SCHB 1

SCHB is your link to ACS networks and resources

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As we celebrate our 35th year, SCHB member benefits include: free membership for the first year, a deeply discounted booth exhibit space at ACS national meetings, a listing on our website business directory, Discounted SOCMA membership, outstanding programming at ACS national, regional, and (started in 2012) partnerships with local sections for programming, webinars, and other events. At the heart of it all are amazing networking opportunities for established and start-up chemical businesses. Join us at our networking breakfasts, lunches, and social event at the ACS Boston 250th national meeting, where the real business takes place! Connect with SCHB members and colleagues in the chemical enterprise at the SCHB technical sessions, Expo Booth, and social events. Follow SCHB throughout the year via social media.

SCHB 2

Chemical Angel Network: Chemical professionals investing in chemistry enabled businesses

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Angel investing is the critical source of funding between friends, family, and fools and venture capital. In terms of both dollar amount and deal volume, angel investing far exceeds the more visible venture capital. An example of an angel investing network is the Chemical Angel Network (CaN), the only nation-wide angel investing network for early stage chemical businesses (i.e., businesses with a significant chemistry component). The CaN offers chemists, chemical engineers, and other chemical professionals a unique opportunity to participate in the growth of companies in the chemical and chemistry enabled industries. In addition to possibly significant financial upside opportunities, the CaN network encompasses several unique elements: beyond financial capital, the CaN draws upon the members' unique experiences and knowledge base to provide comprehensive due diligence, mentoring, contacts, and general technical expertise. After four years of operation, the CaN has become the smart capital choice for early staged chemical companies and an excellent resource and co-investor for other angel networks and funds.

SCHB 3

Cannabis regulatory awareness, quality assurance, and the future of the industry

***Jahan Marcu**, jahan.marcu@gmail.com, Melissa J. Wilcox, Ezra M. Pryor, Joseph Payack. Cannabis Chemistry Committee, Brooklyn, New York, United States*

The American Herbal Pharmacopeia (AHP) recently published a cannabis monograph, setting standards for identification, analysis, and quality control. Additionally, the American Herbal Products Association (AHPA) issued basic product safety guidelines in 2014 for cultivation, manufacturing, dispensing, and laboratory operations for medical cannabis. Recommendations from the AHP and AHPA are steadily being adopted and are implemented in several states through the 3rd party oversight program: Patient Focused Certification. However, a number of significant hurdles must be overcome in this industry to reach higher levels of product safety. Among the issues facing operators are access to reference standards, transportation of samples, pesticide or contaminant analysis, efficiently quantifying several compounds from a variety of complex matrices in a high throughput manner, dependency on the use of high amounts of toxic solvents, and a shortened life span of expensive analytical equipment used in the routine analysis of viscous and particulate samples.

SCHB 4

Starting small companies focused on rare diseases

***Sean Ekins**[1,2], ekinssean@yahoo.com, Jill Wood[2]. (1) Collaborations Pharmaceuticals, Fuquay Varina, North Carolina, United States (2) Phoenix Nest, Brooklyn, New York, United States*

In the space of a few years, we formed two rare disease focused companies. The first resulted from a meeting between parents of several children with rare diseases: Phoenix Nest is working on treatments for Sanfilippo syndrome, a devastating neurodegenerative lysosomal storage disorder of childhood. In two years, we built collaborations with leading academics and industry and submitted multiple grant proposals and were able to secure our first NIH NINDS STTR, to fund development of an enzyme replacement therapy. All of our resources are spent on supporting research and development with minimal overhead, as we leverage collaborative researchers and tools to ensure we reach our goal. The second, Collaborations Pharmaceuticals, Inc. was founded in an attempt to scale the strategy to address some of the 7,000 or so rare diseases, as well as infectious diseases, many of which are neglected or rare. Lessons learned in this process are that anyone can start a company and it can be inexpensive. Parents, patients, and/or advocates started a foundation and were aware of the science and this was influential. Ideally, at least one scientist who can submit grant proposals and an entity that can license technology is important. We encourage other scientists interested in treating rare diseases to meet parents, patients, and advocates and work with them to further the science.

SCHB 5

Big data applications in small chemical businesses

***Peng-Ting Chen**, pengting.chen@gmail.com. Department of Business Administration, National Kaohsiung University of Applied Sciences, Kaohsiung, Taiwan*

The chemical industry has applied information technology in design, process management and process modeling for many years. Applying digital technologies can help companies respond to market shifts and gain competitive advantage over their industry peers. With the advances in digital technology, business interactions now generate vast amounts of information. Companies need advanced analytics capabilities to handle the massive data to make better, faster and more-informed decisions. Executives in chemical companies think big data analytics and cloud computing are necessary to remain competitive. “Big data” is a term that describes the application of new tools and techniques to digital information on a size and scale well beyond what was possible with traditional approaches, typically involving data sets that are so large and complex that they require advanced data storage, management, analysis, and visualization technologies. Big data analytics is the process of examining large data sets containing a variety of data types to uncover hidden patterns, unknown correlations, and other useful business information. The analytical findings can lead to improved operational efficiency, competitive advantages over rival organizations and other business benefits. Several industries have already developed best-practice models. This research analyzed empirical cases of big data applications, and identified key benefits and implementation factors for small chemical business.

