career in the area of adsorption and ion exchange of small molecules with a focus on downstream processing of biotechnology products. The Carta lab is devoted to gaining a fundamental understanding of equilibrium and transport processes to aid in the rational design of novel materials for bioseparations as well as efficient processes for the recovery, separation and purification of biologicals.

Prof. Carta ("pied") with group members Timothy Pabst, Emily Schirmer, Theresa Bankston, and Melani Stone.

Research projects in the lab include the design and optimization of polymer-grafted hydrogel materials that are synthesized with a wide range of desirable properties for protein chromatography. Specifically, these resins are being developed with properties that allow for the efficient separation of monoclonal antibody aggregates, an important goal of the pharmaceutical industry. Both macroscopic and microscopic techniques are used to measure partitioning and diffusion phenomena of proteins in order to develop separation media. Preparative scale chromatofocusing using pH-gradient separations on weak-acid and weak-base exchangers is also being studied. Modeling pH transitions allows the lab to optimize buffer systems and design efficient separations of protein variants differing by a single charge. Work is also underway to elucidate the effects of apolipoprotein self-association on bind-and-elute ion exchange chromatography. This work includes experimental and modeling efforts. Collaborations with Bio-Rad Laboratories, Pfizer, Inc., Merck & Co., Inc., and Ajinomoto Co., Inc. keep the research exciting, and drive technology development in the field.

Professor Carta is very well-respected in the bioprocess industry. He has authored about 100 refereed journal articles, is the holder of two US patents,

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Biogen Idec: Searching for Stability

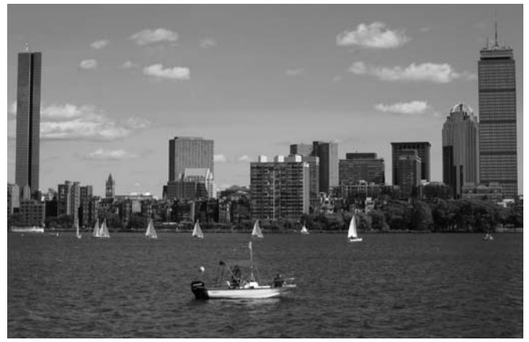
By Jacob L. Jordan

FOR 8 WEEKS THIS SUMMER I had the opportunity to intern in the molecular modeling group of Biogen Idec (BIIB) in Cambridge, Massachusetts. With approximately 3,700 employees, patients in over 90 countries, and 2006 revenues in excess of $2.7B, Biogen Idec is one of the world's leading biotechnology companies in the core therapeutic areas of oncology, neurology, and immunology. Some of their current products include AVONEX® and TYSABRI®, both used for the treatment of multiple sclerosis, and RITUXAN®, the world's first licensed monoclonal antibody therapy for the treatment of certain B-cell non-Hodgkin's lymphomas.

Under the direction of Dr. Alexey Lugovskoy and Dr. Deping Wang I worked to develop computational methods for predicting stabilizing mutations of antibodies. Their group, dedicated exclusively to computational modeling and design, is somewhat rare in an industrial setting. Working in collaboration with protein crystallographers and analytical experimentalists, Dr. Lugovskoy and his team help to develop drug targets based on protein-protein and protein-ligand interactions, and serve as consultants for the entire protein drug discovery group regarding specific problems with molecular stability.

Due to their specificity for a myriad of disease targets monoclonal antibodies continue to grow in importance as therapeutics. Unfortunately, in an effort to reduce immunogenicity a number of "man-made antibodies" have resulted in less stable, aggregation-prone molecules. My project while at BIIB focused on identifying characteristics of mutations known to stabilize these molecules and thereby create a more robust expression, purification, and storage process. A unique aspect of this externship is that upon leaving the BIIB campus my work was not complete. Instead we have arranged a collaboration whereby our group will study the conformational stability of some of these molecules experimentally using hydrogen-exchange mass spectrometry (HX-MS).

