The American Society of Pharmacognosy

Summer 2019

Discovering Nature's Molecular Potential

The ASP Newsletter: Summer 2019, Volume 55, Issue 2

60th ASP Annual Meeting: Innovations in Natural Products Chemistry

By Melany Puglisi-Weening, PhD and Tim Bugni, PhD

The organizing and scientific committees of the 2019 American Society of Pharmacognosy are looking forward to seeing you in Madison, Wisconsin for the 60th Anniversary of the Society. Rooms have been reserved at the beautiful and conveniently located Madison Concourse Hotel located in the center of Madison within steps of the Wisconsin State Capitol and surrounded by "farm to table" restaurants. You will be able to step outside the hotel and experience the thriving city of Madison. The concourse is located only a short walk from the Monona Terrace on Lake Monona. The hotels are located five miles from Dane County Regional Airport. Attendees can also fly into the General Mitchell International Airport in Milwaukee, WI or O'Hare Airport in Chicago, IL. Shuttle service to Madison can be arranged from both airports.

There is still time to sign up for the two work-

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Wisconsin State Capital, just steps from our Madison Concourse Hotel

The organizing and scientific committees have worked hard to make this a dynamic and inclusive meeting. Our plenary, invited and contributed talks include topics from many areas of natural products chemistry and speakers from diverse backgrounds. So please join us in Madison!

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EDITOR'S CORNER

By Edward J. Kennelly, PhD

The 60th ASP Annual Meeting will take place in Madison, Wisconsin from July 14 to 17. Our lead article describes the latest details about this exciting meeting. The organizers continue to highlight the diverse and interesting group of invited speakers. The overall theme of the conference is "innovations in natural products chemistry." In addition to the scientific program, there are plenty of other opportunities to enjoy Madison. This is not the first time that ASP has met in Wisconsin. As Lloyd Library archivist Devhra BennettJones reminds us, the 17th annual meeting of the ASP was held at the Telemark Lodge in Cable, Wisconsin. It is fun to read the memories of this conference from ASP Fellow Dr. Susan Horwitz and ASP Honorary Member Dr. Harry Fong from decades ago.

As *Newsletter* editor, I think one of my most important duties is to cover the deaths of ASP members in a way that helps members learn more about the lives and scientific achievements of those who have passed away. In this issue, we cover the deaths of two members who have made significant contributions to natural product chemistry in distinct ways. ASP Fellow Professor Koji Nakanishi passed away on March 28, 2019, and ASP member Dr. Ray Cooper has put together a comprehensive obituary that covers the amazing breath of Dr. Nakanishi's career. The ASP is planning to further honor Dr. Nakanishi at the 2020 International Congress of Natural Products meeting that the Society will be hosting in San Francisco. The Society also lost Dr. Judy Bolton after a long battle with cancer. Dr. Bolton's distinguished career in natural products, especially for women's health, is described in a beautiful tribute by her former UIC colleague and friend, Dr. Richard van Breemen. They worked together on UIC's NIH-funding of the Botanical Center for Women's Health, which has been funded continuously since 1999, and Dr. Bolton was a central figure in the conception and direction of this important research effort.

On a happy note, three ASP Fellows have been recognized for their achievements with significant awards. The first female president of ASP, Dr. Alice Clark, was recognized by her alma mater, University of Mississippi, for her career achievements. Dr. Susan Horwitz was given the Gairdner Award for her seminal research in cancer therapeutics. Dr. Otto Sticher received the American Botanical Council's Farnsworth Award for his many contributions to pharmacognosy research. Furthermore, three new ASP Fellows have been selected, Drs. Susan Mooberry, Bradley Moore, and Valerie Paul. Younger ASP member Ms. Vanessa Nepomuceno has, for the second year in a row, written a comprehensive introduction to the new ASP Fellows. I hope you will take a moment to get to know our ASP Fellows better.

The signing of the Dietary Health and Education Act by President Clinton in 1994 has impacted the research careers of many ASP members in various ways, from the formation of a unique part of NIH devoted to dietary supplement research to the funding of botanical research centers around the US. After 25 years, many questions about the regulation of botanicals in the US market remain. ASP member Dr. Bill Gurley has written a tour-de-force article about the status of DSHEA and botanicals in the US, as informed by the 19th Annual International Conference on the Science of Botanicals, hosted by the University of Mississippi's National Center for Natural Product Research on April 8-11, 2019.

I hope you have a great summer, and I look forward to seeing many ASP members in Madison.

EMPLOYMENT SERVICE

The Society offers a placement service to aid our members in seeking positions or employees. This service is available only to ASP members and is free to both the applicant and the employer.

For more information see the services website.
www.pharmacognosy.us/jobs/

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60th ASP Annual Meeting: Innovations in Natural Products Chemistry

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shops on Saturday, July 13. Dr. Pieter Dorrestein of the University of California at San Diego will conduct "A Hands-on Global Natural Product Social Molecular Networking Workshop for Beginners and Advanced Users," and Dr. Thomas Williamson from UNC Wilmington will conduct a workshop called "Expanding the Structure Elucidation Toolbox with Anisotropic NMR Parameters."

The opening reception is on the evening of July 13 on the roof of Monona Terrace overlooking Lake Monona. The opening session on Sunday, "Innovations in Natural Products Chemistry," will kick off a great week of science and social activities. On Sunday afternoon, Dr. Nadja Cech will chair the "Heroes of the *Journal of Natural Products* Symposium," sponsored by the American Chemical Society. This session will celebrate the careers of Drs. Gordon Cragg, David Kingston, Rachel Mata and David J. Newman. These distinguished members of the Society will participate in a panel discussion following brief introductions.

Attendees who consider themselves in the "younger member crowd" should plan to attend the Sunday night event held at the SETT on the campus of the University of Wisconsin at Madison (union.wisc.edu/visit/union-south/the-sett-at-union-south) featuring bowling, pool and table games. Another option for Sunday night is "Dine Around the Square." You can stop by the registration desk Saturday or Sunday to sign up for a table at one of the local restaurants.

On Monday morning plan to attend the National Institutes of Health National Center for Complementary and Integrative Health (NIH/NCCIH) symposium, "Diet and Gut Interactions." Speakers will include Dr. Michael P. Snyder of Stanford University, Dr. Annadora J. Bruce-Keller of the Louisiana State University Biomedical Research Center, Dr. Diana E. Roopchand of Rutgers University, Dr. Hang Xiao of the University of Massachusetts at Amherst and Dr. Jan F. Stevens of Oregon State University. Following lunch Dr. Tawyna McKee will moderate a session on "Breaking the Bias Habit." This is a timely topic for scientists in academia, industry and government. The ASP Diversity and Inclusion Committee, assembled in the last year, is addressing similar topics as they relate to the Society. Monday evening attendees will gather at the Wisconsin Institute of Discovery (discovery.wisc.edu).

Poster sessions will be held on Sunday and Monday afternoon. If you are planning to present a poster, please put your poster up in the morning of your session and remove it at the end of the session to prepare for the next day. For the finalists in the ACS student/postdoc poster competition, plan to be at your poster the full two hours of the session to make sure that the judges from the editorial board of the *Journal of Natural Products* can speak with you. Fifteen (15) finalists will be contacted prior to the conference opening. Three prizes will be awarded for the best posters during the banquet.

On Tuesday morning plan to attend the Young Members Symposium in memory of our long-time treasurer Dr. David Slatkin, sponsored by the ASP Foundation. This symposium features a diverse and dynamic group of international speakers. The afternoon is free for attendees to explore Madison and the surrounding areas. Tuesday afternoon excursions include Build a Wisconsin Cheese Board, Bitters BootCamp and a Stroll Down State Street (aspmeetings.pharmacognosy.us/registration/optional-tours-excursion/).

The organizing and scientific committees have worked hard to make this a dynamic and inclusive meeting. Our plenary, invited and contributed talks include topics from many areas of natural products chemistry and speakers from diverse backgrounds. So please join us in Madison! ■

Attendees who consider themselves in the "younger member crowd" should plan to attend the Sunday night event held at the SETT on the campus of the University of Wisconsin at Madison featuring bowling, pool and table games.

SPEAKER SPOTLIGHT: YOUNGER MEMBERS SYMPOSIUM

Alanna Condren

Alanna Condren is a PhD candidate in the Department of Medicinal Chemistry and Pharmacognosy at the University of Illinois at Chicago. Her research focuses on mass spectrometry and natural products.

Ikenna Ndukwe is a postdoctoral fellow at Merck. He received his MS from the University of Ibadan and his PhD from the University of Bristol. His research focuses on the development and application of novel anisotropic NMR methodologies to solving the constitution and configuration of molecules of varied polarities, complexities and flexibility.

Ikenna Ndukwe

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SPEAKER SPOTLIGHT: YOUNGER MEMBERS SYMPOSIUM, *continued from page 3*

Angela Sester

Angela Sester is a PhD candidate at the Technische Universität Dortmund. Her area of research concentrates on genomics-guided discovery of natural products in a predatory bacterium.

Andres Caraballo Rodriguez

Andres Caraballo Rodriguez is a postdoctoral scholar at the School of Pharmacy and Pharmaceutical Sciences at the University of California at San Diego. He completed his MS and PhD at the Universidade de São Paulo in Brazil. His area of research concentrates on mass spectrometry and natural products.

Elizabeth Kaweesa is a PhD candidate in chemistry at Oregon State University. Her area of research concentrates on the mechanisms of action of anti-cancer leads.

Joseph Egan is a PhD candidate at Simon Fraser University. He received his MS from the University of North Carolina at Greensboro. His areas of research include natural products and metabolomics data analysis.

Elizabeth Kaweesa

Joseph Egan

MADISON TIPS: BUGNI LAB FAVORITES

By Tim Bugni, PhD

Madison, Wisconsin is a small college city that offers something for everyone. The conference venue and the Concourse Hotel are located in the heart of the city. Attendees can step out of the conference and enjoy the city highlights.

State Street. State Street stretches from the Capitol to the University of Wisconsin-Madison campus and is rich with many local favorites. State Street is dense with restaurants, coffee shops, and bars.

Memorial Union Terrace. State Street also provides a fine path from the Concourse hotel to the Memorial Union Terrace, an outdoor music venue with a great selection of beer. The Memorial Union Terrace is an icon of the University of Wisconsin-Madison and is a beautiful lakeside location to relax and discuss science.

Wisconsin State Capitol. The Wisconsin State Capitol sits at the center of the city surrounded by top-rated restaurants featuring farm-to-table menus. The Capitol is well worth exploring either on a guided or self-guided tour.

B-cycle Program. For the more adventurous, bikes are available for rent or through the user-friendly B-cycle program (madison.bcycle.com/station-map). Bike paths are adjacent to the conference venue along Lake Monona and offer a gateway to exploring miles of dedicated bike paths that extend from downtown Madison through the beautiful country landscapes of southern Wisconsin.

Bring the Family. Family-friendly favorites include a free zoo, a children's museum, and the University of Wisconsin Arboretum that hosts abundant hiking trails. Madison also is only 45 minutes from the Wisconsin Dells, the waterpark capital of the Midwest.

Dane County Farmer's Market (www.dcfm.org). For anyone arriving on Friday or early Saturday morning, the farmer's market on the Capitol square is a long standing Madison tradition and a local favorite. We highly encourage you to arrive early to experience the market.

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In Memoriam: Koji Nakanishi

Dr. Nakanishi made seminal contributions to understanding the chemistry of life, natural products, the chemistry of vision, and microanalytical techniques, which were breathtaking in their creativity and breadth.

By Ray Cooper, PhD

It is with deep sadness that members of the ASP mourn the loss of a towering figure who contributed so much in natural products and bioorganic research spanning over 50 years. On March 28, 2019, Dr. Koji Nakanishi passed away in New York City at the age of 93. ASP President Susan Mooberry commented, "Professor Nakanishi was an inspiration for generations of natural products chemists, and his wide influence will continue. We mourn his passing and we will miss his creativity."

Dr. Nakanishi made seminal contributions to understanding the chemistry of life, natural products, the chemistry of vision, and microanalytical techniques, which were breathtaking in their creativity and breadth. He is remembered with affection by the scientific community, and ASP offers a tribute to a splendid teacher, a wise man and a humble and kind soul that touched so many of our lives and careers.

Dr. Koji Nakanishi

PHOTO: JOE PINIERO

Born in Hong Kong on May 11, 1925, Nakanishi earned his bachelor's degree in chemistry from Nagoya University in Japan in 1947. He earned a Fulbright scholarship, one of the first to be awarded to a Japanese student following World War II, and studied at Harvard University with Dr. Louis Fieser from 1950 to 1952. He then returned to Nagoya University and completed his PhD in 1954 and served as assistant professor at Nagoya. In 1969, Nakanishi joined the chemistry faculty of Columbia University and began to take a global approach to his research.

While in Japan in 1967, Nakanishi published the first structures of the ginkgolides from *Ginkgo biloba*, determining complex terpene structures with such small amounts isolated. We can only stand back and admire those efforts in an era of such limited spectroscopy. Nakanishi always considered this work one of his singular achievements, and he in fact returned to ginkgolides almost 40 years later, publishing a simple isolation paper revealing a method to isolate large quantities of ginkgolides in one step (Nakanishi et al. 2002. *Journal of Natural Products* 65:1501-1504). His natural products research not only included the elucidation of exquisite structures, such as the saxitoxins and brevetoxins from marine sources, but remarkable separation techniques on a microscale, using, for example, droplet countercurrent chromatography for work on insect antifeedants and centrifugal countercurrent chromatography for isolating vanadium complexes from tunicates.

Columbia named him Centennial Professor of Chemistry, a title he held until his death. He served as the chairman of the chemistry department from 1987 to 1990, mentored more than 300 doctoral students, and published over 750 papers.