SCHB 6

The GelTex story

***W. Harry Mandeville**[1,2], whmandeville@verizon.net. (1) Chemistry, MIT, Lynnfield, Massachusetts, United States (2) Chemistry, Colorado School of Mines, Golden, Colorado, United States*

It was the best of times . . . What would you do when faced with the challenge of starting a new biopharmaceutical company based on the use of polymers in the gastrointestinal tract? One obvious solution is drug delivery; surely a rich and fertile ground to be plowed. But wait, the real money – and return on investment – comes from the drugs themselves. Is it even possible to use a polymer as a drug? Polymers are not absorbed, so any action would have to take place in the GI tract. What disease targets can be addressed in this curiously indirect fashion? The story of GelTex, the discovery and development of Renagel and WelChol answers all of these question and more. Witness the meteoric rise of a company that put two drugs on the market in less than eight years and was then sold too soon. It was the worst of times. . .

SCHB 7

Understanding, optimizing, and harnessing amphotericin B

***Martin D Burke**, mdburke@illinois.edu. Univ Illinois Urbana Champaign, Urbana, Illinois, United States*

Our research program focuses on the synthesis and study of small molecules that perform higher-order, protein-like functions. Such compounds have the potential to serve as substitutes for missing or dysfunctional proteins that underlie human diseases, thereby operating as prostheses on the molecular scale. We illuminated the mechanism of action of amphotericin B, thereby providing an actionable roadmap to less toxic antifungal agents and experiments targeting the replacement of missing protein ion channels with small molecule surrogates. Collectively, these efforts ultimately seek to build the foundation for the development of molecular prosthetics as a powerful and general strategy for the understanding and betterment of human health. http://www.scs.uiuc.edu/burke/ A new company, REVOLUTION Medicines, is now industrializing and applying this chemistry to enable the discovery of new drugs for treating serious human diseases.

SCHB 8

Engineering catalysts not just for chemical transformations but for building businesses BRIC by BRICK

***Ganapati D. Yadav**, gd.yadav@ictmumbai.edu.in. Univ Inst of Chem Tech, Mumbai Maharashtra, India*

Recent innovations in catalyst engineering and stimulation of businesses in India is described

SCHB 9

Public private partnership: Recipe for discoveries

***Sanjay V. Malhotra**, smalhotra@Stanford.edu. Dept of Radiation Oncology, Stanford University, Palo Alto, California, United States*

Discovery of novel therapies that will eventually reach people remains a daunting task. Given the challenges involved, overall process can be expedited through effective partnership among the stakeholders, i.e., government, academia, and private sector. This talk will discuss examples of case studies, exploring the merits and shortcoming of such partnership.

SCHB 10

Generating effective diagnostic technology for the developing world

***George M. Whitesides**, gwhitesides@gmwgroup.harvard.edu>. Chemistry, Harvard University, Cambridge, Massachusetts, United States*

This talk will discuss a case history—a joint effort between a research group in Harvard University and a not-for-profit company, “Diagnostics for All”—intended to develop effective technologies for the developing world. It will focus on paper diagnostics, but bring in other technologies as appropriate to illustrate its points.

SCHB 11

Across the seven seas: integrated circuit model for drug discovery

***Makarand P. Gore**, gorem@peak.org. R&D, YewSavin, Inc., Fort Collins, Colorado, United States*

Strategies for low-cost development of medicines is a critical need. Harnessing ancient medicines for newer drugs is one of the most rewarding approaches. We have established an Indo-US enterprise to develop single molecule drugs from principles of ancient medicine. This presentation describes development of the model of single molecules multiple activities against HCV and HIV causing viruses. The discoveries are perhaps the first foundational blocks for Reverse Pharmacology Integrative Medicine (RPIM). We discuss the journey of YewSavin USA and AJ Organica (India) to develop natural treatments for virus infections in a RPIM approach.

SCHB 12

Expanding chemistry frontiers: Efficient air-stable catalysts for aqueous chemistry water and chemosynthesis using “synthetic livers”

***Anita Mehta**[2], dranitamehta@gmail.com, Mukund Chorghade[1]. (1) Chorghade Enterprises, Natick, Massachusetts, United States (2) chicago discovery solutions, Plainfield, Illinois, United States*

Cross coupling reactions have been traditionally accomplished in organic solvents. Our work on developing catalysts that work entirely in water has resulted in the discovery of CAT- 53 type catalysts that are air stable and give excellent results in water as a solvent. The implications to green cost-effective synthesis will be delineated. A new sustainable technology involving Biomimetic catalysts that mimic biological oxidation processes for generation of metabolites would be discussed; efforts focused on invention of NCEs and better patient care will be presented.