Outside of work, Boston and the surrounding area offer a number of distractions. From sailing on the beautiful Back Bay to the delicious tour of the Sam Adams Brewery, there's something for everyone in Boston. Just make sure you visit during the summer unless you really like snow. This externship was a very rewarding experience for me due to the people I was able to meet and the inside view of the biotechnology industry I observed each day. Rather than coming to work to earn a paycheck or advance one's career, nearly all of the researchers at BIIB come to work to help patients. They come to make people's lives better and relieve some of their pain. Getting molecules into the clinic for people to test truly is their number one goal. If this doesn't make you happy about the work you're doing, I don't know what will. ■



Boston's Back Bay is a favorite of tourists and locals alike during the mild summers. The esplanade, situated across the Charles River, is home to the July 4th performance of the Boston Pops.

Novartis BioMedical Research Institutes, Inc.: Compound Profiling

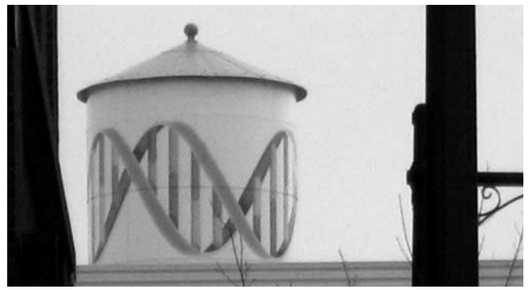
By Erwin P. Gianchandani

FOR MY EXTERNSHIP, I spent March and April 2007 at the Novartis Institutes for BioMedical Research, Inc. (NIBR), in Cambridge, Mass. NIBR is the principal research and development arm of Switzerland-based Novartis Pharmaceuticals, and considerable emphasis is placed on systems-based approaches for discovering novel therapeutics. NIBR employs over 2,500 associates. While at NIBR, I worked on the compound profiling project under the direction of Douglas A. Selinger (Ph.D., in Genetics, with George Church, Harvard Medical School).

Compound profiling involves mapping compounds into assay space, and its objective is to generate testable mode of action (MoA) hypotheses based on the activities of compounds in standardized assay panels. For example, reporter-gene assay or microarray profiles of investigational compounds may be compared with those of reference compounds whose MoAs are known, and similarities in these profiles are indicative of mechanistic and functional correlation between the compounds. The results of compound profiling can suggest possible therapeutic roles for emerging compounds.

My efforts at NIBR focused specifically on optimizing the computational and experimental parameters associated with microarray-based compound profiling. Using an in-house microarray pilot study, I determined the optimal statistical methods for generating gene sets based on reference compounds, ranking microarray data for investigational compounds, and statistically comparing these datasets. In addition, I determined optimal experimental parameters, including cell line, drug dosage, the sample time, and number of replicates to be evaluated.

Aside from the research effort, my time at NIBR facilitated a study of the pros and cons of working at a large for-profit enterprise like Novartis. I came away with a much better understanding of what I would like to do once I complete my Ph.D. ■



The water tower atop NIBR's worldwide headquarters in Cambridge, MA. The tower has been an icon of the Cambridge skyline for over 75 years. In 2004, it was painted with a double helix to symbolize NIBR's takeover of the building of which it is a part. Prior to that, the tower and building were home to the famed candy manufacturer New England Confectionary Company (NECCO).

Pfizer, Inc.: Separation of PEGylated Proteins

By Timothy M. Pabst

THIS PAST FALL I COMPLETED my externship at Pfizer, Inc, the world's largest research-based biomedical and pharmaceutical company, under the guidance of Dr. Alan Hunter (Ph.D., Univ. of Virginia) and Dr. Natraj Ramasubrmanyan (Ph.D., Rutgers Univ.). For four months, I worked with the microbial downstream processing group located in St. Louis, Missouri, the gateway to the west. Many well-known therapeutics are produced by Pfizer, Inc., including Lipitor® (for treatment of high cholesterol), Celebrex® (treatment of arthritis pain), Exubera® (the first inhalable treatment for Type 2 diabetes), Sutent® (advanced renal cell carcinoma treatment), Chantix® (smoking cessation), and even the little blue pill, Viagra® (erectile dysfunction). And that is just the tip of the iceberg, with many of their 100+ therapeutics targeting lesser-known diseases.

