BOYCE THOMPSON INSTITUTE: 40 COUNTRIES. 110 RESEARCHERS.

THE GLOBAL REACH OF SCIENCE

BTI 2016 IN REVIEW

"So, by helping men to study plants, I may perhaps be able to contribute something to mankind."

William Boyce Thompson

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LETTER *from* THE PRESIDENT

Dear Friends,

Like explorers scouting out new terrain, BTI scientists extend the boundaries that define our understanding of the life sciences. 2016 saw breakthrough discoveries about molecular signals in the beneficial interactions between plants and fungi in the periphery of the roots, with potential future applications as natural fertilizers. Greater understanding of roots and their microbial neighbors holds promise for more harmonious relations between agricultural systems and our environment. BTI explorations into the poorly-understood universe of small biological molecules brought new perspectives in the science of aging, challenging us to imagine how we might extend life-spans. At the lab bench, at the computer, or in the field, our scientists pulse with the same thrill of discovery that William B. Thompson expressed when founding the Institute, "The possibilities! I lie awake at night sometimes, thinking about them."

Science is ever more global, interdisciplinary, information-rich, and collaborative, making it imperative to re-imagine how we communicate and build careers. The Plant Science Research Network, which I lead, is a very broad-based organization of plant scientists that has been holding a series of town hall meetings and workshops, to envision the future and build a consensus of how to achieve the potential of plant-based discoveries. The Network is advocating that we dispense with concepts such as a training "pipeline," in favor of a customizable, free-form network of resources, and believes in empowering trainees to discover and achieve their personal goals. The deluge of data is also a major challenge and opportunity for life scientists. Here, the network is advocating actions that connect users and information, and make that information accessible and meaningful. BTI is launching a new computational biology initiative to help this process locally, much as we provide resources to our students, postdocs and technicians to advance their careers in the direction of their choice.

Cultural richness gives BTI strength, diversity, connections, and a unique environment for scholarship and learning.

The global nature of science is reflected in the 40 countries whose citizens currently work at BTI – a number that is astounding given that we are a family-sized organization. Cultural richness gives BTI strength, diversity, connections, and a unique environment for scholarship and learning. Indeed, realizing the potential of life sciences in the 21st century is only possible with an unimpeded flow of knowledge, and of the scientists themselves. BTI is committed to upholding those precious principles.

Sincerely,

LETTER *from* THE BOARD CHAIR

Dear Friends and Colleagues,

2016 provided inspiring examples of how BTI continually raises the bar for research in the life sciences. The board takes pride in the work done at the Institute in Ithaca, and also in collaborations with Cornell, throughout the country and with partners abroad, as we advance BTI's mission of improving agriculture, the environment and human health. BTI's founding vision brings with it hope that we will advance agriculture to meet the demands of a growing population through sustainable, environmentally sound methods.

While agriculture is at the heart of the Institute, BTI also boasts trailblazing scientists who have ignited the interest of board members and BTI supporters through their work in human health. Research on insect viruses, nematodes, and salicylic acid continues to offer potential for both BTI and people who stand to benefit from these discoveries.

BTI's founding vision brings with it hope that we will advance agriculture to meet the demands of a growing population through sustainable, environmentally sound methods.

We were fortunate to add four new members to our board this year: Jacqueline Heard, Nancy Rawson, Jan Nyrop, and Paula Mueller. Jacqueline brings unique experience in entrepreneurship to the board, which will be an asset to the development of BTI's intellectual property and potential startup companies. Paula is an invaluable resource, helping guide BTI's investment strategies to ensure we maintain a healthy endowment. Nancy is already proving to be an asset as we explore new arenas for funds development, and Jan brings scientific expertise regarding crop pests and continues the tradition of Cornell appointed members.

In May, BTI welcomed Stephanie Meyer as the Senior Director for Institutional Advancement. Stephanie's leadership created new momentum, which led to an increase in several key philanthropic categories, including doubling the amount of total dollars raised, growing the base of supporters, enhancing alumni engagement, and broadening the reach of communications. It was especially inspiring to see BTI surpass its employee giving goal, which resulted in the awarding of scholarships to potential first generation college students at greater-Ithaca area schools. I am proud that we maintained 100% board participation for the second year in a row and surpassed our target for the year, which demonstrates both the board's commitment and our enthusiasm for the discoveries that lie ahead. Each member embraces their role as Ambassador for BTI and actively seeks opportunities to represent the Institute and spread news of its accomplishments, impacts and discoveries.

Board member Paul Chomet collaborated with the Postgraduate Society on a pilot program matching postdocs with mentors in industry. The pilot has matched 15 pairs of postdocs and mentors, most of whom are alumni of the Institute. The board applauds this work for providing a much needed networking platform for our skilled lab members and distinguished alumni.

We also witnessed the board in action, using their invaluable business experience and professional network to support a start-up company based on the research of Dr. Frank Schroeder. We look forward to the applications that will emerge from this endeavor.

As we move into 2017 and beyond, I am inspired by the level of board engagement and the exciting work being accomplished by the staff and faculty of BTI.

MESSAGE *from* THE VICE PRESIDENT OF RESEARCH

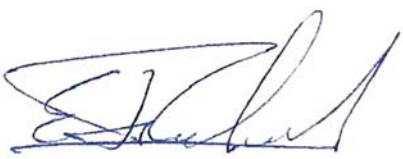
Dear BTI Community,

One measure of the vitality of our research is the large number of peer-reviewed publications authored by BTI scientists in the past year. Nearly 90% of these 101 published reports had authors from more than one research group, most involving scientists from outside the walls of BTI – underscoring the importance of collaboration, a theme highlighted throughout this annual report.