Nakanishi was a major contributor at the crossroads of bioorganic science and at the forefront of introducing Western science to techniques we now take for granted. He published the first comprehensive guide for using infrared spectroscopy in organic structure analysis. His work with the exciton chirality is still used today: a vibrant program he participated in together with Professor Nina Berova at Columbia University. His extraordinary and broad vision of natural products chemistry and his close relationship to bioorganic studies, for which he received many honors and awards throughout

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Nakanishi was a major contributor at the crossroads of bioorganic science and at the forefront of introducing Western science to techniques we now take for granted.

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He constantly looked at challenges in bioorganic chemistry and pushed ever closer the boundaries at the interface between chemistry and biology. His energies took him to all corners of the globe where he contributed to global science projects.

his career, is universally accepted. Most notably he was the first recipient of the ASP Research Achievement Award in 1985 (later to become the Norman R. Farnsworth Research Achievement Award) and was twice honored for his work by the Emperor of Japan in 2007. Nakanishi also was recognized with honorary issues of journals including *Chirality, Heterocycles, Bioorganic and Medicinal Chemistry* and the *Journal of Natural Products*. Nakanishi authored, co-authored, or edited eight more books on spectroscopy and natural products research and served for many years on the editorial board of the *Journal of Natural Products*.

He constantly looked at challenges in bioorganic chemistry and pushed ever closer the boundaries at the interface between chemistry and biology. His energies took him to all corners of the globe where he contributed to global science projects. He was a founding member and the first director of research at the International Centre of Insect Physiology and Ecology in Nairobi, Kenya. He served as the first director of the nonprofit Suntory Institute for Bioorganic Research in Osaka, Japan from 1979 until 1991, and assisted the Brazilian government with the establishment of the Institute of Medicinal and Ecological Chemistry in São Paulo. From 2001 to 2003, Nakanishi served as the director of chemistry at the University of Arizona's Biosphere 2 project.

He achieved all this through his lifelong studies in natural products, his investigations into the chemistry of vision and macular degeneration, and his pursuit of new and evermore powerful analytical and spectroscopic microtechniques, solving complex structural problems and circular dichroism applied to bioorganic science. Nakanishi's insights and curiosity in applying the right solution to challenging problems are among his legacies to which the science community is deeply appreciative and grateful. The investigatory seeds planted by Nakanishi are in full bloom in research gardens worldwide as the hundreds of students and postdocs who had the opportunity and privilege to work with him, in essence, continue his legacy.

There are many examples of his work on spectroscopic techniques with use of IR, and then the development of CD, establishing the benzoate chirality rule. These research interests included the study of toxins from insects and single-celled organisms, detailed NMR studies contributing to our understanding of amyloid proteins and Alzheimer's disease, and important work in unraveling the role of retinal proteins to determine the cause and progression of macular degeneration through his work on the chemistry of vision.

ASP member Michael Tempesta, PhD, who completed two postdoctoral sessions under Nakanishi's tutelage, commented: "For those of us close to the natural products chemistry, bioorganic chemistry, and many other life sciences/healing fields, it was clear that Koji was unique among scientists and researchers. His ability to bridge the disciplines and encourage others in the pursuit, as well as the development of many new techniques for determination of structural features in stereochemical situations, was fundamental."

The science world pays tribute to a friend, teacher, and sensei, whose genius shaped hundreds of scientists' careers. On behalf of those who had the privilege of passing through Nakanishi's orbit, we pay tribute to a remarkable man of humility and warmth, who will be remembered not only for the brilliance of his research, but also for his wit, generosity, and, of course, his inimitable magic shows. ■

On behalf of those who had the privilege of passing through Nakanishi's orbit, we pay tribute to a remarkable man of humility and warmth, who will be remembered not only for the brilliance of his research, but also for his wit, generosity, and, of course, his inimitable magic shows.

In Memoriam: Judy L. Bolton

By Richard B. van Breemen, PhD

Dr. Judy Bolton

PHOTO: UNIVERSITY OF ILLINOIS AT CHICAGO

Judy L. Bolton, PhD, Distinguished Professor of Medicinal Chemistry and Department Head of the Department of Medicinal Chemistry and Pharmacognosy at the University of Illinois at Chicago (UIC), passed away on March 5, 2019 after a long battle with breast cancer. ASP President Susan Mooberry stated that "Dr. Bolton's passing is a loss to the entire natural products community. Judy had a major impact in the area of women's health, and her loss reminds us of the significant work left for us to reduce cancer incidence and develop new effective therapies."

She was born in 1962 to Canadian parents in Cambridge, UK, when her father James R. Bolton was a graduate student studying chemistry. Her family then moved back to North America in 1963 and settled in London, Ontario, where her father had a faculty position. Bolton received a BSc (1984) and a PhD (1988) in organic chemistry from the University of Toronto, where she studied under the mentorship of Dr. Robert McClelland. From 1988 to 1992, Bolton continued her training as postdoctoral fellow and then research assistant professor with Dr. John A. Thompson at the University of Colorado School of Pharmacy. It was during this time that her research on the toxicology of quinones and quinone methides began, and this topic would remain the focus of her career. After two years on the faculty at Queen's University (Kingston, Ontario), Bolton joined the department of medicinal chemistry and pharmacognosy at the UIC College of Pharmacy as an assistant professor.

Recruited to UIC in 1994 by department head Dr. John Pezzuto, Bolton belonged to a cohort of collaborative young investigators with chemistry expertise who would join a tradition of excellence in pharmacognosy research at UIC that included Drs. Geoffrey Cordell, Norman Farnsworth, Harry Fong, Douglas Kinghorn, and Doel Soejarto. Bolton's first research paper at UIC was published in *Chemical Research in Toxicology* a year later in 1995 and concerned the metabolic activation of xenobiotics that form quinones and quinone methides [1]. This research theme included the toxicity and potential carcinogenicity of quinoid estrogens and related compounds that would be the subject of most of her 150+ research papers.

Bolton's collaborative research papers with colleagues at UIC began to appear in 1997. As the most productive of these research partnerships, Judy and I published 67 research papers and one patent together. Other significant collaborators included Drs. Birgit Dietz, Farnsworth, Guido Pauli, and Pezzuto. Nearly one-third of Bolton's papers were pharmacognosy studies, and most were published with the UIC Botanical Center, which Bolton helped establish in 1999.

The NIH Office of Dietary Supplements and National Center for Complementary and Alternative Medicine (now the National Center for Complementary and Integrative Health) launched the "Centers for Dietary Supplements Research: Botanicals" program by issuing a request for applications on March 8, 1999. Applications were due just two months later. By that time, Bolton had been promoted to the rank of associate professor with tenure, and her research on estrogen metabolism and carcinogenesis was funded by two NIH grants.

Two weeks after the NIH had announced the botanical center grant opportunity, no one at UIC had responded to the challenge. With six weeks until the grant proposal deadline, Judy and I decided that each of us could lead a project, but as associate professors at the time, we wanted a full professor to serve as principal investigator. First, we asked Farnsworth to lead the center, but he initially declined. Next, we asked Pezzuto, who said he was too busy with his natural chemoprevention agents discovery program, which had recently discovered resveratrol. Pezzuto advised us to ask Farnsworth again, and he finally agreed to lead the new botanical center with me as co-director. Farnsworth had the foresight to focus the UIC grant proposal on botanical dietary supplements for women's health. The importance of this topic would become evident as data from the Women's Health Initiative alerting menopausal women to the risks of conventional hormone therapy dramatically increased interest in alternatives such as botanical dietary supplements.

With just four weeks remaining before the botanical center grant deadline, we got to work. Bolton, who was always extremely well organized and disciplined, delivered her project on estrogenic botanical dietary supplements with time to spare. With our own projects written, Judy and I then helped our botanical center colleagues write the other parts of the application. She even helped collate and mail the signed original and required photocopies of the 323-page grant application at the nearest Federal Express office just before the shipping deadline. The UIC Botanical Center was funded by the NIH and began operating in the fall of 1999.

Over the next 20 years, there were of course personnel changes in the center, such as the retirement of Farnsworth and the addition of Pauli, but Bolton and her project on estrogenic botanicals and the modulation of endogenous estrogen metabolism by botanical dietary supplements remained an essential component over time. Bolton would author or co-author nearly 50 scientific papers resulting from the UIC Botanical

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Center. Her first botanical center paper, published in 2001, addressed estrogenic botanicals used as dietary supplements and would become the most cited paper in the history of the center [2].

Mentoring young scientists was important to Bolton. During her career, she mentored 20 PhD students, 8 MS students and 24 postdoctoral fellows. About half of her mentees were affiliated with the botanical center and half were women. Bolton was a role model for young women beginning careers in the biomedical sciences, and she worked diligently to guide them. One of her former students Dr. Joanna Burdette, who is now a professor and associate dean for research at UIC's College of Pharmacy, states, "She was always selfless, charitable, and kind. She would stop whatever she was doing when one of us walked into her office with a problem. Her generosity made her a role model. Part of her generosity came from the fact that she had great respect for people. She encouraged us all to be generous with our time and with our work."

Bolton was promoted to full professor at UIC in 2002 and became department head in 2005. As an administrator, her organizational skills and work ethic enabled her to deal promptly and responsibly with her duties. Anyone who attended committee or faculty meetings with Bolton knew that she liked efficiency and expediency. Her parties were legendary, and knowing the unique skills of her faculty, Judy always asked me to select the wines.

Among her honors, Bolton was named a University Scholar in 1998, UIC Woman of the Year in 2013, and UIC Distinguished Professor in 2017. She was an active member of the American Chemical Society and was named an ACS Fellow in 2011. Bolton received the Founder's Award from the ACS Division of Chemical Toxicology in 2018 and the 2016 Taito O. Soine Award from the University of Minnesota for outstanding contributions to chemical toxicology.

Dr. Judy Bolton was tenacious and yet diplomatic in her academic pursuits. She had a wonderful sense of humor and carried gigantic purses rivaling those of Mary Poppins. She faced her illness with dignity and always remained optimistic. Bolton is survived by her father, stepmother, her brother and his family; and she will always be remembered by her academic family including her colleagues, research collaborators, and former postdoctoral fellows and graduate students. ■

ON JUDY BOLTON: A REFLECTION

By Harry H.S. Fong, PhD

Over the last quarter century, Judy Bolton and I went from being total strangers to colleagues and good friends. On August 2, 1994, while attending the ASP meeting in Halifax, Nova Scotia, I was tasked by John Pezzuto, University of Illinois at Chicago's acting head of medicinal chemistry and pharmacongosy (MCP), to persuade Judy, by "all means necessary," to leave Queen's University and take up the position of assistant professor in our department. I rung up Judy and said to her, "Lady, you don't know who I am, but…" I cannot claim credit that my unorthodox telephone greeting did the trick, but eventually she accepted John's offer.

Five years later, I returned from a World Health Organization Traditional Medicine Programme assignment and found Judy and Richard van Breemen deeply immersed at the task of drafting the application for an NIH Botanical Center grant. I rolled up my sleeves, pitched in, and subsequently worked with and got to know Judy much better at the personal and professional levels. Our relationship grew, and when I was drafted to serve as acting head of the department of medicinal chemistry & pharmacognosy in the fall of 2002, I recruited Judy to serve as assisting head for administration.

By and by, when Judy took over the helm of the department in late 2004/2005, I would "advise" her from my "emeritus" post by phone, e-mail and, occasionally, "working lunches" to share professional experiences and psychotherapy. With the passage of time, our working lunches became social events, the last of which was on the planning stage when Judy left us. I will sorely miss her and our get-togethers. Farewell, my friend.

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The ASP Welcomes Three New Fellows

By Vanessa Nepomuceno, BS

The ASP would like to congratulate and celebrate the addition of three new ASP fellows: Drs. Susan Mooberry, Bradley Moore and Valerie Paul. Selection as an ASP Fellow is one of the highest honors that the Society can impart to a research scientist in the field. Distinguished by their achievements and contributions to the field of pharmacognosy, the fellows will aid the advancement of natural product sciences by advising on science and professional matters within the ASP. In addition, the fellows serve as global advocates for our Society. The ASP recognizes and commemorates the incoming fellows.

DR. SUSAN MOOBERRY

Dr. Susan Mooberry

PHOTO: UTHSA PHOTO TEAM

Dr. Susan Mooberry is a professor of pharmacology and the Greehey Distinguished Chair in Molecular Therapeutics at the University of Texas Health Science Center at San Antonio (UTHSCSA). Dr. Mooberry's research efforts have been directed towards the discovery and development of more effective treatments for difficult diseases, such as cancer. A common theme in her work has been the discovery and understanding of the mechanisms of action of diverse microtubule targeting agents. While she has worked with natural products from a variety of sources, she is currently focusing on plants, particularly plants of the American Southwest.

"She once described herself as a combination of organic chemist and horticulturalist," notes ASP chair, Dr. Jon Clardy, "which is a pretty good definition of many ASP members."

Dr. Susan Mooberry earned her doctorate in pharmacology at the Medical University of South Carolina in Charleston and completed her postdoctoral training in molecular oncology at the Cancer Research Center of Hawaii at the University of Hawaii. In 2008, she joined UTHSCSA as a professor of pharmacology. Additionally, she is the co-leader of the Experimental Therapeutics Program of the Cancer Therapy & Research Center at UTHSCSA, an NCI-designated cancer center. Dr. Mooberry has published over 110 peer reviewed articles, reviews and book chapters and holds seven patents on new classes of microtubule targeting agents.

As the current president of ASP, her significant contribution to the Society goes without saying.

"Being elected to be an ASP fellow is very meaningful for me especially as a pharmacologist who has enjoyed the opportunity to investigate the biological mechanisms of action of diverse natural products from a wide range of biosynthetic sources. This acknowledgement from my peers demonstrates the value of chemists and biologists working together to identify new drug leads and targets for human diseases. This significant honor means a great deal to me, and I look forward to working with the other ASP Fellows in years to come."