A view of the Old Courthouse in Downtown St. Louis, MO, as seen from atop the 630-foot Gateway Arch.

One therapeutic manufactured by Pfizer, Inc. is different from the rest. Somavert® is growth hormone receptor antagonist for the treatment of acromegaly Aromegaly is a debilitating disease caused by non-cancerous tumor of the pituitary gland that as a result produces excess IGF-1 growth hormone. It is the first product offered by Pfizer, Inc. to utilize PEGylation technology—the covalent attachment of poly (ethylene glycol) to a protein therapeutic. Only a handful of PEGylated therapeutics are on the market currently, but their development has seen increased interest in recent years.

While retaining bioactivity, PEGylated protein conjugates often have much greater in vivo circulation half-lives and show reduced immunogenicity. The increase in serum half-life has been attributed to the ability of the neutral inert PEG chain to protect the protein surface from proteolytic degradation and increase the hydrodynamic radius of the protein to reduce renal clearance rates. Unfortunately, PEGylation of a protein also complicate its bioprocessing and purification.

Ion-exchange chromatography (IEC), which separates molecules based on electrostatic interactions, is one of the most commonly used techniques for the purification of PEGylated proteins. I studied the effect of PEGylation on the anion-exchange chromatography of bovine serum albumin (BSA). Native BSA has been well studied in the literature in terms of its chromatographic behavior. IEC stationary phase manufacturers typically report BSA binding capacity of anion-exchangers in sales and technical literature. The wide use of BSA as a model protein in the bioseparations field made it an ideal candidate for this study. The details of the study were recently published in *Journal of Chromatography A* (2007, vol. 1147, pp 172–182).

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Compnay Tour

Large-Scale Biotechnology: Visiting the J. Craig Venter Institute and Human Genome Sciences

By Brian Schmidt

THE SEQUENCING OF THE HUMAN GENOME is an accomplishment that has had revolutionary implications for the way biological and biomedical research is conducted. The sequences resulting from the project are publicly available from internet sources, including GenBank, making it easy for investigators to look for homologous sequences in coding and non-coding portions of the genome to identify genes that might have similar function or share regulatory characteristics. The sequencing was a $3 billion dollar international project supported by China, France, Germany, Japan, the United Kingdom, and the United States. The National Human Genome Research Institute (NHGRI) was the US institute responsible for the effort. In addition to the government-sponsored sequencing project, there was a private effort to sequence the genome to patent and develop new commercial therapeutics by a company called Celera, which was founded by the Applera Corporation and Dr. John Craig Venter.

The J. Craig Venter Institute (JCVI) in Rockville, MD, was founded in 2006 by merging several institutes that conducted genomic research, including the Institute for Genomic Research (TIGR), which helped with the sequencing of the human genome project. We were fortuitously invited to visit both the JCVI and Human Genome Sciences, Inc. (HGS), to see their bioprocess development and production facilities. Our trip on January 24th was an exceptional opportunity to learn more about potential career opportunities, observe monolithic-scale biological research in progress, and see a piece of scientific history.

Our trip to Rockville, MD started at the Joint Technology Center, the building where the bulk of the sequencing work is done for the JCVI. Lisa McDonald of the JCVI told us a little of the institute's history and about the projects they are currently working on, including the Sorcerer II Expedition. The goal of the expedition is to gather data for a metagenomic analysis of marine micro-organisms from across the globe; the results from the first portion of the voyage have been published in PLoS Biology. Then, she took us on a tour of the sequencing facilities. The automation at the Joint Technology Center is remarkable: they have 100 DNA sequencers running and the capacity for 300 more.