One of the major activities of the BTI research community was the search for a new BTI faculty member. I want to thank my fellow members of the search committee as well as the Postgraduate Society and the many other members of the BTI community that made this search a success. From this process, I am delighted that we were able to recruit Fay-Wei Li to join the BTI faculty. As you will read elsewhere in this report, Fay-Wei is an evolutionary biologist who employs genomics to study plant adaptation and diversity. His research represents an important shift in approach to harness a wider range of biological phenomena found outside of the traditionally well-studied "reference" organisms or agronomically important species. This approach, enabled by technologies that allow cataloging of large amounts of genetic and biochemical information from diverse species, forms the core of the planned BTI Computational Biology Center focused on understanding the molecular underpinnings of biological diversity.

In closing, I want to acknowledge one notable transition and several important awards lauding members of the BTI faculty. To begin with the transition – Klaus Apel retired in late 2016 after 9 years as a member of the BTI faculty. Klaus was one of the pioneers of plant molecular biology, and we will miss his insight and collegiality. Klaus put an exclamation point on his long and distinguished career with a publication in the Proceedings of the National Academy of Sciences USA identifying how damage in the photosynthetic apparatus in chloroplasts sends a systemic stress signal throughout the cell. The past year was also remarkable for several outstanding awards won by BTI faculty members. In May, Jim Giovannoni was elected to the US National Academy of Sciences in recognition of his distinguished career devoted to the study of tomato fruit ripening and tomato genomics. In September, Frank Schroeder was selected to join an elite cadre of scientists in the inaugural class of the Howard Hughes Medical Institute (HHMI) Faculty Scholar Program. Finally, in early 2017, Michelle Cilia was selected by then President Obama to receive a Presidential Early Career Award for Scientists and Engineers.

Congratulations to Jim, Frank and Michelle for these well-deserved honors! Your achievements cap a remarkable year for BTI science as we look forward to a strong and exciting 2017.



101 PAPERS PUBLISHED

15 PERCENT HIGHER THAN 5 YEAR AVERAGE

LEARN MORE AT BTISCIENCE.ORG/PUBLICATIONS

OR FOLLOW **@BTIPUBLICATIONS ON TWITTER**

RESEARCH COLLABORATORS

BTI's research is made possible by, and is better because of the many collaborations with peer institutions around the world. BTI is grateful to the many collaborators who share a dedication to the future of sustainable agriculture, human health, and environment. The following is sampling of the many agencies, institutions, and universities who collaborated on and/or supported active projects at BTI during 2016.

THE POWER OF DISCOVERY SCIENCE

W.B. Thompson's founding vision included the belief that studying plants at the fundamental level would have immeasurable benefits for people in terms of food security, environmental sustainability, and human wellness. After more than 90 years of advancing that vision, BTI continues to demonstrate how basic research unlocks clues into each of these areas, using traditional scientific resources and emerging technologies.

HUMAN HEALTH

During 2016, insect borne illnesses such as Zika virus made headlines around the world. Rising rates of autoimmune disease and enduring neurodegenerative conditions like Alzheimer's continue to challenge families and the medical community. BTI scientists seek the answers to fundamental questions that may one day hold the key to solving challenges such as these.

At the end of BTI's second floor, you'll find **Gary Blissard** investigating interactions between insects and viruses at a molecular level. His work has yielded lines of insect cells that grow in the lab and are free of natural insect viruses. These lines are useful not only for studying how insects transmit plant and animal viruses, but can be grown at industrial scales for use in biotechnology and therapeutic applications, such as vaccine production. Gary's work studying virus/gut interactions in insects has the potential to support the fight against diseases like malaria and Zika. Studying how the virus makes its way through the gut could unlock clues to help slow or halt the spread of these diseases. Additionally, Gary helped coordinate a large consortium to decode the genome of the tobacco hornworm, a major milestone for a popular model organism used by many researchers to investigate insect biology.

Nematodes usually bring to mind the unpleasantries of battling infestation in one's body or garden. But at BTI, **Frank Schroeder's** work on small molecules that nearly microscopic nematode worms produce to communicate with each other is yielding fascinating insights into aging, and also opens new avenues for drug development. Schroeder's innovative work earned him a prestigious Howard Hughes Medical Institute Faculty Scholars Award, which provides research support to promising early-career scientists.

Mosquitos can quickly spread disease such as malaria and Zika. Work from the Blissard lab has potential to defend against these illnesses that kill over one million people each year.

Sometimes the most unique insights come from the commonplace. One-third of U.S. adults take a daily, or every-other-day, aspirin, and while the little white pill's ability to support heart health and ease aches and pains is well documented, there is still more to be discovered. **Dan Klessig** has spent decades investigating salicylic acid, the active ingredient in aspirin and a vital component of the plant immune system. His latest work investigates the many effects that salicylic acid causes when a person takes aspirin, including interactions with proteins involved in neurodegenerative conditions, like Alzheimer's and Parkinson's disease, and inflammation-related diseases, including rheumatoid arthritis, heart disease and colorectal cancer. His work has uncovered more powerful variants of aspirin and gives hope that more effective drugs will be developed to treat these pervasive and devastating diseases.

Recent accelerations in technology have resulted in massive amounts of data build up. For the average person, this means mountains of family photos, selfies, and videos floating in the Cloud. For scientists, this burgeoning growth of big data offers immense opportunity. **Zhangjun Fei's** lab develops computational tools that can make sense of giant data sets of biological information. He recently released VirusDetect, a free analysis tool that can identify both known and unknown viruses from certain types of sequencing data in a highly efficient way. Already in use to detect sweet potato viruses in African countries, it could also monitor new and existing human viruses on a local, regional or even global scale, rapidly identifying new viral outbreaks.

