

REMARKS, STATE OF THE CENTER 2014

John McDonnell, Chairman, Board of Trustees

Welcome to the 2014 State of the Center. My name is John McDonnell and I am Chairman of the Board of Trustees for the Danforth Plant Science Center. Thank you all for coming out this morning.

I want to start by telling you that recently, soon after taking on the role of Chairman, I participated in a series of four in-depth sessions to learn more about the scientific research and community at the Center. I was struck by the depth of research, the enthusiasm of the scientists, and the breadth of education and training programs. I was also struck by how nearly everything that the Danforth Center does is the result of collaboration – collaboration between Center scientists, trainees, staff, and partner organizations.

This morning, we will be hearing about the State of the Center from three key individuals:

- Dr. Bill Danforth, Founding Chairman
- Dr. Jim Carrington, President
- Sam Fiorello, Chief Operating Officer

The program will conclude with a question and answer session with Bill, Jim, Sam and me, moderated by Dr. Molly Cline. Molly, a plant scientist by academic training, was the Senior Director of Industry Affairs at Monsanto before retiring in 2010. She is a past president of the St. Louis Agribusiness Club and a long-time volunteer at the Danforth Center in various capacities. We're thrilled to have her join us.

And now, please join me in welcoming my good friend, Dr. Bill Danforth, Founding Chairman, to the podium.

William H. Danforth, Founding Chairman

Thanks, John, and thanks for accepting the chairmanship of our Center.

We could not have a better leader at this exciting time, or perhaps any time, in our history.

But now especially, the potential benefits to human betterment from first rate plant science seem unlimited. As I am grateful to John, so I am grateful to all here today. When we started, I dreamed, perhaps romantically, that our Center would be part of a major human adventure of the 21st century. We would try to make the most of the wonderful human desire to know how the world really works, in our case how plants really work.

This drive to understand, shaped through its evermore powerful modern offspring, science, can help hold off potential environmental disaster. In doing so, we hoped also to bring benefits and perhaps even a little credit to our home community.

Pursuing such goals is exhilarating for me; I hoped it would be for others as well.

But I worried; science can seem esoteric and difficult to understand. Moreover, the benefits of better understanding can be delayed, even a decade or more while results that are faster, even if not as game changing, may seem more appealing to many donors. To really succeed we would have to have world-class scientists and scientific leaders, volunteers, donors, facilities, wise decision makers, a helpful local culture, money and luck. So I am thrilled to see you here and to try to say how much the support and enthusiasm of talented friends, colleagues, scientists and staff mean.

I could not have expected when we started that our Center would be as successful as it is by February 2014. I did not know that this building would be full or dream that we would be preparing to start a new wing, or that we would have an endowment worth over \$230 million, or annual gifts well over \$1.5 million, from over 740 supporters or that our science and scientific leaders would be world class, as would our staff, or that BRDG Park would be successful, or that there would even be an Ag Innovation Showcase or strong education programs, or that our contributions to science and modern technologies would have advanced so rapidly that we would be in the leadership role we are today.

So thanks for getting us off to a great start of a long journey.

I hope you will not mind if I add a few thoughts about the importance of our work.

The world faces a serious challenge, different in magnitude from ever before. Humans in the past have suffered greatly from environmental problems. A decade ago Jared Diamond wrote *Collapse, How Societies Choose to Fail or Succeed*, an arresting book on ecological disasters of Easter Island of the Pitcairn Island chain, of the Mayans and of the Norse in Greenland, all caught by unforeseen environmental change to which they failed to adapt. Why did they not change and adapt? One, failure to perceive the problems, two, failure to act after perceiving the problem, especially failure to act for selfish reasons – e.g. “If I continue doing what I am doing, others may suffer, but my family will still be OK.” I’d add another reason: too short time horizons; we think in weeks when we should be thinking in decades’ imagine that such causes of error are always with humans.