—Dr. Susan Mooberry

Dr. Bradley Moore

PHOTO: UCSD PHOTOGRAPHY

DR. BRADLEY MOORE

Dr. Bradley Moore is a professor of marine chemical biology in the Center for Marine Biotechnology and Biomedicine at Scripps Institution of Oceanography at the University of California, San Diego (UCSD). In addition to his position as professor, he is chair of the pharmaceutical chemistry department at the UCSD Skaggs School of Pharmacy and Pharmaceutical Sciences where he holds a joint faculty appointment. Dr. Moore's research interests are in marine microbial natural products, primarily in the biosynthesis of molecules as well as their genetic manipulation. His work has led to the development of several genome mining techniques that are now standard in the biosynthetic community. Moore established biosynthetic pathways to several marine microbial compounds.

"As a Fellow, I look forward to helping expand the reach of the ASP to new research communities and investigators, such as microbiome science and synthetic biology, that study and apply the remarkable diversity of chemistry in nature," Moore states.

Regarding Moore, Dr. Clardy states, "Brad was destined to be a researcher on marine natural products as his first

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research on these fascinating molecules was conducted in his father's laboratory at the University of Hawaii while he was a high school student."

Dr. Moore received his PhD in bioorganic chemistry at University of Washington under Dr. Heinz Floss, also an ASP fellow. He completed a postdoctoral fellowship in bioorganic chemistry at the University of Zürich (Switzerland). Presently, Dr. Moore is an elected fellow of the Royal Society of Chemistry and the American Academy of Microbiology, a former president of the ASP (2013-2014), and the editorial chair of the journal, *Natural Product Reports*.

"I am just thrilled to become an ASP Fellow. The ASP is such a special organization that plays such a leading role in advocating natural product science and in supporting new generations of scientists, which are topics that I am particularly passionate about."

—Dr. Brad Moore

Dr. Valerie J. Paul

PHOTO: JOHN SPIERS

DR. VALERIE PAUL

Dr. Valerie J. Paul is currently the director of the Smithsonian Marine Station at Fort Pierce, Florida. Best known for her emphasis on marine chemical ecology, Dr. Paul's research interests include marine plant-herbivore interactions, coral reef ecology, and marine natural products. Moreover, her research has always had a large component of field work. Her current research objectives involve cyanobacteria and their sporadic, often harmful, blooms.

"Valerie has focused on marine chemical ecology since her undergraduate days at the University of California, San Diego where she worked in the laboratory of Bill Fenical, who is also an ASP Fellow," states Dr. Clardy.

Dr. Paul received her PhD in marine biology in 1985 from the University of California San Diego, Scripps Institution of Oceanography. She joined the faculty of the University of Guam Marine Laboratory in 1985, serving as director of the laboratory, and then became a full professor until 2002, when she began working at the Smithsonian. Dr. Paul has served on the editorial boards of the *Journal of Natural Products* and *Coral Reefs*. In addition, she is the author or co-author of over 285 research papers and review articles.

"I was surprised and thrilled to hear I was selected as an ASP Fellow. This is such an honor! It means a lot to me that my research in marine chemical ecology and natural products has been recognized by the ASP and the current ASP Fellows. I look forward to helping to serve and being more engaged as a Society Fellow."

—Dr. Valerie Paul

This year's new fellows work in a number of diverse areas: a prominent biomedical research center, a university-based marine institute, and a field station for the Smithsonian.

Furthermore, each researcher has distinctive research objectives: treating cancer, understanding the mechanistic logic underlying the incredible diversity we see in natural products, and diving into coral reefs to see what's happening in nature.

The ASP bestows its warmest felicitations to the three new ASP Fellows, along with gratitude for past efforts in support of ASP initiatives and anticipation for their future contributions.

Horwitz Honored with Gairdner Award

By Susan Mooberry, PhD

On April 2nd ASP Fellow Dr. Susan Band Horwitz, Distinguished Professor, Rose C. Falkenstein Chair in Cancer Research, Department of Molecular Pharmacology, Albert Einstein College of Medicine, was announced as a recipient of the prestigious Gairdner International Award, which has been likened to the Canadian Lasker, Kyoto or Nobel award. "The Canada Gairdner International Award recognizes outstanding biomedical scientists who have made original contributions to medicine with the goal of contributing through research to increased understanding of human biology and disease."[1] Awardees are individuals who have made "seminal discoveries and major scientific contributions that constitute an original and significant achievement in biomedical science."[1]

Dr. Susan Horwitz

PHOTO: ALBERT EINSTEIN COLLEGE OF MEDICINE

Gairdner Award Trophy

Dr. Horwitz' significant contributions were identifying the mechanisms of action of multiple natural products, most importantly Taxol® . Her identification of the novel mechanism of action of Taxol® facilitated its clinical development for cancer therapy, and today Taxol® remains a valuable drug in the treatment of a wide range of malignancies.

The impact of her work was summarized by the Gairdner Foundation: "Dr. Horwitz' research played a crucial role in encouraging the development of Taxol® for use in the clinic. Although no one was interested in Taxol® when she began her studies, today it is an important antitumor drug approved by the FDA for the treatment of ovarian, breast and lung carcinomas, as well as Kaposi's Sarcoma. The drug has been given to millions of cancer patients worldwide. Taxol® also is used in the preparation of stents for cardiac disease. In addition, Taxol® has proven to be an indispensable tool for scientists interested in microtubule structure, dynamics, and function."[1]

The April 18 issue of *Cell* highlighted "Leading Edge Stories" of the 2019 Gairdner awardees, and Dr. Horwitz wrote an article, "Reflections on My Life with Taxol." It highlights the serendipity as well as the challenges of research, and this thoughtful history will be of interest to natural product researchers, especially junior investigators (www.cell.com/cell/fulltext/S0092-8674(19)30326-5).

ASP President Susan Mooberry notes that the Gairdner award is a timely acknowledgement of the major impact that Susan's research has had in the field of oncology. ASP member Dr. April Risinger commented: "Dr. Horwitz' career is an inspiration. Her ability to effectively demonstrate and champion the importance of her finding that Taxol® was mechanistically distinct from other microtubule binding agents required a great deal of tenacity and dedication that ultimately resulted in the development of one of the most effective anticancer drugs in use today."

As a Gairdner Laureate Dr. Horwitz will give a series of lectures across Canada and receive a monetary prize at the awards ceremony on October 24, 2019. Heartfelt congratulations to ASP Fellow Susan Horwitz for achieving this high honor recognizing her exceptional research with natural products. ■

[1] gairdner.org/winners/current-winners/#Susan_Band_Horwitz

Dr. Horwitz' significant contributions were identifying the mechanisms of action of multiple natural products, most importantly Taxol®. Her identification of the novel mechanism of action of Taxol® facilitated its clinical development for cancer therapy, and today Taxol® remains a valuable drug in the treatment of a wide range of malignancies.

Sticher Receives ABC's 2018 Farnsworth Award

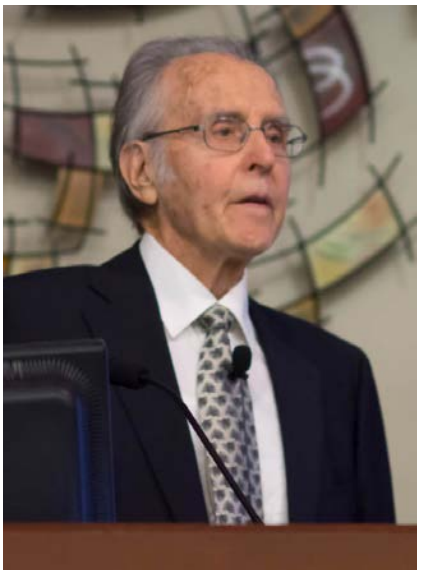
"Professor Sticher may be best known to the natural products research community for his seminal work on the structures and bioactivities of iridoids, but he was also one of the pioneers in using HPLC to measure the composition of plant extracts."

By Patricia Carver, MA

The American Botanical Council (ABC) presented its 2018 Norman R. Farnsworth Excellence in Botanical Research Award to ASP Fellow Dr. Otto Sticher, professor emeritus of pharmacognosy at the Swiss Federal Institute of Technology in Zürich, Switzerland. The prize, named after the late ASP founding member Dr. Norman Farnsworth, is awarded annually in recognition of significant research contributions made in the fields of ethnobotany, ethnopharmacology, pharmacognosy or other related area of medicinal plant research.

An ASP member since attending the first ASP/GA joint meeting in Vienna, Austria in 1970, Dr. Sticher remarked on "this outstanding recognition" and stated, "I was very honored to receive this prestigious award from the American Botanical Council. But mostly the naming of the award after Professor Norman Farnsworth honored me." He and Farnsworth first met in the late 1970s at the 20th annual ASP meeting. Their labs shared a close collaboration over the years, which, according to Sticher, "resulted in an ongoing exchange of visitors between ETH and UIC. By fostering such collaborations, Norman Farnsworth helped to build bridges internationally among scientists in the field of traditional (herbal) medicine."

Dr. Sticher himself values the importance of international collaboration and has hosted many visiting scientists at ETH Zürich from various fields of natural product research, including ASP Fellows Drs. Geoff Cordell, Heinz Floss, Harry Fong, A. Douglas Kinghorn, and David Kingston. Sticher also attended more than 20 ASP annual meetings, stating, "Over all of these years discussions with ASP members were always fruitful… I have always appreciated the meetings very much due to the high scientific level, the professional organization, the cooperativeness among participants and the excellent possibilities to meet friends."



Dr. Otto Sticher presents the 5th Farnsworth Lecture at UIC College of Pharmacy in 2017.

PHOTO: GUIDO F. PAULI

Dr. Sticher served as both a member of the board of directors of the ASP Foundation (1994-2002) and a member of the advisory board of the *Journal of Natural Products* (1994-2003). He has published over 400 papers and was senior author of approximately 250 poster presentations or short lectures. He is also the co-editor of the textbook *Pharmakognosie – Phytopharmazie,* now in its 10th edition.

ASP member Dr. Stefan Gafner, Chief Science Officer of the American Botanical Council, stated, "Professor Sticher may be best known to the natural products research community for his seminal work on the structures and bioactivities of iridoids, but he was also one of the pioneers in using HPLC to measure the composition of plant extracts. Examples of his earliest work include the HPLC analysis of licorice saponins or the bitter principles in gentian in 1977. In addition, he published what may have been the first HPLC-UV method to measure ginsenosides in Asian and American ginseng. While his research publications most often focus on the chemical or quality aspects of plants, he had a much broader view of herbal medicine quality, which he passed on to several generations of pharmacy students through training in botanical identification, macroscopic and organoleptic analysis, and botanical microscopy. Besides being an exceptional scientist, he is known to colleagues and friends mainly as a kind and honest human being, a true gentleman."

In a career that has spanned more than five decades, Sticher has received numerous other honors and awards in recognition of his lifelong contribution to medicinal plant research. Some of these include the Egon-Stahl-Award in Gold from the Society for Medicinal Plant and Natural Product Research (GA) as well as an honorary doctorate from the University of London. He is an honorary member of several societies, including the ASP, and he also was named a Fellow of the Society in 2007. More recently, in March 2014, the *Journal of Natural Products* published a special issue in honor of Dr. Sticher, which included articles by many of his colleagues, collaborators, and former students.

Dr. Sticher was presented the Farnsworth Award in absentia at the 14th Annual ABC Botanical Celebration and Awards Ceremony on March 6, 2019 in Anaheim, California. Among the previous recipients of this award are numerous ASP members, including Drs. John Thor Arnason (2015), Harry Fong (2014), Gordon Cragg (2013), De-An Guo (2012), Djaja Soejarto (2011), and A. Douglas Kinghorn (2010).

ASP President Dr. Susan Mooberry notes that this is a well-deserved recognition of the many significant contributions of Dr. Sticher to the field of pharmacognosy. The Society congratulates Dr. Sticher on another well-earned honor. ■

Clark Named UM Alumna of the Year

By David Cole Stevens, PhD

ASP Fellow and former ASP President Dr. Alice Clark received the 2019 School of Pharmacy Alumna of the Year Award from the University of Mississippi (UM). Throughout her nearly 40 year career at UM, Vice Chancellor Emerita Alice Clark led antimicrobial natural products research efforts as both the F.A.P. Barnard Distinguished Professor of Pharmacognosy and the first director of the university's National Center for Natural Product Research. She also later served in multiple administrative roles including Vice Chancellor for Research and Sponsored Programs.

"I'm so honored to be recognized in this way by the place I've called home for so many years," Clark said. "Throughout my career, I've been very fortunate to be a part of many great teams and to work with many wonderful collaborators and colleagues, especially my late husband, Dr. Charles Hufford. I am grateful to be recognized in this way for our collective efforts."

Dr. Alice Clark

PHOTO: UNIVERSITY OF MISSISSIPPI

ASP President Susan Mooberry commented, "This is a well-deserved honor for Dr. Clark who has made a positive impact for decades at UM in her role as a researcher, a mentor, an administrator and, most importantly, as the founding director of the National Center for Natural Product Research."