Other unexpected connections between plants and human disease are found in the study of the fundamental processes that control how genes are turned on and off within cells. The laboratory of **Eric Richards** focuses on how plant genes are packaged and read from within specialized cellular compartments, called nuclei.

Defects in the structure of nuclei in humans lead to an array of diseases, including certain types of premature aging syndromes. The Richards lab seeks to use plants to understand how the architecture of the nucleus affects gene regulation in hopes of uncovering principles that will apply to both plants and animals.

AGRICULTURE AND ENVIRONMENT

Surveying the abundant produce section of your local grocery store, the concept of food insecurity may seem ludicrous, or distant at best. Shelves packed with freshly misted vegetables, bins full of exotic fruits, and a seemingly endless supply of lettuces creates an illusion of abundance. However, the surging human population and changing climate pose serious challenges for both the malnourished and the well-fed. By 2050, food production must increase by 70%...on the same amount of farmland we use now. As we continue to develop strategies to make use of available land, climate change exacerbates the challenge, as droughts, floods, and fluctuating temperatures continue to put increased stress on vegetation. These factors provide the backdrop for much of the work happening at BTI, where scientists work long hours searching for ways to understand and improve a crop's ability to thrive in a changing environment.

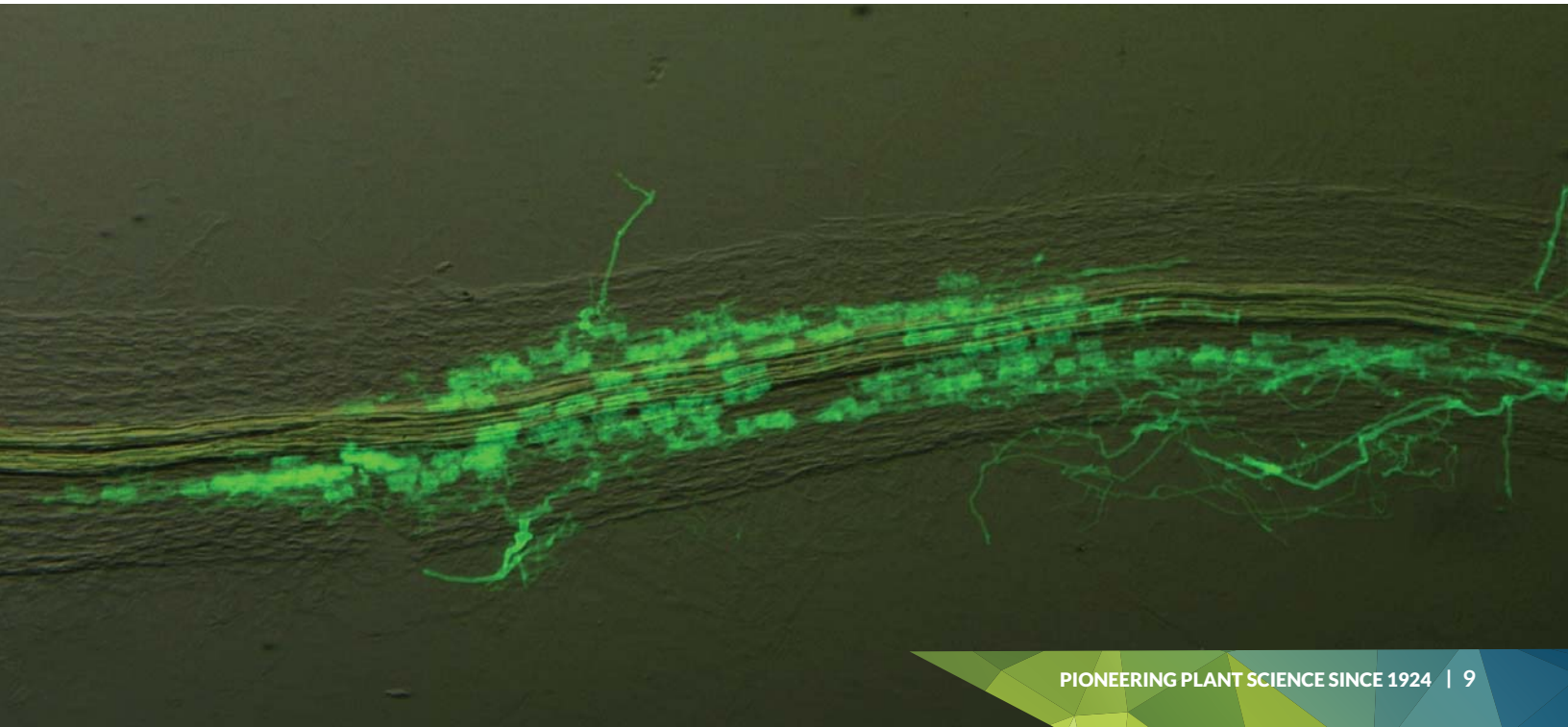
Some estimate that 40% of worldwide crops are lost to disease, an alarming loss, considering pressures on food supply. By examining relationships between model organisms and common pathogens, BTI researchers make strides at improving the bacterial resistance of our crops. **Greg Martin** uses tomatoes to better understand crop damaging bacteria. In the quest to unravel the devious methods that bacteria have evolved to infect crops, and the strategies that the plant uses to defend itself, the Martin lab has uncovered a new twist in the story. They discovered a new receptor in tomato plants called FLS3 that can detect the presence of the bacterium that causes bacterial speck disease. If this receptor could be transferred to other crop plants, it could help reduce food loss to bacterial disease.

