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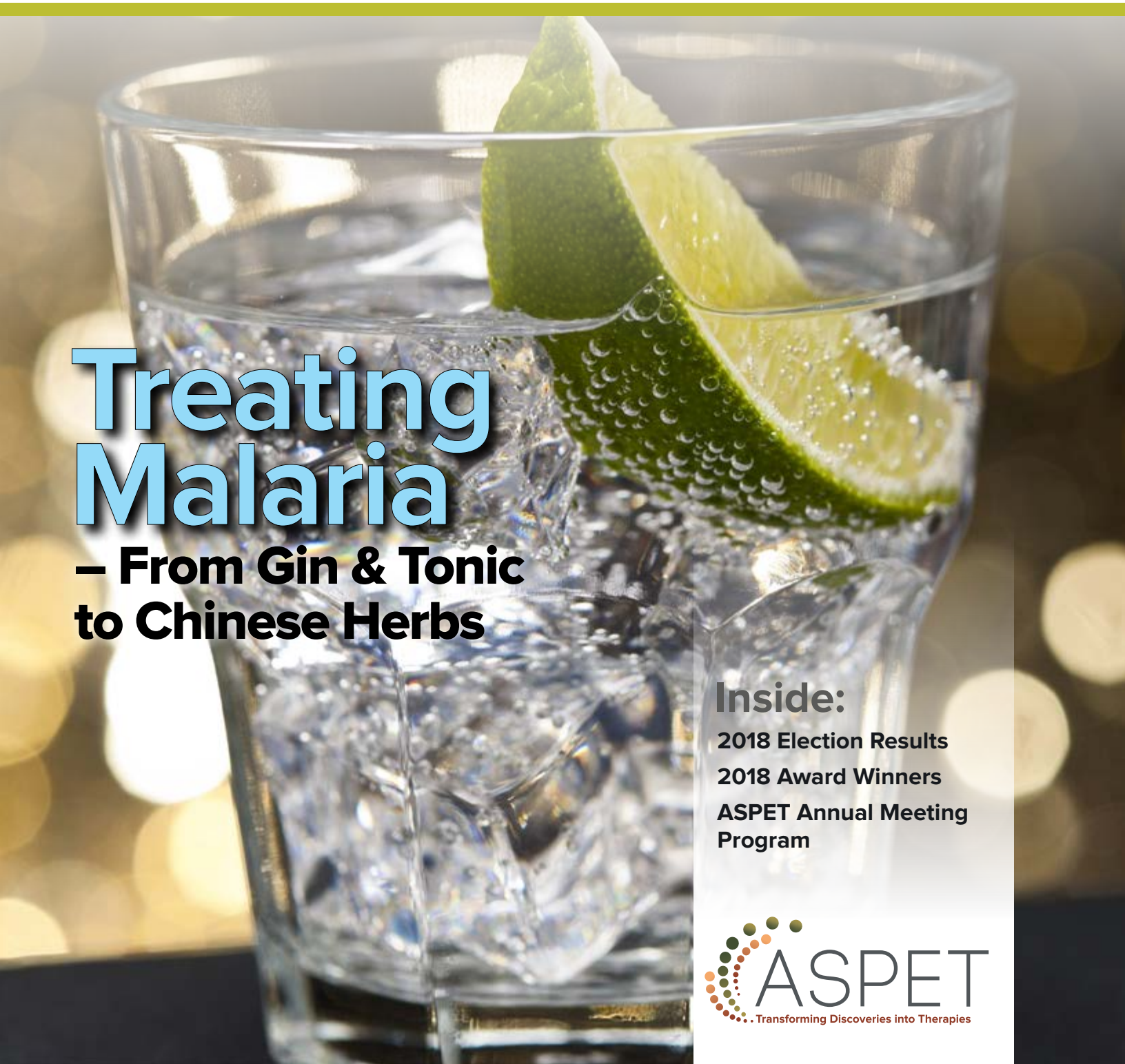

Treating Malaria – From Gin & Tonic to Chinese Herbs

Inside:

ASPET
Transforming Discoveries into Therapies

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Message from The President

Dear ASPET Members,

As an ASPET member, like me, I am sure one of your yearly highlights is our spring Annual Meeting at Experimental Biology (EB). Among the many reasons I look forward to this meeting is the opportunity to network with colleagues and exchange research ideas and tips. But, perhaps the most important reason is the opportunity to interact with young scientists and hear outstanding lectures from our 2018 Scientific Achievement Award winners. Among the awardees this year, lectures will be presented by Kirill Martenyanuv, Marc Caron, Paul Hollenberg, Robert Balster, Michel Bouvier, David Waxman, Thomas Michel, and Virginia Miller. I would also be remiss if I did not acknowledge the debut of ASPET's new Program Committee Chair, Mike Wood, for helping to put together such a superb program. Finally, for those of you who are experiencing an unexpectedly cold winter, the sunny weather of San Diego beckons and provides an additional reason to look forward to the meeting.

If you are planning to arrive early to San Diego, I want to encourage you to give a Day of Service to those in need. This community outreach by ASPET has been sustained by volunteers since 2009 and has included activities ranging from home construction to painting, cleaning, stocking, food preparation and food service. If you have time and a desire to show gratitude, please contact Charles France (france@uthscsa.edu).

As a follow-up to last year's all society welcome reception, and to further encourage interaction among the scientific societies participating in Experimental Biology, the first joint lecture, the Tang Prize Award Lecture, will feature Dr. Feng Zhang delivering a lecture on CRISPR. Immediately following the lecture, this year's EB welcome reception will feature "EB Scientific Highlights Posters," submitted from each society as well as posters describing outreach activities that help communicate our science to the public.

Regarding ASPET posters for EB 2018, one outstanding statistic is the 45% increase in the number of applicants for the poster competition. This speaks to the success of this event, but more importantly – may the best science and scientists win! One topic I've previously mentioned is a new EB event – the daily "ASPET Datablitz." I want to promote this innovative event as it will highlight and draw attention to the posters. How will it work? Each day, ten poster presenters will present short talks (~4 minutes each) in the ASPET poster discussion lounge. These brief snippets provide a preview, like a movie trailer, of the full presentations that will take place when you visit the poster boards. These fast-paced overviews of the most exciting science of the day are not to be missed! In addition, I would like to mention an innovative approach to further encourage poster attendance initiated by the Young Scientists Committee, especially members Sophia Kaska and Josh Lorenz-Guertin: "Poster Bingo." In a nutshell, as attendees visit posters, colored stickers will be collected from each participating poster they visit. Not that we need this incentive, but those who complete their bingo cards and turn them in to the ASPET booth will become eligible to compete in a daily drawing for a Starbucks gift card. For all poster presenters, I want to extend the following message on the benefits of a poster presentation:

1. Learn to talk about your data to those unfamiliar with your area-you are the expert, it's your project
2. Distill your topic into a format that allows you to easily disseminate it
3. Get invaluable peer feedback
4. Develop connections
5. Learn about the advances in your and other's fields
6. Promote pharmacology

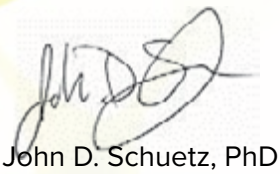
I applaud our divisions that recognize and acknowledge the accomplishments of the young scientist members who have done meritorious work. Showcasing their abstracts and providing an opportunity to give an oral presentation is an important step. Science communication is an essential part of a scientist's life. Why not start early? After all, it has been said that to be an effective scientist, you must be an effective communicator. While there are many venues, preparing a short concise visual presentation that delivers an impactful message is an art, one that, in my opinion, when coupled with an ability to know and engage your audience, will make you an effective communicator.

This past November, as part of our strategic goal of strengthening ASPET through global partnerships, we sent a delegation to the 2nd ASPET-CNPHARS Symposium hosted by the Chinese Pharmacological Society (CNPHARS) in Hangzhou, China. I encourage you to read the recap of this successful meeting (see article on pages 38-40).

I am pleased to announce that Drs. Wayne Backes, Jin Zhang, and Kathryn Cunningham will be joining the ASPET Council on July 1 as your President-elect, Secretary/Treasurer-elect, and Councilor, respectively. In addition, the names of our newly elected division officers can be found on pages 62-64. Please join me in congratulating them and also thanking those individuals who graciously agreed to run for election. Finally, I want to extend my appreciation to all those who volunteer their time and effort to serve ASPET – your service improves our community of scientists and also serves as an example to your mentees.

In closing, I want to thank the ASPET staff for their extraordinary efforts in preparing for EB 2018! See you in San Diego.

Best wishes,



John D. Schuetz, PhD
President, ASPET

2018 Election Results

The 2018 ASPET election closed on February 9, 2018 with a great turnout. Congratulations to newly elected Council members Wayne L. Backes, Jin Zhang, and Kathryn A. Cunningham, who will begin their terms on July 1, 2018.

PRESIDENT-ELECT

Wayne L. Backes, PhD

Associate Dean for Research, School of Medicine/Professor of Pharmacology, Louisiana State University Health Sciences Center, New Orleans

SECRETARY/TREASURER-ELECT

Jin Zhang, PhD

Professor, Department of Pharmacology, University of California, San Diego (UCSD); Member, Moores Cancer Center at UCSD; Adjunct Professor, Department of Pharmacology & Molecular Sciences, Johns Hopkins University School of Medicine

COUNCILOR

Kathryn A. Cunningham, PhD

Chauncey Leake Distinguished Professor of Pharmacology, Vice Chair of the Department of Pharmacology, and Director of the Center for Addiction Research, University of Texas Medical Branch, Galveston

The ASPET Nominating Committee requests nominations (including self-nominations) from our members for President-Elect, Secretary/Treasurer-Elect, and Councilor for consideration in the 2019 ASPET Election. Nominations for the 2019 ASPET Election are open now through April 6, 2018.

2018 Award Winners

ASPET awards recognize accomplishments in all areas of pharmacology and experimental therapeutics. We are pleased to announce an outstanding group of Scientific Achievement Award winners for 2018.

ASPET will present the awards on Saturday, April 21, 2018 at 4:30 pm at the Business Meeting and Awards Presentation during the ASPET Annual Meeting at Experimental Biology 2018 at the San Diego Convention Center in Room 16AB. Please join us to celebrate these inspirational awardees.

John J. Abel Award in Pharmacology

The John J. Abel Award in Pharmacology is named after the founder of ASPET. It was established in 1946 to stimulate fundamental research in pharmacology and experimental therapeutics by young investigators.

Kirill A. Martemyanov, PhD

The Scripps Research Institute

Dr. Kirill Martemyanov is being recognized for his research on how G protein signaling pathways are organized and regulated in the retina, heart, and brain. He was nominated by Dr. Richard Neubig from Michigan State University, who recommended him as "an outstanding young molecular pharmacologist and neuroscientist who has done tremendous work to advance our understanding of signal transduction in the visual system and the CNS."

Dr. Martemyanov received his PhD in molecular biology from the Russian Academy of Sciences in 2000 and did postdoctoral training at Harvard Medical School. He launched his independent career at the University of Minnesota before his appointment in 2011 at The Scripps Research Institute, where he is now a full-time tenured professor.

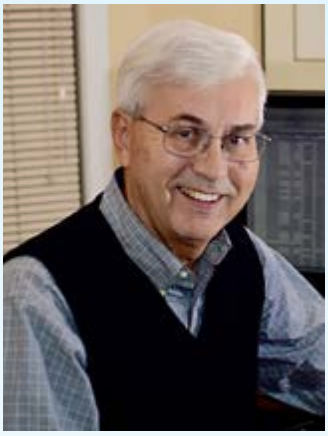
An author of over 100 publications, his lab has made key contributions in the elucidation of the structure/functional organization of RGS protein complexes, their role in controlling ion channels and second messenger pathways, and implications for the physiology of the nervous and cardiovascular systems. More recently, his lab advanced the understanding of the role of GPCR signaling components in disease, linking mutations in several components (Gβ5, Gβ1, Gα-olf) to movement and neuropsychiatric disorders and deciphering the mechanistic basis of signaling alterations that lead to disease.

Dr. Martemyanov will deliver the John J. Abel Award in Pharmacology Lecture titled *Molecular Control of G Protein Signaling* on Sunday, April 22, 2018 from 8:30 am – 9:15 am in Room 16A of the San Diego Convention Center.

Julius Axelrod Award in Pharmacology

The Julius Axelrod Award in Pharmacology was established in 1991 to honor the memory of the eminent American pharmacologist who shaped the fields of neuroscience, drug metabolism, and biochemistry and who served as a mentor for numerous eminent pharmacologists around the world. This award is presented for significant contributions to understanding the biochemical mechanisms underlying the pharmacological actions of drugs and for contributions to mentoring other pharmacologists.

Joseph A. Beavo, Jr., PhD
University of Washington



Dr. Joseph Beavo is being recognized for his research on the identification, regulation, and functions of cyclic nucleotide phosphodiesterases, work on cyclic nucleotides, and for his strong commitment to mentoring. He was nominated by Dr. William Catterall from the University of Washington.

Dr. Beavo earned his PhD in physiology from Vanderbilt University, where his major professors were Dr. Earl W. Sutherland, Jr., who became a Nobel Laureate for his discovery of cAMP, and Dr. Joel G. Hardman. At Vanderbilt, Dr. Beavo discovered that methylxanthines, like IBMX, inhibit phosphodiesterases, laying the key groundwork for this pharmacology.

In 1971, Dr. Beavo joined the laboratory of Dr. Edwin G. Krebs at the University of California, Davis. As a postdoctoral fellow and research faculty member, he made major contributions to understanding cyclic AMP-dependent protein kinases and contributed significantly to work that later led to the Nobel Prize for Dr. Krebs.

In 1977, Dr. Beavo joined the Department of Pharmacology at the University of Washington, where his research revealed 11 diverse families of cyclic-nucleotide phosphodiesterases with different substrate specificity and regulation. This laid the foundation for the development of important pharmacological agents, including Viagra and Cialis. He is now an emeritus professor at the University of Washington.

Dr. Beavo has been an exceptional mentor of junior colleagues both in his own laboratory and as vice-chair of the Department of Pharmacology at the University of Washington. His former student, Dr. Scott Soderling, described being “impressed with Joe’s deep enthusiasm for science and his easy approachability. He truly loved to spend time discussing details of my research and was very encouraging, but also probing in his questions in a way that forced me to think critically and deeply.”

An invaluable member of ASPET for over 35 years, Dr. Beavo served as president of ASPET from 2008-2009, councilor of ASPET from 2000-2009, and was on the program committee of ASPET from 1993-1999. He was also an associate editor of *Molecular Pharmacology* from 1986-1990 and served on the editorial board of *Pharmacological Reviews* from 1995-2000. Dr. Beavo was elected to the National Academy of Sciences in 1996.

Dr. Beavo will present the Axelrod Lecture at the 2019 ASPET Annual Meeting at Experimental Biology in Orlando, April 6-10, 2019.

Otto Krayer Award in Pharmacology

The Otto Krayer Award commemorates the enduring legacy of Dr. Otto Krayer's ethical behavior, commitment to teaching, high standards of scientific scholarship, publication and editorship, promotion of interdisciplinary research to reveal the actions of drugs or other chemicals, and his guidance and support of younger scientists.

Paul F. Hollenberg, PhD
University of Michigan

Dr. Paul Hollenberg is being recognized for his research accomplishments on the role of mechanism-based inactivation of cytochrome P450 function, editorships, including the co-founding of *Chemical Research in Toxicology*, commitment to teaching and editorial service to ASPET, and for his guidance of younger scientists.

He was nominated by Dr. Yoichi Osawa from the University of Michigan Medical School, who called him “the quintessential mentor” and said “his career of leadership and service to ASPET and to the drug

metabolism community is particularly exemplary. Most of all, if you ask anyone who knows Paul, they would all agree that he is a gentleman and a man of his word."

Since 2016, Dr. Hollenberg has been a professor emeritus of pharmacology at the University of Michigan Medical School. He was on the faculty at Northwestern University Medical School, chair at Wayne State University School of Medicine, and chair at the University of Michigan Medical School for more than 20 years. He is also an alumnus of the University of Michigan, having received his PhD in biological chemistry from Michigan.

Dr. Hollenberg's groundbreaking studies led to the identification of CYP450 substrate binding sites and enabled mapping of the active sites of the mammalian P450s. Over the years, his laboratory has played one of the leading roles in the use of mechanism-based inactivators to investigate the substrate binding sites, mechanisms of oxygen activation, formation of reactive intermediates, and the role of various amino acid residues in the active site in the catalytic mechanism.

Dr. Hollenberg has mentored over 50 graduate students, postdocs, and visiting scientists. He has published more than 200 peer-reviewed papers and co-founded *Chemical Research in Toxicology* in 1988, where he served as an associate editor and review editor until his recent retirement.

A highly regarded and active member of ASPET for 35 years, Dr. Hollenberg served as president of ASPET from 2002-2003, as secretary/treasurer from 1997-1998, and was a member of the finance committee from 1996-1999. He has dedicated decades to serving on the editorial boards of both *Drug Metabolism and Disposition* and *The Journal of Pharmacology and Experimental Therapeutics* and currently represents ASPET on the board of the Experimental Biology conference.

Dr. Hollenberg will deliver the Otto Krayer Award in Pharmacology Lecture titled *Active Site Structures and Catalytic Mechanisms of Drug Metabolizing Cytochrome P450s* on Monday, April 23, 2018 from 8:30 am – 9:15 am.

Louis S. Goodman and Alfred Gilman Award in Receptor Pharmacology

The Goodman and Gilman Award was established in 1980 to recognize and stimulate outstanding research in pharmacology of biological receptors. Such research is the foundation for a better understanding of the mechanisms of biological processes and potentially provides the basis for the discovery of drugs useful in the treatment of diseases.

Marc G. Caron, PhD

Duke University Medical Center

Dr. Marc Caron is being recognized for his studies on how the dopamine and serotonin receptor systems control behavior, and how deficits in these pathways mediate disease.

He was nominated by Drs. Jeffrey Benovic, Robert Lefkowitz, Brian Kobilka, Henrik Dohlman, and Bryan Roth, who noted that "Dr. Caron has a long history of outstanding discovery in the G protein-coupled receptor (GPCR) field and his work has tremendous promise for the treatment of a number of debilitating disorders."

Key discoveries of his laboratory include the cloning and knock-out of various monoamine transporters, the identification of novel signaling complexes for the D2 dopamine receptor, the development of biased agonists that might be useful in the treatment of schizophrenia and Parkinson's disease, and the identification of strategies to manage treatment-resistant depression.

Dr. Caron received his PhD in biochemistry from the University of Miami in 1973. In 1975, following a postdoctoral fellowship at Duke, he became an assistant professor at Laval University in Quebec City. In 1977, he returned to Duke University where he has since held numerous professorships for the past 40 years. He

is currently the James B. Duke professor and the vice chair for research in their Department of Cell Biology.

An ASPET member for more than 35 years, Dr. Caron has served on many editorial boards, including *Molecular Pharmacology* from 1983-1991.

Dr. Caron will deliver the Goodman and Gilman Award in Receptor Pharmacology Lecture titled *Physiological and Therapeutic Implications of GPCR Functional Selectivity/Biased Signaling* on Sunday, April 22, 2018 from 2:30 – 3:15 pm.

Pharmacia-ASPET Award for Experimental Therapeutics

The Pharmacia-ASPET Award for Experimental Therapeutics recognizes and stimulates outstanding research in pharmacology and experimental therapeutics, basic laboratory, or clinical research that has had, or potentially will have, a major impact on the pharmacological treatment of disease.

Mark Currie, PhD

Ironwood Pharmaceuticals

Dr. Mark Currie, president of R&D and chief scientific officer at Ironwood Pharmaceuticals, is being recognized for his discovery of the peptide hormones guanylin and uroguanylin that stimulate guanylate cyclase-C (GC-C) and for utilizing the structures of these molecules as the starting point for the invention of a novel, more stable peptide, linaclotide, that would prove useful for the oral treatment of gastrointestinal diseases.

He was nominated by Dr. Perry Halushka from the Medical University of South Carolina, who described Dr. Currie's "contagious passion for pharmacology" and noted that his "accomplishments represent a true journey of scientific innovation, from bench to bedside, led by a single investigator, which is a rare and remarkable accomplishment. His accomplishments have also driven a viable pipeline of innovative medicines that have the potential to treat many tens of millions of patients worldwide in desperate need of new treatments."

Dr. Currie received his PhD in cell biology/anatomy from the Bowman-Gray School of Medicine of Wake Forest University in 1980. He spent 10 years in academia at Washington University Medical School and the Medical University of South Carolina before joining the Monsanto Company. At Monsanto, he initiated, built, and led discovery pharmacology and served as director of arthritis and inflammation, leading an effort that resulted in marketed Cox 2 inhibitors for the treatment of pain in humans and animals.

In 2002, Dr. Currie joined Ironwood Pharmaceuticals, where he has been responsible for R&D efforts. He brought a unique understanding of GC-C pharmacology to Ironwood and coupled these insights with the expertise of his team to discover, develop, and ultimately bring to market linaclotide for the treatment of adults with irritable bowel syndrome with constipation (IBS-C) and chronic idiopathic constipation (CIC). During this journey of advancing linaclotide to patients, he and his team have defined a novel intestinal analgesic pathway through the GC-C/cyclic GMP pathway that has potential implications for treating not only abdominal pain but also more broadly other forms of visceral pain.

An ASPET member for 10 years, Dr. Currie has had many papers published in scientific publications, including *The Journal of Pharmacology and Experimental Therapeutics*.

Robert R. Ruffolo Career Achievement Award in Pharmacology

The Robert R. Ruffolo Career Achievement Award in Pharmacology was established in 2011 in recognition of the contributions made to drug discovery and

development by Dr. Ruffolo. The award recognizes the scientific achievements of scientists who are at the height of their careers and who have made significant contributions to any area of pharmacology.

Raymond J. Dingledine, PhD

Emory University School of Medicine

Dr. Raymond Dingledine is being recognized for his research achievements on the pharmacology of glutamate receptors and the causes of epilepsy, including his earlier work that provided insight into the regulation of postsynaptic glutamate receptors and his more recent studies that led to the identification of novel EP2 prostaglandin receptor antagonists. He was nominated by Dr. John S. Lazo from the University of Virginia School of Medicine, who noted that Dr. Dingledine "shares with Dr. Ruffolo an appreciation of high throughput methods, a deep respect for the power of quantitative pharmacologic methods, and a bent toward drug discovery."

He received his PhD in pharmacology from Stanford University in 1975. He spent time at the University of Cambridge, the University of Oslo, The Salk Institute, and the University of North Carolina at Chapel Hill before joining Emory University School of Medicine in 1992, where he currently is a professor and chairs the Pharmacology Department.

Dr. Dingledine's research focuses on the pharmacology of glutamate receptors and the causes of epilepsy. His early work provided numerous seminal insights into the regulation of postsynaptic glutamate receptors. Some of these findings led him to co-found NeurOp, Inc., a company focused on novel therapeutics for neurological disorders. His recent work has led to the identification of novel EP2 prostaglandin receptor antagonists capable of reducing neuroinflammation, with these studies revealing diverse immunomodulation pathways in epilepsy.

Dr. Dingledine has published over 200 research papers during his career. An ASPET member for 35 years, he has served as editor of *Molecular Pharmacology*, served on the editorial board of Molecular Interventions, and currently serves on the ASPET Investment Subcommittee.

Over the years, Dr. Dingledine has been recognized with numerous awards, including the ASPET Epilepsy Research Award in 1991 and election to the National Academy of Medicine in 2010.