SCHB 13

Chemical sensors: An ideal application for organic electronics

***Timothy M. Swager**, tswager@mit.edu. MIT, Cambridge, Massachusetts, United States*

Chemists are universally fascinated by delocalized electrons and their ability to interact with light, applied voltages, and magnetic fields. The key property is the ability of these systems to transport charge or energy (excitons). It is also the modulation of this property in a predictable way that enables new technology. Early in my academic studies I observed the incredible sensitivity of conducting organics to their chemical environment and hypothesized that they would be excellent sensory materials. This has led to more than 25 years of work on integrating receptors and selectors into different types of semiconductive polymers and carbon nanomaterials to make selective and sensitive chemical sensors. We are now in an information age wherein society has an interest in knowing about the chemical environments virtually everywhere. I will detail our established technologies for ultratrace detection of explosives, as well as new sensor technologies that are finding broad utility in food management and production. Organic electronics is the enabling element in these technologies that are becoming integrated into our daily lives.

SCHB 14

Chemical management for safe, secure, and environmentally sound chemical facilities

Nancy B. Jackson*, jacksonnb@state.gov. E/STAS, Room 3209, Department of State, Washington, District of Columbia, United States*

Strong management of chemicals – from “cradle to grave” – is important for chemical safety, security and the environment. It is important to manage chemicals in a manner that enhances safety and security and prevents environmental damage. The curriculum for an organization that has chemical laboratories includes learning about laboratory design, procurement, chemical storage, chemical inventory, laboratory use of chemicals, and chemical waste management. A number of controls are needed including administrative, operational, engineering, and personal protection equipment. The knowledge of dual use chemicals can raise awareness regarding which chemicals should be most protected. The culture of safety and security needs to be built with an awareness of these issues and a strong commitment from leadership. The curriculum for a small or medium sized enterprise that uses or makes chemicals would include more than just laboratory training. These include transportation of chemicals, knowing whom you are selling chemicals to, a more significant chemical waste program, and, if needed, process safety. The protection of chemicals that are stored and the instruments and equipment used with chemicals are important aspects to consider.

SCHB 15

Chemosynthetic livers: Predict, prepare, and prove the structure, activity, and toxicity of drug metabolites

Mukund Chorghade[1]*, chorghade@comcast.net, Rajeev Chorghade*[2]*. (1) Chorghade Enterprises, Natick, Massachusetts, United States (2) Chemistry, THINQ, Natick, Massachusetts, United States*

We report advances in proprietary in vitro green chemistry-based technology, mimicking in vivo metabolism of several chemical entities used in pharmaceuticals, cosmetics, and agrochemicals. Our catalysts enable prediction of metabolism patterns with soft-spot analysis and the methodology introduces new paradigms for drug discovery and drug-drug interactions for clinical diagnostics. Present-day processes involving animal studies are expensive, labor-intensive, and chemically inconclusive. Our catalysts (azamacrocycles) are sterically protected and electronically activated, providing speed, stability, and scalability. We predict structures of metabolites, prepare them on a large scale by oxidation, and elucidate chemical structures. Polypharmacy, involving co-administration of several drugs, is common among the elderly and chronically ill. It is a risk factor for adverse drug reactions and drug-drug interactions (DDIs). One plausible DDI occurs when a drug interferes with another, causing irreversible changes to formation of metabolites from one or both. Such suppression or attenuation of metabolism could cause variances in toxicity and efficacy. We report experiments to predict and confirm modulation of oxidative metabolites from several combinations of common drugs for cancer, diabetes, hypercholesterolemia and hypertension in the presence of each other.

SCHB 16

Perspectives on the science, technology, and innovation ecosystem as drivers of economic growth in BRIC countries

Jonathan Margolis[2]*, MargolisJA@state.gov, Samuel Howerton*[1]*, David MacDonald*[1]*. (1) Office of Science and Technology Cooperation, U.S. Department of State, Washington, District of Columbia, United States (2) Bureau of Oceans and International Environmental and Scientific Affairs, U.S. Department of State., Washington, District of Columbia, United States*

Science, technology, and innovation drive economic growth and support open and transparent governance. While research and development investments are important to sustainable development, building and growing innovation ecosystems require more than money. Sound government policy creates the enabling environment that allows scientists and entrepreneurs to translate bench research into commercial products. ‘Lab to market’ activities require partnerships from all sectors, government, academia, business, and non-governmental organizations. The U.S. Department of State, in consultation with agencies across the U.S. government, engages with the S&T communities in BRIC countries using a ‘top-down, bottom up’ approach. This approach leverages our relationships with government officials, members of civil society, and industry. This presentation will highlight lessons learned from the Department’s experiences using this approach, and illustrate the value-added of international science diplomacy to promoting entrepreneurship and economic growth within BRIC countries.