The United States is the world's third highest exporter of citrus, which ranks as the most valuable fruit crop. Unfortunately, citrus greening disease currently wreaks havoc on the industry, as evidenced in Florida. Over 100,000 acres of orange groves have been abandoned there, due to the crippling effects of the disease. **Michelle Cilia** and her team make discoveries that bring hope that oranges, lemons and limes will long be a part of our diet. Her work to understand how insects spread bacteria and viruses to plants has identified potential strategies for combating the bacterium that causes citrus greening disease. In 2016, Cilia was nominated by President Obama to receive the Presidential Early Career Award for Scientists and Engineers, which recognizes scientists with the potential to make significant contributions to their field.

Phosphate is an essential component of fertilizers used to boost the production of food crops, but can also have the unfortunate side-effect of contaminating water supplies. **Maria Harrison** studies the relationship between plant roots and fungi in the soil. Her research advances our understanding of how plants and underground fungi work together to mine vital nutrients from the soil, a relationship that yields healthier plants. In a recent study, her group made use of bioinformatics tools to analyze 50 plant genomes in order to identify the genes necessary to establish this plant-fungal partnership. By finding ways to optimize this partnership, farmers may be able to reduce the need for added fertilizers, which take significant amounts of energy to mine and produce, and pollute rivers and streams through agricultural runoff.

Insect pests take a significant bite out of the global food supply each year, but increasing the use of pesticides is not a sustainable answer to the problem. **Georg Jander** and his research team want to boost plants' natural defenses against insects, so that farmers can use fewer chemical pesticides on their crops. His work looks at insects that attack from above as well as from below, and aims to

A clarified root segment has been stained with a green fluorescent dye that binds to the walls of arbuscular mycorrhizal fungi. Researchers in the Harrison lab study how these fungi are able to provide vital nutrients, such as phosphate, to their host plant.



The Giovannoni lab's research on tomato ripening could soon deliver tastier, more nutritious tomatoes to a supermarket near you.

get down to the gene level to understand how plants produce chemicals that ward off insects, and how those defenses are triggered. The research will aid breeders who want to develop varieties of corn and other crops that can better fend for themselves against hungry insect pests. More food and fewer chemicals is a win-win for the people and the planet.

People like food that tastes and looks appetizing, but crops bred to feed the masses are often lacking in flavor. The research of both **Jim Giovannoni** and **Carmen Catalá** may allow you to have your tomatoes and enjoy them too. The Giovannoni lab uses wild relatives of the garden variety tomato to delve into how tomatoes ripen, and how that process impacts the tomato's flavor, aroma and nutritional content. If growers can control when and where ripening occurs, then consumers will enjoy tastier, more nutritious tomatoes, and the industry can reduce loss from over-ripe produce. In 2016, Giovannoni's tomato research and his work with the International Tomato Sequencing Project led to his inclusion in the world's "Most Influential Scientific Minds," a list compiled by Thompson Reuters, and earned him a place in the National Academy of Sciences.

Catalá's research probes the intricacies of hormone signaling and other processes that turn a flower into a tasty, ripe fruit, using the tomato as a model. Along with colleagues at BTI and Cornell University, Catalá works to compile the Tomato Expression Atlas, a highly visual, clickable database where fellow tomato researchers can access images and information on the genes and tissues required to make a tomato fruit form properly. This information will be useful not only for making tomatoes more flavorful, but also for improving a variety of different fruits.

Getting to the heart of our agricultural problems may rest in our ability to impact the heart of a plant. **David Stern's** research revolves around the chloroplast, a tiny structure within plant cells where photosynthesis occurs—a process that captures the sun's energy and converts it into chemical energy that fuels the plant, and in turn, much of the life on Earth. His research team has developed software for the plant research community that can analyze sequencing data from the chloroplast. The advance brings us one step closer to engineering a chloroplast which could help boost yields for crops to a level needed to serve a growing human population.

BTI labs increasingly leverage emerging technologies and "Big Data" in an effort to tackle fundamental questions related to global agricultural and environmental issues. **Lukas Mueller's** work aims to improve multiple crops by providing tools to harness massive amounts of genetic and genomic information to solve agricultural problems. His group also partners with several other research

teams, including labs at BTI and USDA studying citrus greening disease, the Arabica Coffee Genome Consortium and the Genomic and Open-source Breeding Informatics Initiative (GOBII), which works to facilitate the breeding of five staple crops—just to name a few. One collaborative project, NextGen Cassava, received technology from Dow Agrosciences this past year to accelerate the breeding of better varieties of cassava, an important staple crop that is vital to food security in many parts of Africa. The Fei and Mueller labs collaborate with labs throughout the Institute, helping each lab to integrate the promise of new technologies and bioinformatics into their research.

If we are to feed a growing population in the face of climate change, we must find ways to help plants adapt to the changing environment. **Joyce Van Eck** is leading the charge to improve plants so they not only provide more food, but in some cases, avoid extinction. Van Eck is the Director of the Center for Plant Biotechnology Research, where she develops strategies to genetically improve plants. Besides working on ways to improve the nutritional content and productivity of potato and tomato, Van Eck also works with undomesticated plants, such as milkweed and pichuberry. In 2016 she published a paper describing her efforts to culture and multiply woodland agrimony, a threatened species in New York State, in the lab. Her group generated 1013 plants from a starting population of just 35, which enabled her colleagues to transplant the agrimony into forest field sites to help understand why the plant is in decline.

Understanding the origin of plant biodiversity and the evolution of novel traits are the objectives of the newest research program at BTI under the direction of **Fay-Wei Li.** By combining genomic approaches, evolutionary analysis and traditional systematics expertise, Li has made exciting discoveries about how plants adapt to their environments. For example, in his previous work, Li showed that genes can be transferred between unrelated species over evolutionary timescales to give rise to new traits that allow plants to exploit new habitats. We look forward to the many contributions and collaborations that will undoubtedly result when Li's dynamic research program begins at BTI in 2017.