ASPET Annual Meeting Program

For speakers and full session descriptions, visit www.aspet.org/eb2018. *Schedule subject to change.* Check the EB 2018 Mobile app for the final schedule. All ASPET events will be held at the San Diego Convention Center (SDCC) and the adjacent Marriott Marquis San Diego Marina.

Friday, April 20, 2018

Session/Event	Location	Time
Give a Day of Service to San Diego at EB 2018 *Contact Dr. Charles France to participate (france@uthscsa.edu or 210-567-6969)* UG PB GS PD	St. Vincent de Paul Village	7:00 am – 3:00 pm

Saturday, April 21, 2018

Session/Event	SDCC Location	Time
Teaching Institute: *Flipping Not Flopping: Active Learning Strategies for Graduate and Healthcare Pharmacology* *Chairs: L. Gorman and S. Rahman*	Room 14B	10:30 am – 1:00 pm
Assessing Pharmacology in Integrated Curricula *Chairs: R. L. Carrier and J. S. Reuben*	Room 14B	1:30 pm – 4:00 pm
Clinical Paths for Soluble Epoxide Hydrolase Inhibitors *Chairs: J.D. Imig and B. Hammock*	Room 17A	1:30 pm – 4:00 pm
Graduate Student – Postdoctoral Colloquium: Tools and Tricks for Success in Science GS PB PD *Chair: J. E. Clark*	Marriott: Grand Ballroom 1-3	1:30 pm – 4:00 pm
ASPET Business Meeting and Awards Presentation UG PB GS PD	**Room 16AB**	**4:30 pm – 6:00 pm**
All Society EB Lecture – Tang Prize *Keynote: Feng Zhang* *Harnessing Nature's Diversity for Gene Editing and Beyond*	Ballroom 20ABC	6:00 pm – 7:00 pm
All Society EB Welcome Reception *Including Scientific Highlights Posters* UG PB GS PD	Sails Pavilion	7:00 pm – 8:30 pm

☐ = Lectures ☐ = Networking Opportunity UG = Session of Interest for Undergraduate Students PB = Session of Interest for Post-baccalaureate Students GS = Session of Interest for Graduate Students PD = Session of Interest for Postdocs

Sunday, April 22, 2018

Session/Event	SDCC Location	Time
Diversity and Inclusion Breakfast UG PB GS PD *Facilitator: Iris Wagstaff* ***RSVP Required***	Room 14B	7:30 am – 9:30 am
John J. Abel Award in Pharmacology Lecture *Keynote: Kirill Martemyanov* *Molecular Control of G Protein Signaling*	Room 16A	8:30 am – 9:15 am
ASPET Presidential Symposium: ***Deadly Liaisons: Squeezing the Life Out of Cancer*** *Chairs: J. Schuetz and M. A. Bjornsti*	Room 16A	9:30 am – 12:00 pm
Nancy Zahniser Memorial Symposium: ***The Dopamine Transporter in Health and Disease*** *Chairs: L. Daws and H. Khoshbouei*	Room 16B	9:30 am – 12:00 pm
Ray Fuller Lecture and Symposium: ***State-of-the-Art on Regenerative Pharmacology: The Future is Now*** *Keynote: George Christ* *Symposium Chairs: G. Christ and K. Marra*	Room 17A	9:30 am – 12:00 pm
Placental Xenobiotic Metabolism and Transport *Chairs: Q. Mao and L. Aleksunes*	Room 15A	9:30 am – 12:00 pm
Humanized in vitro and in vivo Models in Drug Discovery and Development *Chairs: X. Ding and A. Sawant-Basak*	Room 15B	9:30 am – 12:00 pm
Undergraduate Networking and Career Development Luncheon UG PB ***RSVP Required***	Room 14B	12:15 pm – 2:00 pm
ASPET Poster Presentations UG PB GS PD	Exhibit Hall A-D	12:30 pm – 2:30 pm
Daily Poster Datablitz UG PB GS PD	ASPET Poster Discussion Area, Exhibit Hall #820	1:00 pm – 2:00 pm
Goodman and Gilman Award in Receptor Pharmacology Lecture *Keynote: Marc Caron* *Physiological and Therapeutic Implications of GPCR Functional Selectivity/ Biased Signaling*	Room 16A	2:30 pm – 3:15 pm

ASPET Welcomes our Guest Societies!

The following are ASPET guest societies at EB 2018. Members of these organizations can register for EB using the ASPET member discount.

Behavioral Pharmacology Society
British Pharmacological Society
Global GI Club
International Transmembrane Transporter Society

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Sunday, April 22, 2018, continued

Session/Event	SDCC Location	Time
Adhesion GPCRs as Neurotherapeutic Targets *Chairs: G. Tall and X. Piao*	Room 16A	3:30 pm – 6:00 pm
Epigenetics in Drug Discovery *Chairs: V. Vaka and J. Jilek*	Room 15B	3:30 pm – 6:00 pm
Pro-Psychotic Effects of Drugs of Abuse *Chairs: M. D. Berquist and M. W. Wood*	Room 16B	3:30 pm – 6:00 pm
The Microbiome and Cancer *Chairs: M. A. Bjornsti and H. Jeong*	Room 15A	3:30 pm – 6:00 pm
Update on the Gaseous Signaling Molecules NO, H2S, and CO *Chairs: A. Papapetropoulos and N. S. Bryan*	Room 17A	3:30 pm – 6:00 pm
ASPET Student / Postdoc Poster Competition UG PB GS PD	Ballroom 20BC	6:30 pm – 8:30 pm
ASPET Student / Postdoc Mixer UG PB GS PD	Marriott: Grand Ballroom 10	8:30 pm – 11:00 pm

Give a Day of Service to San Diego at EB 2018

Join us for a day of volunteer service on Friday, April 20, 2018

Since 2009, ASPET members attending Experimental Biology have given a day of volunteer service in the local communities where we convene. Volunteer activities have ranged from home construction to painting, cleaning, stocking, food preparation, and food service.

At EB 2018, EB attendees will spend the day at St. Vincent de Paul Village, doing whatever we can to help the dedicated people at Father Joe's Villages provide assistance to San Diegans.

If you plan to join us, please contact Charles P. France at your earliest convenience at france@uthscsa.edu or 210-567-6969. Space is limited and further details will be provided to those who volunteer.

At EB 2017 in Chicago, ASPET members spent the day volunteering at Pacific Garden Mission, helping to provide food and shelter for individuals in need.

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Monday, April 23, 2018

Session/Event	SDCC Location	Time
Otto Krayer Award in Pharmacology Lecture *Keynote: Paul F. Hollenberg* *Active Site Structures and Catalytic Mechanisms of Drug Metabolizing Cytochrome P450s*	Room 16A	8:30 am – 9:15 am
Surmounting the Insurmountable: Obstacles in Drug Discovery and Development – Real World Case Studies PB GS PD *Chairs: K. He and P. Hollenberg*	Room 16A	9:30 am – 12:00 pm
G Proteins and G Protein-Coupled Receptors in Cancer *Chairs: J.S. Gutkind and P. Insel*	Room 16B	9:30 am – 12:00 pm
RNA Binding Proteins in Cardiovascular Disease *Chair: M. Tranter and E. Tarling*	Room 15A	9:30 am – 12:00 pm
The Bright and Dark Side of Nrf2 for Tissue Protection *Chair: Q. M. Chen*	Room 15B	9:30 am – 12:00 pm
Transporters at the Blood-CNS Barriers *Chairs: J. Wang and P. T. Ronaldson*	Room 17A	9:30 am – 12:00 pm
ASPET Poster Presentations UG PB GS PD	Exhibit Hall A-D	12:30 pm – 2:30 pm
Daily Poster Datablitz UG PB GS PD	ASPET Poster Discussion Area, Exhibit Hall #820	1:00 pm – 2:00 pm
P.B. Dews Lifetime Achievement Award for Research in Behavioral Pharmacology Lecture *Keynote: Robert L. Balster* *Drug-behavior Interactions and Drug Discrimination Learning*	Room 16A	2:30 pm – 3:15 pm
Division for Pharmacology Education – ***Bringing Basic Sciences into Clinical Education*** *Chairs: R. J. Theobald and K. J. Karpa*	Room 15A	3:00 pm – 5:30 pm
Division for Behavioral Pharmacology – ***Looking to the Future of Behavioral Pharmacology*** *Chairs: R. I. Desai and E. M. Jutkiewicz*	Room 16A	3:30 pm – 6:00 pm
Division for Cancer Pharmacology **— Young Investigators Symposium** UG PB GS PD *Chairs: J. Yalowich and C. Canman*	Room 15B	3:30 pm – 6:00 pm
Division for Neuropharmacology **— Postdoctoral Scientist Award Finalists** UG PB GS PD *Chairs: J. Traynor and S. Tsirka*	Room 16B	3:30 pm – 6:00 pm
Division for Translational and Clinical Pharmacology **— Young Investigator Awards Platform Session** UG PB GS PD *Chair: F. Kim*	Room 17A	3:30 pm – 5:30 pm
Division for Translational and Clinical Pharmacology **— Early Career Faculty Showcase** UG PB GS PD *Chair: P. Hornby*	Room 17A	5:30 pm – 6:00 pm
Division Annual Meeting for Pharmacology Education	Room 15A	5:30 pm – 6:30 pm

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Monday, April 23, 2018 continued

Session/Event	SDCC Location	Time
Division Annual Meetings for: • Behavioral Pharmacology • Cancer Pharmacology • Neuropharmacology • Translational and Clinical Pharmacology **UG PB GS PD**	Room 16A Room 15B Room 16B Room 17A	6:00 pm – 6:30 pm
Division Joint Mixers for: • Behavioral Pharmacology and Neuropharmacology • Cancer Pharmacology, Drug Discovery and Development, Pharmacology Education, and Translational and Clinical Pharmacology **UG PB GS PD**	Marriott: Rancho Santa Fe 1-3 Marriott: Torrey Pines 2-3	6:30 pm – 8:30 pm
Young Experimental Scientists Y.E.S. Mixer **UG PB GS PD** *(All Society EB event for students and postdocs)*	Hilton: Aqua ABC	9:00 pm – 11:00 pm

Tuesday, April 24, 2018

Session/Event	SDCC Location	Time
Julius Axelrod Award in Pharmacology Lecture *Keynote: Michel Bouvier* *Unraveling the Molecular and Structural Determinants of GPCR Functional Selectivity; Potential for Drug Discovery*	Room 16A	8:30 am – 9:15 am
Julius Axelrod Symposium: ***The Pluridimensionality of G Protein-Coupled Receptor (GPCR) Signaling*** *Chairs: M. Bouvier and A. Salahpour*	Room 16A	9:30 am – 12:00 pm
'Bath Salts': The Ever-Changing Landscape of Synthetic Cathinones *Chairs: S. J. Kohut and M. A. Taffe* *Sponsored by La Jolla Alcohol Research, Inc.*	Room 16B	9:30 am – 12:00 pm
Can Metabolic Vulnerabilities in Tumors be Therapeutically Exploited? *Chairs: S. Cole and K. van de Wetering*	Room 15A	9:30 am – 12:00 pm
Challenges and Promises of CNS Orphan Drug Development: Stories from Bench to Clinic *Chairs: D. Davies and J. Paul*	Room 15B	9:30 am – 12:00 pm
There's Always Room for Dessert: Examining the Effect of Insulin and High Fat Diet on Neurotransmission, Motivation and Cognition *Chairs: C. R. Ferrario and L. P. Reagan*	Room 17A	9:30 am – 12:00 pm

☐ = Lectures ☐ = Networking Opportunity **UG** = Session of Interest for Undergraduate Students **PB** = Session of Interest for Post-baccalaureate Students **GS** = Session of Interest for Graduate Students **PD** = Session of Interest for Postdocs

Tuesday, April 24, 2018 continued

Session/Event	SDCC Location	Time
Division for Translational and Clinical Pharmacology – Trainee Mentoring and Career Development UG PB GS PD ***RSVP Required***	Room 14B	12:30 pm – 2:00 pm
ASPET Poster Presentations UG PB GS PD	Exhibit Hall A-D	12:30 pm – 2:30 pm
Daily Poster Datablitz UG PB GS PD	ASPET Poster Discussion Area, Exhibit Hall #820	1:00 pm – 2:00 pm
Bernard B. Brodie Award in Drug Metabolism Lecture *Keynote: David J. Waxman* *Sex Differences in Drug Metabolism: From Steroids and P450s to Transcription Factors and Chromatin States*	Room 16B	2:30 pm – 3:15 pm
Division for Cardiovascular Pharmacology Trainee Showcase *Chairs: C. Marziano and S. Schumacher* UG PB GS PD	Room 16A	2:30 pm – 4:10 pm
Computational Approaches to G Protein-Coupled Receptor Structure and Function Co-sponsored by the British Pharmacological Society *Chairs: E. Kelly and A. Conibear*	Room 17A	3:30 pm – 6:00 pm
Division for Drug Metabolism and Disposition Gillette Awards and Junior Investigator Platform Session UG PB GS PD *Chairs: N. Isoherranen and X. Ding*	Room 16B	3:30 pm – 6:00 pm
Division for Molecular Pharmacology Postdoctoral Scientist Award Competition and Keynote Address UG PB GS PD *Chairs: L. Hazelwood and H. Dohlman*	Room 15B	3:30 pm – 6:00 pm
Division for Toxicology – *Novel Genetic-based Tools for Toxicity Screening, Precision Medicine, and Mode of Action Analysis* *Chair: A. Harrill and B. Cummings*	Room 15A	3:30 pm – 6:00 pm
Hot Topics in Cardiovascular Pharmacology UG PB GS PD *Chairs: W. Koch and S. Lindsey*	Room 16A	4:10 pm – 5:00 pm
Cardiovascular Pharmacology Division Annual Meeting	Room 16A	5:00 pm – 5:30 pm
Paul M. Vanhoutte Distinguished Lectureship in Vascular Pharmacology *Keynote: Virginia Miller, Estrogen and Vascular Function: The Clash between Basic Pharmacology and Clinical Practice* *Keynote: Thomas Michel, Life History of eNOS*	Room 16A	5:30 pm – 6:30 pm
Division Annual Meetings • Drug Discovery and Development • Drug Metabolism and Disposition • Molecular Pharmacology • Toxicology	Room 17A Room 16B Room 15B Room 15A	6:00 pm – 6:30 pm
Division Mixers for: • Drug Metabolism and Disposition and Toxicology • Cardiovascular Pharmacology • Molecular Pharmacology UG PB GS PD	Marriott: Grand Ballroom 12 Grand Ballroom Terrace Grand Ballroom 13	6:30 pm – 8:30 pm

☐ = Lectures ☐ = Networking Opportunity **UG** = Session of Interest for Undergraduate Students **PB** = Session of Interest for Post-baccalaureate Students **GS** = Session of Interest for Graduate Students **PD** = Session of Interest for Postdocs

Wednesday, April 25, 2018

Session/Event	SDCC Location	Time
Journals Workshop: Hear It from the Editors PB GS PD *Chairs: R. C. Dodenhoff and M. Vore*	Room 14B	8:30 am – 11:00 am
Cardiovascular Consequences of Metabolic Targeting in Obesity *Chairs: A. C. Arnold and D. I. Diz*	Room 16B	8:30 am – 11:00 am
The Organization of Signal Transduction and Its Impact on Receptor Function *Chair: J. M. Streicher*	Room 16A	8:30 am – 11:00 am
Tissue Free Drug Concentrations *Chair: D. Zhang and J. Lade*	Room 15B	8:30 am – 11:00 am
University Startups: From Invention to Commercialization UG PB GS PD *Chairs: H. Neelakantan, K. Tonsfeldt, and S. Umar*	Room 17A	8:30 am – 11:00 am

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EB Programming

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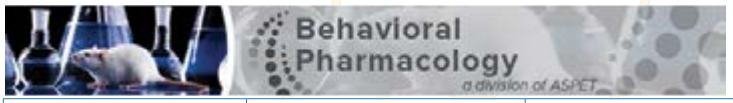
Before heading to San Diego, download the EB 2018 app in the Apple and GooglePlay store. Search for "Experimental Biology 2018." The EB 2018 app will keep you organized with up-to-the-minute event information and build your personalized schedule.

ASPET Booth # 602

Visit the ASPET booth in the Experimental Biology exhibit hall! Items for sale at **"Shop ASPET"** include t-shirts, hats, plush donkeys, and much more. Plus, pick up a FREE ASPET lanyard and the 2018 Special Edition of *The Pharmacologist*, a compilation of feature articles from 2016 – 2017.

Division Meetings and Activities

View the full schedule of sessions by division online at: https://www.aspet.org/aspet/meetings-awards/meetingsannual-meeting/annual-meeting-2018/program/sessions-by-division



	Time	Session/Event	Location
Monday, April 23	7:00 am – 8:15 am	BEH Executive Committee Meeting *(invitation only)*	**Marriott** Torrey Pines 2
Monday, April 23	2:30 pm – 3:15 pm	P.B. Dews Lifetime Achievement Award for Research in Behavioral Pharmacology Lecture	**SDCC** Room 16A
Monday, April 23	3:30 pm – 6:00 pm	Division Programming: "Looking to the Future of Behavioral Pharmacology"	**SDCC** Room 16A
Monday, April 23	6:00 pm – 6:30 pm	BEH Annual Division Meeting	**SDCC** Room 16A
Monday, April 23	6:30 pm – 8:30 pm	Joint Mixer: BEH with Neuropharmacology	**Marriott** Rancho Santa Fe 1-3

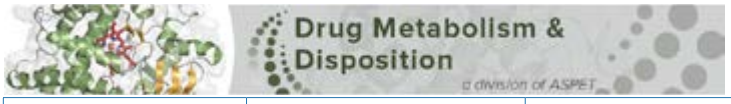
	Time	Session/Event	Location
Sunday, April 22	7:00 am – 8:15 am	DCP Executive Committee Meeting *(invitation only)*	**Marriott** Torrey Pines 2
Monday, April 23	3:30 pm – 6:00 pm	Division Programming: Young Investigators Symposium	**SDCC** Room 15B
Monday, April 23	6:00 pm – 6:30 pm	DCP Annual Division Meeting	**SDCC** Room 15B
Monday, April 23	6:30 pm – 8:30 pm	Joint Mixer: DCP with Drug Discovery and Development, Pharmacology Education, and Translational and Clinical Pharmacology	**Marriott** Torrey Pines 2-3

Make sure to attend your Division's Annual Meeting to learn how you can become more involved!

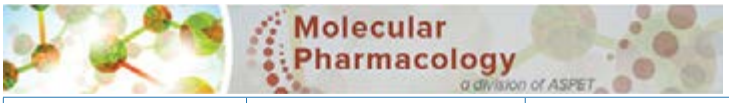
BEH = Behavioral Pharmacology, **CVP** = Cardiovascular Pharmacology, **DCP** = Cancer Pharmacology, **DDD** = Drug Discovery and Development, **DMDD** = Drug Metabolism and Disposition, **MP** = Molecular Pharmacology, **NEU** = Neuropharmacology, **DPE** = Pharmacology Education, **TCP** = Translational and Clinical Pharmacology, **TOX** = Toxicology

	Time	Session/Event	Location
Tuesday, April 24	7:00 am – 8:15 am	CVP Executive Committee Meeting *(invitation only)*	**Marriott** Presidio
Tuesday, April 24	2:30 pm – 4:10 pm	Division for Cardiovascular Pharmacology Trainee Showcase	**SDCC** Room 16A
Tuesday, April 24	4:10 pm – 5:00 pm	Hot Topics in Cardiovascular Pharmacology	**SDCC** Room 16A
Tuesday, April 24	5:00 pm – 5:30 pm	CVP Annual Division Meeting	**SDCC** Room 16A
Tuesday, April 24	5:30 pm – 6:30 pm	Paul M. Vanhoutte Distinguished Lectureship in Vascular Pharmacology	**SDCC** Room 16A
Tuesday, April 24	6:30 pm – 8:30 pm	CVP Mixer	**Marriott** Grand Ballroom Terrace

	Time	Session/Event	Location
Monday, April 23	7:00 am – 8:15 am	DDD Executive Committee Meeting *(invitation only)*	**Marriott** Rancho Santa Fe 1
Monday, April 23	6:30 pm – 8:30 pm	Joint Mixer: DDD with Cancer Pharmacology, Pharmacology Education, and Translational and Clinical Pharmacology	**Marriott** Torrey Pines 2-3
Tuesday, April 24	6:00 pm – 6:30 pm	DDD Annual Division Meeting	**SDCC** Room 17A
Wednesday, April 25	8:30 am – 11:00 am	Division Programming: "University Startups: From Invention to Commercialization"	**SDCC** Room 17A



	Time	Session/Event	Location
Monday, April 23	7:00 am – 8:15 am	DMDD Executive Committee Meeting *(invitation only)*	**Marriott** Rancho Santa Fe 3
Tuesday, April 24	2:30 pm – 3:15 pm	Bernard B. Brodie Award in Drug Metabolism Lecture	**SDCC** Room 16B
Tuesday, April 24	3:30 pm – 6:00 pm	Division Programming: Gillette Awards and Junior Investigator Platform Session	**SDCC** Room 16B
Tuesday, April 24	6:00 pm – 6:30 pm	DMDD Annual Division Meeting	**SDCC** Room 16B
Tuesday, April 24	6:30 pm – 8:30 pm	Joint Mixer: DMDD with Toxicology	**Marriott** Grand Ballroom 12

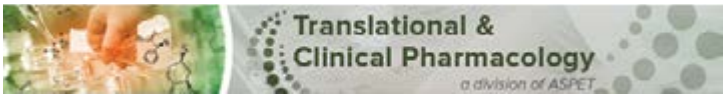


	Time	Session/Event	Location
Sunday, April 22	7:00 am – 8:15 am	MP Executive Committee Meeting *(invitation only)*	**Marriott** Rancho Santa Fe 3
Tuesday, April 24	3:30 pm – 6:00 pm	Division Programming: Postdoctoral Scientist Award Competition and Keynote Address	**SDCC** Room 15B
Tuesday, April 24	6:00 pm – 6:30 pm	MP Annual Division Meeting	**SDCC** Room 15B
Tuesday, April 24	6:30 pm – 8:30 pm	MP Mixer	**Marriott** Grand Ballroom 13

	Time	Session/Event	Location
Monday, April 23	7:00 am – 8:15 am	NEU Executive Committee Meeting *(invitation only)*	**Marriott** Rancho Santa Fe 2
Monday, April 23	3:30 pm – 6:00 pm	Division Programming: Postdoctoral Scientist Award Finalists	**SDCC** Room 16B
Monday, April 23	6:00 pm – 6:30 pm	NEU Annual Division Meeting	**SDCC** Room 16B
Monday, April 23	6:30 pm – 8:30 pm	Joint Mixer: NEU with Behavioral Pharmacology	**Marriott** Rancho Santa Fe 1-3

	Time	Session/Event	Location
Monday, April 23	7:00 am – 8:15 am	DPE Executive Committee Meeting *(invitation only)*	**Marriott** Torrey Pines 3
Monday, April 23	3:00 pm – 5:30 pm	Division Programming: "Bringing Basic Sciences into Clinical Education"	**SDCC** Room 15A
Monday, April 23	5:30 pm – 6:30 pm	DPE Annual Division Meeting	**SDCC** Room 15A
Monday, April 23	6:30 pm – 8:30 pm	Joint Mixer: DPE with Cancer Pharmacology, Drug Discovery and Development, and Translational and Clinical Pharmacology	**Marriott** Torrey Pines 2-3