But today the risks are truly greater. Populations have grown. I was born in 1926 when the world’s population was about 2 billion, having doubled in the previous century. Today it is about 7.15 billion, three and a half times as many as when I joined. And the numbers continue to grow. Rapid use of resources. As meat eating has spread, each person needs much more land, more water, more energy and more fertilizer just to eat. In addition, with the help of science and technology we humans now consume more resources as we pursue our dreams. We can fly to California or Beijing or Paris. We can reclaim petroleum and coal buried for centuries, extract the energy and use it to drive to Schnucks and buy blueberries with outside temperatures below zero. We can build massive bridges and tunnels; we can transform mountains into ski resorts with hot food and warm buildings. No one knows what the carrying capacity of the world is, but no one thinks it is infinite. Humans, like all living things, are dependent on a supportive environment for survival. In the past when environments have collapsed, those affected have died or moved on while the rest of the world hardly noticed.

But now there are so many of us with so much power we can change the environment of the whole world all at once and we can’t run away to the moon or Mars. Edward Gibbon, author of

The Decline and Fall of the Roman Empire, is often quoted as pointing out that history “registers the crimes, follies and misfortunes of human kind”. I doubt if any of us would disagree or could not add chapter and verse. But we might not sound so pessimistic. We have seen too many unselfish heroes, too many good things, too much improvement in the health and wellbeing of most people, too much expansion of democracy and freedom and learning and you can add to the list.

These wonders have come to us because of deeper understanding of how the world really works, insights gained slowly and painfully over centuries of trial and error. But fortunately science has speeded up and hastened discovery and learning so that we have fewer excuses for repeating the errors of the past. And thanks to science, we have seen an enormous increase in understanding of nature, how to live with it, how to preserve the environment, and even how to make it better. And we now detect warning signs better so that, if we are willing, we can recognize the risk of environmental catastrophes that caught our ancestors unprepared. And we have also learned how to learn faster, much faster. We live in a grand and glorious era, with opportunities for each generation to learn more from history and chart wiser courses. Since this is the annual report of the DDPSC, you will not be surprised if I say that we are all contributing by helping Center scientists succeed in the quest better to understand how plants really work, how they fit into the environment, how we can alter them to make them work better for us, how we humans can alter our behavior, to make us better partners with plants in feeding the hungry and in preserving and improving the environment. Finally, I believe if we educate ourselves and put our confidence in human intelligence and in science rigorously applied by talented individuals, we can help add another positive chapter to the human story. Thanks for being a part of all this.

James C. Carrington, Ph.D., President

Thank you, Dr. Danforth, and thank you all for coming out to the Center on this balmy day. Dr. Danforth just presented the reasons WHY we’re here. MY goal is to communicate what we’re doing and where we’re headed.

I want to start by revisiting the Danforth Center Discovery and Impact Flywheel. This helps us understand and visualize the critical components necessary for the Center to deliver the outcomes we desire. Those outcomes are indicated in the middle, and IF they occur, then we’re doing our job of using plant science to improve the region, the nation and the world. We’ll see improved crops that produce more, that grow with less water and fertilizer, and that have less environmental impact. We’ll see innovation that catalyzes growth of our plant science-based industries, and we’ll produce new scientists to solve the next generation of problems.

Note that for the flywheel to start turning, we depend on our generous donors, who provide essential resources to 1) build critical facilities, and 2) recruit and equip exceptional scientists.

Our scientists identify important problems to address, and then secure grant funding to solve those problems. In 2013, our scientists were awarded \$12 million in competitive grants to fund projects to

understand the mechanisms of defense against diseases, to increase the energy content of bioenergy crops, and to increase the productivity of staple food crops in developing regions. They published 89 peer-reviewed articles and filed 7 U.S. or international patent applications. And based on these and prior technologies, we closed or maintained 9 licensing deals with for-profit companies.

Now, I want to focus the rest of my presentation on two other topics.