A pioneer in the efforts to explore natural products to address drug-resistant, pathogenic fungal infections associated with patients undergoing immunosuppressive therapies, Dr. Clark continues to serve as a mentor to junior faculty within the School of Pharmacy at UM. Dr. Clark was honored with the award at the UM School of Pharmacy's annual awards banquet on April 6, 2019. ■

Bolzani Honored by Brazilian Chemical Society

Editor's note: The ASP was recently able to expand international collaborations with a grant funded by the government of Brazil, which enabled joint membership in the ASP for all members of the Sociedade Brasileira de Farmacognosia*, and Dr. da Silva Bolzani is one such member. This relationship has brought benefits to both societies; one being that ASP members are broadening the understanding and appreciation for the important contributions of Brazilian ASP members.*

By Barry O'Keefe, PhD

ASP member Dr. Vanderlan da Silva Bolzani, professor of chemistry at the Institute of Chemistry in Araraquara, State University of São Paulo (UNESP) and vice president of the Brazilian Society for the Advancement of Science, was recently honored by the *Sociedade Brasileira de Química* (SBQ) with a prize named in her honor. The Vanderlan da Silva Bolzani Prize for Outstanding Women in Chemistry will reward women for their contributions to chemistry.

Dr. da Silva Bolzani is a vital figure in natural product research in Brazil with over 250 publications and dozens of national and international awards, including being honored with the Distinguished Women in Science Award from the American Chemical Society and being named a Fellow of the Royal Society of Chemistry. Dr. da Silva Bolzani was also the first woman president of the SBQ from 2008-2010. Her work in both research and the mentoring of young scientists has made a great impact on Brazilian pharmacognosy. The award was conferred for the first time this May at the annual meeting of the SBQ.

Dr. da Silva Bolzani

Dr. da Silva Bolzani was born in a small town called Santa Rita to a Portuguese mother and a father of indigenous heritage. She became interested in science at a young age and received a bachelor's degree in pharmacy from the Federal University of Paraíba. She then received a master's degree and continued her studies for a PhD from the Chemistry Institute of the University of São Paulo where she worked with the renowned chemist Dr. Otto Gottlieb, one of the most important figures in natural product research in Brazil. Her PhD research was on the plant order Gentianales and its production of alkaloids, including important work on the Rubiaceae. She overcame many difficulties during her education and research career and was able to excel at her scientific work while having two children and later, after her husband Jorge Bolzani's debilitating stroke, also supporting her family.

The ASP congratulates Dr. da Silva Bolzani on this achievement and joins with our Brazilian colleagues in their happiness at her well-earned recognition. We applaud her achievements, her pioneering work as a woman in science, her efforts at further developing Brazilian scientific institutions, and her dedication to training the next generation of pharmacognosists. ■

Journal of Natural Products Recognizes Outstanding 2018 Papers

By Edward J. Kennelly, PhD

The Journal of Natural Products, published jointly between the ASP and the American Chemical Society, has announced the winners of the Arthur E. Schwarting and Jack L. Beal awards for best 2018 papers. Dr. John Sorensen and coauthors received the Schwarting Award for their work on lichens,[1,2] and Dr. Aleš Machara, as a new investigator, was recognized with the Beal Award for his work on volatiles of termites.[3]

Dr. Sorensen's award-winning paper represents the first genome sequencing and annotation of gene clusters that code for natural product biosynthesis in a lichen-forming fungus. He noted, "Our primary interest is the well-known lichen natural product usnic acid, with the goal of identifying the gene cluster responsible for biosynthesis of this molecule. We chose a strain of *Cladonia uncials* that was known only to produce usnic acid as well felt that this improved our chances of success. We carried out the genome sequencing of this strain of *C. uncials* and scanned the assembled genome for the presence of glen clusters that seemed to code for natural product biosynthesis." He hopes that these observations that lichen fungi, similar to non-lichen fungi, harbor a number of "cryptic" biosynthetic pathways may help to generate some interest in this under examined group of fungi.

Dr. Sorensen, who is at the department of chemistry, University of Manitoba, Winnipeg, Manitoba, Canada, went on to say, "For me the best part of receiving this award was the recognition of the amount of hard work and effort that my two students, Robert and Mona, put into this project. I have to say we were all very thrilled we received the news. I am very grateful to the ASP for selecting us for this award."

Dr. Machara and coworkers wanted to unambiguously identify a queen-specific macrolide found in termites, *Silvestritermes minutus*. They detected a previously undescribed volatile compound using mass spectrometry and infrared measurements which led them to propose a macrolide structure. They then conducted enantiodivergent synthesis of two possible enantiomers starting from glycidyl tosylate that led to the assignment of absolute configuration on the stereogenic center and the relative configuration of present double bond. The synthetic macrolide provided sufficient material to investigate its biological role.

Dr. Machara who is at the Institute of Organic Chemistry and Biochemistry of the Czech Academy of Sciences, Prague, Czech Republic stated, "I am honored and thrilled that our paper was selected to receive the Jack L. Beal Award. This paper published in *Journal of Natural Products* is of interdisciplinary origin and does combine organic synthesis with analytical chemistry on the one hand, with ecology and biology on the other. My collaborators from Robert Hanus group and I take such recognition of our work as a kind encouragement to further continue with our research."

From left: Dr. Sorensen, Dr. Machara

The corresponding authors have been invited to attend the banquet at the ASP 2019 Annual Meeting to receive a check and a plaque in honor of their achievement. Congratulations to Drs. Sorensen and Machara and to their co-authors!

In 2001, the Foundation Board of the ASP began a new initiative to recognize the best papers published each year in the journal and named these awards after two former distinguished editors of the journal. The Schwarting Award is open to all papers, print or electronic, published in the journal within a given year. The Beal Award recognizes younger investigators, defined as persons within 12 years of receiving their PhD degree or within 10 years of gaining their first professional appointment.

A two-tier process was used to determine the winners, with editors Drs. Daneel Ferreira, A. Douglas Kinghorn, Cedric J. Pearce, Philip J. Proteau, and Steven M. Swanson having nominated two papers each for the Schwarting Award and one each for the Beal Award. ASP President Susan Mooberry then appointed an ad hoc committee [Drs. Amy E. Wright (Harbor Branch Oceanographic Institution, Florida Atlantic University), Chair; Mark T. Hamann (Medical University of South Carolina); and David J. Newman (special volunteer, National Cancer Institute)] to make the final selections. ■

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Is DSHEA Broken?

By Bill Gurley, PhD

The 19th Annual International Conference on the Science of Botanicals (ICSB) was hosted by the University of Mississippi's National Center for Natural Product Research on April 8-11, 2019. Almost 350 scientists, practitioners, educators, regulators, students, and industry representatives from 22 countries across five continents were in attendance.

This year's meeting highlighted the 25th anniversary of the passage of the US Dietary Supplement Health and Education Act (DSHEA). Accordingly, the majority of scientific sessions and panel discussions focused on key aspects of DSHEA and how its enactment has affected the regulation, marketing, research, quality, and safety of dietary supplements sold in the United States over the past quarter century.

The meeting's keynote address, entitled "25 Years of DSHEA: Historical Perspective," was a dual undertaking by two of the top authorities in the field of botanical dietary supplements: Loren Israelsen, president of the United Natural Products Alliance and a key figure in the passage of DSHEA, and Mark Blumenthal, founder and CEO of the American Botanical Council. Israelsen's and Blumenthal's perspectives on the historical and legislative underpinnings of DSHEA, the act's role in the genesis of the modern dietary supplement industry, not to mention its positive and negative impacts on US health care, were enlightening and entertaining. A central theme of the keynote address was the rapid expansion of the dietary supplements industry since the implementation of DSHEA in 1994 and whether the act is still effective legislation when it comes to regulating dietary supplements, especially with regard to safety.

As testament to this concern, approximately 4,000 dietary supplements were on the US market in 1994 with annual sales of approximately $100 million, whereas by 2019 more than 75,000 products crowd the marketplace generating annual sales in excess of $40 billion. Much of this expansion can be linked to the internet – a phenomenon whose implementation was coeval with the enactment of DSHEA – and its impact on dietary supplements-related markets, both domestically and globally.

An expanded feature of this year's ICSB was the implementation of nine separate panel discussions delivered by internationally-recognized experts focusing on the impact that 25 years of DSHEA has had on: supply, conservation, sustainability, and regulatory compliance of botanical ingredients; sports nutrition; botanical dietary supplement safety (2 panels); methods for toxicological assessment of botanical safety; medical hemp; pharmacopeial standards and botanical quality; evolution of analytical approaches for botanical standardization; and basic and clinical research on botanical dietary supplements. Without detailing each presentation, it was clear that several important "lessons" have been learned over the last 25 years of dietary supplements research. Some of those hard-learned lessons include the following:

1) Botanical dietary supplements (BDS) are complex phytochemical mixtures that beget complex research problems requiring, at times, complex solutions.

The archetypal category of complex BDS, especially from a safety perspective, are "proprietary blends." The complex pharmacology that can arise from blends of multiple botanical extracts is perhaps best exemplified by *Ephedra*-containing BDS, proprietary blends of natural sources of ephedrine alkaloids, caffeine, and other phyto-stimulants. *Ephedra*-containing BDS, marketed from 1994-2004 as weight-loss aids and exercise performance enhancers, were ultimately removed from the US market by the FDA due to "an increased risk for adverse health effects." Today, several categories of proprietary BDS blends (e.g., exercise performance enhancers, sexual performance enhancers, weight-loss products) still challenge the FDA and the medical community.

2) BDS must be independently verified for phytochemical content.

Researchers who fail to heed this warning will be vexed in a host of ways. Unlike conventional medications, dietary supplements are not required to undergo premarket safety and efficacy testing, thus the product label claim may not always reflect its phytochemical content. Several experts at this year's ICSB discussed the evolution of analytical methods, instrumentation, and good practices for botanical verification and phytochemical characterization.

3) Contamination and adulteration plague many BDS

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categories.

From 1994-2008, the rapid expansion of the dietary supplements industry not only heightened demand for botanical ingredients, but also set the stage for certain suppliers and manufacturers to adapt dubious business practices. Problems of purposeful adulteration with conventional medications or surrogate botanicals as well as contamination by heavy metals, microbes, and pesticide residues have caused many consumers and health care professionals to eschew BDS altogether. Other victims of these practices, and the subsequent negative publicity, have been ethical dietary supplements manufacturers. Although implementation of current good manufacturing practices (cGMPs) for the dietary supplements industry in 2008 helped curb many of these concerns, certain categories of BDS (e.g., weight-loss products, sexual performance enhancers, and body-building supplements) are still plagued by these bad practices. At this year's ICSB, representatives from FDA, other international regulatory agencies, and several dietary supplements industry advocacy groups addressed how these issues have been, and are still being, addressed.

4) Human clinical pharmacokinetic parameters for most unique phytochemicals are unknown.

It was clear from several oral and poster presentations at this year's ICSB that a basic understanding of phytochemical disposition in humans is still woefully inadequate. This stems from the fact that basic research into the pharmacokinetics of phytochemicals is not a pre-marketing requirement under DSHEA. Accordingly, research into this important aspect of dietary supplements safety and efficacy is left up to academicians and a few prudent DS companies.

5) BDS can interact with conventional medications, although only a few appear to be clinically relevant.

As BDS safety was a common theme at the 2019 ICSB, the topic of herb-drug interactions took center stage in several panel discussions. Since 2000, when it was recognized that St. John's wort (*Hypericum perforatum*) can render many conventional medications ineffective, research into the area of herb-drug interactions (HDI) has continued apace. While only a few botanicals appear to pose clinically relevant interactions with prescription drugs, the vast majority have yet to be examined. While clinical HDI studies are the gold standard, they are oftentimes cost prohibitive; however, several novel *in vitro* approaches were presented that may aid in identifying those botanicals that would merit further clinical study.

6) Significant disconnects exist between *in vitro* HDI predictions and *in vivo* realities.

Due to their ease of performance, low cost, and multiplicity of available platforms, *in vitro* studies conducted with microsomal systems, primary hepatocytes, transfected cell lines, sandwich human hepatocyte cultures, and many others, have been a mainstay for predicting potential HDIs. Unfortunately, very few of these predictions translate to the human *in vitro* condition. Despite the identification of several factors underlying this *in vitro/in vivo* disconnect, a significant body of misinformation about HDIs has been disseminated to the medical community. Several novel *in vitro* approaches, whose HDI predictions have been confirmed in clinical settings, were presented at the ICSB. The success of these new platforms may pave the way for more reliable *in vitro* predictions of clinically relevant HDI.

7) Dosage form performance (e.g., disintegration and dissolution) is largely unknown and can adversely affect clinical study outcomes.

Poor dosage form performance is an overlooked and underappreciated aspect of questionable BDS efficacy. If a BDS dosage form does not disintegrate properly or release its phytochemical components into gastrointestinal fluids in a reasonable time frame, the product is unlikely to meet up to its "structure function" claim. A basic tenet of pharmaceutics, the science of drug dosage form design, is that "if a drug doesn't go into solution it cannot be absorbed." This holds true for phytochemicals as well. Many purportedly "active" phytochemicals are very lipophilic and are not readily solubilized in gastric or intestinal fluids. On the other hand, hydrophilic phytochemicals may be easily solubilized, but their extreme polarity may preclude uptake across the intestinal mucosa. In both instances, BDS oral bioavailability can be very low. By assessing dosage form performance, an insight into BDS efficacy, or lack thereof, can be achieved. Many clinical studies of BDS fail to assess performance characteristics of the selected dosage form. This aspect was noted by several participants at the ICSB as a possible reason for the lack of efficacy of several large clinical trials funded by industry and the National Institutes of Health.

8) Novel BDS dosage forms may enhance efficacy and/or toxicity.

Recognizing that poor BDS dosage form performance can adversely affect bioavailability, several new technologies have been adapted to improve phytochemical solubility and absorption. Technologies utilizing phytosomes, liposomes, nanoemulsions, lipid nanoparticles, and others can marked-

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ly improve phytochemical bioavailability when compared to dosage forms containing conventional botanical extracts. At present, many conventional BDS dosage forms have excellent safety profiles and low HDI potentials simply because their phytochemical physicochemical properties, in the context of a conventional extract, render them insoluble. While these new technologies may improve BDS efficacy, they may also negatively impact safety. To date, very few of these novel dosage forms have been evaluated for their HDI potential.