	Time	Session/Event	Location
Tuesday, April 24	7:00 am – 8:15 am	TOX Executive Committee Meeting *(invitation only)*	**Marriott** Rancho Santa Fe 3
Tuesday, April 24	3:30 pm – 6:00 pm	Division Programming: "Novel Genetic-based Tools for Toxicity Screening, Precision Medicine, and Mode of Action Analysis"	**SDCC** Room 15A
Tuesday, April 24	6:00 pm – 6:30 pm	TOX Annual Division Meeting	**SDCC** Room 15A
Tuesday, April 24	6:30 pm – 8:30 pm	Joint Mixer: TOX with Drug Metabolism and Disposition	**Marriott** Grand Ballroom 12



	Time	Session/Event	Location
Sunday, April 22	7:00 am – 8:15 am	TCP Executive Committee Meeting *(invitation only)*	**Marriott** Rancho Santa Fe 1
Sunday, April 22	9:30 am – 12:00 pm	Ray Fuller Lecture and Symposium	**SDCC** Room 17A
Monday, April 23	3:30 pm – 5:30 pm	Division for Translational and Clinical Pharmacology - Young Investigator Awards Platform Session	**SDCC** Room 17A
Monday, April 23	5:30 pm – 6:00 pm	Division for Translational and Clinical Pharmacology - Early Career Faculty Showcase	**SDCC** Room 17A
Monday, April 23	6:00 pm – 6:30 pm	TCP Annual Division Meeting	**SDCC** Room 17A
Monday, April 23	6:30 pm – 8:30 pm	Joint Mixer: TCP with Cancer Pharmacology, Drug Discovery and Development, and Pharmacology Education	**Marriott** Torrey Pines 2-3
Tuesday, April 24	12:30 pm – 2:00 pm	TCP Trainee Mentoring and Career Development	**SDCC** Room 14B

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ASPET Meetings

The following are ***invitation-only*** meetings. *Schedule subject to change.*

Thursday, April 19, 2018

Time	Session/Event	Location
5:00 pm – 10:00 pm	Finance Committee Meeting	**Marriott** Rancho Santa Fe 1-2

Friday, April 20, 2018

Time	Session/Event	Location
7:30 am – 6:00 pm	Council Meeting	**Marriott** Rancho Santa Fe 1-2
11:00 am – 8:00 pm	Mentoring Network: Coaching for Career Development (mentors)	**Marriott** Torrey Pines 3
2:00 pm – 8:00 pm	Mentoring Network: Coaching for Career Development (mentees)	**Marriott** Torrey Pines 3
2:00 pm – 5:00 pm	Council of Division Chairs	**Marriott** Torrey Pines 2
6:30 pm – 9:00 pm	Council Dinner	*See invitation for location.*

Saturday, April 21, 2018

Time	Session/Event	Location
8:30 am – 12:00 pm	Mentoring Network: Coaching for Career Development (mentors and mentees)	**Marriott** Torrey Pines 3
12:00 pm – 1:00 pm	Mentoring Network Lunch	**Marriott** Rancho Santa Fe 2-3
2:00 pm – 3:00 pm	Science Policy Committee	**Marriott** Torrey Pines 2
8:30 pm – 10:00 pm	President's Reception *(by invitation only)*	*See invitation for location.*

EB Career Center

SDCC: Exhibit Hall D (Saturday – Tuesday), Sails Pavilion (Wednesday)

Over 30 workshops to help:

- **choose a career**
- **search for a job**
- **improve networking skills**
- **enhance your professional skills**

One-on-one appointments to:

- **critique your resume / CV**
- **assess your personal statement essay**
- **practice your poster/oral presentation with a mentor**
- **general career counseling**

Sunday, April 22, 2018

Time	Session/Event	Location
7:00 am – 8:15 am	Executive Committee – Div. for Translational and Clinical Pharmacology	**Marriott** Rancho Santa Fe 1
7:00 am – 8:15 am	Executive Committee – Div. for Molecular Pharmacology	**Marriott** Rancho Santa Fe 3
7:00 am – 8:15 am	Executive Committee – Div. for Cancer Pharmacology	**Marriott** Torrey Pines 2
7:30 am – 9:30 am	*JPET* Associate Editors Meeting	**Marriott** Torrey Pines 3
7:30 am – 9:30 am	Diversity and Inclusion Breakfast	**SDCC** Room 14B
12:15 pm – 2:00 pm	Undergraduate Networking and Career Development Luncheon	**SDCC** Room 14B
12:30 pm – 2:30 pm	Board of Publications Trustees Meeting	**Marriott** Rancho Santa Fe 2
7:30 pm – 10:00 pm	Board of Publications Trustees Joint Editorial Boards Dinner	**Marriott** Grand Ballroom 8

Monday, April 23, 2018

Time	Session/Event	Location
7:00 am – 8:15 am	Executive Committee – Div. for Drug Metabolism and Disposition	**Marriott** Rancho Santa Fe 3
7:00 am – 8:15 am	Executive Committee – Div. for Drug Discovery and Development	**Marriott** Rancho Santa Fe 1
7:00 am – 8:15 am	Executive Committee – Div. for Neuropharmacology	**Marriott** Rancho Santa Fe 2
7:00 am – 8:15 am	Executive Committee – Div. for Pharmacology Education	**Marriott** Torrey Pines 3
7:00 am – 8:15 am	Executive Committee – Div. for Behavioral Pharmacology	**Marriott** Torrey Pines 2
7:30 am – 9:30 am	*Molecular Pharmacology* Editorial Board Meeting	**Marriott** Presidio
12:30 pm – 2:30 pm	*Pharmacological Reviews* Editorial Board Meeting	**Marriott** Rancho Santa Fe 2
2:15 pm – 3:15 pm	Division Communications Officers	**Marriott** Rancho Santa Fe 3
6:30 pm – 9:00 pm	Past President's Dinner	**Marriott** Presidio 1

Tuesday, April 24, 2018

Time	Session/Event	Location
7:00 am – 8:15 am	Executive Committee – Div. for Cardiovascular Pharmacology	**Marriott** Presidio
7:00 am – 8:15 am	Executive Committee – Div. for Toxicology	**Marriott** Rancho Santa Fe 3
7:00 am – 8:15 am	Nominating Committee Meeting	**Marriott** Rancho Santa Fe 1
7:00 am – 8:15 am	Mentoring and Career Development Committee	**Marriott** Rancho Santa Fe 2
7:30 am – 9:30 am	*Drug Metabolism and Disposition* Editorial Board Meeting	**Marriott** Torrey Pines 2-3
2:15 pm – 3:15 pm	Young Scientists Committee	**Marriott** Rancho Santa Fe 3
3:00 pm – 5:00 pm	*Pharmacology Research & Perspectives* Management Committee	**Marriott** Rancho Santa Fe 1

Wednesday, April 25, 2018

Time	Session/Event	Location
11:30 am – 2:30 pm	Program Committee	**SDCC** Room 7A TBD

Thank you for being an ASPET member.
Visit the ASPET member lounge!

Visit the ASPET member lounge at the Convention Center where members can grab daily morning coffee, hold one-on-one meetings, network with colleagues, meet ASPET members and leaders, relax, or catch up on work using ASPET Wifi.

San Diego Convention Center, Room 17B

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Sunday, 8:00 am – 6:00 pm
Monday, 8:00 am – 6:00 pm
Tuesday, 8:00 am – 6:00 pm
Wednesday, 8:00 am – 12:00 pm

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Treating Malaria – From Gin & Tonic to Chinese Herbs

Rebecca J. Anderson, PhD

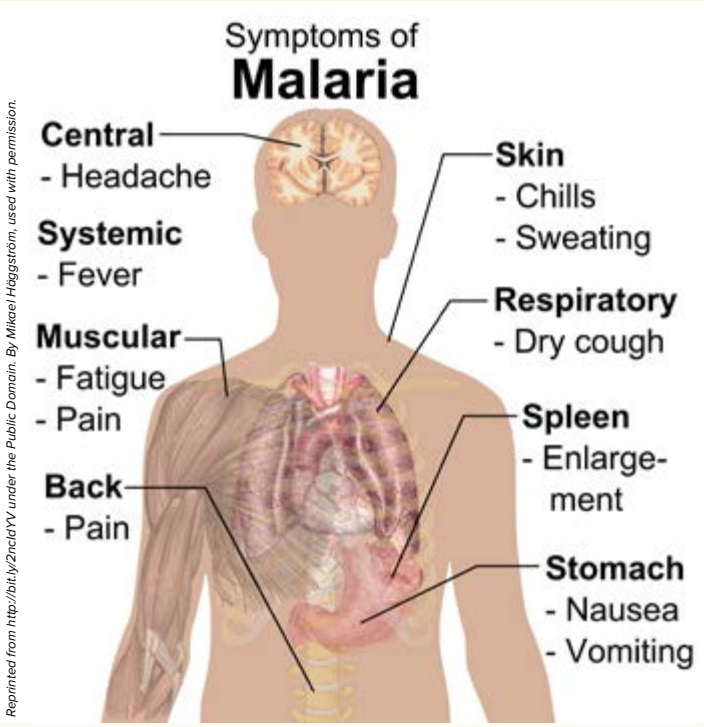
Malaria has plagued humans since the dawn of civilization. Wherever people settled in communities, stagnant pools of fetid water accumulated, and malaria soon followed.

The first documented cases were reported in China 5,000 years ago, in the *Nei Ching (The Canon of Medicine, 2600 BCE)*. But malaria likely originated in tropical Africa thousands of years before that *(1, 2)*.

From Africa, malaria spread to the Mediterranean, Mesopotamia, the Indian subcontinent, and Asia, following paths created by migrating populations, expanding trade routes, and invading military forces. Spanish conquistadors and the African slave trade probably brought malaria to the New World *(2)*.

Like many other infectious diseases, malaria causes fever, headaches, and vomiting *(1)*. But several symptoms distinguish malaria from the rest: a hard, enlarged spleen and an atypical pattern of recurring fevers. Malarial fever "paroxysms" are sudden shifts from fever and sweating to chills and shivering in a

Patient with malaria in Nyangaton, Ethiopia.



repeating cycle lasting several hours. Early physicians classified the disease as either "tertian" fever, in which the paroxysms recurred every two days, or "quartan" fever, which appeared every three days.

Everywhere in the world, the symptoms were the same, but physicians invented a variety of names for it: intermittent fever, ague, pioneer shakes, congestive fever, bilious fever, swamp fever, and marsh fever *(3, 4)*. Long before the cause was identified, both Chinese and Western observers linked the disease to gases or evil spirits emanating from malodorous waters *(4-6)*. "Malaria," the name that stuck, comes from *mal'aria*, Italian for "bad air" *(1, 3)*.

Early Treatments

Ancient practitioners probably stumbled upon the first effective malaria treatments through trial and error. In China, in 340 AD, Ge Hong first described the antifever properties of an herbal remedy, qinghao, in his *Handbook of Prescriptions for Emergencies (1, 4, 7, 8)*. For hundreds of years before that, the Chinese had used qinghao for itches, malignant sores, lice, and hemorrhoids *(4, 7, 8)*.

Subsequent to Ge Hong's book, the use of qinghao, which comes from the *Artemisia* plant (sweet wormwood), was adopted throughout China. *Prescriptions for Universal Relief*, published in 1406, contained recipes for qinghao soup, pills, and powders to relieve malaria symptoms. In the 16th century, Li Shizhen's *Compendium of Materia Medica* also included qinghao preparations for curing malarial chills and fever *(4, 9, 10)*.

The first effective remedy used by Western practitioners also came from a natural plant source. And it was also discovered by chance. In the early 17th century, Jesuit priests began establishing missions in Spanish-occupied South America. Besides saving men's souls, the Jesuits recognized the importance of good health, and each mission included an infirmary and an apothecary. As part of their studies of botany, they sent expeditions into the wilds of Peru to gather medicinal plants *(3)*.

In the foothills of the Andes Mountains, the Jesuits noticed that Indians sometimes drank tea made from a red bark. It seemed to cure shivering that accompanied exposure to dampness and cold. The Jesuits thought that this tree bark might also alleviate the shivering associated with malaria. They tested a preparation of the powdered bark on a few patients and found that it cured "tertian" and "quartan" fevers *(3)*.

Encouraged by that initial success, the Jesuits began distributing samples of the bark to physicians in Lima, Peru, as well as other missions in the region *(3)*. The bark's curative reputation quickly spread.

Folklore pointed to the Countess of Chinchón, the wife of the Viceroy of Peru, as the most prominent advocate for this magical powdered bark. After she was miraculously cured of her life-threatening tertian fever, the Countess distributed large quantities of the remedy to the poor and sick. Grateful for her generosity, people began calling the red bark "the Countess's Powder" *(3)*.

After reading a description of the Peruvian tree with the red bark, Carl Linnaeus, the father of modern taxonomy, assigned it the genus *Cinchona* in 1738, in honor of the Countess. Later, he received cinchona tree specimens from an Italian botanist in Peru to add to his collection. The misspelled taxonomy assignment, which should have


Cinchona calisaya

been *"Chinchona,"* stemmed from translation of the Countess's Spanish name to Italian by the botanist *(8)*.

In 1930, a diary of the Viceroy's secretary was discovered, providing a detailed contemporaneous account of the Viceroy and his family's activities in Peru. It contradicted the fabled and much quoted story about the Countess. The diary offers no evidence that she ever suffered from malaria, or that she had ever been treated with the Peruvian bark. But after two centuries of use, the genus *Cinchona* was firmly established and has remained unchanged *(3, 8)*.

Western Treatment of Malaria

Father Alonso Messia Venegás, an elderly Jesuit priest, carried the first small supply of cinchona bark from South America to Rome in 1631 *(3)*. Malaria was rampant in Rome, and physicians soon found that cinchona bark was indeed an effective treatment. Juan de Lugo, a Jesuit pharmacist at the Santo Spirito Hospital in Rome and later Cardinal, became the most influential advocate for cinchona bark in continental Europe *(3)*.

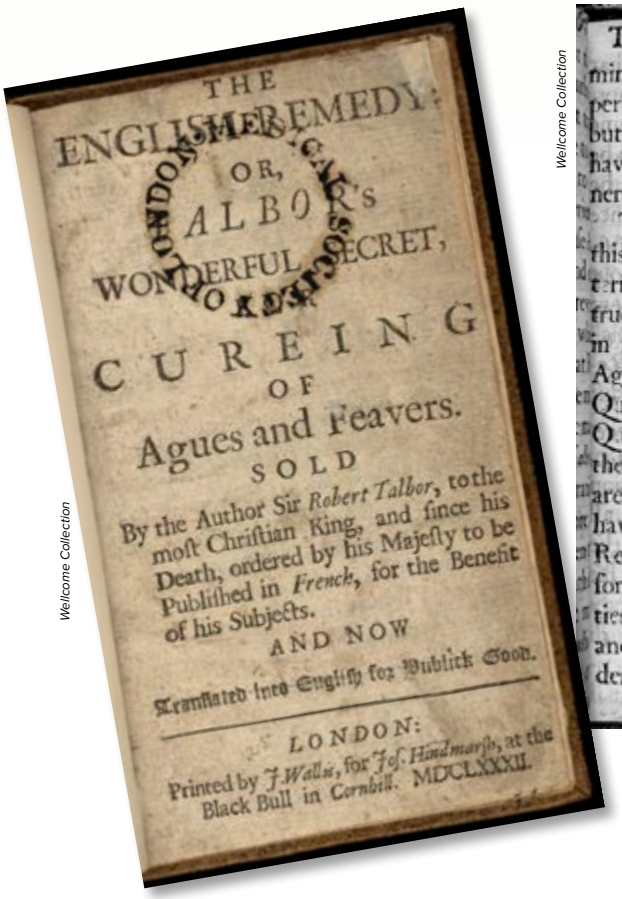
To meet European demand, the Jesuits in Peru organized Indian laborers to harvest and process the bark. By the end of the 18th century, about 80 ships arrived annually in Spanish ports from Peru, each carrying a consignment of cinchona bark. Because of its discovery and strong advocacy by representatives of the Vatican, the red bark remedy was commonly called "Jesuit powder" or "Cardinal's powder" *(3)*.

Malaria was also prevalent in southern Britain in the 17th century, but the predominantly Protestant country was skeptical and critical of any medicine advocated by continental Roman Catholics *(3)*. Also, at that time, prescriptions varied widely, and many patients suffered from the bitter powder's side effects, including tinnitus, nausea, vomiting, and headaches.

In Cambridge, Robert Talbor, an enterprising apothecary apprentice, began studying ways to optimize dosing of the Peruvian bark and minimize its side effects. By 1670, Talbor had perfected his prescription and set up shop in London as a fever specialist *(3, 8)*. Fully aware of the religious stigma associated with cinchona bark, he refused to divulge his recipe, saying only that it consisted of two ingredients from England and two from abroad.

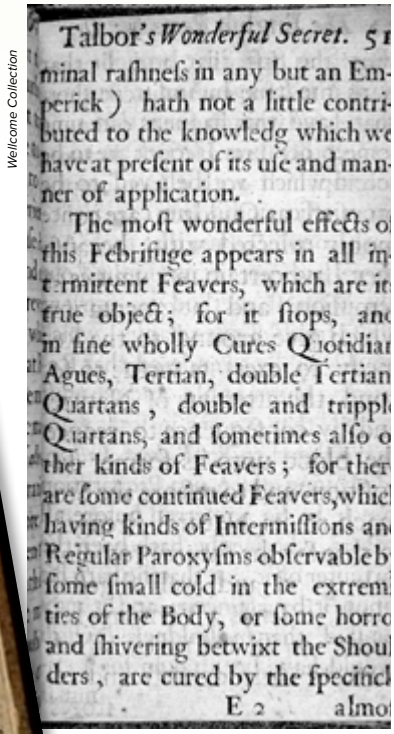
Talbor charged huge fees and was dismissed as a quack by the Royal College of Physicians, but his remedy worked. His fame—and the disdain of the medical establishment—only grew after he cured Britain's King Charles II, as well as the Queen of Spain and Louis XIV's son in Paris *(3)*.

After Talbor's death, his formulation was published in France. It consisted of rose leaves, lemon juice, and a strong infusion of cinchona bark in wine *(3, 8)*. More important than the formulation was Talbor's success in optimizing treatment. He lowered the conventionally used dose and administered his remedy at frequent intervals.



Wellcome Collection

The English Remedy: Or, Talbor's Wonderful Secret for Cureing of Agues and Feavers (1682). In 1682, Talbor's remedy was published in French; the English translation appeared in the same year. Front page of English translation.



Wellcome Collection

Page 51 of The English Remedy: Or, Talbor's Wonderful Secret for Cureing of Agues and Feavers (English translation).

Dr. Sappington's Pills

American physicians were also wary of Peruvian bark, not on religious grounds but rather because

they thought it exacerbated fevers *(11)*. John Sappington, a maverick physician with "modern" ideas, challenged this notion. Born in Maryland in 1776 and raised in Nashville, Sappington apprenticed under his father, also a doctor, and set up his practice in central Missouri *(3)*.

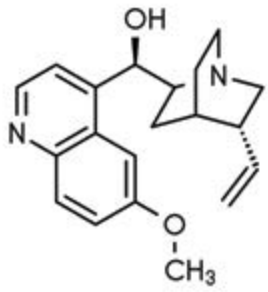
After practicing medicine for about five years, Sappington read an old pamphlet describing the accidental discovery and medicinal properties of the substance known as Jesuit's bark or Peruvian bark *(11)*. Intrigued by the account, he cautiously administered the powdered red bark to several feverish patients with good results and then did a primitive placebo-controlled experiment. Within a few hours—or a few days, at most—the bark-treated patients' fevers broke, their thirst abated, their pulse returned to normal, and their restless anxiety (which almost always accompanies malarial fevers) would subside *(11)*.

Sappington swallowed a ten-fold dose of the bark and convinced himself that the substance did not cause fever or increase heart rate, as many had claimed. The only adverse effect was some dizziness. He concluded that the bark's bad reputation was due to its irritating bitter taste and that other substances in the raw bark caused the nausea and diarrhea experienced by some patients *(11)*.

Quinine

In 1820, two French chemists, Pierre Joseph Pelletier and Joseph Caventou, isolated an alkaloid from cinchona bark and named it quinine, after *quinquina*, the Peruvian Indians' name for the cinchona tree *(3, 8, 12)*. Soon, industrial-scale extraction and distribution of quinine was established on both sides of the Atlantic *(13)*.

Boehringer-Mannheim began producing quinine sulfate from bark in 1837 and became Germany's largest manufacturer. By the end of the 19th century, it had joined two other German companies to form the first global quinine cartel *(3, 8, 14)*.



Quinine molecule

In 1823, Rosengarten & Sons in Philadelphia began isolating quinine from cinchona bark using the Pelletier-Caventou method. Rosengarten & Sons (later acquired by Merck) became America's largest supplier of quinine *(3)*.

After experimenting on various patients, Sappington found it easier to optimize dosing with quinine than cinchona bark. He also concluded that quinine was far superior to blood-letting, purging, and other traditional tonics and stimulants for curing fevers *(11)*.

Eventually, Sappington settled on a standard pill formulation that consisted of 65 mg of quinine sulfate, licorice to mask the bitter taste, a drop of sassafras oil to give "an agreeable odor," and gum of myrrh to bind it all together *(11)*. One of these pills every 2 hours for 2-3 days cured fevers *(3, 11)*.

By 1832, Sappington had launched a thriving business selling Dr. Sappington's Anti-Fever Pills. Unlike many other patent medicines, Sappington's pills worked, making the doctor a very wealthy man. By 1836, he was ordering over 372 pounds of quinine sulfate annually—by far, Rosengarten & Sons' biggest customer *(3)*.

Friends of Arrow Rock

Dr. Sappington's Anti-Fever Pills

By 1844, Sappington had distributed more than a million boxes of fever pills throughout the Mississippi River Valley and the Republic of Texas. Patients, without medical supervision, were taking his pills at all stages of every type of fever. Sappington claimed "no unpleasant effects have ever within our knowledge resulted from mistakes being made in the use of the remedy" *(11)*.

Sappington may also have been the first to ascertain quinine's prophylactic properties, a conclusion he reached after experimental treatment of his own family and his employees *(11)*. His 15-25 salesmen traveled to all of the endemic states and regions of America during the months when malaria was most prevalent. He told them to take one pill 3-4 times a day, "and there has never yet occurred a single instance in which any one of them has contracted a fever of any kind" *(11)*.

Schweppervescence

Demand for cinchona bark and quinine continued to grow, driven largely by European colonial expansion. From Columbus's first expedition until the mid-19th century, European trade and colonization in the tropics were accompanied by malaria, which claimed one in ten lives annually *(2)*. In the humid tropical regions of Africa, India, and Asia, European colonists' survival heavily depended on quinine *(2, 13, 15)*.

In India, the British Army issued quinine in a tonic to prevent and treat malaria. By the 1850s, soldiers were adding sugar and lime to make the bitter quinine water more palatable. They were already getting a gin ration, and soon, the liquids were combined to produce the first gin and tonic *(3, 16)*.