After visiting the JCVI, we visited HGS. Our first stop was to their 80,000 square foot cGMP clinical manufacturing facility, just down the street from their offices and bioprocess development facilities. The facility was an impressive example of the technologies required for the large-scale production of human pharmaceuticals, including a 10,000 L bioreactor, seed reactors, purification equipment, packaging facilities, and all of large supporting utilities, including water-for-injection purification systems. Finally, we went to visit HGS's headquarters, which also houses their process development research laboratories. The engineers there showed us how they optimized the bioreactor conditions for a large pharmaceutical yield and how they designed and scaled affinity purification equipment.

In summary, our trip was an excellent opportunity to become familiar with many aspects of developing therapeutics to treat disease: from high-throughput technologies that may facilitate the discovery of disease-protective genes and targets to producing the therapeutics that would ultimately capitalize on that knowledge. I would like to thank Lisa McDonald of the JCVI and Miranda Neville and John Salim of HGS for helping to arrange our visit, as well as the many engineers at HGS that took us around their facilities and made the visit a great learning experience. Thirteen graduate students, one brave undergraduate, and the Biotechnology Training Program Director, Dr. Laurie, went on the trip. We would like to thank the Biotechnology Training Program for making this possible as well as the Department of Biomedical Engineering for their shared support. ■

Events

Annual Fall Dinner, with Speakers George Martin and Jay Reuben, a Success

By Erwin P. Gianchandani

ON TUESDAY, NOVEMBER 28, 2006, the Biotechnology Training Program (BTP) hosted its annual fall dinner, welcoming the program's newest members and showcasing the accomplishments of its current enrollees over the previous year, in the Cell Biology Conference Room in Jordan Hall. The dinner was arranged by second-year BTPer Erwin Gianchandani (BME, mentor – Jason Papin) and catered by Charlottesville-based Simply Delicious. Attendance included many students and program director Gordon Laurie.

Two keynote speakers led interesting and wide-ranging discussions on biotechnology during the dinner. Dr. George R. Martin, Scientist Emeritus at the National Institutes of Health and a consultant for numerous biotechnology companies, described his past role as Vice President for Scientific Affairs of FibroGen, a biotechnology company developing drugs for fibrotic disease and anemia. Martin talked specifically about his studies on compounds that elevate hypoxia-inducible factor (HIF) and are currently in clinical trials for the treatment of anemia. Dr. Jay H. Reuben, Director for Microbiology Research and Development at Becton Dickinson Diagnostic Systems, a unit of Becton Dickinson and Co. (BD), described current perspectives on in vitro diagnostic microbiology. He focused on new technology sensing, strategic development, and new product and integrated systems development. Both Martin and Reuben were presented with Jefferson Cups by the program in appreciation of their talks and efforts following the dinner.

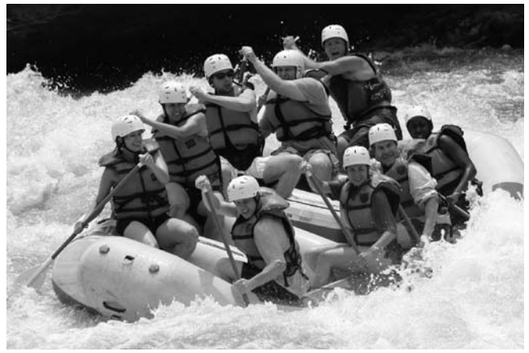
In addition, three BTP'ers summarized successful externships at the dinner. The externs included Alex Baras (Pathology, mentor – Chris Moskaluk), who worked at the research arm of Novartis Pharmaceuticals, the Novartis Institutes for BioMedical Research, in Cambridge, MA.; Emily Cushine (ChE, mentor – Cato Laurencin), who worked at Tissue Genesis, Inc., a privately-owned tissue engineering company in Honolulu, HI.; and Brian Schmidt (BME, mentor – Michael Lawrence), who worked with Philips Research Europe in Eindhoven, The Netherlands. Baras described how he implemented computational methods to analyze data from single nucleotide polymorphism (SNP) DNA arrays; Cushnie how she conducted a study that investigated the regenerative potential of a cellularized commercial wound dressing; and Schmidt how he developed a minimally acoustically attenuating parallel plate flow chamber for the study of potential polymeric contrast agents as drug delivery vehicles.