SCHB 17

Olefin metathesis chemistry as a catalyst for building businesses BRIC by BRIC

***Robert H. Grubbs**, rhg@caltech.edu. Cal Tech 164-30, Pasadena, California, United States*

The pivotal role of the olefin metathesis reaction in stimulating businesses in the BRIC countries is described

SCHB 18

Reverse pharmacology and systems approaches for chemical biology, drug discovery, and development: Inspiration from the wisdom of Mother Nature

***Mukund Chorghade**[1], chorghade@comcast.net, Rajeev Chorghade[2]. (1) Chorghade Enterprises, Natick, Massachusetts, United States (2) Chemistry, THINQ Pharma, Natick, Massachusetts, United States*

Our natural product discovery programs utilize bioactive natural products as an advanced starting point for discovery. These are “pre-validated by nature”, having been optimized for interaction with biological macromolecules through evolutionary selection processes. Embedded in these bioactive natural products are a number of diverse, chiral functional groups which are potential sites for protein binding. This diverse source of novel, active agents serve as leads/scaffolds for elaboration into desperately needed efficacious drugs for a multitude of disease indications. We begin with Ayurvedic medicine research, clinical experiences, observations or available data on actual use in patients as a starting point. We use principles of systems biology where holistic yet rational analysis is done to address multiple therapeutic requirements. We aim to reconfigure products into chemical hybrid “molecular legos” and to screen the deck of diverse compounds against targets. A significant disadvantage of natural products is the draconian organic synthesis/medicinal chemistry effort required for commercialization. We offer unique and elegant solutions to these twin challenges by bringing together structure guided drug design and hybrid molecule synthesis.

SCHB 19

Antifouling marine and medical technology

***Melissa Grunlan**, mgrunlan@tamu.edu. 3120 TAMU, Texas AM University, College Sta, Texas, United States*

The global marine coating market is predicted to exceed ~$10 billion (by 2019) and the global medical device market is forecasted to exceed ~$400 billion (by 2017). The global marine coating market is predicted to exceed ~$10 billion (by 2019) and the global medical device market is forecasted to exceed ~$400 billion (by 2017). Silicones

are widely-used for both marine and medical applications due to the foul-releasing behavior (marine) and low modulus, i.e., flexibility (medical). Unfortunately, their extreme hydrophobicity causes poor-antifouling behavior resulting in substantial adhesion of blood proteins, bacteria, and marine biofoulers. We have developed poly(ethylene oxide)-silane amphiphiles which may be incorporated into silicones to improve antifouling behavior. These additives show a tremendous capacity to undergo water-driven surface-migration and thereby reducing biofouling. Coatings modified with PEO-silane amphiphiles were tested against various biofoulers to assess performance. The utility and outlook for this technology is described.

SCHB 20

Olefin metathesis for commercial development of polymers on a commercial scale

Robert H. Grubbs*, rhg@caltech.edu. Cal Tech 164-30, Pasadena, California, United States*

Olefin metathesis is a key reaction used to develop polymers on an industrial scale. Product development and utility of selected polymers is described.

SCHB 21

Polymer chemistry innovations from an academic start-up to where it is going

Bernard Gordon*, bg3@polychemistry.com. Polymer Chemistry Innovations, Tucson, Arizona, United States*

Polymer Chemistry Innovations, Inc. (PCI), was incorporated in 1990, and has successfully leveraged the expertise of its technical staff, to keep abreast of current advances in polymer science, and its nimble business department, to quickly offer highly desirable products in new markets. PCI was spun out of research at Penn State University and has retained an inquisitive, research-based culture, while providing expanded commercial product lines. PCI produces medical grades of poly(ethylhexylmethacrylate) and custom molecular weight grades of linear polyethylenimine and is the sole global producer of the expanding family of Aquazol® (poly(2-ethyloxazoline)) polymers: commercial, medical high purity, and end-functionalized high purity grades. These, and other new products, result from a tight focus on addressing customer needs. Lessons learned in the past 25 years will be discussed.

SCHB 22

Organic growth of a polymer analysis business

***James Rancourt**, jim@polymersolutions.com. Polymer Solutions Incorporated, Christiansburg, Virginia, United States*

Polymer Solutions Incorporated is an ISO 17025 accredited, FDA registered, cGMP compliant independent chemical analysis and physical testing laboratory, serving medical, pharmaceutical, and industrial clients globally. PSI initially provided analysis and development of polymeric systems, spring-boarding off the founders' experience with high temperature thermally stable polymers. PSI started with personal funds and has grown organically over the years to become a premier provider of analytical services for high-consequence applications. The business inception and its transformation from being defense-related, to industrial clients, and clients dominated by medical devices, pharmaceuticals, and law firms will be described, including details of starting and growing the business, specific challenges facing an independent analysis and testing laboratory, and examples of areas with both good and bad execution will be discussed.