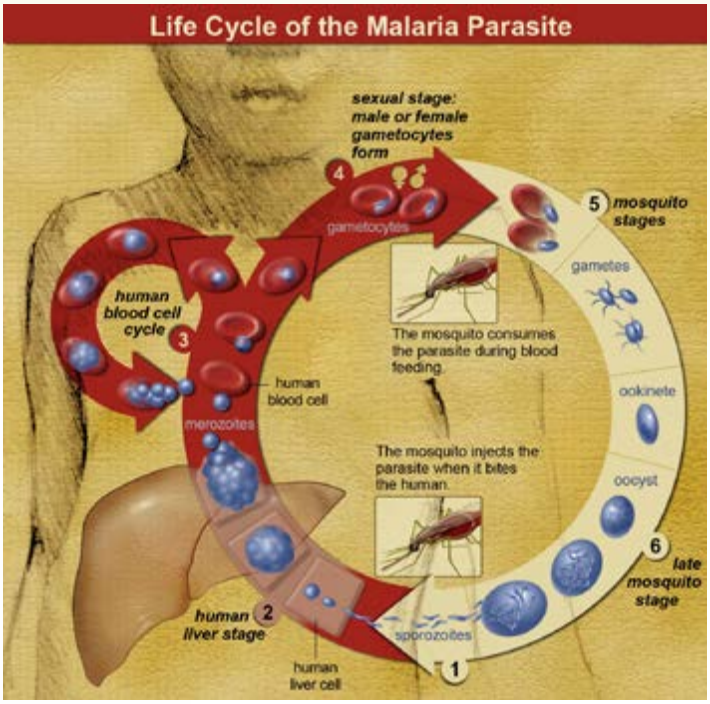
In the 1870s, the Schweppes Company in Geneva carbonated water containing oranges, sugar, and quinine, called Schweppes Indian Tonic Water *(3)*. Today, Schweppes® and other brands, including Fever-Tree Tonic Water®, still contain quinine. But it is a lower quinine concentration, making tonic water less bitter—and less effective against malaria *(16)*.

Scoping a Cause

Colonial expansion also intensified European scientists' studies of tropical diseases, especially malaria. Those researchers were greatly aided by new, high-power microscopes, and a wave of discoveries resulted. The most significant were made by Charles Louis Alphonse Laveran and Ronald Ross.

Laveran, a French army surgeon stationed in Algeria, was the first to observe microscopic parasites in fresh blood smears of patients suffering from malaria *(3, 5)*. In 1880, he reported his results to the French Academy of Medicine, announcing that a parasite, not bad air, caused malaria. Laveran and others (notably Patrick Manson in England) suspected that mosquitoes transmitted the malaria parasite from person to person *(3)*.

Patrick Manson (considered by many the father of tropical medicine) strongly encouraged Ronald Ross, a British officer in the Indian Medical Service, to study malaria transmission. Guided by Manson, Ross dissected hundreds of mosquitoes that had fed on the blood of healthy and malaria-infected birds *(1, 3)*. In 1897, he demonstrated that the malaria parasite was indeed transmitted from one victim to another by *Anopheles* mosquitoes *(17)*.



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Life cycle of malaria parasites

Circumstances in India limited Ross's ability to conduct clinical studies. But convinced that Ross was right, Manson repeated the bird experiment using his own son, P. Thurburn Manson, as the subject. *Anopheles* mosquitoes, which had fed on malaria patients in Rome, were shipped by diplomatic pouch to London and used to infect Thurburn, at the time a 23-year-old medical student *(18)*. Thurburn developed malaria, which was subsequently cured by quinine treatment. Patrick Manson also demonstrated that workers who slept in huts constructed with special mosquito netting remained healthy in a malaria-infested region of Italy *(18)*.

CDC/James Gathany

Anopheles *mosquito*

For their landmark contributions to understanding malaria's cause and transmission, Ross and Laveran received the Nobel Prize in Medicine or Physiology in 1902 and 1907, respectively.

Many other researchers confirmed and expanded Ross and Laveran's findings, defining the parasite's complicated life cycle, which depends on both animal and mosquito hosts. Italian researchers assigned the parasite to the genus *Plasmodium*. More than 100 species of *Plasmodium* have been identified, selectively infecting birds, rodents, monkeys, porcupines, squirrels, bats, lizards, and snakes, as well as humans *(1, 3)*.

For their landmark contributions to understanding malaria's cause and transmission, Ross and Laveran received the Nobel Prize in Medicine or Physiology in 1902 and 1907, respectively.

Only five *Plasmodium* species infect humans. Of them, *Plasmodium falciparum* is the deadliest. It rapidly multiplies in the blood, causing severe malaria symptoms, and can clog small blood vessels. Parasitic occlusions in the brain result in cerebral malaria, leading to life-threatening encephalopathy, seizures, and coma *(1)*. *P. falciparum* accounts for most of the 500 million malaria cases in Africa *(2)*.

Plasmodium vivax accounts for most of the 100-300 million malaria cases in the rest of the world *(2)*. This parasite can remain dormant in the liver for months or years after an initial infection and therefore causes recurring episodes of malarial fever and chills *(1)*.

New Strategies

Once they learned that mosquitoes transmitted the parasite, officials tried eliminating malaria by eradicating mosquitoes. They improved sanitation, drained stagnant bodies of water, and sprayed oil on ponds where mosquitoes bred. Ronald Ross spearheaded eradication efforts during construction of the Suez Canal and in the Mediterranean during World War I. He also assisted Surgeon General William Gorgas during construction of the Panama Canal *(3, 6)*.

Although mosquito control helped reduce the prevalence of malaria in many regions, quinine remained the mainstay for preventing as well as treating malaria. The growing demand for quinine, especially by colonists in the tropics, made it a commodity more valuable than gold and silver *(3, 8, 11)*. But it remained difficult to obtain, and Spain controlled the only source *(8, 13)*.

In the early years, Jesuit missionaries conserved this precious resource by training native workers to plant 5 cinchona trees for every one they felled. Unfortunately, in 1767, the Jesuits were expelled from South America by Spain's King Charles III, who feared the religious order's growing power. Conservation efforts ceased, and aggressive harvesters systematically destroyed much of the natural cinchona growth in Peru, Bolivia, Ecuador, and Columbia *(13)*.

Faced with this situation, various European colonial powers attempted to grow cinchona *(3, 13)*. European-led expeditions to Peru, Ecuador, and Bolivia collected cinchona seeds and saplings for transplanting on colonial plantations. The British tried cultivating cinchona in the mountainous regions of India. The Dutch established plantations in Java and extraction facilities at the Amsterdam Quinine Company. But the cinchona tree seemed to prefer the climate in the Andes Mountain foothills, and few plants survived the long, hazardous voyage to their colonial destinations. The most successful plantations were in Germany's eastern Africa colonies, which supplied quinine producers in Germany, primarily Boehringer-Mannheim *(13)*.

Ledger's Cinchona

At the same time, South American governments took steps to retain their revenues from this valuable natural resource. They imposed tight restrictions and high tariffs on foreigners who sought to export cinchona *(3)*.

The most successful foreigner to run this gauntlet was Charles Ledger, a British cinchona broker in Peru who supplied London merchants. As Peruvian cinchona became harder to find, Ledger, like other brokers, searched for quality bark in virgin areas, including government-restricted areas in Bolivia. Ledger engaged Manuel Incra Mamani, a native Bolivian bark harvester, to make the hazardous journey high in the Bolivian Amazon to a site where Ledger had previously spotted a single virgin grove of lush cinchona trees *(3)*.

Mamani and his sons patiently waited through five years of sub-optimal weather before finally harvesting a crop of high quality seeds from the virgin

grove. Then, one day, Mamani suddenly appeared at Ledger's door in Peru and delivered 40 pounds of the precious seeds *(3)*. Ledger sent half of the seeds to his brother, George, in London, hoping to bolster Britain's advantage in the cinchona market.

By this time, British botanists had been largely frustrated in their attempts to germinate and grow the finicky cinchona tree and showed little interest. Finally, George contacted the Dutch Consul-General in London. The highly regarded Dutch botanist, F. A. W. Miquel, immediately recognized the seeds' value. At his urging, the Dutch government purchased one pound of the Ledger seeds for 100 Dutch guilders. The seeds were sent to the Dutch cinchona plantations in Java, Indonesia *(3)*.

Ledger's seeds grew so well in Java that they transformed not just the Dutch plantations but the entire cinchona industry. The quinine content of the bark grown from Ledger's seeds averaged 14%, seven-fold higher than the typical cinchona species *(3)*. After detailed examination, botanists determined that Ledger's seeds produced a previously unknown variety of cinchona. In his honor, the species was named *Cinchona ledgeriana*. The Dutch grafted *C. ledgeriana* onto the hardier *Cinchona succirubra*, and the resulting trees dominated cinchona cultivation *(8)*.

Finding Substitutes

Quinine has 5 asymmetric centers and is one of 16 possible stereoisomers, making synthesis of the stereo-selective drug extremely difficult. In 1894, Friedlieb Runge tried to make quinine from coal tar and managed to produce quinoline *(3)*. A decade later, William Perkin, a young British chemist, also used coal tar but only produced a purple goop. Realizing that this permanently staining goop might have commercial value, he called it mauveine, the first aniline dye. It not only triggered a craze for mauve fashions but also launched a new industry that produced a variety of cheap synthetic aniline dyes *(15)*. Neither Runge or Perkin succeeded in making quinine.

By 1897, annual quinine production had soared to 85 tons, most of which was extracted from cinchona by the German cartel *(13)*. After World War I, Germany lost its African colonies and was forced to hand over 25% of its quinine production to the Allies *(3, 13)*. This renewed efforts by German chemists to find synthetic substitutes.

In the 1920s, German chemists at I. G. Farben screened thousands of compounds *(3, 8)*. In 1932, they discovered Atabrine (mepacrine), which appeared to act like quinine, only better. It could prevent as well as cure malaria and had a much longer half-life *(19)*. However, Atabrine's unpleasant side effects included psychotic reactions and yellow-tinged skin, so chemists continued the search for better alternatives *(3, 8, 19)*.

In 1934, Hans Andersag, a chemist in the Bayer dye works division of I. G. Farben, synthesized Resochin (chloroquine), which was as effective as Atabrine *(1, 20)*. Unfortunately, researchers over-interpreted the animal toxicology results and considered Resochin "too toxic for practical use in humans" *(1, 8, 20)*.

Farben sent samples of Atabrine and Resochin to its US sister company, Winthrop Chemical Company. There, the drugs sat on a shelf until World War II, when Winthrop patented them *(19, 20)*.

Controlling Quinine

Reparations imposed on Germany after World War I allowed the Netherlands to take control of the global quinine market. The Dutch consolidated their cinchona plantations in Java and their quinine extraction plants in Amsterdam into a cartel. In the 1920s, the Dutch cartel controlled 95% of the world supply of cinchona and quinine *(13, 14)*.

In 1940, the German Army invaded the Netherlands and took control of the Amsterdam quinine inventory *(8, 19)*. In 1942, Japan invaded the Dutch Indies, taking control of the cinchona plantations in Java *(8, 13, 14, 19)*. Being cut off from access to quinine, the Allies pursued other ways of curing malaria.

In studies conducted in Panama, the US Army established that Atabrine was an acceptable substitute for quinine and issued it to soldiers serving in the South Pacific *(3, 19)*. Winthrop Chemical Company had severed its ties with I. G. Farben, as directed by the Alien Properties Act, and increased domestic production. Winthrop also granted royalty-free licenses to Abbott, Eli Lilly, and Merck, further boosting Atabrine production *(19)*.

Atabrine was effective, and its side effects (nausea, diarrhea, headaches, and yellow-tinged skin), though annoying, were tolerable. More problematic for the Army's malaria control efforts was Japanese propaganda. Rumors spread that Atabrine caused impotence, and many US soldiers went to great lengths to avoid taking it *(19)*.

Screening New Compounds

During World War II, the US screened 16,000 compounds in a search for better synthetic antimalarial drugs, of which about 80 entered clinical trials. At Winthrop, researchers made a series of 4-aminoquinoline analogs of Atabrine and tested them against bird malaria *(20)*. Clinical trials conducted by the US Army and Navy in 1943-1944 showed that SN-7618 was the most effective compound in the series. Winthrop named it chloroquine and later found SN-7618 was identical to Resochin, which had been sitting on the shelf since it had been shipped from I. G. Farben a decade earlier *(8, 20)*.

Chloroquine was fast-acting and easy to administer, and contrary to the assessment by Farben scientists, its side effects were mild compared to quinine (3). Unfortunately, confusion and miscommunication during World War II caused delays in implementing production, and chloroquine was not available for general use until after the war *(1, 8)*. In the 1950s, chloroquine became the drug of choice for both treatment and prevention of malaria *(8, 21)*.

Unfortunately, after only 10-12 years of use, *Plasmodium falciparum* became resistant to chloroquine *(1, 8)*. In the 1960s, this was a grave concern in Southeast Asia, where malaria is particularly troublesome and another war was raging *(3, 4)*. In 1964, US military casualties in Vietnam due to malaria were 4-5 times higher than from direct combat *(4)*. Fighting malaria became a top priority.

Clinicians returned to quinine, which remained effective, even against chloroquine-resistant parasites *(1, 3)*. But quinine produced more side effects and was shorter-acting than chloroquine. Better alternatives were needed, and the US government launched the largest drug discovery program ever mounted. This malaria research effort was coordinated by Walter Reed Army Institute of Research and included numerous governmental, academic, and commercial organizations. By 1976, they had screened over 250,000 compounds and found two with commercial potential: mefloquine and halofantrine *(22)*.

Project 523

Malaria was also devastating North Vietnam—both the civilian and military populations—and the Vietnamese government asked China for help *(7)*. The Chinese government launched a secret military project aimed at finding a remedy for chloroquine-resistant malaria. They called it Project 523, because the covert operation began on May 23, 1967 *(7)*.

Youyou Tu

Over the next two years, researchers screened several thousand compounds but found no drug candidates *(4, 9)*. In 1969, three representatives from the Project 523 national office visited the Academy of Traditional Chinese Medicine, seeking help *(4)*. They thought that traditional Chinese medicines might provide new leads. The Academy, in turn, appointed 39-year-old Youyou Tu to head this initiative *(4, 9)*.

Tu, a phytochemist, had credentials in both Western and traditional Chinese medicine *(23)*. At Beijing Medical College's pharmacy program, she trained in medicinal chemistry, phytochemistry, and pharmaceutical science under repatriated Chinese professors who had received their education in Western countries *(4, 9)*. She graduated in 1955 and began her career in the Institute of Chinese Materia Medica of the Academy of Traditional Chinese Medicine *(9)*.

In 1959, Tu was released from her job to participate in a two-year training program organized by the Ministry of Health. It was designed for professionals, like her, with Western medical training and introduced her to traditional Chinese medicine *(9, 23)*. This balanced background made Tu ideal to lead Project 523's malaria research at the Academy.

Because Project 523 was a confidential, high-profile program, Tu was under tremendous pressure to complete the military project on schedule. *(4)* For the next few years, the search for a new malaria cure remained her top priority.

The Old is New Again

Malaria has one of the most comprehensive records in the literature of traditional Chinese medicines. Tu began by reviewing those records and interviewing experienced traditional Chinese practitioners *(9)*. Within 3 months, she had compiled a list of 2,000

herbal, animal, and mineral prescriptions *(4, 7, 9)*. She prepared a brochure describing the best 640 remedies and distributed it to the other Project 523 research groups *(4, 9, 23)*.

Over the next 2 years, her research team prepared more than 380 extracts from about 20 Chinese herbs and evaluated them in a mouse model of malaria. None showed significant activity *(7, 23)*. Then, in the summer of 1971, they saw promising activity from an extract of the Chinese herb, qinghao *(Artemisia) (4, 7, 9)*. Unfortunately, the results were inconsistent and not reproducible *(9)*.

Tu went back to Ge Hong's *Handbook of Prescriptions for Emergencies* (340 AD), the first documented description of qinghao's antifever properties *(7, 4, 12)*. One passage caught her attention: "Take a handful of qinghao, soak in two liters of water, strain the liquid, and drink it all" *(7, 9, 23)*. Tu realized that their standard extraction procedure, which used high temperature, may have destroyed qinghao's medicinal properties. She altered the method, extracting *Artemisia* stems and leaves at reduced temperature using water, ethanol, and ethyl ether *(7, 9, 23)*.

On October 4, 1971, Tu tested sample 191, a qinghao ethyl ether extract *(4, 9)*. Sample 191 completely eliminated malaria parasites in the mice. Between December 1971 and January 1972, another extract of qinghao produced 100% efficacy in malaria-infected monkeys *(4, 9)*.

The next step was clinical trials, but their efforts were hampered by a lack of infrastructure. During the Cultural Revolution, most pharmaceutical operations in China had been shut down *(7, 23)*. With no access to manufacturing facilities, Tu's group did the work themselves, scaling up the *Artemisia* extraction using repurposed household water vats *(9)*.

They worked long hours in their make-shift factory, constantly exposed to large quantities of organic solvents. Insufficient ventilation resulted in deteriorated health for some members of the team, including Tu *(4, 9)*. "This, however, did not stop our efforts" *(9)*.

Debates over the animal toxicology results threatened to delay the start of the clinical trials. As the summer progressed, and the end of the malaria epidemic season approached, they risked having to delay the trial for a year *(9)*.

To expedite the human safety evaluation, Tu volunteered to take the extract herself. In July 1972 and under close monitoring in the hospital, Tu and two other team members took the extract for a week. They experienced no side effects. Five additional team members then volunteered as subjects in the dose-escalation study *(9)*.

The first malaria patients were treated in August 1972. Qinghao relieved the fevers of all 21 chloroquine-resistant patients, and no malaria parasites were detected in their blood *(4, 7, 9)*. The results of the mouse, monkey, and human studies were reported at a national Project 523 meeting in Beijing in November 1972 and triggered a nationwide research collaboration on qinghao *(4, 9)*.

From Herb to Drug

In parallel with the first clinical trials, Tu's group began purifying qinghao to isolate the active substance. In November 1972, they crystallized the antimalarial compound and named it qinghaosu *(7, 10, 23)*. (In Chinese, "su" means "basic element" *(23)*) In the West, qinghaosu is called artemisinin, acknowledging its plant origin.

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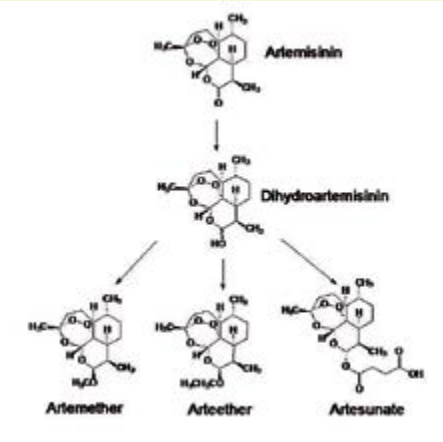
Artemisia annua*, the source of artemisinin*

Tu's group had been using an *Artemisia* source locally available in Beijing, but it contained relatively small amounts of artemisinin. They determined that of the various species, fresh leaves of *Artemisia annua* contained the most artemisinin. For commercial pharmaceutical production, the Project 523 team turned to Sichuan Province, where *Artemisia annua* is the native species *(23)*.

With the assistance of other Chinese institutes, Tu and her collaborators elucidated the chemical structure of artemisinin in 1977. It is a sesquiterpene lactone containing a peroxyl group *(4, 10)*. While conducting structure-activity relationship studies, Tu found that the peroxyl group is essential for antimalarial activity.

She also found that modifying the carboxyl group to a hydroxyl (i.e., dihydroartemisinin) not only improved



Artemisinin and its derivatives

efficacy 10-fold but also permitted synthesis of a series of analogs. Those analogs (artemether, artesunate, and arteether) were effective antimalarial drugs, and they had better pharmacokinetics than the parent compound *(4, 7, 21)*. Subsequent studies showed that artemisinin and its analogs were more effective and faster-acting than chloroquine and quinine *(7)*.

The prevailing environment in China restricted publication of papers on artemisinin to just a few that were published in Chinese *(23)*. The first English language report appeared in December 1979. As was customary at the time in China, the authors were anonymous *(7, 10)*.

The 1979 publication reported that artemisinin had cured more than 2,000 malaria patients, including more than 90% of those with cerebral malaria. Furthermore, patients experienced no serious adverse reactions *(10)*.

The World Stage

In October 1981, the World Health Organization (WHO) invited Tu and her colleagues to present their findings to its Working Group on the Chemotherapy of Malaria *(7, 23)*. The impressive antimalarial properties of artemisinin generated an enthusiastic response and stimulated Western interest *(4, 7)*.

Many active analogs of artemisinin were subsequently synthesized, and this family of compounds is now the most potent and effective antimalarial therapy, particularly against chloroquine-resistant malaria *(8)*. So far, clinically relevant resistance has not been reported, but the parasite in some regions has become increasingly tolerant to the artemisinins, requiring longer treatment schedules *(8, 24)*.

In 2006, WHO began recommending combination therapy, to avoid emergence of resistance: an artemisinin-based compound plus a drug that acts by a different mechanism *(7, 23, 24)*. Artemisinin-based combinations are now the standard regimen because, according to WHO, "no alternative antimalarial medicine is currently available offering the same level of efficacy and tolerability" *(4)*.

Over the past several decades, more than 200 million malaria patients have received artemisinin or artemisinin-based combination therapies *(9)*. Even patients with artemisinin-tolerant malaria are cured, as long as the partner drug remains effective and treatment time is extended *(7, 24)*.

In 2015, a research group in Singapore discovered intriguing properties related to artemisinin's mechanism of action *(25)*. They found that artemisinin covalently binds to 124 protein targets, many of which are involved in the parasite's essential physiologic processes. The multiple parasitic targets help to explain artemisinin's rapid onset, impressive efficiency, and relatively lower and slower development of parasite tolerance *(25)*.

Youyou Tu receiving the Nobel Prize from King Carl XVI Gustaf of Sweden in 2015.

For her work on artemisinin, Youyou Tu received numerous awards by the government and other organizations in China. In 2011, she received the Lasker-DeBakey Clinical Medical Research Award. In 2015, she received the Nobel Prize in Physiology or Medicine.

In her comments to the Nobel Committee, Tu said, "Nothing can be more rewarding than the fact that artemisinin, since its discovery, has saved many malaria patients' lives" *(9)*.

Biosketch:

Rebecca J. Anderson holds a bachelor's in chemistry from Coe College and earned her doctorate in pharmacology from Georgetown University. She has 25 years of experience in pharmaceutical research and development and now works as a technical writer. Her most recent book is *Nevirapine and the Quest to End Pediatric AIDS*. Email rebeccanderson@msn.com.

In the next issue of *The Pharmacologist...*

Dr. Anderson will share the story of Margaret Crane and the first home pregnancy test.

Don't miss the June 2018 issue.

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Meeting News

WCP2018 Kyoto: 18th World Congress of Basic and Clinical Pharmacology

July 1 – 6, 2018

Kyoto, Japan

ASPET is pleased to participate as a platinum sponsor for the 18th World Congress of Basic and Clinical Pharmacology (WCP2018) taking place in Kyoto, Japan on July 1–6, 2018. The meeting theme is "Pharmacology for the Future – Science, Drug Development and Therapeutics." As a sponsor, ASPET will send a delegation of members to the meeting and is providing travel awards to young scientists.