BASIC UNDERSTANDINGS

"I don't know where these experiments are going to lead...but the possibilities! I lay awake nights sometimes, thinking about them." William Boyce Thompson

While much attention is given to science that can easily be connected to future applications, the path to discovery begins at understanding. Fundamental research at BTI untangles the complexities of life and provides the knowledge needed to advance agriculture, the environment, and human health. The power is not only in solving a problem, but sometimes in discovering the unexpected. Even though the finished product may steal the spotlight, it is undeniable that the discoveries needed to produce applications require endless hours of basic research. BTI's commitment to discovery research will continue to yield crucial insights which serve as important pieces of science's biggest puzzles.

Members of the Mueller lab in a cassava field in Nigeria. Cassava is an important staple crop in many developing nations.

BTI FACULTY & KEY INQUIRIES

KLAUS APEL
BTIscience.org/apel

How do plants sense and respond to environmental stress? *BTI bid a fond farewell to Klaus in 2016, and we wish him all the best in his retirement.*

DANIEL F. KLESSIG
BTIscience.org/klessig

Uncovering salicylic acid's roles at the crossroads of plant and human health

GARY BLISSARD
BTIscience.org/blissard

How do viruses interact with insects?

FAY-WEI LI
BTIscience.org/li

What are the evolutionary and genetic factors that shaped plant diversity?

CARMEN CATALÁ
BTIscience.org/catala

The making of a fruit: What are the processes involved in fruit formation?

GREGORY MARTIN
BTIscience.org/martin

How do bacteria infect plants and how do plants defend themselves from attack?

MICHELLE CILIA
BTIscience.org/cilia

How do pathogens commandeer plants and insects to promote their own transmission?

LUKAS MUELLER
BTIscience.org/mueller

How can genomics contribute to improved crop breeding?

ZHANGJUN FEI
BTIscience.org/fei

How can scientists access and use massive amounts of plant genomics data?

ERIC J. RICHARDS
BTIscience.org/richards

How does the three-dimensional organization of the genome within the cell affect gene activity?

JIM GIOVANNONI
BTIscience.org/giovannoni

What is the genetic basis of fruit ripening and nutritional quality?

FRANK SCHROEDER
bti.cornell.edu/staff/dr-frank-c-schroeder

Missing pieces in the chemistry of life: biogenic small molecules control development and aging

MARIA HARRISON
BTIscience.org/harrison

How do plants form symbiotic associations with fungi to access phosphate from the soil?

DAVID STERN
BTIscience.org/stern

How can combining genetics and Big Data help us understand and improve photosynthesis?

GEORG JANDER
BTIscience.org/jander

How do plants defend themselves against insect herbivory?

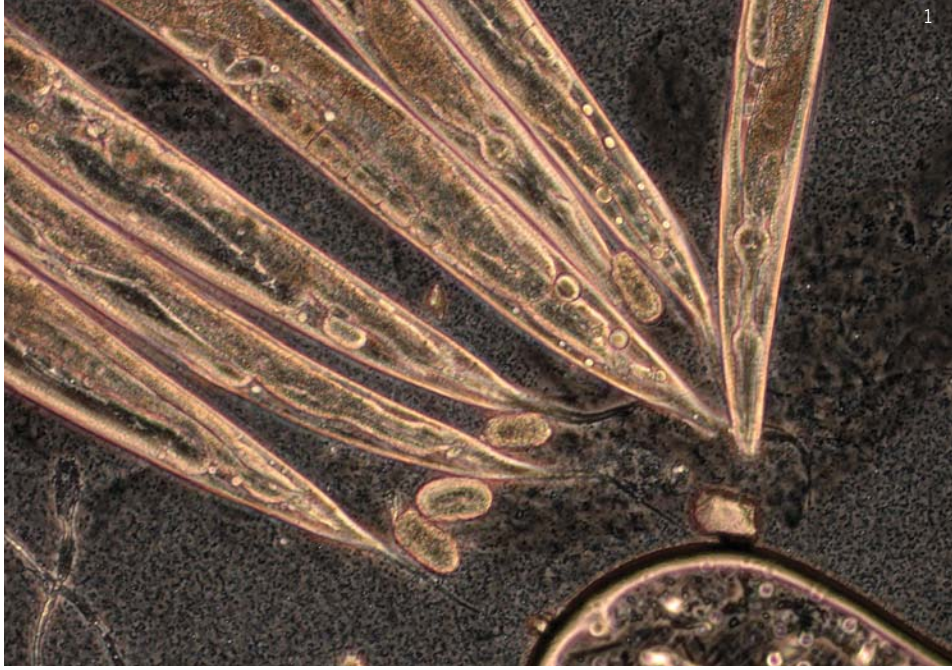
JOYCE VAN ECK
BTIscience.org/van-eck

How can biotechnology create better crops?

TECHNOLOGY TRANSFER

BTI labs engage in a non-stop quest for discovery and when discovery happens, Director of Technology Transfer Paul Debbie is there to help BTI scientists determine how those discoveries can be protected and applied to solve real world problems. 2016 saw the formation of a new spin-off company based on BTI small molecule technology, and several new patents were filed for applications ranging from higher yield corn to increased disease resistance in crops, and more.

A one-millimeter nematode may be humble, but the discoveries being made in BTI's Schroeder lab have generated several patents in 2016. Frank Schroeder's lab was issued two for the use of signaling compounds in the roundworm C. elegans, which could offer insights into how to control parasitic nematodes who do big damage to plants. Schroeder also teamed up with fellow BTI faculty member Dan Klessig to apply this work to immune system modulation in plants. Through a collaboration with researchers at Caltech, it has been discovered that some of these related compounds could grant insights into treating autoimmune disease in humans as well.