First, I'll review progress toward outcomes in that last category - training the next generation of plant scientists. And then I'll review some of the strategic investments we're making in people and facilities to take the Danforth Center to the next level, to accelerate outcomes and to increase impact.

Considering its importance, we don't talk nearly enough about what we do to train plant scientists. Training infuses all of our research programs. Trainees come to the Center at all levels – postdoctoral, graduate student, undergraduate student, and K through 12.

And they come from around the world! Since inception, we've had 504 trainees from 46 countries. Currently, we have 53 postdoctoral trainees and graduate students from 23 countries, and will take on 14 more undergraduate research trainees in June, 2014. Fifty percent of our trainees are international.

Postdoctoral trainees are at the core of our research enterprise. They do a large amount of the research, and in turn, they take major steps in their careers through developing a research portfolio, and through developing their grant-getting, communication, interdisciplinary and management skills.

Graduate student training at the Center was identified as a priority three years ago. We strengthened our affiliations with partner universities, devoted resources to both recruiting and Ph.D. student stipends, and partnered with Washington University to improve and expand the Plant and Microbial Biology graduate program.

Today, we support 19 Ph.D. students in 9 different Center labs. These students include 7 each from Washington University and the University of Missouri system. With recent gifts to the Center and to Washington University, we're committed to growing graduate education, and I recognize the great work that Jim Umen and Toni Kutchan are doing to make this happen.

Undergraduate student training is thriving at the Center. Our National Science Foundation-funded Research Experience for Undergraduates (REU) program, led by Sona Pandey and Tom Smith, was recently renewed with a \$750,000 grant as it enters its 12th year. We support 14-16 students through a 10-week, intensive summer research experience, which also includes training in scientific writing, oral communication, and research integrity.

We've had 162 interns since NSF began funding in 2003. It's become a highly competitive program – among the 167 applicants from 37 states in 2013, only 16, or 9%, were admitted. And it's a diverse program – in the past 3 years, 57% of our students were from research-limited colleges and universities. And 35% were from underrepresented groups.

Remarkably, our summer interns have co-authored 13 peer-reviewed, scientific publications with their Danforth Center mentors since 2009. Forty percent have gone on to careers in plant science, mostly through entering Ph.D. programs in plant sciences. We consider that a successful outcome to date!

No one embodies this success more than Andrew Mutka. Andrew was an undergraduate biology major at Valparaiso University in Indiana, came to the Danforth Center for the summer intern program in 2005, discovered that he loved doing this and went on to receive his Ph.D. in Plant Biology from Washington University. And in November, Andrew came back to the Danforth Center as a postdoctoral trainee in Becky Bart's lab. He's here today, and for all he's achieved so far, let's give Andrew a hand.

We're even engaging high-schoolers in real research at the Center. Terry Woodford-Thomas, in collaboration with Tom Brutnell's lab, recently brought the "Mutant Millet" program to 448 students at 6 high schools in the region. Mutant Millets uses the students, in their classrooms, to identify, characterize and catalog new variants of millet, which are then used in the Brutnell lab.

I hope you will agree that the Danforth Center is making measurable progress in training young scientists.

But doing so, as well as achieving all of our other desired outcomes, it requires that we make strategic investments in our scientists and in our facilities.

Creating best-in-class facilities and strengthening our scientific staff are, in fact, strategic priorities of the Danforth Center.

We're thrilled that four new PIs - Dan Chitwood, Becky Bart, Chris Topp and Toby Kellogg – have joined the Danforth Center over the past five months. This highly collaborative group strengthens our work using high-throughput technologies, computation and genetics to understand the basis for important crop traits, like seed and fruit quality, root growth, disease resistance and natural variation that can be tapped for crop improvement.

Regarding major investments in new facilities, let me mention two projects of great importance to the Center.

First, the Bellwether Foundation Phenotyping Facility is now up and running. This one-of-a-kind facility automates measurements of multiple plant properties, like biomass and leaf shape, light energy capture, and water use. This allows us to more quickly and more accurately identify important traits, and to understand better how plants respond to changes in their environment.