ASPET Delegates

James E. Barrett
Professor and Chair, Drexel Univ College of Medicine, Former ASPET President

Carol L. Beck
Associate Professor, Thomas Jefferson Univ, ASPET Councilor

Charles P. France
Professor, Univ of Texas Hlth Sci Ctr, ASPET Past Secretary/Treasurer

Margaret E. Gnegy
Professor, Univ Michigan Medical School, ASPET Secretary/Treasurer-Elect

Edward T. Morgan
Professor, Emory Univ, ASPET President-Elect

John D. Schuetz
Member and Vice Chair, St. Jude Children's Research Hospital, ASPET President

David R. Sibley
ASPET Past-President

Kenneth E. Thummel
Professor and Departmental Chair, Univ of Washington, Former ASPET President

Michael W. Wood
SVP Drug Discovery & Strategic Partnerships, Circuit Therapeutics, Inc., ASPET Program Committee Chair

Young Scientist Travel Awardees

Khaled Abdelrahman, PhD

University of Ottawa

Dr. Khaled Abdelrahman holds a BSc (pharmaceutical sciences) and MSc from the Faculty of Pharmacy, University of Alexandria, Egypt where he was also a lecturer in the Department of Pharmacology and Toxicology. He moved to Canada to finish his PhD at the University of Calgary, exploring how diabetes alters brain blood flow regulation. He then joined the Department of Cellular and Molecular Medicine at the University of Ottawa as a postdoctoral fellow exploiting new targets for the treatment of neurodegenerative diseases. His findings that define the link between metabotropic glutamate receptors 5 and autophagy in Huntington's disease were recently published in *Science Signaling*. He is also a Registered Clinical Pharmacist and holds two of the most prestigious clinician postdoctoral fellowships offered to a researcher pharmacist in Canada.

Farjana Akther

University of the Pacific, T.J. Long School of Pharmacy

Farjana Akther received her MSc from the University of Asia Pacific, Bangladesh in 2011 and worked in the pharmaceutical field for three years before joining Dr. Roshanak Rahimian's laboratory at the University of the Pacific in 2014. She is currently a fourth-year PhD student in the pharmaceutical and chemical sciences graduate program in the T. J. Long School of Pharmacy at Pacific. She is examining the aortic function of a novel and validated UC Davis rat model of type 2 diabetes mellitus (UCD-T2DM), a project which has been funded by the National Institutes of Health. Furthermore, she is investigating the mechanisms underlying the metabolic and vascular effects of glucose or fructose intake, a collaborative effort with investigators at the University of Barcelona. So far, her data have been published in the form of eight abstracts and one paper in the *American Journal of Physiology*.

Yin Cai, PhD

University of Hong Kong

Dr. Yin Cai obtained his bachelor's degree (2007) in the national base of life science and biotechnology education and master's degree (2010) in microbiology and biochemical pharmacy from China Pharmaceutical University. He completed his PhD in cardiovascular and metabolic diseases research at the Department of Pharmacology and Pharmacy, University of Hong Kong in 2014. Currently, he is a postdoctoral fellow in the Department of Anaesthesiology at the same institution. His research focuses on the signaling pathways involved in the inflammation, apoptosis, oxidative stress, and energy metabolism in the normal, aging, and diabetic heart and the heart with ischemia/reperfusion injury. The work conducted by Dr. Cai has helped identify a new cardiac dimension played by the most conserved telomeric protein, the repressor activator protein 1 (Rap1). Rap1 deficiency may activate p53, lead to mitochondrial defects and cardiomyocytes apoptosis, and in turn develop compromised cardiac structural and functional changes during aging.

Stephanie Davis, PhD

University of Kentucky School of Medicine

Stephanie Davis, PhD graduated *summa cum laude* with her BS in biochemistry and molecular biology from Florida Southern College. In 2012, she was accepted as a Presidential Doctoral Fellow to the Biomedical Sciences PhD program at the University of South Florida. Her dissertation research, which was performed under the supervision of Dr. Keith Pennypacker, focused on the pharmacological targeting of antioxidant enzymes to promote neuroprotection during focal cerebral ischemia. After receiving her PhD, Stephanie began her postdoctoral work at the University of Kentucky Center for Advanced Translational Stroke Science.

Jessica Murray, PharmD

Lipscomb University

Jessica L. Murray is a fourth-year pharmacy student at Lipscomb University College of Pharmacy in Nashville, TN. She is interested in elucidating genetic and metabolic factors that influence adverse drug reactions and the impact of xenobiotics on disease progression. Her research, which is supported by the American Foundation for Pharmaceutical Education Gateway Research Scholarship, focuses on metabolic characterization of the opioid analgesic meperidine. Upon graduation, she plans to pursue a PhD and study inter-individual differences in drug metabolism and pharmacokinetics.

Angelique Nyinawabera

University of Toledo

Angelique I. Nyinawabera, a native of Rwanda, Africa, is a third-year PhD student in the College of Pharmacy and Pharmaceutical Sciences at the University of Toledo, Ohio. Nyinawabera holds a BS in chemistry from Wofford College, Spartanburg, SC. Nyinawabera's graduate work is focused on understanding the molecular mechanisms that make triple negative breast cancer a deadly disease in African-American women, which, due to lack of targeted therapy, is difficult to treat. Furthermore, currently used drugs work by inducing programmed pro-apoptotic cell death and are eventually rendered resistant by TNBC cells. Nyinawabera and the team led by Dr. Amit K. Tiwari at the Cancer Pharmacology and Systems Therapeutics Laboratory discovered a novel class of TNBC targeted molecules that, at nano-molar concentrations, induce a unique cell death mechanism, selectively in TNBC cells, that is independent of apoptosis. These new agents inhibit autophagy, a cell-survival process, and kill the cell through necroptosis.

Marta Sanchez Soto, PhD

NINDS/NIH

Marta Sanchez Soto attended the University of Barcelona and earned a bachelor's degree in biology (2010) and a master's degree in biomedicine (2011). At the end of 2012, she joined the lab of Sergi Ferré at NIDA/NIH as a PhD student, in partnership with Dr. Vicent Casadó at the University of Barcelona. During her stay at NIDA, she studied GPCR signaling and regulation of multi-receptor complexes, focusing on dopamine and adrenergic receptors. After graduating in January 2017, she joined the lab of Dr. David Sibley at NINDS/NIH as a postdoctoral fellow where she continues her research on the identification of mechanisms of receptor regulation, G protein and arrestin interactions, and molecular determinants of receptor activation using a wide variety of biophysical approaches, radioligand binding, and molecular biology techniques.

Priyanka Swami, MS

North Dakota State University

Priyanka Swami is a fourth-year PhD student in the Department of Pharmaceutical Sciences at North Dakota State University (NDSU) in Fargo, ND. She completed her bachelor's degree in pharmacy in India. After securing a scholarship from the government of India, she got her master's degree in medicinal chemistry from the National Institute of Pharmaceutical Education and Research, India. In pursuit of becoming a cancer biologist, Swami started her PhD at NDSU. Her research focuses on understanding the role of RAGE (Receptor for Advanced Glycation End-products) in pancreatic cancer. Currently, she is working on determining the efficacy of anti-RAGE molecules as a combination therapy in pancreatic cancer. She is also actively involved in various organizations and is the current vice-president of the College of Health Professions Ambassadors at NDSU. Through her research, she aspires to contribute significantly to the field of cancer therapeutics.

Pierre Thibeault

University of Western Ontario

Pierre Thibeault is a third-year PhD candidate in the Ramachandran Laboratory (Department of Physiology and Pharmacology, University of Western Ontario), investigating the proteinase activated receptor (PAR) family of G protein-coupled receptors. Specifically, he is investigating the signaling and regulation of PAR4, which performs many physiological roles including platelet activation and aggregation. His recent work and collaborations have led to examination of agonist-receptor interactions with the intention of designing novel drug targets for PAR4. He and his colleagues have created a library of PAR4 activating peptides with unique pharmacology, and he looks forward to sharing these findings at the World Congress of Pharmacology.

Jennifer Wong, PhD

Emory University

Dr. Jennifer Wong, PhD, is currently a postdoctoral fellow in the laboratory of Dr. Andrew Escayg at Emory University. Her research focuses on the development of more efficacious treatments for refractory forms of epilepsy. She recently demonstrated that selective knockdown of the sodium channel *Scn8a* can effectively prevent the development of seizures in a mouse model of mesial temporal lobe epilepsy. She has also shown that the naturally occurring reversible acetylcholinesterase inhibitor, Huperzine A, can provide robust protection against induced seizures in mouse models of *Scn1a*-derived epilepsy. Dr. Wong is a recipient of a postdoctoral fellowship from the American Society of Epilepsy (AES) and was an invited speaker at the Dravet Syndrome Foundation Roundtable at the 2016 AES Meeting. Dr. Wong will be presenting her work on the role of donepezil, an FDA-approved acetylcholinesterase inhibitor, in a mouse model of Dravet syndrome at WCP2018.

2nd ASPET/Chinese Pharmacological Society (CNPHARS) Joint Meeting

Submitted by John Schuetz, PhD

November 2-5, 2017

Hangzhou, China

John J. Abel's goal upon founding ASPET in 1908 was to "... further the growth of pharmacology and experimental therapeutics...and to facilitate personal intercourse among investigators of these branches of science." Pharmacologists are practicing their craft throughout the world. To further Abel's vision, embrace our strategic plan's goals of strengthening ASPET through key global partnerships, and importantly, to build upon our first meeting with the Chinese Pharmacological Society (CNPHARS) held at Experimental Biology (EB) in San Diego, 2014, ASPET co-organized the 2nd ASPET- CNPHARS joint

Mary-Ann Bjornsti, chair of the ASPET Division for Cancer Pharmacology

meeting held November 2-5, 2017 in Hangzhou, China. Hangzhou, a city of almost 10 million people, is considered one of China's seven ancient capitals, and a place Marco Polo described as the "city of heaven". CNPHARS selected a great venue in Hangzhou, a historic and beautiful city where the 2016 G20 meeting was held, renowned for the West Lake district, and a tourist destination that has been celebrated by poets, artists, and now visiting pharmacologists.

The delegation from ASPET wanted to not just encourage an exchange of scientific knowledge but foster collaboration between Chinese and American pharmacologists, especially since our discipline is integrative in that it spans studies ranging from molecules to organelles, to cells and the whole organism. Further, both societies agreed that this meeting was all too rare, but a great opportunity to have our young scientists participate and interact with one another. The meeting featured a welcome address given by CNPHARS President Yongxiang Zhang, followed by a speech given by ASPET president, John Schuetz. Dr. Schuetz provided historical context for the meeting, discussing past collaborations between ASPET and CNPHARS.

The key themes of the meeting were "Molecular Pharmacology and Drug Discovery" and "Traditional Chinese Medicines and Natural Products in Treating Disease". Keynote speakers were featured from both ASPET and CNPHARS. Paul Insel, MD, University of California, San Diego opened the session on drug discovery. Using a genomics approach, he revealed how novel insights can be gained by plumbing the depths of orphan GPCRs. These studies lead to the identification of promising novel targets that might be important in pancreatic cancer treatment. The session on traditional Chinese medicine featured Dr. Yongxiang Zhang, Beijing Institute of Pharmacology and Toxicology, who provided unique insights into the holistic requirements and key properties needed to develop traditional Chinese medicines.

To facilitate the participation of young scientists from ASPET and CNPHARS, a special session of platform presentations were given by the young scientists. ASPET provided travel awards to five young scientists: Brenda Gannon, University of Texas Health Science Center at San Antonio; Joshua Lorenz-Guertin, University of Pittsburgh; Kenneth McCullough, McLean Hospital/Harvard Medical School; Amy Moritz, National Institutes of Health; and Shu Wiley, University of California, San Diego. Top prizes for best presentations were awarded to Amy Moritz, Shu Wiley, and Hou Biyu.

The scientific part of the meeting was a great success, but an added benefit was the positive experience of visiting China. Directly following the end of the meeting, CNPHARS arranged a guided tour around Hangzhou for ASPET attendees. Guests visited the West Lake region, Leifeng Pagoda, and the Mansion of Hu Xueyan (the most famous businessman of the Qing Dynasty).

The success of the visit was made possible by CNPHAR's kindness, generosity, and hospitality. Their assistance with travel logistics provided to the entire ASPET delegation was invaluable and greatly appreciated. Dr. Ying Zhao, director of the CNPHARS administrative office, worked behind the scenes to create a seamless, well-run meeting

John Schuetz with winners of the Young Scientist Outstanding Oral Presentation Award

Meeting attendees at the Baimahu Jianguo Hotel

that included opportunities to experience both the culture and cuisine of China in addition to the scientific presentations.

Partnering with other pharmacological societies like CNPHARS, coupled with the sharing of information and perspectives, will encourage us in our efforts toward new discoveries that will advance therapeutics for citizens in every country and at every level of society. As CNPHARS President Yongxiang Zhang and Past-President Guanhua Du said, "The deep communication between our two societies … promote[s] the regional and international development of pharmacology." Certainly, strategic partnerships are crucial to the future of pharmacology.

Drs. Paul Insel and Shu Wiley on the 6th floor of the Leifeng Pagoda

"The joint ASPET/CNPHARS meeting was an outstanding success. This meeting really highlighted Traditional Chinese Medicine and what this field can contribute to the scientific community. It is important to foster cross-talk between these societies, and that goal was thoroughly accomplished."
-Kenneth McCullough, ASPET Travel Award recipient

Science Policy News

Science Policy Update

Though the FY 18 funding process is not yet resolved, ASPET is looking ahead to the FY 19 appropriations process with an eye towards securing increases in federal funding for the biomedical sciences. Robust federal investment in science leads to new treatments for life-threatening diseases and enhanced quality of life for all citizens. For FY 19, ASPET, along with the 30 other scientific societies that make up the Federation of American Societies for Experimental Biology (FASEB), is recommending the following funding levels for agencies that conduct biomedical scientific research:

National Institutes of Health (NIH)
- $38.2 billion

National Science Foundation (NSF)
- $8.0 billion

Veterans Affairs (VA) Medical & Prosthetic Research Program
- $787 million

U.S. Department of Agriculture (USDA)
- $700 million

Department of Energy Office of Science (DOE SC)
- $6.0 billion

These funding levels are necessary to preserve the U.S.'s scientific preeminence and ensure that our country does not lose its position as the worldwide leader in cutting edge biomedical research. To learn more about ASPET's positions on FY 18 and FY 19 research funding, please visit www.aspet.org/aspet/advocacy.

Meet the 2018 ASPET Washington Fellows

ASPET received numerous applications for the 2018 Washington Fellows program, making the selection process extremely competitive. All submissions were carefully reviewed and the ten strongest applicants were selected to come to Washington, D.C. this spring to speak with their legislators about how to address the challenges facing the scientific community. Additionally, the Washington Fellows will receive complimentary registration to ASPET's Annual Meeting at Experimental Biology 2018 in San Diego, where they will have the opportunity to network with each other and with Fellows from previous years.

Tracey (Liz) Bailey

University of Western Ontario

Born and raised in Raleigh, NC, Tracey 'Liz' Bailey earned her BS in chemistry and psychology from the University of North Carolina, Chapel Hill in 2015. She then moved to Atlanta, GA where she worked as an Oak Ridge Institute for Science and Education (ORISE) research fellow at the Centers for Disease Control and Prevention (CDC). Following her time at the CDC, Liz began graduate school at the Scripps Research Institute in Jupiter, FL. She is pursuing her PhD in the lab of Dr. Patricia McDonald within the Department of Molecular Medicine. Liz's research interests are primarily focused on identifying novel therapeutic pathways for chronic non-communicable diseases like Type 2 Diabetes Mellitus.

Stephanie Davis

University of Kentucky School of Medicine

Stephanie Davis grew up in Clearwater, FL and graduated *summa cum laude* with her BS in biochemistry and molecular biology from Florida Southern College. In 2012, she was accepted as a Presidential Doctoral Fellow to the Biomedical Sciences PhD program at the University of South Florida. Her dissertation research, which was performed under the supervision of Dr. Keith Pennypacker, focused on the pharmacological targeting of antioxidant enzymes to promote neuroprotection during focal cerebral ischemia. After receiving her PhD, Stephanie began her postdoctoral work at the University of Kentucky Center for Advanced Translational Stroke Science. As an ASPET Washington Fellow, Stephanie hopes to enhance funding for STEM education and biomedical research, specifically in the fields of stroke and cardiovascular disease.

Laura Erwin

Louisiana State University Health Sciences Center

Laura Erwin received her BS in microbiology from Louisiana State University and upon graduation moved to Dublin, Ireland to gain research experience working with the Ana Liffey Drug Project. After moving back to the United States, she then entered the Department of Pharmacology and Experimental Therapeutics at Louisiana State University Health Sciences Center in New Orleans. As a direct applicant into the Louisiana Board of Regents Superior Graduate Student Training Program, she secured independent funding as a Louisiana Board of Regents Fellow. Under the guidance of Dr. Peter Winsauer, she studies the deleterious behavioral effects of drugs

of abuse. Laura's dissertation research focuses on the interaction between gonadal hormones and cannabinoid abuse, and the subsequent effects this interaction has on development as it relates to learning and memory. Outside of her studies, Laura is actively engaged in outreach and advocacy. In her second year, she served as the student government vice president for community outreach and, now in her third year, currently serves as the president. In addition, she represents all six schools of the Health Sciences Center on the Louisiana Council of Student Body Presidents. As an ASPET Washington Fellow, Laura hopes to learn more about how to further communication and understanding between the scientific community and our elected officials.

Huijie (Jade) Feng

Michigan State University

Jade Feng was born and raised in China. She earned a BS in pharmacy from China Pharmaceutical University in Nanjing in 2014. Following graduation, she entered the Michigan State University PhD program in the Department of Pharmacology & Toxicology. She is currently in her fourth year. Jade's research focuses on investigating the mechanisms of a rare genetic mutation caused by pediatric neurological abnormalities including epilepsy and movement disorders. As an ASPET Washington Fellow, she is interested in learning how to communicate with elected officials to advocate for promoting diversity and interdisciplinary research and to discuss how support for funding and research for all scholars can impact the future of the nation and the world.

Sterling Glass

University of Connecticut

Sterling Glass completed his BS in marketing at the University of Colorado, Boulder and is a former entrepreneur specializing in marketing, fashion, e-commerce, and socially-responsible business practices. Realizing that his true passions lay in the life sciences, he completed a BS in biology at the University of Colorado, Denver and subsequently joined the Pharmacology and Toxicology Doctoral program at the University of Connecticut. His ongoing research focuses on nanoparticle drug delivery technology in Dr. Xiuling Lu's lab and involves nanoparticle-mediated approaches to novel anti-cancer therapies. As a Washington Fellow, Sterling is eager to improve communication between scientists and lawmakers to guide evidence-based policymaking.

Lalage Katunga

Saint Louis University

Lalage Katunga was raised in Zimbabwe. She earned her BS in biology from Methodist University. She spent a year studying nutritional transition and the incidence of chronic disease in indigenous populations (Inuit and Inuvialuit) at University of North Carolina, Chapel Hill, Nutrition Research Institute. Pursuing her passion for understanding the role of nutrition in disease, she began her PhD at East Carolina University in the Department of Pharmacology and Toxicology. Dr. Katunga's graduate work focused on the novel role of glutathione peroxidase 4 (GPx4) in preventing cardiometabolic disease in obesity. She received numerous awards for her work, including the ASPET Travel Award to Cape Town, South Africa for the World Congress of Pharmacology in 2014. Dr. Katunga continues to explore the interaction between diet and cardiometabolic disease during her postdoctoral fellowship in the Ford Lab in the Department of Biochemistry and Molecular Biology at Saint Louis University. Her research is on the contribution of myeloperoxidase, a leukocyte-derived enzyme mechanistically linked to oxidative stress (ROS), to obesity related diseases. Dr. Katunga is passionate about increasing the visibility of scientists in the community, especially in underserved and minority communities. She volunteers with local middle schoolers and contributes to science literacy through lay media outlets. As an ASPET Washington Fellow, Dr. Katunga plans to work to reduce the barrier between biotechnology research and entrepreneurship for young researchers.

Sean Moran

Vanderbilt University

Sean Moran grew up in Niantic, CT and gained his bachelor's degree in biology from Clarkson University. Upon graduation, Sean developed a passion for neuropharmacology research over several years as a research assistant at the Yerkes National Primate Research Center, where he investigated neurological disorders using transgenic nonhuman primate models. Sean is currently a graduate student under the mentorship of Dr. P. Jeffrey Conn at the Vanderbilt Center for Neuroscience Drug Discovery at Vanderbilt University. His research focuses on characterizing and understanding the various pharmacological profiles of structurally distinct M1 muscarinic receptor allosteric modulators, thereby providing key insight into the therapeutic potential of allosteric modulation of M1 as a potential treatment for the cognitive disruptions found in Alzheimer's disease and schizophrenia. As an ASPET Washington Fellow, Sean aims to learn how to effectively communicate with policy makers to ensure continual government investment into basic and translational science.

Filomene Morrison

Boston University School of Medicine

Filomene Morrison was born and raised in Berkeley, CA. She earned her BA in molecular and cellular biology from the University of California, Berkeley, and received her PhD in neuroscience from Emory University. Her thesis research focused on the molecular mechanisms underlying the acquisition and extinction of learned olfactory fear memories, under the direction of Dr. Kerry Ressler. Filomene is currently a postdoctoral fellow in Dr. Erika Wolf and Dr. Mark Miller's laboratory at Boston University School of Medicine and the VA Boston Healthcare System. Her research examines how the stress of posttraumatic stress disorder (PTSD) and related conditions influence the aging process at the cellular level and impact neuroinflammatory processes in the brain. As an ASPET Washington Fellow, Filomene hopes to use her training in scientific research to advocate for the informed and effective use of scientific knowledge and discoveries in governmental and judicial decision making and science policy.

Ryan Stoudt

University of Pittsburgh

Ryan Stoudt was born and raised in the suburbs of Philadelphia, but his education has since taken him to other exotic Pennsylvania locations like State College and Pittsburgh. He received his BS in immunology and infectious disease at Penn State University, and through his undergraduate research and coursework Ryan developed a deep interest in both drug discovery and molecular virology. Those interests led him to attend graduate school at the University of Pittsburgh, where he is currently pursuing a PhD in molecular pharmacology. Under the mentorship of Dr. Thomas Smithgall, Ryan has been working to develop small molecule inhibitors of the HIV-1 accessory protein Nef, a project which blends together training in pharmacology, structural biology, and virology. Ryan's love of writing and communication runs as deep as his love of biomedical research, and he plans to pursue both passions through a future career in science policy. As an ASPET Washington Fellow, Ryan hopes to serve as an effective advocate for biomedical and basic research, and help lawmakers understand the essential challenges, common misconceptions, and funding needs behind that research.

Jared Tur

University of South Florida, College of Pharmacy

Jared Tur received his BS in biomedical sciences as well as a BA in anthropology from the University of South Florida (USF). His PhD is in medical sciences, where he specialized in cardiovascular physiology, examining the novel roles of potassium channel regulators at USF, College of Medicine. Currently as a postdoctoral fellow, Jared investigates novel pharmaceutical therapies including nanoparticle formation for the treatment of cardiovascular disease, including heart attacks and heart disease. Dr. Tur has remained active in advocacy work in postdoctoral affairs writing for the National Postdoctoral Association. Through the ASPET Washington Fellows program, Dr. Tur hopes to gain a greater insight into advocating for postdoctoral affairs and young investigators receiving adequate funding and support. He is looking forward to this unique interactive experience meeting congressional delegates to truly advocate for support.

Education News

ASPET Mentoring Network Commences Its Third Year at EB 2018

BIG IDEAS

The *ASPET Mentoring Network: Coaching for Career Development* program was established by the BIG IDEAS initiative in 2015 as a means to promote diversity in the scientific workforce through career coaching. This program follows a coaching model that matches established scientists with cohorts of young scientists to help guide them in their professional development and career advancement. The activities of the program are designed to complement, not replace, scientific mentors at participants' home institutions. We are pleased to launch the third iteration of the *ASPET Mentoring Network* at EB 2018 with in-person programming on Friday, April 20 and Saturday, April 21, followed by virtual interactions throughout the year. Activities at EB 2018 will encourage relationship building across coaching groups, near-peer mentoring between graduate students and postdoctoral scientists, and networking. The program will lay the groundwork for the rest of the year's activities, with a special emphasis on deconstructing success skills for a variety of career paths.