9) Despite 25 years of use, health care professionals are still largely ignorant of the positive and negative aspects of BDS.

As pointed out by several presenters at ICSB, perhaps the most discomfiting legacy of 25 years of BDS usage in the US is that most consumers and health care professionals remain largely ignorant of the positive and negative attributes of these products. It is not uncommon to hear consumers say that "BDS are natural and more safe than conventional drugs," whereas health care professionals often claim that "BDS are unregulated and therefore unsafe." In both instances, these statements are largely untrue. Despite the fact that most pharmacies sell BDS, the pharmacist is rarely able to counsel a patient on the usage, selection, and safety of a particular product. This holds true for physicians as well, even though most BDS label claims warn that a physician should be consulted before using the product. Educating consumers and practitioners about BDS will be one of the most important goals for the next 25 years of DSHEA.

In between panel discussions were scientific sessions whose major themes were education, safety, and cannabis. Specific among these topics were presentations on educating laypersons and health care professionals about botanicals (both dietary supplements and traditional uses); botanical characterization and quality assessment; natural product drug discovery; global perspectives on the regulation of botanical products; traditional Chinese medicine; and cannabis—a lot on cannabis, especially the regulation and safety of medical cannabis.

While all nine presentations on cannabis and its regulation were very instructive, three on cannabidiol deserve more detailed commentary. Dr. John Ingram, a pediatric neurologist at the University of Mississippi Medical Center, described his group's success in treating several types of drug-resistant pediatric epilepsies with a cannabidiol-rich cannabis extract produced at the National Center for Natural Product Research. Perhaps the most compelling aspect of Dr. Ingram's data was the dramatic reduction in seizure frequency once the cannabis extract was incorporated into a regimen of other antiepilepsy medications. Alice Mead, a representative of Greenwich Biosciences, detailed the development history, regulatory hurdles, and manufacturing process for Epidiolex®, an FDA-approved cannabidiol-rich product marketed for the treatment of several neurological conditions. Her talk helped illustrate how lessons 1, 2, 4, 5 and 7 can be adequately addressed when bringing a drug of natural product origin to market. Dr. Igor Koturbash, a toxicologist at the University of Arkansas for Medical Sciences, presented data from his laboratory highlighting several safety concerns regarding cannabidiol hepatotoxicity and the potential for a significant hepatotoxic acetaminophen-cannabidiol interaction. Dr. Koturbash's data reveals some of the latent concerns for natural products like cannabidiol that undergo little medical or scientific scrutiny prior to marketing.

In short, a lot has changed in the first 25 years of DSHEA. Going forward, should there be changes made to DSHEA in order to "catch up" to the ever-expanding DS market? Should there be another tier/category of BDS products that have demonstrated adequate quality and safety? Is a product registry needed in order to rein in some of the DS industry's "bad actors"? After 25 years, is there now a need for BDS clinical research organizations that can conduct the proper clinical "safety" studies for products aiming for this upper-tier category? In turn, can the demonstration of "safety assurance" impart some type of market exclusivity? These were just a few of the queries that arose during question and answer sessions – a few of which were quite heated – following each panel discussion.

With indications from the US Food & Drug Administration that it may revisit how dietary supplements are regulated, coupled with the meeting's upcoming 20th anniversary, the 2020 ICSB meeting will likely be another edition "not to miss." ■

As pointed out by several presenters at ICSB, perhaps the most discomfiting legacy of 25 years of BDS usage in the US is that most consumers and health care professionals remain largely ignorant of the positive and negative attributes of these products.

Extremophiles on the Rise

By Gordon Cragg, DPhil

ASP members Lesley-Ann Giddings and David Newman have noted that microbes are, and continue to be, a valuable source of natural product therapeutics for the treatment of disease, and that "the continuous number of drugs derived from these agents that are approved each year remains unmatched by compounds synthesized via combinatorial chemistry, renewing scientific interest in natural product drug discovery." [1,2] They also note that the "low-hanging fruit" derived from microbes found in "normal" terrestrial environments has been exhausted. This has resulted in a rise in the exploration of unique terrestrial and marine environments in the quest for extremophilic microbes as a source of novel bioactive agents, and they have reviewed the progress made in these areas.[3,4,5]

A recent article in *Chemical & Engineering News* highlighted some of the novel bioactive metabolites discovered from microbes isolated from toxic remnants of now defunct industrial operations.[6] The focus of the article is on the evolution of the research program of ASP members Andrea and Don Stierle who, in 1995, launched their studies of extremophilic microbes isolated from the metal-laden, highly acidic waters of Berkeley Pit, a toxic lake of wastes generated by what used to be one of Montana's richest copper mines. Their research has led to the discovery of a range of novel structure types exhibiting activity against MMP-3 and caspase-1. Of these, berkeleydione showed activity against non-small-cell lung cancer lines in the NCI 60 cell line screen,[7] while a new spiroketal, berkelic acid showed activity against ovarian cancer cell lines.[8] Later work studying metabolites generated by the co-cultivation of two fungi yielded novel 16-membered macrolides, one of which, berkeleylactone A, exhibited potent activity against gram-positive bacteria, particularly those already resistant to other antibiotics, including methicillin-resistant *Staphylococcus aureus* (MRSA); it is thought to act by a novel mechanism of action.[9]

The article also refers to Lesley-Ann Gidding's study of the extremophilic microbes thriving in abandoned copper mines in Vermont using the metagenomic analytical approach, as well as to Jon Thorson's research exploring abandoned coal mines in Kentucky for novel extremophiles, including abyssomicin metabolites from *Streptomyces* species.[10,11]

ASP members are involved in several other relevant projects of considerable interest. Among these are Christine Salomon who is exploring the hibernation habitats of American bats located in underground mines, such as Soudan Iron Mine in Tower, Minnesota, in search of microbial sources of antifungal agents to combat white-nose syndrome. This syndrome is a deadly invasive mycosis caused by the psychrophilic fungus *Pseudogymnoascus destructans,* which is decimating large populations of hibernating bats.[12] In addition, Bill Fenical and his colleagues at Scripps Institution of Oceanography, Paul Jensen and Brad Moore, have been at the forefront of marine microbial research, particularly microbes collected from marine sediments, which has yielded a host of bioactive agents as exemplified by metabolites isolated from the *Salinispora* genus.[13] Finally, Kerry McPhail has been collaborating with Richard Lutz of the Center for Deep Sea Ecology and Biotechnology at Rutgers University in the study of deep sea hydrothermal vent organisms as a source of novel metabolites.[14]

The promise of extremophiles has also attracted the attention of the public through press reports. *The Washington Post* recently carried an article "Microbes Called Extremophiles Might Combat Superbugs, Biowarfare Agents" which highlighted research funded by the Department of Defense on samples collected from various environments, including deep sea vents.[15] *The Post* has also highlighted the research being performed by Sean Brady and his group and their public outreach through the "Drugs from Dirt" project.[16]

All this favorable publicity augurs well for promoting public interest in the immense value of natural products in expediting the discovery of novel drugs for the treatment of a range of serious diseases, in particular the development of effective drugs for the treatment of drug resistant microbial infections which pose a significant threat to the health of numerous patients worldwide. Kudos go to the many ASP members involved in these important research endeavors. ■

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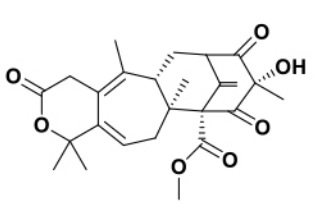
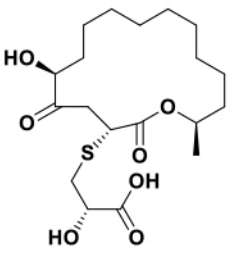
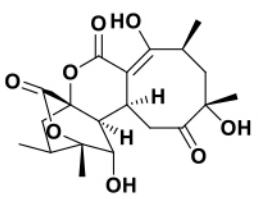


Berkeleydione



Berkeleylactone A



Abyssomicin W

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Purdue Graduates Sweep ASP 2019 Elections

By Edward J. Kennelly, PhD

ASP President Dr. Susan Mooberry announced the results of the 2019 elections on April 12 in an e-mail to ASP membership.

Dr. Nicholas Oberlies, Patricia A. Sullivan Distinguished Professor of Chemistry at University of North Carolina, Greensboro, will be the incoming vice president beginning this July. In accordance with the ASP bylaws, Dr. Oberlies will then assume ASP presidency in July 2020 for a one-year term. Dr. Oberlies currently serves as the ASP secretary.

Dr. Craig Hopp, deputy director, Division of Extramural Research, National Center for Complementary and Integrative Health of the National Institutes of Health, has been elected for a four-year term on the ASP executive committee.

Drs. Hopp and Oberlies were both doctoral students of ASP member Dr. Jerry McLaughlin at Purdue University, and both received their PhD in medicinal chemistry and pharmacognosy in 1997.

Dr. Mooberry wrote, "Thanks to all the candidates for participating and being willing to serve the American Society of Pharmacognosy, and thank you for voting in this important election."

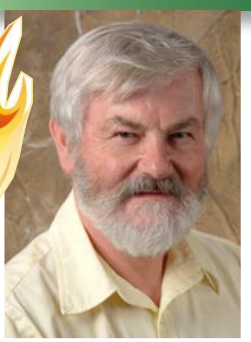
Dr. Nicholas Oberlies

PHOTO: UNC GREENSBORO

Dr. Craig Hopp

Dr. Mooberry wrote, "Thanks to all the candidates for participating and being willing to serve the American Society of Pharmacognosy, and thank you for voting in this important election."

Hot Topics in Pharmacognosy: A(g)kemy and Modern Drug and Drug Candidates!



By David Newman, DPhil

As a result of surfing the ACS journals recently, I came across an ASAP Perspective in *Journal of Medicinal Chemistry*[1] that piqued my interest. This perspective was from a group of Italian researchers and covered the "Medical Uses of Silver." It came about as a result of a discussion with a layman attending an open meeting and proudly stating that he made his own colloidal silver preparations and used these as "medicine etc."

A search of the available current literature unearthed an online book published by Springer in 2018 entitled *Biomedical Applications of Metals*[2] with one of the editors being the lead author in the *J. Med. Chem* article. There are two particular chapters in that book that are of interest from the aspect of silver and compounds as drugs. The first by Martins et al.[3] covers "Biomedical Applications and Adverse Effects"; the second by Marcelino et al.[4] covers "Metal-Based Drugs for Treatment of Malaria." Reading the latter chapter took me back to 1965-1966 when I was working as an organometallic chemist in the United Kingdoms's Unit of Nitrogen Fixation at Queen Mary College in London. There we worked with "pyrophoric phosphines," but these current ligands as discussed below are stable to water and oxygen.

In the Marcelino et al. chapter[4] they report on agents based on phosphane complexing agents, producing ionic metallo-complexes with Ag^{+} as the metal and the counterion being PF_6^{-}. Quoting from the actual paper[5] rather than the chapter "[Ag(thp)4]PF6 [**1**] was the best performing complex: ESS development was found to be reduced by >85% in all experimental replicates at 100 μM and in 2 out of 3 experiments at 10 μM. Dose range experiments allowed to estimate a half maximal inhibitory value below 5 μM (IC50 2.24μM)." ESS refers to *Plasmodium* Early Sporogenic Stages, using an assay that followed parasite development in the host's midgut within 24 hours. Further details are given in the 2016 paper, and in that paper the authors point out that metallo-compounds are actively being studied as antimalarials, but currently not including silver complexes.

Moving away from antimalarials and into usage of silver in antiquity and forwards, as methods for what today would be known as either disinfectants or antimicrobial activities, there is a long history of the application of metallic silver for such uses. It must be appreciated that using today's definitions may not always be correct, but in the absence of other information, it is all that we have. Paraphrasing some of the information from the Martins[3] chapter, Herodotus (middle 400s BCE) stated that the Persian kings never drank water unless it had been stored/transported in silver containers. Macedonians (perhaps Alexander the Great) attempted to prevent or treat surgical (war wounds?) infections and used silver plaques to encourage healing. Silver nitrate was mentioned in a pharmacopoeia published in Rome in 69 BCE, so it was probably used as a medicament, though for what is unknown.

Over centuries, the use of silver as a "disinfectant" for water purification was widespread, though evidence as to "purification" in the modern sense is absent, as this was well prior to van Leeuwenhoek's identification of "animalcules" in 1676. It was also used in wound dressings and neonatal ophthalmia, with a requirement in the United States starting in 1881 that a 1% solution of $AgNO_3$ should be used with a single drop in each eye following birth.[6] Evidently the original source of this usage was by Crede in Leipzig in 1881.[7] Before the introduction of penicillin in the late 1940s, this was the only effective prophylaxis for what was known as "gonococcal ophthalmia neonatorum." The essay by Standler[6] is freely available and should be read if only to show how backward state regulations/statutes can be when no scientific input is required. Although there were many folk remedies that used silver (colloidal or as particles), and there are complementary and alternative treatments for many "diseases," no valid scientific/clinical evidence has been published for such usage.

Moving away from antimalarials and into usage of silver in antiquity and forwards, as methods for what today would be known as either disinfectants or antimicrobial activities, there is a long history of the application of metallic silver for such uses.

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Hot Topics in Pharmacognosy: A(g)kemy and Modern Drug and Drug Candidates!

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Currently the "approved" use of a silver-based medication is the topical treatment of burns by using silver sulfadiazine cream [**2**]. Although this appears on the WHO 2015 List of Essential Medicines, a systematic review in 2016 by Heyneman et al.[8] recommended against the usage of the cream as sloughing of skin cover can occur, and there can be significant absorption of the sulfa portion of the medication due to removal of the silver ion by body fluids.