New BTP'ers Kristina Little and Dan Leslie were also formally introduced at the dinner. Little, a student in Klaus Ley's lab (BME), is a 2006 graduate of the College of William and Mary, where she received a bachelor of science in mathematics and physics. Leslie received his BS in chemistry from Colorado State University in 2005, and he is in the lab of James Landers (Chemistry). ■

Rafting the New River

By Dan Leslie

SATURDAY, JUNE 30, 2007 was shaping up to be a beautiful day. At 6:45 AM, the sleepwalking trainees assembled at Jordan Hall to eat some bagels and start the three-hour drive to the stunning New River Gorge in Hico, WV. As we passed through the rolling hills of western Virginia, we watched the sun peak over the horizon through groggy eyes. When we arrived at the rafting company, the sun was midway up in the sky and it was clear there would be no need for wetsuits on this warm, summer day. After we gathering our paddles, lifejackets, and helmets, we boarded the bus to the river. During the 30-minute bus ride we were given instructions and raft guides. At the drop-off point of the river, Dan Leslie, Corinne Locke, Olugbemisola (Gbemi) Oredein, Emily Cushnie, Tim Pabst, Kristina Little, Brian Schmidt, Professor Laurie, and Derek, our guide, all piled into one raft to start our six hour descent down the river. With high hopes, a few nervous thoughts, and numerous math jokes from Kristina we set out to take on the Class 1–5 rapids and show how our team could conquer the Lower New River. The paddles stroked in unison, the laughter came in waves, and the fun was never ending. Halfway down the river, we stopped for a brief hard-earned lunch. After lunch, three Class 5 rapids and awaited us on the remaining leg of the journey. The first of which, Middle Keeney rapids, left Gbemi



The BTP group and our guide, Derek, (clockwise from left: Corinne, Emily, Brian, Dan, Derek, Gbemi, Prof. Laurie, Kristina and Tim) brave the rough waters of the Lower New River.

swimming after being tossed from the raft. "I was really scared because I'm not the world's best swimmer. Let's just say it was a life changing experience," joked Gbemi after she had safely reached dry land at the end of the day. Along the trip, there were two rock cliffs where rafters could leap into the river below, and as well as two Class 3 rapids were rafter could voluntarily swim the rapids. After a great day of rafting, the group headed back to Charlottesville. Along the way, we stopped for dinner and agreed that the day had been a great team-building experience. ■

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I spent time exploring the area. I was able visit the many of the city parks, the art museum, science center, and zoo. I also had the chance to visit famous landmarks such as the Busch Stadium (home of the St. Louis Cardinals), the Anheuser-Busch brewery, Grant's Farm, the Jefferson National Expansion Memorial and the Gateway Arch. I would recommend the tram ride to the top of the arch to experience the city from 630 feet up in the sky!

The opportunity to work at a large-scale pharmaceutical company has given me experience that cannot be obtained in an academic lab. Much like my training in the Biotechnology Training Program, I was able to meet people from the different backgrounds that taught me many different aspects of bioprocessing. It was an experience that I can look back upon as an important step in my career in the biotechnology field—wherever it may lead. ■

Moving On

By Timothy M. Pabst

RECENT GRADUATES OF THE BTP include Matthew Stark, Jace Fogle, Katie Horsman, and Michelle Kofron. Matthew (BME, mentor – Klaus Ley) is working for W.L. Gore & Associates in Flagstaff, AZ as a Clinical Research Associate. Jace (ChE, mentor – Erik Fernandez) just finished his first year out in San Francisco, CA, working in the downstream process group with Genentech. Katie (Chemistry, mentor – James Landers) is living and working in Richmond, VA, and has joined the Virginia Department of Forensic Science. Michelle (BME, mentor – Cato Laurencin) is currently a fellow in the Laurencin lab and is likely going to pursue a career in academia. Congratulations to all of the recent BTP graduates. The program now has 13 graduates since its inception in 2000. ■