The program has adapted a coaching model developed by Rick McGee and his colleagues at Northwestern University. Coaches for 2018 include Jan Clark (National Institutes of Health), John Harrelson (Pacific University) Pam Hornby (Janssen Pharmaceutical Companies of Johnson & Johnson), and Brandi Wynne (Emory University). McGee and his colleague Veronica Womack will once again be facilitating the training during EB 2018, and we are grateful to him and his team at Northwestern for their continued involvement and expertise. Susan Ingram, past-chair of the Mentoring and Career Development Committee, continues to assist in providing oversight for the program and its activities in collaboration with ASPET staff. We congratulate the following young scientists who were chosen to participate in the third year of the *ASPET Mentoring Network*:

Postdoctoral Scientists

Stephanie Davis, *Univ of Kentucky Coll of Med*

Mohamed Ghonim, *Louisiana State Univ Sch of Med*

Audrey Hager, *Univ of Texas HSC at San Antonio*

Kathryn Luderman, *Molecular Neuropharmacology Section, NINDS, NIH*

Sarah Martin, *UT Southwestern*

Vanessa Minervini, *Univ of Texas HSC at San Antonio*

Natalie Scholpa, *Univ of Arizona*

Jared Tur, *Univ of South Florida*

Graduate Students

Dina Akasheh, *Creighton Univ*

Rachel Altshuler, *Univ of Michigan*

Kibrom Alula, *Michigan State Univ*

Edwin Arauz, *Univ of Florida*

Chris Bolden, *Univ of Arkansas for Med Sciences*

Melodi Bowman, *Univ of Texas HSC at San Antonio*

Jonas Calsbeek, *Univ of California, Davis*

Sarra Djemil, *Georgetown Univ*

Bettine Gibbs, *Butler Univ*

Joseph Lebowitz, *Univ of Florida Coll of Med*

Lakeisha Lewter, *Univ at Buffalo*

Samantha McClenahan, *Univ of Arkansas for Med Sciences*

Erickson Paragas, *Washington State Univ*

Yadira Perez-Paramo, *Washington State Univ*

Rajesh Kishore Kumar Sanku, *Temple Univ Sch of Pharmacy*

Priyanka Swami, *North Dakota State Univ*

PIIPS Interns Gain Valuable Experience in Industry

Established through the BIG IDEAS initiative, the Pharmacology Industry Internships for PhD Students (PIIPS) program provides a unique opportunity for funded institutions to offer internships that provide PhD students with experience in industrial settings, such as the pharmaceutical/biotechnology or government regulatory sectors, while enrolled in graduate school. Preparation for a diverse array of career paths is becoming increasingly important in graduate training. The objectives of the PIIPS program include:

- To increase opportunities for PhD students enrolled in graduate programs with an emphasis on pharmacology to participate in industrial internships during their graduate training
- To develop and foster university–industry partnerships facilitating diversity in graduate training and career options related to pharmacology
- To facilitate opportunities for PhD students to make informed decisions about careers in the pharmaceutical and biotechnology sectors as well as other allied disciplines such as the FDA and Contract Research Organizations
- To increase participation by industrial organizations in graduate student internships

In 2016, the following programs were selected for three years of funding beginning in 2017:

- **Duke University Medical Center —** Program Director: Cynthia Kuhn, PhD, Professor, Department of Pharmacology and Cancer Biology
- **University of California, San Diego School of Medicine —** Program Director: Joan Heller Brown, PhD, Distinguished Professor and Chair, Department of Pharmacology
- **University of Illinois, Chicago, College of Pharmacy —** Program Director: Joanna Burdette, PhD, Associate Professor and Associate Dean for Research & Graduate Education, Medicinal Chemistry & Pharmacognosy and Center for Biomedical Sciences

Each program arranged internships directly with companies, in some cases reaching out to existing collaborators and in others working to establish new connections. ASPET funds provided students with stipends during their internships. Participating companies for the first year included Adello Biologics, AbbVie, Sirenas Marine Discovery, Celgene, Roivant, Pfizer, and Janssen.

The first year of internships have now concluded (eight placements across the institutional programs named above), and early evaluation data suggests these have been valuable experiences for the students and industry mentors alike. Every industry mentor surveyed either agreed or strongly agreed that their intern was a valuable member of their team. In one case, the intern was later invited to interview for a position with the company. Student interns reported that they made gains in skills such as project management and teamwork, and that they learned first-hand what it would be like to have a career in industry. Here are some reflections on the experience from PIIPS participants:

"For my internship I worked at Celgene Corporation as part of a team to develop a platform for the functional characterization of specific cell populations. I was then able to use this platform to screen compounds in vitro for early target validation. In addition to lab work, I was able to see firsthand how the efforts of cross-functional teams come together to move a product further along the drug development pipeline. This exposure greatly deepened my understanding of drug development in industry such as the decision-making process, prioritization of projects and targets, and strategies for compound commercialization. Lastly, I was able to build valuable connections with individuals in my field of interest. This experience far exceeded my expectations, and as I result I feel more confident in my ability to make informed career decisions and follow a path into industry, if I choose."
Christine Daniels, Duke University

"The PIIPS fellowship was really an eye opening experience that helped highlight the differences in scientific practice between industry and academia, as well as the role these enterprises play in drug development. More specifically, I learned new experimental approaches, how to develop and conduct protocols according to good manufacturing practice, and about how a small pharmaceutical company is organized. While I will continue my career as a postdoctoral fellow in an academic setting, this experience gave me valuable information that I will undoubtedly use during the rest of my career!"
Thomas Hanigan, UIC College of Pharmacy

"My internship at AbbVie helped me confirm that, after completing my PhD, I wanted to find a career in industry. I believe that having this internship on my resume helped me get interviews at both large and small pharmaceutical companies. The direct work experience I gained during my internship gave me confidence during these interviews that I could fulfill the requirements outlined in a job posting and helped me get a job after my defense."
Emily Pierce, UIC College of Pharmacy

"Working for a small pharmaceutical company has always been something I have considered upon completing graduate school. However, I did not have any experience in industry prior to my time at Sirenas. The fellowship through PIIPS gave me an invaluable opportunity to evaluate this potential career path."
Peter Sullivan, UIC College of Pharmacy

We look forward to following the progress of these programs across the next two years of their awards. The ASPET Council will be evaluating the PIIPS program at the conclusion of its current funding. We want to thank the program directors, students, and mentors for a successful first year.

Journals News

Journals Workshop at Annual Meeting

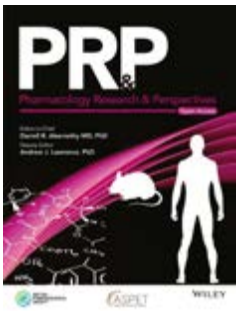
Building on the successful workshop format at EB 2017, the Board of Publications Trustees (BPT) will again present "Hear It from the Editors" at ASPET's Annual Meeting at EB 2018 on Wednesday, April 25 from 8:30 am to 11:00 am. This interactive workshop is designed for everyone from undergraduate students to established researchers and will tackle real-life publishing issues. Despite the session title, we expect to hear from attendees as much as from the editors—bring your questions!

The workshop will focus on three areas. Dr. Kenneth Tew, editor of *The Journal of Pharmacology and Experimental Therapeutics*, will cover the manuscript review and decision process. Dr. Kay Meier, editor of *Molecular Pharmacology,* and Dr. Jeff Stevens, editor of *Drug Metabolism and Disposition*, will work with attendees on how to be a good reviewer. Rich Dodenhoff, ASPET's journals director, will focus on how to avoid ethics and copyright problems.

The majority of the session will be spent in small round-table discussions built on case studies provided to attendees. BPT members and associate editors from the journals will facilitate discussions. Attendees are encouraged to bring questions and take advantage of the opportunity to speak directly with the editors, associate editors, and BPT members.

Former editor of Drug Metabolism and Disposition Dr. Edward T. Morgan speaking with attendees at the Journals Symposium during the ASPET Annual Meeting at EB 2017.

This session at last year's meeting generated many lively discussions in small-group settings. It enables you to have direct interaction with senior researchers who serve as knowledgeable, experienced reviewers and editorial board members. Wind up your time at EB 2018 getting the answers you want.



Calling on Pharma to Publish in *PR&P*

Submitted by Prof. Andrew Lawrence, Editor-in-Chief, PR&P

Pharmacology Research & Perspectives (PR&P) is jointly published by ASPET, the British Pharmacological Society (BPS), and Wiley/Blackwell. We are an open access journal that aims to promote the publication of all types of pharmacological studies: original articles, reviews, hypotheses, opinions – including what has historically been perceived as "negative data," for example, failed replication, target (in)validation, and similar topics. A historical example would be the development of tricyclic antidepressants that were derived indirectly from an antihistamine program, and monoamine oxidase inhibitors that came from antitubercular compounds, both of which contributed to the development of rational drug design.

On the other hand, multiple teams in pharma and biotech have been working on projects that have been stopped for various reasons, in many cases unrelated to scientific issues, generally referred to as "strategic considerations." Sometimes, such projects have led to development of candidates that may have been explored in the clinic. In other cases, projects have at least led to the production of tool compounds that may be of great value for the scientific community to validate/invalidate targets or pathways. Indeed, such projects may have been stopped because the data that have been published earlier in high profile journals could not be reproduced, yet the teams did not publish the data, as the team members were allocated to other projects and publication was not a priority. At times, teams may also have been disbanded, and some of the scientists may have joined academia or have retired. In these cases, the data could be written up (traditionally, when projects are stopped, a "post-mortem" has been written to allow management to proceed) and submitted to *PR&P*, as there is now renewed interest in such reports.

We believe publication of such studies is important for a number of reasons:

1. It promotes transparency.
2. It should aid in reproducibility.
3. It could very well prevent unnecessary time, expense, and animals being used in experiments that are not warranted if all the facts are available.
4. Even if a target fails, the program may still result in the provision of new molecules that could be highly useful tools for fundamental discovery-based research.

Accordingly, in 2018, *PR&P* will publish reviews that highlight historical cases where what was initially perceived as a "negative" result, in fact turned out to change the field and/or lead to new medications, even if not for the originally intended condition. We have some already "locked in," but if you have ideas please feel free to contact the editor-in-chief, Prof. Andrew Lawrence (Andrew.Lawrence@florey.edu.au).

From the perspective of original articles, we would like to call on those engaged in pharma R&D to actively consider publishing data from shelved projects (for the reasons enunciated above). We acknowledge that when a program is ceased and the researchers are aligned with new projects, priorities may change. Therefore, in order to facilitate the process/minimize the time factor for manuscript writing, we would be happy to accept submissions in the form of internal reports, simply reformatted for *PR&P* style. In addition, we would be happy to consider monograph-style submissions. To start the ball rolling, I am delighted to announce that Professor Daniel Hoyer will contribute such articles from his time in pharma. We encourage others to also contribute.

ASPET Journals – What's in it for Authors?

Members may well know the importance of the Society's journals to ASPET's finances, and access to the journals is cited as one of the primary benefits of membership. But, do you know the benefits to authors who publish in an ASPET journal? In a recently published editorial, Mary Vore, chair of the Board of Publications Trustees, explains the many advantages that the Society's journals provide to authors. Read what's in it for you as an ASPET author at http://bit.ly/2FC2pxF.

New Associate Editors

The Journal of Pharmacology and Experimental Therapeutics recently welcomed two new associate editors:

James M. Gallo, PhD

Albany College of Pharmacy and Health Sciences

Dr. James M. Gallo is professor and chair of the Pharmaceutical Sciences Department at the Albany College of Pharmacy and Health Sciences, New York. He is also an adjunct professor at the Mount Sinai School of Medicine's Department of Pharmacology and Systems Therapeutics in New York City.

Kent E. Vrana, PhD

Pennsylvania State University College of Medicine

Dr. Kent E. Vrana is with the Department of Pharmacology at the Pennsylvania State University College of Medicine in Hershey, where he is the Elliot S. Vesell Professor and serves as chair of the department. He is also a College of Medicine Distinguished Educator.

New Staff Member

The journals department welcomes Jacqueline Perry who has succeeded Dianne King-McGavin as peer review manager. Jackie comes to ASPET from the Society for Neuroscience (SfN) where she oversaw the editorial and production teams as Senior Publications Manager. She was involved in a wide variety of projects related to SfN's publishing program that enhanced the journals and their web sites, including launching a new open-access journal and creating a new reviewer training program. She worked extensively with editors, editorial boards, committees, and internal departments while working on these projects. Her extensive publishing experience includes positions with the American Society of Civil Engineers and the National Academy of Sciences.

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Congratulations to **Dr. William Chilian** on being the winner of the $50.00 AMEX gift card. Thank you for renewing early and participating in our 2018 Renew to Win raffle.

Congratulations to **Angela Chen**, **Madeline Jackson**, and **Ryan Shami** on being the raffle winners of the ASPET 2017-2018 Member-Get-A-Member program. Please continue to support ASPET by encouraging your colleagues and students to join ASPET.

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A Tribute to Darrell Abernethy (1949-2017)

Submitted by S.J. Enna, PhD

On November 18, 2017 the discipline of pharmacology, ASPET, and the International Union of Basic and Clinical Pharmacology (IUPHAR) suffered a significant loss with the death of Darrell Abernethy from pancreatic cancer.

A Kansas native, Darrell was born in 1949 in Mitchell County and raised on the family farm near Scottsville, population 25, in the north-central portion of the state. He left home in 1967 to pursue an undergraduate degree in chemistry at the University of Kansas in Lawrence, and MD and PhD pharmacology degrees at the University of Kansas Medical School in Kansas City. His doctoral work, which focused on cholesterol biosynthesis, was performed under the guidance of Daniel Azarnoff, MD, a renowned clinical pharmacologist. Following an internship and residency in internal medicine at the University of Miami, Darrell undertook postdoctoral training in clinical pharmacology with David Greenblatt, MD at Harvard Medical School. This launched a productive 36 year collaboration that resulted in over 100 published reports on drug metabolism and pharmacokinetics. He also trained in geriatric medicine at Boston University.

Darrell held faculty appointments in medicine and clinical pharmacology at Tufts University School of Medicine, Baylor College of Medicine, Brown University, and Georgetown University Medical Center, where he was the Francis Cabell Brown Professor of Medicine and Pharmacology and director of the Division of Clinical Pharmacology. In 1999, he became chief of the Laboratory of Clinical Investigation at the National Institute on Aging Gerontology Research Center. From 2007-2009, he was the chief science officer of the United States Pharmacopeia, and from 2009 until his death the associate director for drug safety in the Office of Clinical Pharmacology at the U.S. Food and Drug Administration (FDA).

Darrell's research included both pharmacodynamic and pharmacokinetic studies, with particular emphasis on cardiovascular pharmacology. He had a special interest in the molecular mechanisms

responsible for the therapeutic and toxic effects of cardiovascular agents, particularly in the aged. In recent years, he was involved in defining the role of drug target polymorphisms in determining therapeutic responses and was a leader in the development of the Drug Burden Index for defining the effects of medications on functions that determine independence in the elderly. His highly cited work appears in over 300 published research articles, reviews, and book chapters.

Given his prominence in the field and administrative skills, Darrell was invited to serve on many local, national, and international boards. Included were appointments to advisory committees for the National Institutes of Health, FDA, National Board of Medical Examiners, United States Pharmacopoeial Convention, American College of Physicians, Veterans Administration, Pharmaceutical Research Manufacturers Association Foundation, Burroughs Wellcome Foundation, and ASPET. He held elective office in professional societies, including the presidency of the American Society of Clinical Pharmacology and Therapeutics (ASCPT), and as chair of the American Board of Clinical Pharmacology, the American Association for the Advancement of Science, and the Clinical Division of IUPHAR. He was also a member of the IUPHAR Executive Committee. He was on the editorial boards of some of the leading journals in the field, such as *Clinical Pharmacology and Therapeutics, British Journal of Clinical Pharmacology, Journal of Clinical Psychopharmacology*, and *Clinical Pharmacology in Drug Development*. In service to ASPET, he was a member of the editorial board of *Molecular Interventions*, associate editor of the *Journal of Pharmacology and Experimental Therapeutics*, editor-in-chief of *Pharmacological Reviews*, the original Deputy Editor of *Pharmacology Research & Perspectives*, and that journal's second editor-in-chief. He was a visiting lecturer at nearly two dozen universities and was the recipient of numerous awards in recognition of his research and other contributions to the field. These included the Rawls-Palmer and the William B. Abrams awards from ASCPT and the Nathaniel T. Kwit Memorial Distinguished Service Award from the American College of Clinical Pharmacology.

Darrell rapidly gained the respect and admiration of those who knew him. Although humble and self-effacing, he would readily, and candidly, share his thoughts and advice when asked. His guidance was sought routinely. His opinions were always based on common sense, experience, and consideration for others.

Darrell said that although he left Mitchell County decades ago, he remembered the lessons learned as a young farm hand in a remote area known for its frigid winters and blistering summers. These included an appreciation for the importance of hard work, self-reliance, personal responsibility, and initiative. These values, combined with his native intelligence and curiosity, propelled him into a world that differed considerably from that of his childhood. Taking full advantage of opportunities offered, Darrell contributed significantly to the basic understanding of drug actions, to education in the field, to the development of healthcare policy, and to the advancement of our discipline.

According to his wishes, Darrell's remains were buried beside his parents on the family farm. He returned home exactly 50 years after departing for college. The medical community is fortunate he chose to forsake the tranquility of country living for the challenges of a career in the biomedical sciences. He will be remembered by his friends for his laconic wit, keen insights, and sage counsel. His legacy is the legions of patients who benefit directly from his work.

"Darrell came to Georgetown at an important time. It really needed a true card-carrying clinical pharmacologist. He brought new ideas, tech, and really supported young faculty. He had a great approach to mentoring and breadth of influence. He collaborated with more people, on more subjects, with more classes of drugs than anybody. His office was always filled with fellows and young faculty; it was an electric time. At the FDA, he changed the course of drug development and career training of younger people. He knew what was important for that person to be successful, he directed specific resources to that person, and most importantly, he protected their time. This was a big part of his mentoring."

– Dr. Monica Javidnia and Dr. Ray Woosley

Members in the News

Achievements, Awards, Promotions, and Scientific Breakthroughs

Bryan Roth, PhD

University of North Carolina at Chapel Hill, School of Medicine

A research team at the University of North Carolina (UNC) School of Medicine led by Bryan Roth, PhD, has isolated the receptors in the brain that activate pain relief from the ones that cause side effects like addiction, a crucial step in developing a safer opioid.

The work was done in cell cultures in Dr. Roth's lab, where two postdoctoral fellows, Tao Che and Daniel Wacker, played pivotal roles in the research and collaborated with other scientists at UNC and around the world. Wacker, Che, and colleagues used lipid cubic phase crystallization and once they had the crystal structure in hand, Che, Wacker and colleagues could see which parts of the receptor were important for binding to drug-like compounds. Collaborators at the University of Southern California, led by Vsevolod Katritch, PhD, used computer models of ligands to see which parts they could chemically modify to make the ligands more likely to bind tightly to kappa opioid receptors (KORs) but not to other receptors. With those modifications, they synthesized a new compound and showed in lab tests that it is extremely selective for KORs.

In the future, researchers will test this and related compounds in animal models. Using the detailed structure of the KOR, Dr. Roth's lab and other scientists could develop other drug-like compounds highly selective for specific opioid receptors now that the structure is available.

Dr. Roth has been an ASPET member since 2000, currently serves on the *Molecular Pharmacology* Editorial Board, and is a member of the **Divisions for Molecular Pharmacology** and **Behavioral Pharmacology**.

Margarita L. Dubocovich, PhD

University at Buffalo

Margarita L. Dubocovich, PhD, SUNY Distinguished Professor in the Department of Pharmacology and Toxicology and senior associate dean for diversity and inclusion at the University at Buffalo (UB), Jacobs School of Medicine and Biomedical Sciences, received the 2017 American College of Neuropsychopharmacology (ACNP) Dolores Shockley Minority Mentoring Award. The award, which was presented during the President's Plenary at the ACNP 2017 Annual Meeting, is given to an ACNP member who has been particularly successful in mentoring young scientists from underrepresented groups in the field of neuropsychopharmacology and related disciplines. "It was an incredible honor to receive this award from Dr. Dolores Shockley who attended the meeting with her wonderful family," said Dubocovich.

At the UB Jacobs School of Medicine and Biomedical Sciences, Dr. Dubocovich develops and implements innovative programming that ensures inclusion and cultural enhancement as a means to achieve excellence for students and faculty, thereby enriching the learning environment, strengthening the school's ties to nearby communities, and contributing in measurable ways to improving the health of the region.

Dr. Dubocovich was awarded the 2017 UB President Medal given in recognition of extraordinary service to the university and was honored as the 2017 Outstanding Research Mentoring Award recipient from the UB Collegiate Science and Technology Entry Program (CSTEP), a grant-funded program sponsored by the New York State Department of Education to support talented

underrepresented students pursing science, technology, engineering and mathematics (STEM), licensed professions and health-related professions.

Dr. Dubocovich is the director of the Collaborative Learning and Integrated Mentoring in the Biosciences (CLIMB) Program, from which 5 CLIMB UP students are annually selected to receive the ASPET Summer Undergraduate Research Fellowship (SURF). She is also co-director of the UB Institute for Strategic Enhancement of Educational Diversity (iSEED) and principal investigator of two institutional grants funded by the National Institutes of Health, the Initiative for Maximizing Student Development (IMSD) for doctoral students and the CTSA-linked KL2 Mentored Career Development Award for junior faculty.

Dr. Dubocovich has been an ASPET member since 1983 and is a member of the **Divisions for Neuropharmacology**, **Behavioral Pharmacology**, **Drug Discovery and Development**, **Pharmacology Education**, **Molecular Pharmacology**, and **Translational and Clinical Pharmacology**.

Reheman Adili, PhD

University of Michigan

Reheman Adili, PhD, has been awarded the prestigious 2018 Karl Link Early Career Investigator Award in Thrombosis for his paper, "First Selective 12-LOX Inhibitor, ML355, Impairs Thrombus Formation and Vessel Occlusion in Vivo With Minimal Effects on Hemostasis", which was published in 2017 in the journal *Arteriosclerosis, Thrombosis, and Vascular Biology (ATVB)*. In this paper, Drs. Adili and Holinstat showed that 12-LOX is an important regulator of platelet reactivity and that inhibition of 12-LOX may represent a new target for anti-platelet therapeutics with the goal of preventing thrombotic complication associated with cardiovascular disease. Regulation of platelet function is essential for the prevention and treatment of cardiovascular atherothrombotic events such as coronary artery disease and stroke. While current antiplatelet drugs effectively inhibit platelet function and prevent thrombotic complications, these interventions are often associated with an increased risk of bleeding. In their preclinical study, inhibition of platelet 12-LOX by oral administration of ML355 in mice showed protection against injury-induced thrombosis without notably impairing hemostasis. This is the first in vivo study showing that platelet 12-LOX is an important regulator of thrombosis and pharmacologically targeting 12-LOX is a viable anti-platelet approach.