Microscopic picture of the roundworm, Caenorhabditis elegans. Work from the Schroeder lab concerning signaling compounds in these worms has produced several patents for BTI, including two new ones this year.

Two labs patented technologies that may assist with increasing global food supply by increasing yields and improving resistance to infection. The Institute, through work in David Stern's lab, has filed for a patent on technology that modulates the corn plant's photosynthetic machinery in a way that increases yield under cold and normal growing conditions. Greg Martin's lab identified a new receptor in tomato plants called FLAGELLIN-SENSING 3 (FLS3), which triggers defenses against bacterial attack. This technology could be used to protect other plants from other diseases. The Martin lab also discovered a disease resistance gene, *RPH1*, in tomatoes which could be used to protect tomato crops from emerging strains of bacteria that have been plaguing tomato growers in recent years.

COMMUNICATING BTI SCIENCE *to the public*

Recent global events and pervading misconceptions around vaccines, disease, climate, and genetically enhanced foods have highlighted the need for more robust science communications to the broader public, challenging us to create accurate and accessible content for audiences ranging from young students to policy makers, to prospective postdocs and potential donors. In 2016, BTI Communications took large steps forward in the mission to reach these audiences in meaningful and engaging ways.

An increased focus on video and digital content resulted in a massive increase in audience engagement. The last quarter of 2016 was highlighted by 25 videos being produced, 14 of which were live-streamed, resulting in a 600% increase in social media engagement. BTI's new website debuted in December, and provides a more enticing and efficient portal for visitors of all levels of scientific interest and aptitude.

In 2017, Communications aims to expand upon the end of year momentum and continue to develop dynamic content that will engage our colleagues, while inspiring non-scientists to become more intimately involved with and excited by the research that benefits us all.

The Jander Lab participated in a Giving Tuesday live stream event to celebrate donors.

EDUCATION & OUTREACH

Nurturing the Scientists of the Future

2016 marked the 15th anniversary of the REU summer internship program, a six week, hands-on experience for undergraduate and high schools students interested in careers in plant science. Twenty-nine students came to BTI this summer for lab work, bioinformatics training, and mentoring by scientists at BTI, Cornell University and the USDA Holley Center. BTI emphasizes the inclusion of interns from diverse backgrounds, helping to increase the number of underrepresented students pursuing careers in STEM. The undergraduate portion of the program is supported by the NSF, through a grant to Georg Jander, BTI faculty, and Jian Hua, a faculty member in the Cornell School of Integrative Plant Science. High school participants are funded through philanthropic support.

"I have grown drastically as a plant scientist. I have gained indispensable knowledge and have met wonderful people that are humble and always willing to help. This internship solidified my aspirations to pursue a career in the life sciences." 2016 BTI Intern Carina Sandoval, California State University

THE CURRICULUM DEVELOPMENT PROJECT

Fifteen teachers from schools around the country were chosen from a record breaking applicant pool for a week of intensive curriculum development training. The BTI Education and Outreach team selected participants in order to create a diverse class of teachers who serve varied populations of students, choosing teachers from a range of STEM subjects and experience levels.

A segment of the participants also came from "high-needs" schools, a classification used to describe schools with a majority of students who qualify for free or reduced-cost meals. "These selection criteria enable us to direct resources and support to excellent teachers in schools and communities with fewer resources available for hands-on, project based learning, or basic experimental equipment," said Fleming. "A major goal of the program is to ensure that a broader population of students across the country have opportunities to learn about and engage in cutting-edge science."

Imani Ritchards (Giovannoni Lab) from Carleton College

IMPACT

42% *from* DEMOGRAPHICS *that are* UNDERREPRESENTED *in science*

25% FIRST GENERATION *college students*

85% *are* LIKELY *to* ENROLL *in a* STEM *related* PHD PROGRAM

93% *agreed the* RESEARCH EXPERIENCE HELPED *to* CLARIFY *which* FIELD OF STUDY TO PURSUE

92% *agreed the* RESEARCH EXPERIENCE PREPARED *them for graduate school*

100% *feel that the* EXPERIENCE FOSTERED A GREATER APPRECIATION *of the* IMPORTANCE OF PLANT RESEARCH.

80% *of* FORMER REU STUDENTS HAVE ATTENDED GRADUATE SCHOOL

A.

B.

C.

D.

E.

A. Right to Left: Hailey Edmondson (Mike Scanlon Lab) Purdue University, Nicholas Often (Adrienne Roeder Lab) Baltimore City Community College, Carina Sandoval (Maureen Hanson Lab) California State University Fullerton, Luc Wetherbee (Jia Hua Lab) Ithaca HS Student

B. Ethan Thibault (Maria Harrison Lab) University of Vermont

C. Xuepeng Sun (Fei Lab) and intern Angela Taylor (Zhangjun Fei Lab) Rampo College of New Jersey

D. & E. 2016 Summer Interns

SPONSOR *profile*

Rheonix, an Ithaca-based company founded by BTI board member, Greg Galvin, made a generous pledge to support a portion of the high school internship program over the course of three years. Rheonix has a history of supporting high-quality STEM activities for youth.

The 2016 BTI Science Symposium featured five faculty speakers from BTI and Cornell. The theme for this year's symposium was "The future of plants in a changing environment."

THE POSTGRADUATE SOCIETY

FOSTERING COMMUNITY AND PROFESSIONAL DEVELOPMENT

for emerging scientists

BTI is home to fifteen labs featuring dozens of passionate and talented researchers. In an evolving industry where new careers continue to emerge, it's imperative that our researchers have access to a professional network and receive education on the robust opportunities that exist in life after BTI.