My First Year in the Golden State

By Jace Fogle, BTP Class of 2006

IT'S BEEN JUST OVER ONE YEAR since I left the friendly confines of Thornton Hall to start a career in San Francisco, CA. I used to be a graduate student in chemical engineering at UVa; now I am an engineer at Genentech, Inc. Defending my Ph.D. has ushered in a whole new world of experiences. I used to attend BTP journal club; now I go to staff meetings. I pay mortgage payments instead of bar tabs. I try not to spend all night at work instead of trying to stay up all night on the Corner. Everything has changed except my cell phone number.

While adjusting to a new life is challenging, it can be rewarding too. My job in process research and development at Genentech has proven to be everything that I had hoped for and more. It's true that Genentech has been able to maintain a science-driven culture and academic environment while growing into a multi-national corporation. My department is split up into lab groups in much the same way that departments at UVa were organized. I work in the Rancatore lab in Early Stage Purification; our leader is Pat Rancatore, a senior scientist with over 25 years of experience at Genentech. My lab is not unlike those in Thornton or Jordan Hall — we even have a safety committee that conducts surprise inspections. And I still find myself hiding ÄKTA parts and other supplies all over the lab so they don't get "borrowed" and never returned.

My department is responsible for the purification of molecules advancing out of research. This entails hands-on purification of small quantities of protein in the lab, as well as developing processes that will run at larger scale in the pilot plants and clinical manufacturing facilities. We support the production of material that will be used in toxicology studies and Phase I clinical trials. We also assist with the preparation of regulatory documents and validation protocols. Individuals in our department develop a great deal of expertise in liquid chromatography and filtration.

I feel that graduate school at UVa prepared me well for my current job. As a member of the Fernandez lab, I gained an understanding of chromatography theory as well as the biophysical mechanisms that control protein stability and structure. While most of the chromatographic systems I encounter in industry are too complicated to be explained by well-established models, understanding things like mass transfer limitations and aggregation mechanisms is helpful in explaining lab results. Further, I sharpened skills such as data analysis and technical writing; these are crucial to success in any scientific work. Working in the biotech industry is an excellent opportunity to apply engineering and biochemical principles to solve real-world problems.

Likewise, my BTP externship at MedImmune, Inc. (now AstraZeneca) was critical in getting off to a strong start at Genentech. This is because I did almost exactly the same work at MedImmune as I do at Genentech. I worked on very different molecules at MedImmune, and the company was organized somewhat differently, but the emphasis on chromatography and filtration was very much the same. This also allowed me to converse more intelligently in job interviews, and lent credibility to the fact that I knew I wanted a purification-related career in the biotech industry. I feel extremely lucky to have had the opportunity to do an externship at a great company like MedImmune. I would recommend MedImmune to any BTP trainee seeking an externship in the biotechnology industry.

I will definitely miss my days at UVa. The Biotechnology Training Program provided some of the more memorable experiences: getting thrown in the New River during a rafting trip and driving home from Becton-Dickonson in Maryland via West Virginia are a few. With any luck, at least a couple current BTP'ers will find their way out to Genentech in the near future. ■

The Growing BTP Family

By Timothy M. Pabst

MATTHEW AND ALICIA STARK love the west. Since leaving Charlottesville for Flagstaff, AZ about a year and a half ago, time has flown by for the couple. Matt is busy with his research position with W.L. Gore & Associates and Alicia is working as a nurse on a Navajo reservation. In their downtime, the two have been enjoying the miles of trails, literally at the end of their street. On April 7th, 2007, the couple had their first baby boy, Dakota (Cody for short). "Save a few hours of sleep, everyone is doing just fine," Matt happily reported.