Dr. Adili is a research assistant professor in the Department of Pharmacology at University of Michigan in the research group of Dr. Michael Holinstat, an ASPET member. His research focus is on platelet biology, thrombosis, and hemostasis. Dr. Adili is greatly interested in understanding how platelets adhere, aggregate, and form thrombi on a molecular and cellular level in order to develop novel therapeutics to treat thrombotic diseases and bleeding disorders. In addition to research, Dr. Adili contributes his expertise and mentorship to students and trainees in order to promote translational research.

The Karl Link award was established in honor of Dr. Karl Link, an investigator who identified dicoumarol as the hemorrhagic factor in spoiled sweet clover hay, and then developed dicoumarol and warfarin as anticoagulant drugs. Dr. Link received the Lasker Award for Basic Biomedical Research "for fundamental contributions to our understanding of the mechanism of blood clotting." He also received the Lasker Award for Clinical Medical Research "for pioneering the development and use of anticoagulant drugs." The award was extremely competitive, with more than 400 manuscripts nominated in 2017 for this Early Career Investigator Award. Dr. Adili will be recognized by the *ATVB* Council of the American Heart Association, which will be held on Friday evening, May 11, 2018 at the Hilton San Francisco Union Square. This award is an important recognition of Dr. Adili's contribution in the field of thrombosis research.

Dr. Adili has been an ASPET member since 2016, currently serves as a member of the executive committee of the Division for Translational and Clinical Pharmacology and Program Committee of ASPET, and is a member of the **Divisions for Translational and Clinical Pharmacology**, **Cardiovascular Pharmacology**, **Drug Discovery and Development**, **Pharmacology Education**, **Molecular Pharmacology**, and **Toxicology**.

Lakshmi A. Devi, PhD

Icahn School of Medicine, Mount Sinai

Lakshmi A. Devi, PhD, professor of pharmacological sciences, neuroscience, and psychiatry at the Icahn School of Medicine at Mount Sinai in New York, will be receiving the Winter Conference on Brain Research (WCBR) Pioneer Award at the 51st annual meeting in Whistler, BC, Canada. This award recognizes her neuroscience research on opioid and cannabinoid signaling in analgesia and addiction, and her commitment to mentorship. Along with her team, Dr. Devi has demonstrated that G protein-coupled receptors can function as heterodimers, with unique pharmacology and selective upregulation associated with various disease states. The WCBR provides an annual forum for the sharing and dissemination of the latest advances in neuroscience and supports continuing education, mentorship, diversity, outreach, and financial support for junior investigators. Dr. Devi serves on the WCBR Board of Directors.

Dr. Devi has been an ASPET member since 1999, currently serves as the chair of the Mentoring and Career Development Committee at ASPET, and is a member of the **Divisions for Neuropharmacology** and **Molecular Pharmacology**.

Terry Kenakin, PhD

University of North Carolina, School of Medicine

Terry Kenakin, PhD, professor in the Department of Pharmacology at the University of North Carolina, School of Medicine at Chapel Hill, was elected as Fellow of the British Pharmacological Society.

Beginning his career as a synthetic chemist, Terry Kenakin received a PhD in pharmacology at the University of Alberta. After a postdoctoral fellowship at University College London, he joined Burroughs-Wellcome as an associate scientist and held that position for seven years. From there, he continued working in drug discovery at Glaxo Inc., GlaxoWellcome and finally GlaxoSmithKline Research and Development laboratories at Research Triangle Park, NC, where he was for 25 years. After leaving his position as a director at GlaxoSmithKline, Dr. Kenakin went to the University of North Carolina at Chapel Hill.

Currently, Dr. Kenakin is engaged in studies aimed at the optimal design of drug activity assays systems, the discovery and testing of allosteric molecules for therapeutic application and the quantitative modeling of drug effects. In addition, he is director of the pharmacology graduate courses at the UNC School of Medicine. He is a member of numerous editorial boards as well as editor in chief of the *Journal of Receptors and Signal Transduction*. He has authored numerous articles and has written 11 books on pharmacology.

Dr. Kenakin has been an ASPET member since 1983, currently serves on the *Molecular Pharmacology* Editorial Board, and is a member of the **Divisions for Molecular Pharmacology**, **Pharmacology Education**, and **Translational and Clinical Pharmacology**.

Mark M. Rasenick, PhD

University of Illinois, College of Medicine

Mark M. Rasenick, PhD, Distinguished Professor of Physiology & Biophysics and Psychiatry at the University of Illinois was recently elected to be a member of the National Academy of Science of Cuba. Dr. Rasenick's work has focused on G protein signaling in the nervous system and the relationship between neurotransmitter activation and rapid modification of the cytoskeleton. He has been particularly interested in how G proteins and the cytoskeleton work in concert to modify synaptic shape and to form a molecular basis for depression and the action of antidepressant drugs. The most recent work from his group suggests the possibility of a simple blood test indicating depression and therapeutic response to antidepressant therapy. This has led to the creation of Pax Neuroscience, which recently received SBIR funding from the National Institute of Mental Health (NIMH).

Dr. Rasenick has been an ASPET member since 2017, currently serves on the ASPET Science Policy Committee, and is a member of the **Divisions for Cardiovascular Pharmacology**, **Molecular Pharmacology**, and **Neuropharmacology**.

Shankar Munusamy, PhD

Drake University, College of Pharmacy and Health Sciences

Shankar Munusamy, BPharm, MS (Pharm), PhD, an associate professor of pharmacology in the Department of Pharmaceutical and Administrative Sciences at Drake University College of Pharmacy and Health Sciences, was recently awarded an Early Career Investigator Grant from the NASA Iowa Space Grant Consortium to study renal cell carcinoma and the anti-cancer effects of metformin. Renal cell carcinoma (RCC) is one of the 10 most commonly diagnosed forms of cancers in the United States. The proposed study will investigate the anti-cancer potential of metformin (a widely used anti-diabetic drug) and the molecular mechanisms that underpin metformin's anti-cancer effects in RCC.

Dr. Munusamy has been an ASPET member since 2013 and is a member of the **Divisions for Translational and Clinical Pharmacology**, **Cancer Pharmacology**, **Drug Discovery and Development**, **Pharmacology Education**, **Molecular Pharmacology**, and **Toxicology**.

Andrea Gaedigk, PhD

Children's Mercy Kansas City

Andrea Gaedigk, PhD, a member of the executive committee of the TCP division of ASPET, is the director of the Pharmacogenetics Core Laboratory in the Division of Clinical Pharmacology, Toxicology & Therapeutic Innovation at Children's Mercy Kansas City and a professor of pediatrics at the University of Missouri-Kansas City School of Medicine. Dr Gaedigk also serves as the principal investigator of the Pharmacogene Consortium (PharmVar), a NIH-funded resource of the Pharmacogenetics Research Network (www.PGRN.org).

PharmVar is a central repository for pharmacogene variation that focuses on haplotype structure and allele variation. The information in this resource facilitates the interpretation of pharmacogenetic test results to guide precision medicine (https://www.pharmvar.org/). As described in an inaugural article published in *Clinical Pharmacology & Therapeutics* (https://www.ncbi.nlm.nih.gov/pubmed/29134625), PharmVar carries on the legacy of the Human Cytochrome P450 *(CYP)* Allele Nomenclature Database, which became an invaluable resource for the field of pharmacogenetics and genomics, by developing a new interactive database (launching mid-March of 2018), user-friendly features, and expanding to pharmacogenes beyond CYPs. Dr. Gaedigk says that "PharmVar takes pharmacogene nomenclature to an entirely new level by building a resource with the PGx community for the community" and encourages everyone with interest and expertise in pharmacogene variation and willingness to participate to become a PharmVar member to help move PharmVar efforts forward.

Dr. Gaedigk has been an ASPET member since 2005 and is a member of the **Divisions for Translational and Clinical Pharmacology** and **Drug Metabolism and Disposition**.

Jeffrey M. Witkin, PhD

Eli Lilly and Company

Jeffrey M. Witkin, PhD, from Eli Lilly and Company was awarded a patent for predicting the anticonvulsant activity using the first molecule to bind only the subset of AMPA receptors that contain the auxiliary protein TARP γ-8. CERC-611 is currently in clinical development for epilepsy.

Dr. Witkin has been an ASPET member since 1986 and is a member of the **Divisions for Behavioral Pharmacology**, **Drug Discovery and Development**, and **Neuropharmacology**.

Clinton E. Canal, PhD

Mercer University

Clinton E. Canal, PhD, recently accepted a tenure-track position in the Department of Pharmaceutical Sciences at Mercer University. Dr. Canal was also recently awarded a grant of $90,000 over two years from FRAXA Research Foundation. His project seeks to examine the function and the numbers of serotonin receptors of various subtypes (of which there are many) in the brains of fragile X knockout mice.

Dr. Canal has been an ASPET member since 2007 and is a member of the **Divisions for Behavioral Pharmacology**, **Drug Discovery and Development**, **Molecular Pharmacology**, and **Neuropharmacology**.

Peter F. Weed, PhD

Louisiana State University Health Sciences Center, New Orleans

Dr. Peter F. Weed recently accepted an assistant professor position with a primary appointment in the School of Nursing and a secondary appointment in the Department of Pharmacology at Louisiana State University Health Sciences Center in New Orleans. Dr. Weed has been an ASPET member since 2014 and is a member of the **Divisions for Behavioral Pharmacology**, **Molecular Pharmacology**, and **Neuropharmacology**.

Answer key for word jumble:

MOSQUITO
FEVER
CINCHONA
CHLOROQUINE
ARTEMISININ
Bonus Word - QUININE

PARASITE
MALARIA
TONIC
PLASMODIUM
SAPPINGTON

Share your achievements, awards, promotions and scientific breakthroughs with fellow ASPET members. Send your news to your division's communications officer:

Behavioral Pharmacology:
- Brenda M. Gannon, PhD at *GannonB@uthscsa.edu*

Cancer Pharmacology:
- Jack C. Yalowich, PhD at *yalowich.1@osu.edu*

Cardiovascular Pharmacology:
- David B. Averill, PhD at *daverill@tcmc.edu*

Drug Discovery and Development:
- Przemyslaw Radwanski, PharmD at *Przemyslaw.Radwanski@osumc.edu*

Drug Metabolism and Disposition:
- Aarti Sawant-Basak, PhD at *aarti.sawant@pfizer.com*
- Lindsay M. Henderson at *lmhender@uw.edu*

Molecular Pharmacology:
- Kathryn E. Livingston, PhD at *kathrynlivingston@gmail.com*
- Amy E. Moritz, PhD at *amy.moritz@nih.gov*

Neuropharmacology:
- Luisa Torres, PhD at *lft9@cornell.edu*

Pharmacology Education:
- Catherine M. Davis, PhD at *cdavis91@jhmi.edu*

Toxicology:
- Alison H. Harrill, PhD at *harrill.alison@gmail.com*

Translational & Clinical Pharmacology:
- Naeem K. Patil, PhD at *naeem.patil@vanderbilt.edu*

Division News

2018 Division Elections

The following Divisions held elections for 2018:

- **Division for Cancer Pharmacology**
- **Division for Drug Discovery and Development**
- **Division for Drug Metabolism and Disposition**
- **Division for Molecular Pharmacology**
- **Division for Neuropharmacology**
- **Division for Toxicology**

Please join us in welcoming all newly elected chairs and secretary-treasurers to their respective division's executive committee. The new officers will begin their terms on July 1, 2018.

Division for Cancer Pharmacology

Chair-Elect

Andrew Thorburn, DPhil
Professor and Chair, Department of Pharmacology, University of Colorado

Secretary/Treasurer-Elect

Christine E. Canman, PhD
Associate Professor of Pharmacology, University of Michigan Medical School

Division for Drug Discovery and Development

Chair-Elect

Tom J. Parry, MBA, PhD
Founder and Principal, Skyline Biopharma, LLC

Secretary/Treasurer-Elect

Benita Sjögren, MSc, PhD
Assistant Professor, Department of Medicinal Chemistry and Molecular Pharmacology, Purdue University

Division for Drug Metabolism and Disposition

Chair-Elect

Aiming Yu, PhD
Professor, Department of Biochemistry and Molecular Medicine, University of California Davis

Secretary/Treasurer-Elect

Bhagwat Prasad, MS, PhD
Assistant Professor, Department of Pharmaceutics, University of Washington

Division for Molecular Pharmacology

Chair-Elect

Allyn C. Howlett, PhD
Professor of Physiology and Pharmacology, Wake Forest School of Medicine

Secretary/Treasurer-Elect

Angeline Lyon, PhD
Assistant Professor of Chemistry and Biological Sciences, Purdue University

Division for Neuropharmacology

Chair-Elect

Kelly M. Standifer, PhD
Chair and Professor, Department of Pharmaceutical Sciences, College of Pharmacy, University of Oklahoma Health Sciences Center

Secretary/Treasurer-Elect

Shaifali Bhalla, PhD
Associate Professor of Pharmaceutical Sciences, Midwestern University, Chicago College of Pharmacy

Division for Toxicology

Chair-Elect

Brian S. Cummings, PhD
Professor and Director, Interdisciplinary Toxicology Program, University of Georgia

Secretary/Treasurer-Elect

Brendan Stamper, PhD
Associate Professor, Pacific University School of Pharmacy

ASPET Division Sponsored Awards

Division for Behavioral Pharmacology

P.B. Dews Lifetime Achievement Award for Research in Behavioral Pharmacology

The ASPET Division for Behavioral Pharmacology sponsors the Dews Award to recognize outstanding lifetime achievements in research, teaching, and professional service in the field of behavioral pharmacology and to honor Dr. Peter Dews for his seminal contributions to the development of behavioral pharmacology as a discipline.

Robert L. Balster, PhD
Virginia Commonwealth University

Dr. Robert Balster is being recognized for his outstanding lifetime achievements in research, teaching, and professional service in the field of behavioral pharmacology.

He was nominated by Dr. Katherine Nicholson from Virginia Commonwealth University (VCU). In addition to his scientific achievements, she noted that "Bob is known for his ability to form teams, to inspire others to work together and to develop new programs while being an accessible and amiable colleague. He is one of the most collegial and positive individuals I have known." She described that his accomplishments "span the gamut from basic research to serving as a Scientific Advisor for the [USAID's] Global Health Bureau reflecting his breadth of knowledge and scientific versatility. His list of trainees does not completely reflect his mentoring impact as I have seen him provide expert council to established scientists." Agencies such as the Food and Drug Administration and World Health Organization seek his scientific input.

Dr. Balster received his PhD in psychology from the University of Houston in 1970. In 1973, he joined the faculty of VCU. Dr. Balster is the co-founder and co-director of the International Programme in Addiction Studies and associate coordinator of the Hubert H. Humphrey Fellowship Program in Substance Abuse Prevention, Treatment and Policy. He also co-founded the Center for the Study of Tobacco Products at VCU.

Dr. Balster has greatly advanced the field of substance abuse research. His seminal work with the self-administration model examined the impact

of procedural variables on the ability of drugs to function as reinforcers. Dr. Balster was also the first to utilize operant behavior to study the ability of animals to detect the interoceptive effects of psychoactive drugs establishing the drug discrimination paradigm. He is widely known for his pioneering work with phencyclidine, as well as being one of the first scientists to study the behavioral toxicity and abuse of inhalants using animal models.

A member of ASPET for more than 35 years, Dr. Balster served on the editorial board of *The Journal of Pharmacology and Experimental Therapeutics*, the Public Affairs Committee, and the Dews Award Committee. He also served as the editor of *Drug and Alcohol Dependence* for 12 years.

ASPET will present Dr. Balster with the P.B. Dews award during the ASPET Annual Meeting at Experimental Biology 2018 in San Diego, CA on Saturday, April 21, 2018 from 4:30 pm – 6:00 pm.

Dr. Balster will deliver the P.B. Dews Lifetime Achievement Award for Research in Behavioral Pharmacology Lecture titled *Drug-behavior Interactions and Drug Discrimination Learning* on Monday, April 23, 2018 from 2:30 pm – 3:15 pm.

Division for Cardiovascular Pharmacology

Paul M. Vanhoutte Distinguished Lectureship in Vascular Pharmacology

The ASPET Division for Cardiovascular Pharmacology awards the Vanhoutte Lectureship to honor Dr. Vanhoutte's lifelong scientific contributions to our better understanding and appreciation of the importance of endothelial cells and vascular smooth muscle function in health and disease and for his mentoring of countless prominent endothelial and vascular biologists and pharmacologists.

Virginia M. Miller, PhD
Mayo Graduate School of Medicine

Thomas Michel, MD, PhD
Harvard Medical School and Brigham and Women's Hospital

Drs. Virginia Miller from the Mayo Graduate School of Medicine, and Thomas Michel from Harvard Medical School (HMS) and Brigham and Women's Hospital (BWH), are the co-recipients of the 2018 Paul M. Vanhoutte Distinguished Lectureship in Vascular Pharmacology.

Dr. Virginia Miller was nominated by Dr. Richard Cohen of Boston University School of Medicine, who noted that "Over the last 30 years Dr. Miller has embodied the spirit of Paul's mentorship through her excellence in science, innovation, and diversity in both application and translation of her work."

Dr. Miller received her PhD in physiology from the University of Missouri in 1976, and began her career in cardiovascular pharmacology under the mentorship of Paul Vanhoutte in 1983 at the Mayo Clinic. Since then, she has become an internationally recognized expert in the physiology of the cardiovascular system, most notably in the area of hormonal modulation of vascular function and sex-differences in the etiology of cardiovascular disease. She is currently professor of surgery and physiology at the Mayo Clinic Graduate School of Medicine, consultant in the Department of Surgery, and director of the Women's Health Research Center at Mayo Clinic.

An ASPET member for 12 years, Dr. Miller served on the editorial board of *The Journal of Pharmacology and Experimental Therapeutics*. She has been recognized with many awards, including the Women's Day magazine Red Dress Award in 2015 for improving women's heart health and the Bernadine Healy Award for Visionary Leadership in Women's Health in 2014.

Dr. Thomas Michel was nominated by Nobel Laureate Dr. Louis Ignarro from the University of

California, Los Angeles, who noted that Dr. Michel's "scholarly achievements and inspired mentorship reveal him as an exemplar of the academic pharmacologist, very much in the mold of Paul Vanhoutte himself."

Dr. Michel received his PhD in biochemistry from Duke University in 1983. After completing his postdoctoral training in medicine at HMS and BWH, he was appointed to the faculty, where he has worked as a scientist, teacher, and clinician for many years. Dr. Michel has led studies on the molecular mechanisms controlling the endothelial nitric oxide synthase (eNOS), a key enzyme in cardiovascular homeostasis. His laboratory was the first to clone and characterize eNOS. Dr. Michel's research studies have had a broad impact in vascular pharmacology, and span from cellular imaging approaches to the creation and analysis of informative mouse models.

As a young scientist, Dr. Michel was the recipient of the 1995 ASPET John J. Abel Award in Pharmacology and went on to serve the Society in division leadership positions. He has been an ASPET member for more than 20 years.

The Paul M. Vanhoutte Distinguished Lectureship in Vascular Pharmacology and award presentation will be held during the ASPET Annual Meeting at Experimental Biology 2018 in San Diego, CA on Tuesday, April 24, 2018 at 5:30 pm.

Dr. Miller will give a talk titled *Estrogen and Vascular Function: The Clash between Basic Pharmacology and Clinical Practice*. Dr. Michel will give a talk titled *Life History of eNOS*.

Division for Drug Metabolism

Bernard B. Brodie Award in Drug Metabolism

The ASPET Division for Drug Metabolism and Disposition established the Brodie Award to honor the fundamental contributions of Bernard B. Brodie to the field. The award recognizes outstanding original research contributions in drug metabolism and disposition, particularly those having a major impact on future research in the field.

David J. Waxman, PhD

Boston University

Dr. David J. Waxman, professor of cell and molecular biology in the department of biology at Boston University (BU) and professor of medicine at BU School of Medicine, is the recipient of the 2018 Bernard B. Brodie Award in Drug Metabolism.

He was nominated by Dr. Paul Ortiz de Montellano from the University of California, San Francisco, who called his contributions "impressive" specifically noting "the creativity and solidity of his research, and his broad impact on the field of drug metabolism." As Dr. Frank Gonzalez states in his supporting letter of nomination, "David has virtually owned this field of investigation over the past 25 years".

Dr. Waxman received his PhD in biochemistry and molecular biology from Harvard University in 1980. After postdoctoral training at MIT and faculty appointments at Harvard Medical School and Dana Farber Cancer Institute, he joined the faculty at BU as professor in 1994. In addition to currently being professor of cell and molecular biology in the department of biology and bioinformatics program and professor of medicine at BU School of Medicine, he is also professor of biomedical engineering in the College of Engineering at BU.

Dr. Waxman's research has led to many important discoveries on the endocrine control and epigenetic regulation of cytochrome P450 and other enzymes of drug metabolism. His laboratory has also pioneered research in the field of cancer gene therapy using prodrug-activating P450 genes. Dr. Waxman's most recent work has led to important translational advances on the interactions of P450-activated cancer chemotherapeutic drugs with anti-angiogenic agents and on the impact of drug scheduling on the immune system.

An ASPET member for almost 20 years, Dr. Waxman has a long record of service on the editorial boards of

both *Drug Metabolism and Disposition* and *Molecular Pharmacology*.

ASPET will present Dr. Waxman with the Brodie award during the ASPET Annual Meeting at Experimental Biology 2018 in San Diego, CA on April 21, 2018 from 4:30 pm – 6:00 pm.

Dr. Waxman will deliver the Brodie Award Lecture titled *Sex Differences in Drug Metabolism: From Steroids and P450s to Transcription Factors and Chromatin States* on Tuesday, April 24, 2018 from 2:30 pm – 3:15 pm.

James R. Gillette Award

The James R. Gillette Award is presented each year by the ASPET Division for Drug Metabolism and Disposition for two outstanding papers published in the previous year's *Drug Metabolism and Disposition*.

The award recipient in the Drug Metabolism category for 2017 is **Casey R. Dorr** for the paper titled "CRISPR/Cas9 Genetic Modification of CYP3A5 *3 in HuH-7 Human Hepatocyte Cell Line Leads to Cell Lines with Increased Midazolam and Tacrolimus Metabolism."

The award recipient in the Pharmacokinetics/Drug Transporters category for 2017 is **Marilyn Giacomini** for the paper titled "Interaction of 2,4-Diaminopyrimidine–Containing Drugs Including Fedratinib and Trimethoprim with Thiamine Transporters."

The Gillette awards and short talks based on the papers will be presented during the ASPET Annual Meeting at Experimental Biology 2018 in San Diego, CA on Tuesday, April 24, 2018 from 3:30 pm – 6:00 pm.

Division for Neuropharmacology

Early Career Independent Investigator Award

The ASPET Division for Neuropharmacology sponsors the Early Career Independent Investigator Award to honor a young investigator working in neuropharmacology.

Richard Daneman, PhD

University of California, San Diego

Dr. Richard Daneman, assistant professor in the departments of neuroscience and pharmacology at the University of California, San Diego (UCSD), is the recipient of the 2018 ASPET Division for Neuropharmacology Early Career Independent Investigator Award.

Dr. Daneman was nominated by Dr. Joan Heller Brown from UCSD with the support of Drs. Roland Bainton and Ben Barres, who describe him as "an amazingly insightful scientist" who is a "leader in his field and highly sought after by industry and academic collaborations."

Per Dr. Bainton, he "single handedly brought the field of vertebrate CNS barrier studies from a descriptive science with vaguely defined clinical relevance to an interrogatable system that allows regulatory models to be tested and for new therapeutic approaches to be conceived."