SCHB 23

From university to reality

***George M. Whitesides**, gwhitesides@gmwgroup.harvard.edu. Department of Chemistry & Chemical Biology, Harvard University, Cambridge, Massachusetts, United States*

This talk will address strategies for making the leap from university research to commercial development. It will use two examples: soft robotics, and paper diagnostics.

SCHB 24

Discovery and development of Renagel and WelChol

***W. Harry Mandeville**[1,2], whmandeville@verizon.net. (1) Chemistry, MIT, Lynnfield, Massachusetts, United States (2) Chemistry, Colorado School of Mines, Golden, Colorado, United States*

Renagel, a selective, phosphate binding polymer and WelChol, a bile acid sequestering polymer, have both achieved the status of reaching the lofty plateau of more than a billion dollars in sales per year. Renagel, used in end-stage renal disease, efficiently removes phosphate from the blood of dialysis patients. Its action occurs in the gastrointestinal tract, a useful window into the body's circulatory system. Easily outperforming calcium and aluminum salts, the standard of care before Renagel, it has been proven one of the safest drugs available. WelChol acts by selectively binding to causing the elimination of bile acids. As bile acids are lost, the body quickly synthesizes more, consuming LDL cholesterol as its preferred starting material. Once again, treatment of a circulatory problem is addressed through the gastrointestinal tract, with

the utmost in safety and vanishing side-effects as the polymer pharmaceutical is completely unabsorbed.

SCHB 25

Delivery to biotech: Alkermes' and TransForm's stories

***Julius F. Remenar**, jules.remenar@gmail.com. Alkermes, Inc, Waltham, Massachusetts, United States*

Alkermes has evolved from a technology based drug delivery company to a fully integrated biopharmaceutical company. Initially, Alkermes was focused on technologies such as low-density inhalables and PLGA microsphere technology that were developed at MIT for delivery of long-acting formulations, and partnered with other companies to create long. Alkermes began its transition to a commercial biopharmaceutical company by using its platform microsphere technology to create VIVITROL® (naltrexone for extended-release injectable suspension). The company's focus began shifting toward novel chemistry about nine years ago, and the effort has resulted in a rich pipeline of improved and novel therapeutics.

TransForm Pharmaceuticals was in the process of evolving from a drug delivery technology company toward one that included a pipeline of proprietary drug products, a factor that led to their acquisition by J&J. TransForm developed proprietary, high throughput screening technologies to search for crystals forms and for formulations with the goal of improving bioavailability of poorly soluble molecules, and for ensuring that all polymorphs of a given drug were discovered and characterized. Their chemists pursued newer concepts, such as the use of pharmaceutical cocrystals, to improve solubility and the use of crystallization inhibitors to create supersaturation. Finally, TransForm's scientists used their platforms to study already marketed drugs with a goal of creating a pipeline of improved proprietary products.

SCHB 26

Evolve or die: Life and times of a biotech start-up

***Ross Stein**, rstein@targanox.com. Targanox, Inc., Cambridge, Massachusetts, United States*

Targanox was founded in early 2009 as a proteomics start-up. Its original mission was to identify disease-relevant targets that could be drugged through interaction of small molecules or antibodies with critical, redox-sensitive cysteine residues. While such protein targets were identified, partnering difficulties led Targanox to change direction in mid-2012 from proteomics to drug discovery. Targanox brought to bear medicinal chemistry resources on a handful of proteins whose activities are known to be regulated by reversible oxidation of specific cysteines residues. By the middle of 2014, Targanox had transformed simple probe molecules into compounds that could covalently react

with protein sulfenates to irreversibly and selectively trap proteins in their inactive form. However, partnering difficulties again motivated a change in emphasis. In the summer of 2014, Targanox licensed a program from Massachusetts General Hospital that focuses on the Keap1/Nrf2 pathway, a major regulator of cytoprotective responses to oxidative and electrophilic stress. Compounds developed at Targanox interact covalently with key cysteine residues of Keap1. Modification of these cysteine residues ultimately leads to translocation of Nrf2 into the nucleus where it drives the expression of a host of antioxidant enzymes. Currently, we are working with a pharma partner to develop these compounds into drugs to treat neurodegenerative disorders.