The Postgraduate Society (PGS) plays a crucial part in this process. PGS is a group of graduate students, postdoctoral researchers and technicians dedicated to advancing careers in academia and industry. They put in time outside of the lab to plan scientific talks and symposia, present professional development opportunities and cultivate community among BTI researchers in an effort to expose members to the breadth of potential opportunities that lie ahead.

SYMPOSIA

PGS planned the 2016 BTI Science Symposium, with the theme "Plant adaptations to biotic and abiotic stresses." The symposium featured talks from faculty at BTI, the USDA and Cornell University and a poster session where BTI researchers presented their work. Scientists discussed the challenges that plants—and plant scientists—face in a changing world, including drought, disease and climate change.

PGS members also organized an Industry Symposium in 2016. A panel of six industry scientists, including three alumni of BTI, advised early-career researchers about career opportunities within companies and how best to prepare for entering the job market. Panel members then led small, focused group discussions with attendees.

GUEST SPEAKERS

BTI enjoyed presentations from several outside speakers, including two Distinguished Lectures which bring new perspectives on life sciences research and give young scientists the opportunity to network within their field. Distinguished speakers included Toby Kiers from the Department of Ecological Science at VU University of Amsterdam and Liam Dolan, Department of Plant Science from the University of Oxford.

PGS also organized five additional events, which they named "PGS Fests." These talks not only offered exposure to professionals doing a wide range of work, but they also offered lab members a chance to hear from two members of the BTI Board of Directors. Board members Nancy Rawson and Paul Chomet each gave a talk while they were visiting BTI for the semi-annual board meeting. Other Fest speakers featured two Cornell researchers, Philipp Messer from the Department of Biological Statistics and Computational Biology, and Josh Chappie from the Department of Molecular Science. Mark Stowers, VP and Global Head of Research and Development at HM.Clause, rounded out the list of Fest speakers, offering a first-hand perspective on the work of a plant seed company.

MENTORING YOUNG RESEARCHERS

BTI benefits greatly from our distinguished alumni and board members. They help advance the Institute through volunteerism and philanthropy. In 2016, a new opportunity was created that offered alumni and board members an opportunity to help advance the careers of our researchers.

In collaboration with BTI board members and alumni, PGS created a mentorship program to help early-career researchers forge their own path to a satisfying career. A committee of PGS members, faculty and staff match up graduate students and postdoctoral researchers with a professional in their chosen field. The mentors provide advice and feedback to help mentees navigate the diverse job opportunities open to scientists and to prepare themselves for jobs in academia, industry, policy and communications.

BTI **ALUMNI**

Alumni are essential to the longevity of any institution. They are ambassadors, supporters, and family. BTI takes great pride in ensuring that postdocs, graduate students, interns, and even staff have an experience that positions them to become leaders in academia or industry. In early 2016, BTI embarked on an initiative to reinvigorate its alumni network through improved communications and increased opportunities for active engagement. An alumni survey was distributed and the results showed that alumni are eager for engagement.

Based on the early success of the new Alumni Relations program, BTI has big hopes for the future. Numerous alumni expressed interest in reunion and networking events, and postgraduates are increasingly eager to connect with alumni for guidance and career connections.

alumni profile: DR. REENA THOMAS

One of the most intriguing aspects of basic research is not knowing where your work will lead you. For Dr. Reena Thomas, three years in BTI's Stern lab provided a foundation that allowed her to transition to human medicine. Today, Reena is the Director of the Adult Neuro-Oncology Fellowship at Stanford University.

Reena expressed her appreciation for the early mentorship she received in David Stern's lab, "I spent three years at Boyce Thompson [Institute] and David Stern was a mentor to me in my earliest stage of scientific development." After graduating from Cornell, she received her medical degree from Georgetown University School of Medicine and her PhD from the City of Hope Graduate School. She completed her training at Stanford University Hospital before assuming her current position. When asked on a recent visit how her experience at BTI helped her achieve her later career success, Reena explained, "...the scientific process is the same, weather it is in plant biology or medical biology and immunology - understanding a scientific article, being able to write a scientific article, and being able to understand the grant writing process, the grant funding process, - all of that began here."

Dr. Thomas visited BTI when she was on the Cornell campus to give a talk, "A Medical and a Research Career: The Path to Academic Medicine" in November. While planning her trip to Ithaca, Reena knew her itinerary wouldn't be complete without a visit to BTI, where she had worked as an undergraduate research assistant from 1999 to 2002.

During her visit, she met with her former mentor, and President of BTI, David Stern, and spoke with representatives from BTI Alumni Relations. You can watch a video of that conversation here.

2016 HIGHLIGHTS

10 alumni serve as mentors to BTI postgraduates in a new pilot program

3 alumni returned to speak at lectures or participate in symposia

Alumni profiles are now frequently featured in newsletters, the annual report, and social media

New groups on Facebook and LinkedIn allow 100+ alumni and researchers to network, stay connected, and share updates.

alumni profile: DRS. HARRY FLORE & ANJA DERKSEN-FLORE

While BTI considers all of our alumni to be family, one of the unique aspects of the Institute is how many of our scientists have come to the Institute as a researcher couple. Such was the case when Drs. Harry Flore and Anja Derksen-Flore came to BTI to study insect virology. The married couple joined BTI in 1984 as members of Robert Granados' lab.

Harry and Anja visited BTI from the Netherlands in August, joined by their adult children, Rick and Kirsten. During their visit, they reconnected with Bob Granados as he guided them on a tour of the BTI facilities. Harry and Anja also met with President David Stern and spoke with several scientists throughout the Institute.

Currently, Harry is the CEO of HAL Allergy Group, and Anja is Head of Quality Assurance at Vibalogics.