Dr. Daneman received his PhD in developmental biology from Stanford University in 2008. He has made important discoveries that have changed our understanding of how the blood-brain barrier (BBB), which is crucial to protect the brain from disease, but also greatly impedes drug delivery to the central nervous system (CNS), is regulated to treat neurological disease. Dr. Daneman's studies have shown that BBB-specific gene expression is induced during angiogenesis, and vascular leakiness is further limited by pericytes. He has further identified mechanisms by which BBB dysfunction regulates disease, identifying molecular signatures of the CNS vasculature during BBB leakage and neuroinflammation. Dr. Daneman is currently investigating novel behavioral regulation by the BBB, and its adaptation and response in disease including multiple sclerosis, stroke and other neurological disorders.

The Early Career Independent Investigator award will be presented during the ASPET Annual Meeting at Experimental Biology 2018 at the Division for Neuropharmacology's Annual Meeting in San Diego on Monday, April 23, 2018 from 6:00 pm – 6:30 pm.

Division for Pharmacology Education

Travel Award for Pharmacology Educators

The ASPET Division for Pharmacology Education sponsors travel awards for pharmacology educators. The primary goal of these travel awards is to promote participation in the ASPET Annual Meeting by pharmacology educators and to foster career development in pharmacology education.

Willmann Liang, BSc (Hon), PhD, PDip, CBiol
The Chinese University of Hong Kong

Diptiman D. Bose, BPharm, MS, PhD
Western New England University

James J. O'Donnell, MS, PhD
Rosalind Franklin University of Medicine and Science

Dr. Willmann Liang received his PhD in cardiovascular pharmacology in 2004 from the University of British Columbia in Canada. He received a postgraduate diploma in higher education in 2007 from the National Institute of Education at Nanyang Technological University in Singapore. He currently is an adjunct assistant professor in the Department of Life Science at Tunghai University in Taiwan, as well as a lecturer in the School of Biomedical Sciences at The Chinese University of Hong Kong.

Dr. Diptiman Bose received his PhD in pharmacology in 2006 from the Thomas J. Long School of Pharmacy at the University of the Pacific in California. He spent 5 years as a postdoctoral scholar at the University of California, Davis. He currently is an assistant professor for pharmacology in the Department of Pharmaceutical and Administrative Sciences, College of Pharmacy and Health Sciences at Western New England University in Massachusetts. For the 2014-2015 academic year, he was awarded Professor of the Year by the university.

Dr. James J. O'Donnell received his PhD in pharmacology in 2011 from Rush University Medical Center. He was a postdoctoral fellow at the University of Chicago Department of Medicine and Indiana University School of Medicine, South Bend. Currently, he is an assistant professor at Rosalind Franklin University of Medicine and Science.

The awards will be presented during the ASPET Annual Meeting at Experimental Biology 2018 at the Division for Pharmacology Education's annual meeting on Monday, April 23, 2018 from 5:30 pm – 6:30 pm.

Division for Toxicology

Career Award

The ASPET Division for Toxicology annually sponsors the Career Award to recognize outstanding original research contributions to toxicology by an established investigator.

Paul B. Watkins, MD

University of North Carolina, Chapel Hill

Dr. Paul B. Watkins, director of the Institute for Drug Safety Sciences at the University of North Carolina, Chapel Hill, Eshelman School of Pharmacy and the Howard Q. Ferguson Distinguished Professor in the Division of Pharmacotherapy and Experimental Therapeutics, is the recipient of the 2018 ASPET Division for Toxicology Career Award.

Dr. Watkins was nominated by Dr. Alison Harrill from the National Institute for Environmental Health Sciences, who cited that his "ability to see value in developing a variety of experimental models is truly visionary and is reflective of toxicity testing in 21st century approaches."

Dr. Watkins received his MD at Cornell Medical College in 1979. After academic appointments at the Medical College of Virginia and the University of Michigan, he joined the faculty at the UNC, Chapel Hill in 1999, where he has held many professorships and leadership positions.

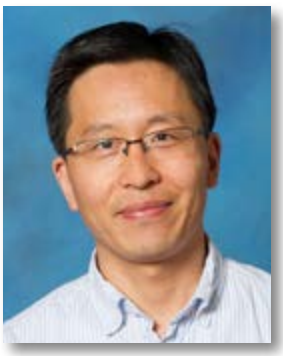
Dr. Watkins has been a leading researcher in understanding mechanisms underlying interactions between drugs and the liver and intestine. He is one of the most highly cited researchers in the field, due to his discovery of mechanisms underlying many drug interactions and toxicities including inhibition of metabolism and transport and the effects associated with consumption of furanocoumarins within grapefruit juice. More recently, Dr. Watkins has continued to move the field of hepatotoxicity forward via deployment of translational technologies that span preclinical models, quantitative systems toxicology, and patients in clinical trials. His work has continued to provide important information regarding detection and mechanistic understanding of drug-induced liver injury of a variety of etiologies.

An ASPET member for 12 years, he has served on the editorial board of *Drug Metabolism and Disposition*.

The Division for Toxicology Career award will be presented during the ASPET Annual Meeting at Experimental Biology 2018 in San Diego, CA at the Division for Toxicology annual meeting on Tuesday, April 24, 2018 at 6:00 pm.

Junior Investigator Award

The ASPET Division for Toxicology annually sponsors the Junior Investigator Award to recognize excellent original research by early career investigators in the area of toxicology.



Xiaochao Ma, PhD

University of Pittsburgh

Dr. Xiaochao Ma, associate professor in the Department of Pharmaceutical Sciences at the University of Pittsburgh School of Pharmacy, is the recipient of the 2018 ASPET Division for Toxicology Junior Investigator Award.

Dr. Ma was nominated by Dr. John Chiang from Northeast Ohio Medical University with support from Drs. Frank Gonzalez and Wen Xie. In describing Dr. Ma, Dr. Gonzalez said "He is an expert in clinical pharmacology, drug metabolism, mouse models, metabolomics, and is well versed in molecular biology. Most importantly, he is bursting with ideas and picks areas of study that are of great clinical importance."

Dr. Ma received his PhD in pharmacology and toxicology from Shanghai Institute of Materia Medica, Chinese Academy of Sciences in 2003 and did his

postdoctoral training at the National Institutes of Health (NIH). Afterward, he worked as an assistant professor at the University of Kansas Medical Center before joining the faculty of the University of Pittsburgh in 2013.

Dr. Ma's research focuses on drug metabolism and drug-induced liver injury. He developed and used genetically engineered mouse models to investigate the mechanisms of side effects of clinically used drugs. Dr. Ma also used metabolomics to identify endobiotic metabolites that are involved in drug-drug interactions and toxicity. His project studying toxicity of rifampicin and isoniazid using PXR-humanized mice and metabolomics was published in *Nature Medicine*. His future work will continue elucidating the role of drug-endobiotic interactions in drug toxicity.

An ASPET member for 8 years, Dr. Ma was featured in the March 2016 issue of *The Pharmacologist* where he credits ASPET for helping his career. "By coming to the ASPET-sponsored meetings, I learned a lot from other members. I have also found good friends and collaborators in the ASPET family."

The Division for Toxicology Junior Investigator award will be presented during the ASPET Annual Meeting at Experimental Biology 2018 in San Diego, CA at the Division for Toxicology annual meeting on Tuesday, April 24, 2018 at 6:00 pm.

Division for Translational and Clinical Pharmacology

Ray Fuller Lecture

Created in 1999, the Ray Fuller lecture and symposium honors the achievements of Ray W. Fuller, PhD in applying an improved understanding of the central nervous system to discover better treatments for the mentally ill. Dr. Fuller was one of the triad that discovered fluoxetine (Prozac), leading to an entire new approach to the therapy of depression. The ASPET Division for Translational and Clinical Pharmacology took on sponsorship of the lecture in 2017.

George J. Christ, PhD

University of Virginia

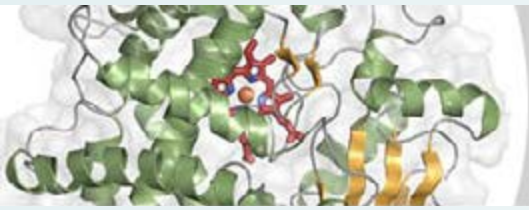
Dr. George Christ, of the University of Virginia (UVA), is the recipient of the 2018 Ray Fuller Lecture and award sponsored by the ASPET Division for Translational and Clinical Pharmacology.

Dr. Christ earned a PhD in pharmacology from Wake Forest University in 1987. He currently holds many positions at UVA, including professor of biomedical engineering and orthopedic surgery, director of basic and translational research in the Department of Orthopedic Surgery, head of the laboratory of regenerative therapeutics, and Mary Muilenburg Stamp Professor of Orthopaedic Research.

The mission of Dr. Christ's lab at UVA is to leverage collaborations to develop novel and more efficacious regenerative medicine/tissue engineering technologies for unmet medical needs. Their major current focus is on musculoskeletal tissue engineering and regeneration. In particular, they are developing a technology platform for the treatment of volumetric muscle loss (VML) injuries.

The Fuller award will be presented during the ASPET Annual Meeting at Experimental Biology 2018 in San Diego on Sunday, April 22, 2018 at 9:30 am, and will be immediately followed by the award lecture by Dr. Christ titled *Regenerative Pharmacology for Muscle Repair* and a symposium chaired by Dr. Christ titled *State-of-the-Art on Regenerative Pharmacology: The Future is Now*.

Other Division News



Drug Metabolism & Disposition

a division of ASPET

Dr. Mary Vore Iwamoto: From Regulation of Hepatic Transport to ASPET Leadership

Submitted by Lindsay Henderson and Aarti Sawant-Basak, PhD

Mary Vore, PhD received her BS in biology from Ashbury College in Wilmore, Kentucky, and in 1972 she earned her PhD in pharmacology at Vanderbilt University in Nashville, Tennessee. She completed her post-doctoral training with Dr. Anthony Lu, after which she returned to Kentucky as an assistant professor in the Department of Pharmacology and in 1986 became a professor at the University of Kentucky College of Medicine. During her career, Dr. Vore has conducted pioneering studies to better understand how pregnancy and lactation affect hepatic and intestinal metabolism and transport processes as well as the mechanisms that cause changes in transporter expression and activity. When asked about narrating her research highlights, Dr. Vore provided us with several of them and said, "Each of these stories is like one of my children!"

In the early stages of her research, Dr. Vore made significant observations using isolated perfused rat liver models. Using phenytoin as a model substrate, her research demonstrated no significant changes in P450 mediated metabolism during pregnancy; however, the biliary excretion of the glucuronide conjugate of hydroxylated phenytoin was profoundly inhibited in liver from pregnant rats. This key observation led to Dr. Vore's future research on hepatic transporters, particularly the ATP-dependent efflux transporter MRP2 (ABCC2), and understanding the mechanisms regulating its decreased expression in pregnancy. Thus, Dr. Vore made major contributions to understanding the function and biological significance of hepatic transport processes for both endo- and xenobiotics. Dr. Vore's laboratory also characterized the expression of bile salt transporters like NTCP and BSEP, non-bile acid OATP1/2, as well as MRP2 during pregnancy and lactation. When studying the recovery of MRP2 expression and function in rat liver postpartum, she found that the lactation-stimulated release of prolactin led to increased expression of NTCP via activation of STAT5 signaling pathway. Dr. Vore's research on liver cholestasis and changes in biliary transporter expression and function in response to estrogens and their metabolites have been fundamental in developing the understanding of how endogenous processes affect drug and toxin disposition in the body.

Not only has Dr. Vore been recognized for her research achievements, but she has also been actively involved in ASPET since becoming a member in 1975. She served as the chair of the Division for Drug Metabolism from 1990 – 1992 and as the chair of the Division for Toxicology

The Vore Lab – August 2011
(from left to right) Drs. Paiboon Jungsuwadee, Donna Coy, Baoxiang Yan, Mary Vore, Tianyong Zhao, Aldo Mottino, Wei Zhang, and Jun Deng

from 2007 – 2010. Dr. Vore was the ASPET secretary-treasurer (elect, current, and past) between 1986 – 1989, and again in 2010 – 2013. She also was an associate editor of *Molecular Pharmacology* between 2011 – 2013 and a member of the Editorial Board of *Drug Metabolism and Disposition* between 1980 – 2011. Most recently, Dr. Vore was the chair of the Board of Publications Trustees from 2014 – 2016, and is currently serving a second 3-year term.

Dr. Vore kindly agreed to share her stories with us. We wanted to know more about her path to success, involvement in ASPET, and advice for junior scientists.

Q: You have been very involved in ASPET leadership since joining the Society in 1975. Can you briefly describe your ASPET journey and comment on the most rewarding aspects of being involved in a professional society?

A: I was very fortunate to have mentors who supported me and helped me, support that I did not recognize as such until much later. I was encouraged to join the Division for Drug Metabolism, which I believe was new at the time, and encouraged to co-sponsor a symposium with scientists in drug metabolism from Japan. I needed, and received, a good deal of help in orchestrating what turned out to be two symposia. That opportunity allowed me to interact with many scientists well beyond "my paygrade", but which was very instructive. What I learned from these early experiences was to say "yes" when asked to do something you are not sure you know how to do, and then to be sure and ask for help. I have found ASPET to be very welcoming and supportive of young scientists, providing them with opportunities and support. The most rewarding aspect is that you are able to work with truly outstanding scientists and good people who can be role models, and who inspire you to work harder – and provide good examples of how to work smart!

Q: Can you share with our readers some of the most challenging and most exciting aspects of your academic career?

A: My husband (Dr. Edgar Iwamoto) and I were both new faculty in pharmacology, trying to start labs and get National Institutes of Health (NIH) grants – that was very challenging, especially when we had two children and no family to help with child care. We took turns coming back to work at night and on weekends. Having a supportive spouse was absolutely essential, and I am forever indebted to him for his support. The fun part was getting really nice data – I loved that part more than anything – the excitement and reward more than made up for the long hours and frustration of the experiments that "didn't work." Experiments that gave puzzling results always led to deeper thinking, trying to understand what the data were telling you, and then designing a new experiment. External signs of success were nice, of course, but the data were always my first love!

Q: As a mentor, what advice do you give junior scientists who are pursuing a higher degree in the field of drug metabolism and disposition?

A: Design and carry out experiments meticulously and carefully so that you can trust the data, and then believe your data and try to understand what it means. I also always told my students that I did not care what the results were, as long as they were reproducible – the goal was *not* to obtain a certain desired result.

Drug metabolism and disposition is a rich source of new insights. Each new drug is a novel probe of how the body can respond, e.g., with new pathways of metabolism that lead to discovery of the seemingly unending capabilities of P450. The new biologic drugs now require new methodologies for characterizing their disposition and mechanisms of elimination, which in turn will lead to novel findings.

Q: Can you comment on the significance of collaborations in today's changing world?

A: You can't possibly be an expert in all of the techniques and fields that are necessary to integrate the data and obtain conclusive evidence needed for publication in excellent journals. You need novel antibodies, expertise in structural analyses of proteins, in understanding how proteins interact to carry out metabolic reactions and a myriad other new techniques in cell biology. An important challenge for young scientists today is in knowing how to pick reliable collaborators who can provide the needed data in a timely manner – and with whom it is fun to work! Scientific meetings such as Experimental Biology (EB) or Gordon Research Conferences provide good opportunities for learning not only new techniques, but finding good collaborators. Do your homework and ask trusted mentors and colleagues in the field of drug metabolism and disposition who they recommend as good collaborators. The Division for Drug Metabolism and Disposition is a rich source of expertise – use it, and enjoy learning!

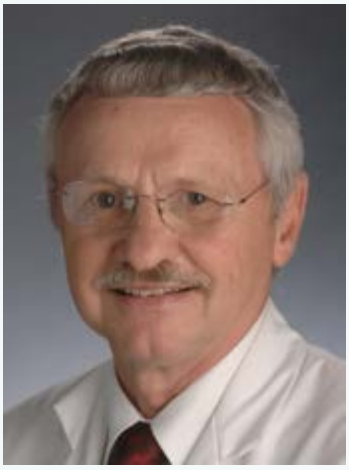
NEU Division Blog

Our first blog post highlights the work of ASPET NEU member Dr. Jeffrey Conn, who along with colleagues at Vanderbilt University, succeeded in advancing a compound that could benefit patients with Alzheimer's disease and schizophrenia into phase 1 clinical trials. You can find this story in the following link: http://bit.ly/2IY2Cj6.

If you are interested in contributing stories to the NEU Division blog, please contact Luisa Torres (NEU communications officer) at lft9@cornell.edu. Ideas for posts include research advances, stories about scientists associated with ASPET, and potential applications of their work for improving people's health.

Member Highlight: Interviews with Dr. Curtis D. Klaassen and his past trainees, Drs. Nathan Cherrington and Lauren Aleksunes

Submitted by Qin M. Chen, PhD and Alison Harrill, PhD



Curtis Klaassen

Curtis D. Klaassen, PhD, was the recipient of the 2017 Career Achievement Award in Toxicology from ASPET. His career spanned 45 years at the University of Kansas, where he served as chair and University Distinguished Professor of the Department of Pharmacology, Toxicology and Therapeutics in the School of Medicine. During his faculty tenure, Dr. Klaassen mentored over 120 graduate and postdoctoral students. He also serves as the director of the Mid-America Toxicology Course that has helped over 3000 scientists prepare for certification in toxicology.

Dr. Klaassen's research has focused on how chemicals reprogram the liver to deviate the path of toxicity. This research interest originated from his doctoral dissertation studies 50 years ago when Dr. Klaassen noted that chemicals known to increase the cytochrome-P450 enzymes in the liver can also increase the biliary excretion of some drugs and chemicals. Over the past five decades, he and his trainees have demonstrated that this phenomenon was due to the ability of these chemicals to activate transcription factors and the subsequent synthesis

Nathan Cherrington

Lauren Aleksunes

of transporter proteins that move chemicals into and/or out of liver cells. Dr. Klaassen refers to this phenomenon as “reprogramming the liver”. Similar to a computer programmer that programs a computer through software, the chemical reprograms the liver to increase the synthesis of transporter proteins to eliminate the toxic chemical. They showed that the heavy metal cadmium can reprogram the liver to decrease its toxicity by enhancing transcription of metallothionein protein, which bound cadmium and decreased its distribution to cadmium-sensitive proteins in the liver. During the past few years, he and his students have demonstrated that plant derived natural products can activate the Nrf2 transcription factor to induce transporter proteins, in addition to the synthesis of phase-II metabolism enzymes for chemical conjugation and detoxification.

His successful career in toxicology education and research has earned him a reputation as an internationally renowned superstar toxicologist. The Division for Toxicology was grateful for his enthusiasm to share his experience with us for this article, and to two of his previous students, Drs. Nathan Cherrington and Lauren Aleksunes, for providing the perspective of their training with Dr. Klaassen.

Read the full interview at https://www.aspet.org/aspet/news/news/2018/03/14/member-highlight-interviewees-with-dr.-curtis-d.-klaassen-and-his-past-trainees-drs.-nathan-cherrington-and-lauren-aleksunes.

Translational & Clinical Pharmacology
a division of ASPET

Translational and Clinical Pharmacology (TCP) Division Outreach at the 15th International Conference on Bioactive Lipids in Cancer, Inflammation, and Related Diseases

Submitted by Reheman Adili, MD

The 2017 Bioactive Lipids Conference took place in Puerto Vallarta, Mexico from October 22 – 25. Dr. Michael Holinstat (chair of the TCP division of ASPET) and I attended this meeting as TCP division representatives. More than 300 researchers from various academic institutions and industries from many countries attended this meeting. The TCP division of ASPET was registered as a sponsor for this international meeting and aimed to reach out to an audience composed of graduate students, postdocs, and junior faculties in order to introduce them to our division and the many benefits of being an ASPET member. The division set up a booth alongside the meeting's big sponsors in a main hallway next to the meeting room. This allowed us to interact with all attendees during coffee breaks, social hours, and poster and networking sessions. The TCP division was well represented at the meeting and we were able to talk to attendees in person-mainly the graduate students and postdocs. We were able to distribute more than 150 copies of the TCP division fliers containing information about our division throughout the meeting. Many of the attendees at the meeting were interested in continuing contact with the TCP division of ASPET and were specifically interested in becoming an ASPET member. Attendees showed interest in activities of the TCP division such as abstract submission and wished to participate in the upcoming ASPET Annual Meeting at Experimental Biology 2018 to network with the preexisting members of the TCP division. We got a lot of positive feedback from numerous attendees, especially the graduate students, on both the diversity of translational research we were able to present as well as the support we are able to offer to trainees. Students expressed interest in the mentorship programs we have in our division and the student mentor lunch sessions. Overall, the TCP division outreach at this international meeting was very successful.

2017 Bioactive Lipids Conference

Chapter News

Great Lakes Chapter

31st Annual Meeting, June 22nd, 2018

The Great Lakes Chapter (GLC) of ASPET will hold its 31st Annual Scientific Meeting on Friday, June 22nd, 2018 at the Loyola University Stritch School of Medicine.

The goal of the 2018 meeting is to highlight major advances in the pharmacological understanding and treatment of cardiovascular disease, as well as provide an opportunity for students, postdoctoral fellows, and scientists working in related areas to learn about the field. The annual meeting of the GLC of ASPET also provides a forum of learning and exchanging of ideas in all fields of the pharmacological sciences and is a major networking event for biomedical scientists in the area. The meeting schedule includes:

Poster Session: 8:30 am – 10:30 am
Vendor Exhibit: 8:30 am – 12:00 pm
Young Investigator Symposium: 10:45 am – 11:45 am
Lunch and Learn Career Workshop: Noon – 1:30 pm
Symposium: Advances in Cardiovascular Pharmacology: 1:30 pm – 4:45 pm

Keynote:
Dr. Joan Heller Brown (University of California, San Diego)
Initiation of Cardiac Inflammation and Fibrosis Through CaMKII Signaling in Cardiomyocytes

Speakers:
Dr. Paul Burridge (Northwestern University)
Dr. Raul Gazmuri (Rosalind Franklin University)
Dr. Gary Gintant (AbbVie)
Dr. Keith Jones (Loyola University)

Poster Awards and Business Meeting: 4:45 pm – 5:30 pm

Check the GLC website at www.aspet.org/GLC to register and for more information about the 31st annual GLC meeting. Abstracts are due by June 8th, 2018.

ASPET Word Jumble

Can you solve it?

Rearrange the scrambled letters to form each word. The letters in the circles form a special bonus word.

Hint: All of the words are from this issue's feature article, "Treating Malaria – From Gin & Tonic to Chinese Herbs."

SOIMOUTQ

REFVE

MIDPASLOMU

NITCO

LRMAIAA

PTNASPIOGN

PATRIASE

NCHCNIAO

QIEROCLHONU

RETNISNIMAI

Bonus Word:

Answer key is found on page 61.

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Patient with malaria in Nyangaton, Ethiopia.

CDC/James Gathany

Anopheles *mosquito*

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Cinchona calisaya

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Employers:

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- Reach ASPET's Twitter followers (almost 2,000), LinkedIn Members (over 2,000), and email subscribers (over 4,000)
- Post to just ASPET or to the entire NHCN network
- Sign up for automatic email notifications of new résumés that match your criteria
- Job activity tracking

ASPET is committed to your success:

The ASPET Career Center is the best resource for matching job seekers and employers in pharmacology and related health science fields. Our vast range of resources and tools will help you look for jobs, find great employees, and proactively manage your career goals.

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9650 Rockville Pike, Suite E220, Bethesda, MD 20814-3995
Main Office: 301.634.7060
www.aspet.org