SCHB 27

Calculario: The spin out process for an advanced organic materials computational discovery startup

Alan Aspuru-Guzik*, aspuru@chemistry.harvard.edu, Rafael Gomez-Bombarelli, Jorge Aguilera-Iparaguirre, Timothy Hirzel. Harvard University, Cambridge, Massachusetts, United States*

The Aspuru-Guzik group at Harvard is spinning out a molecular discovery startup focused on three aspects of high throughput virtual screening. First, we generate application-specific customized libraries of molecular candidates numbering in the millions. Quantum simulations are run on tens of thousands of candidates. Second, we leverage machine learning algorithms to gain an order of magnitude performance increase in our search speed. Third, we leverage human feedback to select synthetically accessible high-performance candidates through web-based collaboration tools that capture experimentalists' experience to enhance candidate quality. We have been going through the process of fundraising and forming a company around our technologies. This talk will overview the lessons we learned about the spinoff process, as well as a brief description of the technology and our insights on our business model.

SCHB 28

Catabasis: A biotech start up based on an innovative chemistry platform

Michael Jirousek*, mjirousek@msn.com. Catabasis Pharmaceuticals, Cambridge, Massachusetts, United States*

Our scientific approach is to leverage the growing body of knowledge associated with disease pathways and to rationally design orally bioavailable product candidates that simultaneously interact with multiple biological targets within one or more related disease pathways.
We have developed our SMART linker technology platform to engineer molecules that simultaneously modulate multiple biological targets within one or more related disease pathways. In systemic circulation, our SMART linker conjugates are stable and inactive, potentially reducing off-target toxicities and side effects. The conjugates are designed to

be cleaved by specific enzymes exclusively within cells in order to release the two bioactives inside the cells. By releasing the bioactive components of the conjugate molecule only inside cells, the SMART linker allows the bioactives to reach their targets more efficiently and have greater efficacy than if the bioactives were dosed independently or in combination.
We believe that our SMART linker technology platform provides substantial improvements and has the potential to enhance activity on disease pathways through modulation of multiple biological targets, improve efficacy by matching the pharmacokinetics and tissue distribution of the component bioactives and improve safety and tolerability by releasing the component bioactives only within cells.
We have observed in multiple preclinical studies that our SMART linker conjugates achieved greater efficacy than administration of the two bioactives either independently or in combination. In clinical trials, SMART linker conjugates have demonstrated significant improvements in activity on disease pathways and tolerability relative to equivalent doses of the two bioactives delivered in combination.
We have used this platform to develop clinical candidate compounds to treat Duchenne muscular dystrophy through modulation of NF-kB (CAT-1004) and hypercholesterolemia through modulation of SREBP (CAT-2054).

SCHB 29

Career transitions in a rapidly evolving industry: Large company, small company, consulting, and virtual company

***Mark J. Tebbe**, tebbe.mj@gmail.com. Quartet Medicine, Arlington, Massachusetts, United States*

After a 16-year career with Lilly, where I delivered multiple drug candidates to the organization, including being a co-inventor of a billion-dollar drug (Telaprevir/Incivek), and held positions of increasing responsibility, including head of medicinal chemistry at Lilly's site in Hamburg, Germany, head of chemistry at Lilly's site in Research Triangle Park, and head of global operations for discovery chemistry, and finally back to the science side of the business working in endocrine-based diseases, I transitioned from traditional big pharma in 2010 to a consulting role. After a brief stint in consulting, I joined another big pharma, the Boston Biotech Community 2010 to work at a medium-sized biotech focusing on cancer drug discovery: Forma Therapeutics, where I was vice president of medicinal and computational chemistry for more than three years. Then I returned to the consulting business to start or find a smaller company. I currently work at Quartet Medicine, a virtual drug discovery company focusing on peripheral neuropathic pain. I will detail my career path, the hurdles and challenges, and the current story and science behind Quartet Medicine.

SCHB 30

Making molecular prosthetics with a small molecule synthesizer

***Martin D. Burke**, burke@scs.uiuc.edu. Univ Illinois Urbana Champaign, Urbana, Illinois, United States*

Our research program focuses on the synthesis and study of small molecules that perform higher-order, protein-like functions. Such compoundshave the potential to serve as substitutes for missing or dysfunctional proteins that underlie human diseases, thereby operating as prostheses on the molecular scale. To enable these studies, we have developed iterative cross-coupling with MIDA boronates as an increasingly general platform that makes the process of complex small molecule synthesis as simple, efficient, and flexible as possible. In this approach, building blocks having all of the required functional groups preinstalled in the correct oxidation state and with the desired stereochemical relationships are precisely assembled via the recursive application of one mild reaction. Recently we have built a machine that performs this building block assembly in a fully automated fashion. Even very complex Csp^3-rich macro- and polycyclic natural products have been prepared via automated assembly of linear precursors, including iterative Csp^3 couplings, followed by cyclizations. This building block chemistry has illuminated the mechanism of action of amphotericin B, thereby providing an actionable roadmap to less toxic antifungal agents andexperiments targeting the replacement of missing protein ion channels with small molecule surrogates. Collectively, these efforts ultimately seek to build the foundation for the development of *molecular prosthetics* as a powerful and general strategy for the understanding and betterment of human health. http://www.scs.uiuc.edu/burke/ A new company, REVOLUTION Medicines, is now industrializing and applying this chemistry to enable the discovery of new drugs for treating serious human diseases.