The current situation is definitely of interest from a pharmacognosy aspect, and perhaps from a complementary and alternative aspect as well, though not in the United States where colloidal silver cannot be marketed with any claim of efficacy. However, particularly in countries East of Suez, there are some very recent papers that have been published, where medicinal and other plant sources have been used to produce silver nanoparticles that are being investigated for their therapeutic potential. I will discuss one review that was published in 2019 by Rahman et al.[9] from Pakistan, as it has some interesting examples of the use of endophytes to produce silver nanoparticles rather than using the more conventional nanoparticle methods that use a variety of chemical manipulations.

The process is fundamentally simple in that once the endophytic microbe has been isolated and purified (which is not always a simple task as the author can testify to!), then the separated pellet and/or culture supernatant are mixed separately with $AgNO_3$ and the formation of the nanoparticles are demonstrated by a color change from colorless to brown. This might be a problem with some fungal cultures in particular but can be overcome. The further isolation and purification use standard methodologies for dealing with nanoparticles produced by chemical means. An excellent table showing the characteristics of the AgNPs produced is part of this review and covers reports from 2012 to 2018 and demonstrates the differences in the materials that can be obtained in a relatively simple process. An interesting question would be whether or not cultures not from endophytic or epiphytic sources would also produce similar AgNPs.

In addition to using microbes to generate AgNPs, the use of plants (hence the pharmacognosy link) is also a viable route. Consideration has to be given to at least the following factors when working with plant-based systems. The first is pH. A variation in pH can alter the charges of the biomolecules in the extracts, and different interactions can occur with the Ag+ cation, which can alter the physical properties of the AgNPs. Control of temperature can be critical, as thermally stable AgNPs are often the products of higher controlled temperatures and often have a higher yield, though the temperatures used are experimental in nature depending upon the components. The reaction time is also usually a function of temperature. Probably the most important factor is the ratio of extract to silver nitrate as this can materially alter the shape and size of the resulting AgNPs. A table that is somewhat similar to that in Rahman's[9] review is also in the *J. Med. Chem* review in terms of their physical characteristics.

The uses of such AgNPs are being investigated, and an excellent series of examples are shown in the *J. Med. Chem* perspective[1] including a thorough discussion of the potential mechanisms involved in damage to microbial or tumor cells, with the emphasis being that the "active entity" is the released Ag+ ion, but there must be other mechanisms involved as the AgNPs have a higher activity against microbes than a comparable concentration of silver ions.

One very important area, however, that the AgNPs might well prove to be efficacious in in future studies, is their activity against biofilms, which are major problems in patients with in-dwelling catheters, particularly those requiring central line nutrition or delivery of antitumor drugs/antibiotics to areas deep within the body. Currently experimentation is ongoing for such uses.

Finally, the most important take-home lesson is that all of the reported data from controlled studies are from *in vitro* studies, and/or topical applications, not from *in vivo* studies in animals or man. Currently the use of colloidal silver and/or AgNPs, as far as the author is concerned, particularly in the world of alternative and complementary medicine, should currently have *caveat emptor* on any label as evidence as to safety. Efficacy is not proven, except in some very specific cases of the topical use in newborns of $AgNO_3$ and derivatives such as silver sulfadiazine in burn treatment. ■

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One very important area, however, that the AgNPs might well prove to be efficacious in in future studies, is their activity against biofilms, which are major problems in patients with in-dwelling catheters, particularly those requiring central line nutrition or delivery of antitumor drugs/antibiotics to areas deep within the body.

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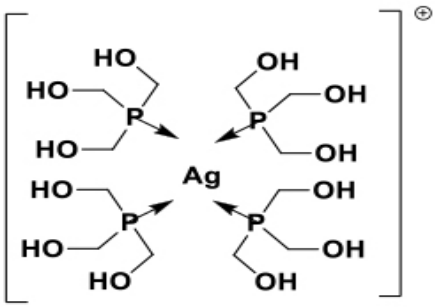

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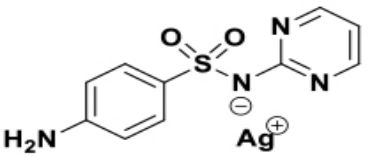

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Behind the Scenes in Pharmacognosy: Scalable Biosynthesis of Kainic Acid

By Andrea Rague, BS

In April of 2019, *Angewandte Chemie International Edition* published an article entitled, "Scalable Biosynthesis of the Seaweed Neurochemical, Kainic Acid," authored by Dr. Jonathan Chekan, ASP member Dr. Bradley Moore, 2018 ASP Undergraduate Research Awardee Ms. Malia Moore, and others. We thank both Dr. and Ms. Moore for taking some of their time to share their work and insights with ASP members. Please read the full article in *Angew. Chem. Int. Ed.,* 2019, DOI: 10.1002/anie.201902910.

The Moore Lab at Scripps Institution of Oceanography, UC San Diego.

PHOTO: FERNANDO CAMARGO

How did you become interested in elucidating the biosynthetic pathway of kainic acid in seaweeds?

We recently established the biosynthesis of a related chemical, the neurotoxin domoic acid, produced by toxic oceanic diatoms of the genus *Pseudo-nitzschia* (Brunson et al., *Science*, 2018, 361, 1356-1358). We were thus curious if the structurally simpler kainic acid from seaweeds would be biosynthesized by related enzymes. We also wondered if seaweeds cluster their genes for biosynthesis, much like we had just unexpectedly discovered in domoic acid-producing diatoms, since there were no known examples in the scientific literature. So, there were lots of motivations from the basic science side of the story, let alone the applied opportunity to produce the commercially important kainic acid in a way superior to current synthetic approaches.

Could you provide a brief explanation of the work and results in your own words?

We predicted that kainic acid is made by just two enzymes based on how domoic acid is constructed in diatoms. So, we set off to find a supply of a kainic acid-containing seaweed so that we could get hold of some DNA. Dr. Toshiaki Teruya from the University of Ryukyus in Japan came to our rescue. Toshiaki collected the red algae *Digenea simplex*, the best known kainic acid seaweed, and mailed us a sample. To make a long and complicated story short (plus it is elaborated below), we sequenced its genome and identified the two domoic acid-like genes we set out to find. We were totally thrilled to see them clustered in the genome, suggesting that perhaps seaweeds cluster natural product genes for biosynthesis much like we see in microbes and some plants. We then expressed the two seaweed genes, a prenyltransferase and an oxygenase, in *E. coli* and showed that they could convert glutamic acid and dimethylallyl pyrophosphate into kainic acid. Short and sweet! I challenged my postdoc to use this information to make not just milligrams of the neurochemical, but rather grams, and he did! So keep reading…

Who in your lab was involved with this research?

The chief architect of the project was Dr. Jonathan Chekan, a LSRF postdoctoral fellow who joined my lab in early 2018. Jon led each part of the project, from sequencing the seaweed genome to developing the biosynthetic strategy to produce kainic acid at the gram scale. Another postdoc Dr. Shaun McKinnie, who was one of the primary drivers of the related domoic acid study, is a superb synthetic chemist and worked with Jon on synthesizing the pre-kainic acid pathway intermediate. The third person in my group was Malia Moore who worked closely with Jon on cloning, expressing and characterizing the kainic acid biosynthesis enzymes from several seaweeds. Malia is a chemical biology undergraduate student at UC Berkeley and spent the summer of 2018 with us as an ASP undergraduate research awardee. Oh, and she's my daughter.

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We also wondered if seaweeds cluster their genes for biosynthesis, much like we had just unexpectedly discovered in domoic acid-producing diatoms, since there were no known examples in the scientific literature.

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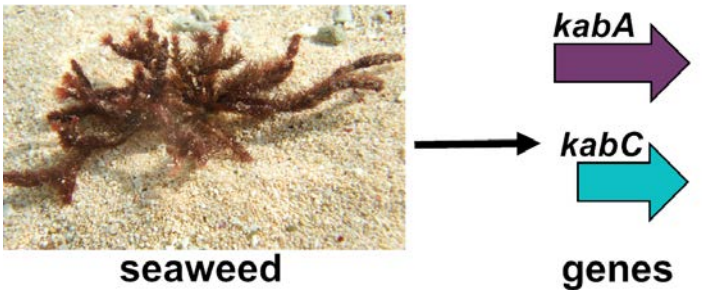
Our greatest challenge was dealing with an environmental seaweed sample full of critters and little friends. So we actually ended up sequencing a metagenome that included a variety of bacteria and microeukaryotes in addition to the seaweed.

Were there any new techniques or instrumentation that you learned to use specifically for this research?
We had never sequenced the genome of a seaweed before. As a matter of fact, very few seaweed genomes have actually been sequenced, so our learning curve was steep. Plus we had to deal with freeze-dried seaweed material mailed to us. Jon tried many different DNA isolation strategies before finally purifying DNA that had to be of high quality because we had decided to use a new long-range DNA sequencing technology. We teamed up with Todd Michael, a professor and director of informatics at the J. Craig Venter Institute in La Jolla and an expert with Oxford Nanopore sequence technology. Todd and Shane Poplawski, also of JCVI, worked with Jon to sequence, assemble, and polish the *D. simplex* genome with nearly 50 Gb of sequence generated on a PromethION sequencer. The longest read was a staggering 1.2 Mb! Really cool and exciting technology that can be done at your bench.



Graphical summary of the work reported in this paper. Seaweed kainic acid biosynthetic gene clusters were found and used to produce kainic acid.

What was the greatest challenge in developing this methodology?
Our greatest challenge was dealing with an environmental seaweed sample full of critters and little friends. So we actually ended up sequencing a metagenome that included a variety of bacteria and microeukaryotes in addition to the seaweed. Jon and Todd had to sort through all these other organism DNA sequences to eventually assemble the *D. simplex* draft genome and locate the co-clustered kainic acid genes.

In this study, you were able to express biosynthetic genes from seaweed in *E. coli* for the scalable production of kainic acid. What relevance does this have for the future of natural products research?
Yes, that was very gratifying being able to prepare the seaweed neurochemical kainic acid by making use of the biosynthetic enzymes in *E. coli*. I was frankly shocked at the simplicity and scalability of the concise biosynthetic process in comparison to the published lengthy synthetic procedures. Kainic acid is such a simple molecule, yet up to that point, chemical synthesis had failed to deliver a similarly simple synthetic answer. So this project has eliminated in my laboratory any hesitancy in mining any genome, or metagenome for that matter, to identify and apply natural product biosynthetic strategies to make molecules. Now that is pretty exciting stuff!

What is a favorite nonscientific activity of your lab?
Without a doubt, my favorite nonscientific activity is our annual Scripps Pier Swim party that we have hosted over the past 13 years. This late summer tradition brings together many of the natural product and microbiome groups at Scripps Oceanography and UC San Diego for a day at the beach complete with fun and competitive activities like swimming around the iconic pier at Scripps, beach flags, beach volleyball, surfing, and tug-of-war. The students and postdocs design a T-shirt each year, make tons of food, and really get to know one another (and their science) in a relaxing and fun atmosphere.

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So this project has eliminated in my laboratory any hesitancy in mining any genome, or metagenome for that matter, to identify and apply natural product biosynthetic strategies to make molecules.

After collecting 16 species and creating a plant extract library of 86 different extracts, I confirmed traditional uses of the medicinal species through pharmacological bioassays in Germany.

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Does your lab have a motto or slogan?
Our recent saying is to *embrace being uncomfortable*. Meaning…I encourage my group members to continually push themselves and explore new scientific methods, resources, and systems in order to bring change and innovation to their research goals and toolbox.

What is your greatest extravagance in the lab?
Well that's easy, our lab is located in Scholander Hall at the Scripps Institution of Oceanography just steps from the Pacific Ocean and one of the nicest swimming and surfing locations in San Diego. Just the other day the group took an impromptu break to watch a humpback whale breaching in front of our building. Where else can you whale watch from the inside of your lab?

What advice would you give to scientists starting their careers in natural products?
Be bold, be passionate, and take risks. I guess that counts for any career.

Ms. Malia Moore spent the summer of 2018 working in the Moore Lab as an American Society of Pharmacognosy Undergraduate Research Awardee. During this time, she was able to work on the research presented in this paper. We are thankful that Malia took the time to answer some of our questions about her undergraduate research.

How has receiving the 2018 ASP Undergraduate Research Award benefitted you, and how do you think it will impact your future?
Receiving an ASP undergrad research grant was very exciting and made me feel like I'd earned a place in the scientific community that I've grown up around and aspired to be a part of. The financial support allowed me to focus on my research while only having to work part time to support my summer. The process of applying was challenging and required me to dig into published literature and revisit my course work. It was a great experience in communicating my science. The grant also supported a purchase of field equipment to help with seaweed collection. Being able to take a lead role in local collection motivated me to apply for the scientific diving program offered through UC Santa Cruz, which I am currently enrolled in while I remain a student at UC Berkeley! This course will prepare me to conduct underwater sampling in grad school. I am grateful to the ASP for awarding me this grant for this project, as it has truly been a catalyst in my studies.

Why do you think that research is a valuable experience for undergraduates? How has it impacted your own undergraduate experience?
I entered college and worked through my freshman year knowing that I liked chemistry and the natural world. However, it took committing to different research labs and projects and spending time in the lab every day to discover what aspects of research I like and dislike and what I want to learn more about. Working closely with Jon on this project was inspiring, as he's a fantastic enzymologist, mentor, and human. A lot of research under the large umbrella of biochemistry excites me, but not all of it, and doing research and being exposed to how science is done, alongside such passionate people, helped me to figure out what direction I want to take things. Being part of a group of researchers imparts a feeling of belonging in the world of science that can be hard to grasp when taking competitive courses full of smart people. It's fun and challenging and great preparation for future work in science.