You Make Discovery and Innovation Possible

BTI is grateful to the following individuals and organizations who have shown generosity during 2016, providing the capacity that makes the research and programs of BTI possible.

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BTI supporters sometimes direct their gift towards an area of the institute that they feel particularly passionate about, in honor of a living individual, or in memory of someone who has passed away.

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Monthly Givers: The following individuals make recurring gifts either from payroll deduction or as part of a monthly giving program.

Patti & Owen Baynham
Zhangjun Fei & Xuemei Tang
Vanessa & John Wyatt Greenlee
Ryan Gutierrez
Christianne McMillan White
Kelli Monce
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PATTI AND OWEN BAYNHAM SUPPORTING BTI *since* 2014

On making monthly gifts to BTI: "There are clear benefits to scheduled monthly giving, both for us and BTI. From a personal perspective, we want to support BTI each year. By setting up a recurring gift we don't have to worry about forgetting. It becomes an assumed part of our monthly budget, and it saves time. Previously we would send a larger donation at year end, but that timing typically does not match the way expenses are incurred by an organization. So we are committing to a regular flow of giving that better matches the way expenses are incurred." As CFO of the Boyce Thompson Arboretum in Superior, AZ, (Arizona's largest and oldest botanical garden) Patti appreciates first-hand how monthly giving can help to sustain a non-profit organization throughout the year and make a big impact on its ability to accomplish its mission. As Patti explains, "It makes a key difference to the organization. From what I've seen, the majority of people don't commit to ongoing scheduled giving. Those who do serve as leaders in demonstrating this way to help make our organization stronger."

To make a gift to BTI, please contact BTI development at 607-254-6775 or email bti-dev@cornell.edu. Visit BTIscience.org/give to make a secure online contribution. Every effort has been made to ensure the accuracy of these lists. If we have unknowingly made an error, please notify the development office.

Legacies Remembered

The memories of the following desceased individuals, who, over the course of the Institute's history, have included BTI in their estate plans, will endure through the work being done to honor W.B. Thompson's vision for the future.

John & Madgolina Bank
Anthony (Andy) Grefig
John & Mayfred Hirshfeld
George & Helen Kohut
George & Elizabeth McNew
William Boyce Thompson

THE W. B. THOMPSON LIVING LEGACY SOCIETY

BTI recognizes living individuals who have remembered, or who've expressed intent to remember, BTI in their estate plans or through other methods of planned giving. Through their generosity and foresight, W.B. Thompson Living Legacy donors help to secure the future of the Institute. We thank them for making their commitment known to BTI, and appreciate their continued generosity and passion for BTI's mission.

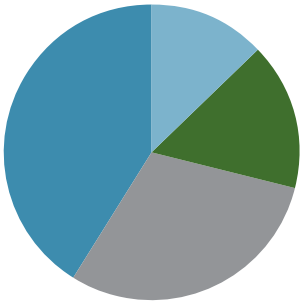
Evelyn Berezin
Brian & Claire Federici
David & Karen Stern

SELECTED *financials*

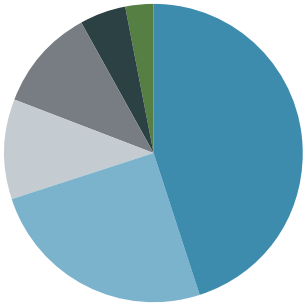
This is an unaudited financial report. The audited report will be available in June, 2017. Please contact BTI development at 607-254-6775 or email bti-dev@cornell.edu if you would like to review the audited report.

2016 NEW GRANTS (TOTAL AWARD LESS SUBCONTRACTS)*

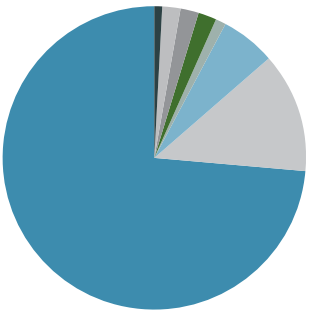
GOVERNMENT		
National Science Foundation	$3,325,112	41%
United States Dept. of Agriculture	$2,418,338	30%
National Institutes of Health	$1,282,674	16%
CORPORATE, FOUNDATIONAL & OTHER		
Foundation funding	$1,067,752	13%
TOTAL	$8,093,876	



SOURCES OF FUNDS (INCOME)		
US Government	$7,080,000	45%
Institute endowment	$3,983,000	25%
New York State	$1,719,000	11%
Foundations	$1,698,000	11%
Other private sources	$744,000	5%
Unrestricted revenues	$405,000	3%
TOTAL	$15,629,000	



USE OF FUNDS (EXPENSES)		
Research	$11,668,000	75%
Administration	$1,973,000	13%
Research support	$894,000	6%
Equipment & facility	$124,000	1%
Communications	$288,000	2%
Development	$263,000	2%
Non-research	$270,000	2%
Education & Outreach	$149,000	1%
TOTAL	$15,629,000	



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*2016 BOARD UPDATES Ralph W.F. Hardy, Emeritus Director, passed away in August. William Wellman, NAC member, passed away in February. We are grateful for the dedicated board service of Gregory Hartz (2007-2016). Over the course of three terms, he helped to build ties between BTI and the surrounding community and ensure the fiscal sustainability of the Institute.

Baby grapevines, cultured from plant tissue, grow on a gel substrate inside magenta boxes. The Van Eck lab is developing new methods to genetically improve many different domesticated and undomesticated plants.

BTI
Discovery & Innovation in the Life Sciences
BOYCE THOMPSON INSTITUTE

MISSION
To advance and communicate scientific knowledge in plant biology to improve agriculture, protect the environment, and enhance human health

AR ONLINE
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Boyce Thompson Institute
533 Tower Road, Ithaca, NY 14853-1801
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