SCHB 31

Intellipigment™ hydrogen detection technology

***Nahid Mohajeri**, nahidmohajeri@hotmail.com. HySense Technology LLC, Rockledge, Florida, United States*

Intellipigment™ tape is an inexpensive, portable, and simple-to-use hydrogen detection tape that changes color in the presence of hydrogen in concentrations as low as 1% to pinpoint the location of dangerous hydrogen leaks. The gas permeable tape is layered with hydrogen sensitive pigments that will change to a dark color to warn users of the presence of hydrogen.

Intellipigment™ Hydrogen Leak Detection Tape Discolored Due to Hydrogen Leak

SCHB 32

Post start-up science: Weathering the seas of change

***Christopher L. Campion**, clcampion@gmail.com. Chemistry, A123 Systems LLC, Townsend, Massachusetts, United States*

Born out of work at MIT, A123 Systems LLC has taken a winding road to success. A start up that received significant government funds who went public via an IPO in 2009, weathered a bankruptcy in 2012 and now sits as a key strategic asset in a multi-billion dollar, multi-national conglomerate; A123 has seen its share of challenges and successes. When starting up and planting the seeds of a new business, all seek gentle nurturing rains; what if what you get is a cyclone? Now, far from the hallowed halls of MIT, unique drivers constantly challenge science professionals in this environment to invent in increasingly creative ways. Faced with the constantly changing winds of business drivers, scientists at the helm need to seek the relative quiet within the eye wall. We will explore the challenges of conducting cutting edge science in a fluctuating business environment, strategies for maintaining discovery as stakeholders, expectations and objectives shift; all from the point of view of the chemistry R&D department.

SCHB 33

Safer, high-performance electrolytes for next-generation lithium-ion batteries

***Robert J. Hamers**[1], rjhamers@wisc.edu, Monica L. Usrey[2], Adrian Pena-Hueso[2], Sarah Guillot[1], Robert C. West[1,2], Michael Pollina[2]. (1) Univ of Wisconsin, Madison, Wisconsin, United States (2) Silatronix, Inc., Madison, Wisconsin, United States*

Silatronix, Inc. was founded in 2007 as a spin-out from research at the University of Wisconsin-Madison. Since then, Silatronix has focused on developing and commercializing organosilicon-based electrolytes for use in energy storage, particularly in lithium ion batteries. Organosilicon-based electrolytes have low vapor pressure, good Li conductiviites and a wide range of electrochemical stability. Over the last 8 years three different generations of compounds have been formed, differing in their molecular structure and electrochemical properties. The advances from one generation to the next arose primariliy from a fundamental understanding of the electrochemical and chemical breakdown processes that occur. This understanding was developed through a combination of laboratory-based studies and density functional calculations of stability and electronic structure enabled via collaborative work between Silatronix and the University of Wisconsin-Madison. The third generation of compounds shows remarkable electrochemical and thermal stability, surpassing that of existing carbonate-based electrolytes and serving as a foundation for next-generation batteries operating at higher voltages and with increased thermal budget. Here I will outline some of these advances that have finally lead to the development of a commercially viable high-performance electrolyte for next-generation lithium-ion batteries. Robert Hamers has a financial interest in the outcome of this work.

SCHB 34

YANACO: Yet another nano company, a lean start-up concept for chemicals and materials

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The original ideas on lean startups (Eric Ries) were developed for IT companies with very fast iterative development timelines. Within this presentation I will show how these original ideas can be adapted for the (nano)chemical space, and what implications this has on expected timelines and investment needs. I will discuss insights from four spin-off companies, which were spun out of ETH Zurich (group Prof. Stark) between 2007 and 2014 (TurboBeads, Nanograde, Smartodont & Novamem). Each of the companies started with the same lean company concept and, depending on individual customer needs and field specifics, developed into a different direction (self funded, strategic partners, cooperate investors, business angels). Cumulatively these companies have already reached several thousand customers worldwide, from local dental patricians to the largest chemical companies. Iterative product development, corresponding decision cycles and the infrastructural needs will be discussed for early product market-launches. I will be able to show that business development can be successful even if the technological idea has only just been realized in an academic laboratory.