How has being a third-generation natural products researcher influenced your interests as a scientist?
Having family background and success in marine natural products demonstrated to me that you don't have to be just a biologist or just a chemist. In fact, where the most insight often occurs these days is when scientific disciplines communicate and draw inspiration from nature. My future research goals lie in marine biochemistry with applications in conservation science. A lot of the work that I have done through my different undergraduate research experiences with enzymatic mechanisms, biotransformations, and analytical chemistry has given me a unique perspective on problems that are most often approached from a bio/ecology perspective. Knowing that my dad and grandfather found their somewhat nontraditional scientific niches emboldens me to be a bit creative in finding mine. ■

A lot of the work that I have done through my different undergraduate research experiences with enzymatic mechanisms, biotransformations, and analytical chemistry has given me a unique perspective on problems that are most often approached from a bio/ecology perspective.

New Members of ASP Summer 2019

ASP would like to welcome our new members. The Society's main objectives are to provide the opportunity for association among the workers in pharmacognosy and related sciences, to provide opportunities for presentation of research achievements, and to promote the publication of meritorious research. New members include 13 full members and 5 associate members. We look forward to meeting you and learning more about you and your work.

FULL MEMBERS

Dr. Munhyung Bae
Postdoctoral Fellow
Harvard Medical School
Boston, Massachusetts

Dr. Caroline Birer
Postdoctoral Associate
University of Pittsburgh
Pittsburgh, Pennsylvania

Dr. Néstor Carballeira
Professor
University of Puerto Rico
San Juan, Puerto Rico

Dr. Sklyar Carlson
Postdoctoral Research Associate
Smithsonian Marine Station
Fort Pierce, Florida

Dr. Amila Dissanayake
Research Associate/Postdoc
Michigan State University
East Lansing, Michigan

Dr. Katherine Duncan
Chancellor's Fellow and Lecturer
University of Strathclyde
Glasgow, Scotland

Prof. Brian Fulton
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Northeastern University
Boston, Massachusetts

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Product Safety Scientist
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Pharmacognosy Field Notes: Unlocking Secrets of the South Pacific Sea

By Anne Marie Sweeney-Jones, MS and Julia Kubanek, PhD

In June of 2018, we traveled from the Georgia Institute of Technology in Atlanta to the brilliant blue waters of Fiji to collect marine organisms and perform chemical ecology experiments around some of the world's most beautiful coral reefs. To get to our destination, we spent 15 hours flying, 4 hours on a bus, 8 hours on a ferry, and the last leg in a small boat filled to the brim with field supplies and researchers. Although much of our stay was spent in cloudy, windy weather that produced some challenging conditions for collecting organisms and conducting field experiments, we successfully accomplished our goals while also enjoying the camaraderie between members of our group, including our Fijian collaborators who are based at the University of the South Pacific in Suva, Fiji.

Fiji

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GOOGLEPHOTO: RICHARD MERCER

Since our research group had previously embarked on similar journeys, our goal for collecting samples on this trip was to prioritize re-collecting marine organisms that were currently being evaluated by students in the lab due to their promising pharmacological potential. On one of our dives, we came across a patch of cyanobacterial tufts that appeared morphologically similar to a species we were studying. Hunting for this cyanobacterium felt like participating in an Easter egg hunt since the tufts were oval and thumb-sized and distributed around the reef in unexpected spots. During another dive, we found a treasure trove of crustose coralline algae growing in nooks and crannies of a steep reef wall, including a species covered in mustard spots that we targeted because previous collections had led to the discovery of a new class of antibacterial diterpene glycosides.

Our "lab" on Ono Island where we set up our chemical ecology experiments and processed collections of marine organisms for our natural product drug discovery project.

PHOTO: ANNE MARIE SWEENEY-JONES

In addition to collecting marine organisms for natural product discovery, we also performed experiments to investigate the ecological roles of the major metabolite from the mustard spotted alga mentioned above. This diterpene glycoside is produced at high concentrations in algal tissue, leading us to question what role it plays in its natural environment. In some cases, algae produce compounds such as these as a defense to prevent herbivores, like fish, crabs, and snails, from eating them. With this in mind, we designed an experiment to determine whether the diterpene glycoside deters herbivore grazing. We used hermit crabs collected in the intertidal zone as our native herbivore and were careful to use replicated, randomized treatments with natural concentrations

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In addition to collecting marine organisms for natural product discovery, we also performed experiments to investigate the ecological roles of the major metabolite from the mustard spotted alga.

Anne Marie Sweeney-Jones deploying the antifouling experiment on ropes under a floating dock.

PHOTO: JULIA KUBANEK

A hermit crab consuming an artificial algal diet containing diterpene glycoside.

PHOTO: ANNE MARIE SWEENEY-JONES

of the compound embedded in realistic artificial food to evaluate our hypothesis. This type of design is in contrast with the early days of marine chemical ecology when a goldfish in a cup with compounds dissolved directly in the water was considered an adequate test condition to evaluate antifeedant activity, demonstrating how dramatically this field has evolved.

When we gave 36 individual hermit crabs the choice of diterpene glycoside-laced food or "control" food, which had the same nutritional value but no test compound, we found that crabs ate both foods at similar rates, indicating that the diterpene glycoside is probably not a feeding deterrent. Even though our hypothesis ended up being rejected by the data, we were excited to answer an ecological question with statistically analyzable, quantitative data despite our "lab" being merely a table in the grass under a tent and palm trees. While setting up this experiment, the lovely Fijian women who worked in the kitchen were incredibly accommodating of our many requests to use their gas stove and tea kettle to prepare the hermit crab food recipe.

A second hypothesis we tested was whether the algal diterpene glycoside prevents the settlement of microorganisms on the surface of the alga, initiating a process known as biofouling. Biofouling can reduce algal photosynthesis and lead to loss of algal tissue. Therefore, producing an antifouling agent can protect algae and reduce the incidence of these negative fitness effects. To determine if the diterpene glycoside reduces or prevents surface accumulation of microorganisms, we deployed dishes of gel embedded with the test compound in the ocean for several days. We encountered numerous challenges while setting up this experiment. Successfully applying the gel to the dishes before it solidified was a race against time that we did not always win. Additionally, some of the gels did not adhere properly to the dishes causing the gels to slide off when submerged in water. Luckily, our careful planning ensured that we had more than enough replicates to generate usable results.

Deploying the fouling experiment involved swimming several hundred meters in full SCUBA gear while carefully transporting the precious gels before descending next to a floating dock located in the middle of the bay. The waves that day added an extra challenge to our task of securing the ropes that were hold-

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Although the diterpene glycoside did not act as a feeding deterrent or prevent biofouling in realistic field assays, the results allowed us to focus on other possible roles the compound might have in the marine environment.

Julia Kubanek assembling test conditions for the antifouling experiment to evaluate if an algal diterpene glycoside prevents settlement of microorganisms.

PHOTO: ANNE MARIE SWEENEY-JONES

Anne Marie Sweeney-Jones with the feeding experiment used to evaluate the palatability of diterpene glycoside-laced food to hermit crabs.

PHOTO: JULIA KUBANEK

ing the test dishes to the chains anchoring the dock. After several days in the ocean, we removed the gels, stained them, and took pictures of each gel. Image analysis of stained gels revealed that there was no discernible difference between the control and test conditions, leading us to conclude that the algal diterpene glycoside does not deter fouling, at least in the timeframe we tested.

Although the diterpene glycoside did not act as a feeding deterrent or prevent biofouling in realistic field assays, the results allowed us to focus on other possible roles the compound might have in the marine environment. Once we returned home, we measured growth-inhibitory effects of the diterpene glycoside against several different marine fungi associated with algal disease and found that it does in fact act as an antifungal defense. Given the high natural abundance of this compound and the observed antifungal activity, this ecological role for the natural product makes sense.

Members of our research team with our Fijian hosts on Ono Island.

PHOTO: RICHARD MERCER

This trip taught us how to overcome challenges and improvise in the field to accomplish our research goals. After putting in a lot of hard work to set up these experiments, it was incredibly rewarding to obtain exciting results. Getting out of the lab to experience the incredible diversity of organisms found in the waters of Fiji, apply our skills as scientific divers, and feel the excitement inherent in the search for promising specimens is a great reminder of why we pursue this area of science. ■

Conference Calendar

The *Newsletter* is pleased to announce the following upcoming conferences and meetings. The events portrayed here reflect what listings and notices the *Newsletter* has specifically received. For a more extensive calendar, please visit the ASP website at www.pharmacognosy.us. If you have a conference or event you would like mentioned, please send us relevant information, including any graphics or appropriate fliers, at asp.newsletter@lehman.cuny.edu.

60th Annual Meeting of the American Society of Pharmacognosy

July 13 – 17, 2019

Madison, Wisconsin

aspmeetings.pharmacognosy.us

Natural Products in Drug Discovery and Health (NatProDDH), organized by Phytochemical Society of Europe (PSE)

July 28 - 31, 2019

University of Lisbon, Lisbon, Portugal

www.emedevents.com/c/medical-conferences-2019/natural-products-in-drug-discovery-and-health-natproddh-2019-1

67th Annual Meeting of the Society for Medicinal Plant and Natural Product Research

September 1 – 5, 2019

Innsbruck, Austria

www.ga2019.at/

XVI International Symposium on Marine Natural Products & XI European Conference on Marine Natural Products

September 1-5, 2019

Peniche, Portugal

wmnp2019.ipleiria.pt/

2nd International Conference on Traditional Medicine, Phytochemistry and Medicinal Plants (TMedPM-2019)

September 30 - October 2, 2019

Berlin, Germany

unitedscientificgroup.com/conferences/traditional-medicine-phytochemistry-and-medicinal-plants/

6th World Congress on Medicinal and Aromatic Plants for Human and Animal Welfare (WOCMAP VI)

November 13 - 17, 2019

Famagusta, Northern Cyprus

wocmap2019.org/

Gordon Research Seminar: Chemical Biology and Drugs Discovery from the Marine Environment

February 22 – 23, 2020

Ventura, California

www.grc.org/marine-natural-products-grs-conference/2020/

12th International Congress on Natural Products Research

July 25 – 30, 2020

San Francisco, California

icnpr2020.org

Brief News from Washington

By Georgia Perdue, PhD

- Even in a contentious atmosphere in Congress, on May 8, **the House Appropriations Committee passed a 2020 spending bill of almost $190 billion for labor, health and education. Included are $41.1 billion for NIH, a hefty $2 billion increase.** As usual, nothing is set in stone. Expect a possible cut in these funds before it is all said and done.
- On April 25, **World Malaria Day,** NIAID Director, Dr. Anthony Fauci, issued a statement noting: "…one of the world's oldest and deadliest diseases remains a critically important public health and biomedical research challenge. Despite remarkable advances in reducing malaria incidence and deaths since 2000, recent progress has become stagnant and has even reversed in some regions." **WHO reported that in 2017 about 219 million cases of malaria occurred worldwide…435,000 people died. NIAID is committing to a "reinvigorated malaria research program…." This year's theme is "Zero malaria starts with me…."**
- **A "Breakthrough Therapy" designation for an "investigational treatment for severe malaria"** was granted on April 24, by **FDA to La Jolla Pharmaceutical Co., for LJPC-0118, superior to quinine, in reducing mortality in people with severe *falciparum* malaria."** The company plans to file a New Drug Application with FDA later this year.
- **After 30 years of research, 10 million doses of a new vaccine developed by GlaxoSmithKline and PATH Malaria Vaccine Initiative were donated to the Malawi government for treatment of babies and children.** Stay tuned. [*FDA News*].
- Relief for another difficult disease was granted to Sanofi Pasteur by FDA on May 3. Approval was granted for the **vaccine, Dengvaxia, the first to prevent dengue disease in youngsters ages 9-16 with past history of the disease. Dengue is also endemic in American Samoa, Guam, Puerto Rico and the Virgin Islands.** [*Medscape*]
- **On April 5 FDA Commissioner Scott Gottlieb stepped down from his job. President Trump wasted no time in nominating NCI Director Dr. Norman Sharpless as Acting FDA Commissioner. Dr. Douglas Lowy** has been elevated from Deputy Director to Acting Director at NCI. "Doug will do a great job," noted Dr. Sharpless at the March 25 NCI Board of Scientific Advisors (BSA).
- At the March BSA meeting, Dr. Sharpless pointed to NCI "Key Focus Areas":
  - Reaffirm our commitment to **basic science** to drive novel approaches and technologies
  - **Big Data** - increase data aggregation and interpretation to speed our work across the cancer enterprise
  - **Workforce Development** - Support the cancer research enterprise by focusing on the workforce of cancer investigators
  - **Clinical Trials** - fully realize the power of clinical trials through innovative design, administration and analysis.
- At the same BSA meeting Dr. Sharpless also noted the

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World Malaria Day "…one of the world's oldest and deadliest diseases remains a critically important public health and biomedical research challenge. Despite remarkable advances in reducing malaria incidence and deaths since 2000, recent progress has become stagnant and has even reversed in some regions."

Plants seem to be in the news a lot lately. The latest... "plant-based diets...lower the risk for [incidence] of heart failure." Normally known as part of the Mediterranean diet, this news is about eating more vegetables and dried legumes, i.e., chickpeas, lentils, etc. I remember being told: *all things in moderation* — a wonderful Greek adage!

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Cancer Moonshot effort **ends in 2024**. The 200 million/year lasts until 2020 then is reduced annually.

> The **big news** at the BSA meeting was the announcement by Dr. Sharpless of **the appointment of Dr. Sara Hook as the new Associate Director at NCI, Frederick.** She received her PhD in pharmacology in 1999 from Duke University Medical Center. She also did post doc research at the Fred Hutchinson Cancer Research Center. **"She has shown commitment and dedication since she came to NCI,"** noted Dr. Sharpless.

➢ Another nugget from Dr. Sharpless at the BSA meeting: **"Vice President Pence believes Congress will increase funding for childhood cancer research."** Stay tuned.