The newest addition to the BTP family: Antonio Marcos Ubiera (left) and Dakota Stark (right)

Antonio and Elaine Ubiera recently had a bouncing baby boy as well. Antonio Marcos Ubiera (7lbs 6.4 oz) was born at 1:49 pm July, 27, 2007 at Georgetown University Hospital. "He has decided to sleep all day and punch and kick all night, so not much sleep for me," reports Antonio with a smile. Both Elaine and little Antonio are 100% healthy and doing very well. ■

CARTA, from page 1

and is a coauthor of the "Adsorption and Ion Exchange" section of Perry's Chemical Engineers' Handbook. Professor Carta has served on the organizing committee for the International Symposium on Preparative/Process Chromatography (PREP) since 1997 and on the Scientific Advisory Committee of the Fifth and Eighth International Conference on Fundamentals of Adsorption (FOA5 and FOA8), and as Co-Chair of FOA9. He also serves as a senior editor for *Biotechnology Journal*, and is on the editorial board of *Separation Science and Technology* and *Adsorption*.

Professor Carta's Mass and Energy Balances, Transport Phenomena, and Bioseparations Engineering classes are ChE favorites. He also organizes and teaches in the PREP Symposium Workshop on Mass Transfer in Liquid Chromatography (since 1997), and since 2003 is a lecturer for the Society of Bioprocessing Professionals Annual Bioprocessing Institute. The Carta lab offers an annual short course in protein chromatography geared towards downstream processing professionals. The course, which combines classroom lectures and hands-on laboratory experiments, provides insight in the application of chromatographic theory with special emphasis on the determination and use of key scale-up parameters. This gives the Carta lab an invaluable opportunity to interact with the industry. ■

Recent News in the BTP Family

New Trainees

By Gordon Laurie

A WARM WELCOME and congratulations to Aaron Bailey, Matthew Oberhardt, Rebekah Neal, Robert Deitcher, Annika Hedin and Alex Bailey for their acceptance into the BTP. Aaron received a BA in Molecular Cell, Developmental Biology/Biochemistry from the University of Colorado in 2003, and will be working jointly in new BTP mentor Xiaowei Lu's lab (Cell Biology) and Don Hunt's lab (Chemistry). Matthew comes from the University of Virginia where he graduated in 2005 with a BA in Physics and Mathematics. Matthew is in the Papin lab (BME). Rebekah is a 2005 grad from Georgia Institute of Technology with a BS in Biomedical Engineering and minor in Spanish. Rebekah is in the lab of Ed Botchwey (BME). Robert holds a BChE from the University of Delaware in Chemical Engineering/Philosophy, and a ME from Lehigh University in Chemical Engineering. He is in the lab of Erik Fernandez (ChE). Annika received her BS in Biomedical Engineering in 2005 from Boston University and is in the Lawrence lab (BME). Alex graduated in Mechanical Eng/Biomedical Engineering from a Tufts University in 2004, and is training in new BTP mentor Shayn Peirce-Cottler's lab (BME). ■

The Faculty & Their Research

Gary Balian—(O&BMG) Biochemistry of connective tissue macromolecules.

Travis Blalock—(EE) CMOS digital and analog signal processor design.

Edward Botchwey—(BME) Studying novel growth factors and stem cell therapies to enhance the growth of new blood vessels and nerves within biological implants and tissues damaged by disease.

David Brautigan—(M) phosphates and cell signaling circuits.

Giorgio Carta—(ChE) Adsorption and ion exchange, chromatography, biocatalysis.

***Linda Columbus**—(C) Biophysical Chemistry: Membrane protein structure, function, and dynamics.

Pat Concannon*—(BMG) Cellular DNA damage responses; Breast cancer genetics; Genetics of type 1 diabetes.

Richard Day*—(InMd, CDB) Cell-type specific regulation of pituitary gene expression.

Zygmunt Derewenda—(MPBP) Protein structure and function: macromolecular crystallography; mechanisms of signaling by GTPases; protein-protein interactions.

Douglas DeSimone—(CB) Cell adhesion molecules in development.

Victor Engelhard—(M) Immune responses to tumors and immunotherapy / Impact of self-tolerance on anti-tumor immunity / Processing and presentation of MHC-restricted antigens.