SCHB 35

Building a microscale future at HD Sciences through high capacity magnetic nanoparticles for compound synthesis

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HD Sciences was founded in 2013 with the idea that the established techniques of high-throughput chemistry (HT-chemistry) for compound library synthesis could be adapted to the current scientific and financial realities of pre-clinical discovery research. Here we describe our initial efforts to employ nanoparticle technology in HT-chemistry to enable the parallel synthesis of hundreds of compounds for assay screening from only a few milligrams of a complex organic starting material. Initial results using ROMPGel functionalized Co/C magnetic nanoparticles (MNPs), developed in partnership with Prof. Paul Hanson at the University of Kansas, to conduct simple nucleophilic coupling reactions on the sub-micromole scale and in reaction volumes of only a few microliters are presented. The implications of the miniaturization of HT-chemistry using the MNPs in medicinal chemistry and strategies for advancing this technology in the marketplace are discussed.

SCHB 36

XploSafe's technologies for a safer world

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XploSafe is a provider of critical safety solutions for homeland security and lab safety. Its products protect people that deal with unstable and hazardous compounds. Improvised homemade explosives and ingredients are a big problem in warzones and on the home front. The underwear bomber, the shoe bomber and the London subway bombings are examples of the problem. Similarly certain organic compounds in the lab can become explosive due to formation of peroxides from reaction with air and sunlight. These unstable and hazardous compounds have led to deaths and millions in property damage.
XploSafe's first product line was XploSens, used for trace detection of improvised explosives. The product works by dramatically changing its color upon reaction with peroxide and chlorate based explosives. The XploSens products provide a one step, real-time, onsite detection of improvised explosives. Customers include bomb squads, first responders, the Transportation Security Administration and military and security personnel. XploSafe's second product line is XPell, which works by eliminating peroxides in organic solvents. XPell allows for the proper management of peroxide-forming solvents, reduces chemical costs, improves reactions and analyses, and mitigates the hazards of peroxide-related incidents. XPell is the only product in the market that provides a visual indication of the solvent's status (safe or unsafe). XploSafe has also developed technologies for immobilization or radionuclides released by nuclear accidents or dirty bombs that are also useful for heavy metal removal from water and juice.

SCHB 37

Efforts to commercialize light and pH activated ruthenium anticancer compounds

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Cancer treatment tends to be toxic and kills quickly growing cells indiscriminately. Our innovation has been to create a new class of tumor activated metallo prodrugs that are selective for cancer cells. Cancer cells typically have a lower pH than normal cells owing to their fast metabolism. We have designed a new class of metallo drugs in which ligand loss is required to form the active drug. We have also demonstrated that ligand loss is faster at lower pH as is typically seen in cancerous cells. This work has come from a collaboration between the groups of Jared J. Paul, Edward J. Merino, and Elizabeth T. Papish. This work has been patented and we are interested in forming joint ventures with industry to enhance our work in this area.

SCHB 38

Sterically protected and electronically activated azamacrocycle catalysts for lignin depolymerization: A new approach to biomass valorization

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We have developed innovative, cost-effective, proprietary technology solutions for pre-treatment of biomass with synthetic catalysts for effective depolymerization of lignin. We have synthesized, efficient, sterically protected and electronically activated organic biomimetic catalysts that depolymerize lignin, at ambient temperatures and pressures, to a mixture of phenolics, hemicellulose and cellulose in excellent yield. Salient features of our technology are: 1) Structural scaffolds incorporate the aza macrocycle into the primary structure. 2) Depolymerization of lignin is complete in primarily aqueous systems; limited amounts of organic solvents are used; the co-oxidants that are used are effective in neutral to mildly alkaline conditions. 3) Reduction/elimination of enzyme in saccharification through in-situ enzyme production with recombinant microbes further reduces the overall production cost. 4) Use of plant waste that is geographically abundant and available locally as feedstock. 5) Improved enzyme efficiency across different environments (pH and temperature.) 6) Genetically modified efficient microbes to gain higher yield in the fermentation process. 7) Adopted sustainable and eco-friendly alternatives. 8) Use a wide variety of plant waste.

SCHB 39

Chemistry and toxicology of e-cigarettes and e-liquids

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The U.S. FDA did not get jurisdiction over tobacco products until June 2009, but early versions of the enabling legislation showed that small tobacco product manufacturers could not survive the anticipated FDA regulations without access to contract scientific and regulatory affairs services to put them on an equal footing with the major manufacturers. Over the next few years, we marketed our services by presenting research at scientific meetings. In 2008, we received our first e-cigarette related contract and made additional presentations on e-cigarettes, e.g., at Society of Toxicology 2012 national meeting. Early work showed that the e-cigarettes would allow smokers to continue smoking, but with significant reductions in inhaled smoke toxicants. However, quality issues with the early products and the unexpected presence of low levels of aldehydes in the aerosol would soon cause concerns about the safety of e-cigarette use. Health authorities are calling for restrictions or bans on e-cigarette manufacture, sale, and use. This presentation will sort out the conflicting data on the chemistry and toxicology of contemporary e-cigarettes.