➢ In the February 5 NIH series of lectures, *Demystifying Medicine,* Dr. Stefan Sievert, Associate Scientist, Biology Department, Woods Hole Oceanographic Institution, and Dr. John Dekker, NIAID's Chief, Bacterial Pathogenesis and Antimicrobial Resistance Unit, part of the Clinical Immunology and Microbiology Laboratory, discussed ***"Exploring Deep Sea Ecosystems and Human Disease."*** (This **most interesting** lecture is available on NIH Videocast.)

➢ ***Tecentriq*** (atezolizumab), an immunotherapy developed by Roche and used in combination with carboplatin and **etoposide,** was approved by FDA to treat lung cancer patients and more significantly extend their lives.

➢ In early April FDA again warned of **kratom** products containing high levels of heavy metals. Kratom is isolated from the leaves of *Mitragyna speciosa* (see previous columns for more details). It is a nemesis!

➢ The decades old drug **colchicine used to treat gout is now available in liquid form under the name Gloperba from Romeg Therapeutics, Woburn, MA.** It was approved by FDA in February. The company noted that this formulation allows doctors to adjust the doses more easily.

➢ Plants seem to be in the news a lot lately. The latest… "plant-based diets…lower the risk for [incidence] of heart failure." Normally known as part of the Mediterranean diet, this news is about eating more vegetables and dried legumes, i.e., chickpeas, lentils, etc. I remember being told: *all things in moderation* — a wonderful Greek adage! [*Medscape Daily News* May 3].

➢ Dietary supplements are in great demand and hence in constant news. Drug interactions caused by supplements are getting attention. A few of the culprits include: garlic, ginger, ginkgo, turmeric…interacting with anticoagulant drugs; goldenseal, hibiscus, hawthorn can lower blood pressure even more for those taking antihypertensive drugs; cinnamon, fenugreek increase risk of hypoglycemia; chamomile, lavender, valerian increase drowsiness. [*Medscape* online, April 13] ■

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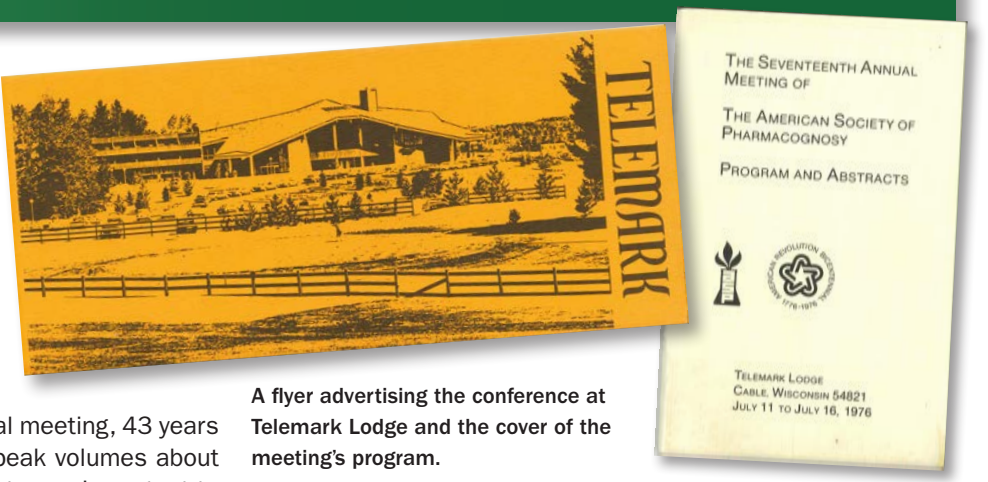
From the Archives:
The 17th Annual ASP Meeting—Telemark Lodge in Cable, Wisconsin

By Devhra BennettJones, CA



A flyer advertising the conference at Telemark Lodge and the cover of the meeting's program.

The ASP's annual meeting prevails as the apogee event of the Society each year. When the Society's members travel to Madison, Wisconsin in July to celebrate 60 years of natural products science through the theme, *Innovations in Natural Products Chemistry – An Interdisciplinary Approach to Understanding Nature's Chemical Library*, they will visit the state that hosted the 17th annual meeting, 43 years ago. Views of past ASP annual meetings speak volumes about the timely topics and academic subjects that were important to the Society. A reflection on the 1976 gathering is a window into the genesis and growth of today's vibrant ASP.[1]

Drs. Phillippe S. Benoit, William D. Loub and Gordon H. Svoboda visited Mt. Telemark Lodge near Cable, Wisconsin during April 18-20, 1975 to explore the venue and negotiate arrangements for the 17th annual meeting.[2] They reserved 125 rooms from Sunday, July 11 to Friday, July 16, 1976. That year the lodge rooms cost $24.00-$32.00 a day, which is equivalent to $107-$142 in 2019. Conference registration cost $45.00 for ASP members, $60.00 for non-members, and a special rate of $5.00 for graduate students.[3]

> **Included in the registration fee:**
>
> **2 complimentary drink tickets for get-together on Sunday, 5:00-7:00 p.m.**
>
> **1 ticket for western cookout, free beer (all you can hold), soda, Monday evening, 6:30 p.m.**
>
> **1 ticket for banquet (plus 2 glasses of French wine), Thursday evening, 7:00 p.m.**
> **Coffee on breaks.[4]**

The committee of three established the ASP headquarters for the week in the Carley Room. They arranged for the executive committee and editorial advisory board to meet in the Pearson Room. The scientific sessions and the Sunday evening get-together were designated for the Laukka Theatre. The Monday evening western cookout was held by the outdoor swimming pool. The annual ASP banquet convened in the Namekagon Room.

The schedule allowed for two free afternoons on Tuesday and Thursday. On Tuesday the scientists and their families enjoyed a canoe trip on the Namakagon River at a cost of $7.00 per canoe. They also had the option to experience Lake Namakagon in pontoon boats or tour the Chippewa Flowage, a man-made lake of 15,300 acres. Telemark also offered resort activities of indoor and outdoor swimming pools, golf, tennis, horseback riding and walking the woods trails. Benoit, Loub, and Svoboda anticipated "a frustrating delay" at lunch on both Monday and Wednesday as the coffee shop capacity was 101 people and the dining room was 160. The 17th Annual Meeting had the highest registration thus far at 249. In lieu of delays, they arranged for an all-you-can-eat style "Special deli platter luncheon" for $4.75 per person on Monday and a "French dip luncheon" for $4.25 each on Wednesday. Benoit, Loub, and Svoboda included in their report that, "Any and all gripes concerning any snafus can be deposited in the circular file behind the box of our unlisted room numbers."[5]

Drs. Steve Byrn, John Cassady, Ted Nettleton, and Mrs. Susan Tafur developed the 1976 scientific program. The symposium *Naturally Occurring Antitumor Agents of Clinical Interest* was composed of eight plenary lectures and three introductory presentations. The

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symposium participants included two members of the ASP (Drs. Heinz Floss and S. Morris Kupchan), three scientists from the US (Drs. Susan Horwitz, Koert Gerzon and Milan Slavik), and one each from Italy (Dr. Federico Arcamone), Canada (Dr. James Kutney) and Japan (Dr. Hamao Umezawa). The session moderators were Drs. John Douros, Gordon H. Svoboda, and William Bradner. Sixty 15-minute paper presentations formed the corpus of the conference with 55 scientists from the US, two from Iran, one from Sudan, and one from Tokyo. The Waters Associates, Co. displayed high-pressure liquid chromatography equipment during the annual meeting.[6]

The publicity for the 1976 annual meeting is an indicator of significant methodology changes from 43 years ago. Instead of social media and the internet, Drs. George Constantine, Elmore Taylor, and Carlton E. Turner sent an announcement to over 95 professional pharmacy journals. They prepared an off-white flier with black lettering and relied on ASP members to publicize the meeting. A flier was placed in all out-going ASP correspondence, regardless of the topic. Individuals in other countries helped promote the meeting, and scientific and local program chairmen distributed the fliers. The committee contacted 40 radio and television stations in the Cable, Wisconsin region. They telephoned the three major television networks ABC, CBS, and NBC with the response, "Gee, I wish I could attend, but I have to attend the Democratic National Convention."[7] Committee members contacted national newspapers of the day—*Wall Street Journal, National Observer, Washington Newsworks.* They also made overtures to the National Institute on Drug Abuse about establishing labs to do x-ray crystallography on drugs of natural origin; however, federal budget reductions prevented their participation.[8]

Highlights of the annual business meeting included passing the editorship of *Lloydia* from Drs. Arthur E. Schwarting and William Kelleher to Jack L. Beal in 1977. Schwarting and Kelleher were lauded for their excellent service and credited with the growth and professionalism of *Lloydia*. The *Botanical Codex* Committee, chaired by Dr. Norman Farnsworth, submitted their report outlining an action-plan to investigate the viability of such an ASP publication. A *Botanical Codex* was envisioned as a compendium of widely used plant and animal products that did not enjoy official status, and therefore did not usually have established quality standards. The primary consideration was the problem of adulterant assessment, particularly chemical compounds that should not be present. This committee was in place for eight years until 1982, when it was dissolved due to lack of initiative from the US Federal Drug Administration.[9]

The ASP's 17th annual meeting closed with resolutions of congratulations and deep gratitude to all of the 1976 officers and committees. Dr. Harry H.S. Fong was installed as the next ASP President. He fondly recalled memories of the annual meeting at Telemark Lodge:

Norman Farnsworth (bottom center) playing a game of poker with some of his colleagues at the annual meeting including: Drs. Hildebert Wagner and William Loub (talking in the background); and Drs. Maung Tin Wa, William Kelleher and Florence Pettler (sitting at table) – circa 1968.

PHOTO: HARRY H.S. FONG

> The ASP meeting at Telemark Lodge, Cable, WI was transformative. I have some great memories, among which was cruising around rural Wisconsin in a Buick convertible with my life mentors/coaches, Gordon Svoboda and Norman Farnsworth, in search of night life (an oxymoronic adventure), prior to the meeting. Most significantly, the ambience of the venue transformed the ASP and took its annual meetings out of the university dorms (forever) and into the family friendly venues that the Society members and their families/significant others enjoy to this day. Norman Farnsworth bemoaned to the end that this meeting marked the end of the close camaraderie of the ASP members……the presence of the wives/husbands/children scattered his buddies and broke up his beloved annual poker games that began in our room at the very first ASP annual meeting. (I was the designated bar keep, being his first graduate student.)[10]

ASP Fellow Dr. Susan Horwitz also reminisced about the evocative experience.

> Telemark Lodge was lovely. I remember the beautiful wild flowers. The land was absolutely flat, and I was told that the US Olympics cross country ski team practiced there in the winter when there was lots of snow. There were few females present. I recall that I flew to Minneapolis and took a very small plane to the lodge. There were three of us on the plane - the pilot, myself and Professor Umezawa. In 1976 I was 39, and I remember being awed by Umezawa. I asked him if he had any women in his group and he told me no - they could not work as late as his students and fellows did. In 1976 I would not have spoken about Taxol since at that time I had never heard of the molecule. I must have spoken about camptothecin or the epipodophyllotoxins.[11] ■

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LITERATURE CITED

[1] *American Society of Pharmacognosy Collection*, Lloyd Library & Museum, Box 1, Folder 11, **1975** Business Meeting Minutes, Report of the 1976 Local Program Committee.

[2] Telemark was founded as an alpine ski area by Tony Wise in 1947. A massive lodge was built in 1972 but struggled financially as ski lifts and less costly airfare opened up bigger hills. The American Birkebeiner ski race was the vision of Wise, who discovered skiing as a soldier serving in Germany in World War II. After the war, Wise brought his concept home to found Telemark ski area, near Cable, WI and later evolved the concept into a cross-country ski race through the north woods of Wisconsin. While the race originally began in Hayward and ended in Cable, WI, since 1993 the race has traveled north to south from the north woods of Cable to Main Street in Hayward, WI. The American Birkebeiner was patterned after the Birkebeiner Rennet ski race held each year in the forests of Norway. Wise's vision shaped a community, a sport and brought the world together with the founding of the Worldloppet, an international sports federation of cross-country skiing marathons. **2019** American Birkebeiner Ski Foundation. www.birkie.com/museum/

[3] *US Inflation Calculator,* Coinnews Media Group, **2008-2018**. www.usinflationcalculator.com/

[4] *American Society of Pharmacognosy Collection*, Lloyd Library & Museum, Box 1, Folder 11, **1975** Business Meeting Minutes, Report of the 1976 Local Program Committee.

[5] *American Society of Pharmacognosy Collection,* **1975.**

[6] *American Society of Pharmacognosy Collection*, Lloyd Library & Museum, Box 1, Folder 12, **1976** Business Meeting Minutes, Report of the 1976 Scientific Program Committee.

[7] The 1976 Democratic National Convention met at Madison Square Garden in New York City in July 1976. They nominated former Georgia Governor Jimmy Carter for President and Minnesota Senator Walter Mondale for Vice President. John Glenn and Barbara Jordan gave the keynote addresses. Jordan's keynote address made her the first African-American woman to deliver the keynote address at a Democratic National Convention. Carter and Mondale went on to win the **1976** presidential election on November 2.

[8] *American Society of Pharmacognosy Collection,* Lloyd Library & Museum, Box 1, Folder 12, **1976** Business Meeting Minutes, Report of the 1976 Publicity Committee.

[9] *American Society of Pharmacognosy Collection,* Lloyd Library & Museum, Box 1, Folder 12, **1976** Business Meeting Minutes, Progress Report from the Botanical Codex Committee.

[10] Fong, H.H.S., email to Lloyd Library & Museum Archivist, Devhra BennettJones, 6 April **2019**, 12:36 p.m.

[11] Horwitz, Susan B., email to Lloyd Library & Museum Archivist, Devhra BennettJones, 11 May **2019**, 11:41 a.m.

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