Erik Fernandez—(ChE) Structural aspects of protein-surface interactions and protein aggregation.

Roseanne Ford—(ChE &CE) Environmental remediation, microbial transport in porous media.

Cassandra Fraser—(C) Metallobiomaterials: synthesis, responsive properties, and imaging and sensing applications.

Jay Fox—(M) Basement membrane structure and metalloproteinases.

H. Mario Geysen—(C) Combinatorial Chemistry.

Stephanie Guerlain—(SE) Product design and decision support systems.

Bill Guilford—(BME) Molecular mechanisms of cell movement and the regulation of muscle contraction.

Brian Helmke—(BME) Endothelial mechanotransduction, cellular biomechanics, nanotechnology tools for cellular bioengineering, cell-cell interactions in microcirculatory blood flow.

John Herr—(CB) Gametogenesis, contraceptive target identification, biomarkers in cancer, immunochromatographic device development, drug development.

Jeffrey Holmes*—(InMd, BME) Cardiac biomechanics.

Rick Horwitz—(CB) Cell adhesion in development and pathobiology.

Donald Hunt—(C&P) Protein sequencing by mass spectroscopy.

Isa Hussaini—(P&NESC) Functional roles of low density lipoprotein receptor-related protein (LRP), proteases and protein kinase C in astrocytic tumor invasive growth.

Inchan Kwon*—(ChE)

James Landers—(C&P) Biological, bioanalytical and clinical chemistry.

Gordon Laurie*—(CB) Molecular control of epithelial differentiation.

Cato Laurencin—(O, BME, and CE) Biomaterials, tissue engineering, drug delivery and nanotechnology

Michael Lawrence—(BME) Biochemical, cellular, and mechanical factors regulating leukocyte adhesion.

Kevin Lynch*—(Pharm, MOMD) Molecular pharmacology of lysophospholipid mediators.

Timothy MacDonald—(C) Bioorganic and synthetic organic chemistry.

Christopher Moskaluk—(P) Genetic and genomic analysis of human cancers.

Pamela Norris—(MANE) Aerogel technology.

Jason Papin—(BME) systems biology, signaling networks, applications in cancer and infectious disease.

J.Thomas Parsons—(M) Protein kinases in cell adhesion.

William Pearson—(BMG) Computational approaches to protein evolution and structure.

William Petri, Jr.*—(InMd, MII, MOMD) Molecular mechanisms of pathogenesis of parasitic infection.

Michele Sale*—(InMd) Genetics of vascular disease; Genetics of otitis media.

Thomas Skalak—(BME) Vascular remodeling, microcirculation, biomechanics.

Ann Sutherland—(CB) Cell matrix interactions in mouse development.

Ronald Taylor—(BMG) Clearance of pathogens.

Martin Schwartz—(M) Integrin signaling and its relevance to mechanotransduction, cancer and vascular disease.

Jill Venton*—(P) Analytical neurochemistry; Electrochemical detection of adenosine; Mechanisms of drugs of abuse using capillary electrophoresis.

Michael Wormington—(B) Post-transcriptional regulation of gene expression; Development of RNA-based therapeutics.

Julius Zhu*—(Pharm) Mechanisms of synaptic plasticity and mental retardation.

*Program Director

Biotech at Virginia
The Newsletter of the University of Virginia Biotechnology Training Program

Biotechnology Training Program Application Deadline: May 7

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Training Departments

B	Biology
BME	Biomedical Engineering
BMBG	Biochemistry, Molecular Biology & Genetics
C	Chemistry
ChE	Chemical Engineering
CB	Cell Biology
EE	Electrical Engineering
InMd	Internal Medicine
M	Microbiology, Immunology &-Infectious Disease
MANE	Mechanical Aerospace & Nuclear Engineering
MMSB	Molecular Medicine & Systems Biology
MPBP	Molecular Physiology & Biological Physics
NESC	Neuroscience
O	Orthopedics
P	Pathology
SE	Systems Engineering