Development of the Bellwether Facility has been through a tremendous collaboration among many at the Center, including scientists in four laboratories and the facility manager. I'm proud to recognize four postdoctoral trainees, and the Bellwether Facility manager, who have dedicated enormous amounts of time and energy to turn this system into a productive, big-data generating facility. They are Mindy Wilson, Noah Fahlgren, Malia Gehan, Max Feldman and Sanki Warnasooriya. Please stand and be recognized.

Finally, as most of you know, we have initiated a significant expansion of the Danforth Center. This includes a new research building, which will extend to the west from the current building, and which is under design by Christner Architects here in town. Importantly, the building will provide capacity for up to 100 new scientists, that is, up to 10 new PIs and their groups.

We're embarking on the expansion so that we can deliver better outcomes, faster; so that we can accommodate needs that our current facility cannot accommodate; so that we are in position to attract best-in-class PIs and trainees; and so that we're a more robust institution. And we believe this will be good for the region by strengthening St. Louis as a world center for plant science discovery, community and impact.

I hope you agree, and I ask for your support as we move forward. We're going to need it!

With that, let me call Sam Fiorello, Senior VP and Chief Operating Officer, to the podium.

Sam Fiorello, Chief Operating Officer, Danforth Center and President, BRDG Park

I would like to wish you all a good morning and, like Jim, Dr. Danforth and John, extend my warmest welcome. I also want to thank all of you for coming this morning to be part of this event. Our mission, "to improve the human condition through plant science" is achieved in three ways: to help Feed the hungry and improve human health, to help Preserve and renew the environment, and to Enhance our region as the world center for plant science.

Today I will use my segment of the joint presentation to talk to you about the BRDG Park, our most significant initiative to drive that third component of our mission.

One of the important things we learned early on in our effort to understand what it takes to create a successful research park is that if you look at the park as simply a real estate play, i.e. if you think – "Build lab space and they will come" – you are destined for failure. What is needed to attract, incubate and grow successful businesses is a robust value proposition. In other words, how will establishing or moving a business to BRDG add value to your company? If you can't answer that question, and articulate the answer clearly, you will fail.

Our tagline "Research + Resources + Relationships" lays out our value proposition. That is: If you are in the ag-tech/plant-tech industry and proximity to best-in-class research is important, and if your company relies on critical infrastructure, and if you would like to be at the center of a vibrant network of entrepreneurs, investors and established industry players, come here.

Let me dive deeper into each component of this value proposition in the ensuing slides.

As you heard from Jim in his remarks, with its body of scientists and state-of-the-art facilities, the Danforth Plant Science Center is a best-in-class research center. But the Danforth Center is not the only plant science research offering in our region. As home to the Missouri Botanical Garden,

Washington University, MUSK, Unit of Missouri-Columbia, Saint Louis University and others, our region features some of the finest plant and Ag research enterprises in the world. In fact, with over 650 plants Ph.D.'s, the St. Louis region is the world's leader in plant scientists.

Unlike an internet startup or a group of young millennials writing the next big iPhone App, plant science companies most often require access to unique and capital intensive infrastructure and instrumentation. Not only are these facilities expensive to build and maintain, they require very specialized and highly trained individuals to run them. As a park tenant on the Danforth Center's campus, your business has immediate, affordable and just-in-time access to a body of core facilities that, in aggregate, cost upward of \$40 million to build and operate. And I will tell you that almost every one of the BRDG Park tenants makes use of some or all of these core facilities.

The final "R" in our tagline – "Relationships" – is in some ways the most difficult to quantify but, as some BRDG tenants have told me, also the most important component of the value proposition. One example of our effort to proactively build and then be central to an Ag innovators network is our establishment of the annual Ag Innovation Showcase, which we launched five years ago. The event, which is held at the Danforth Center, brings together four kinds of attendees – Investors, Entrepreneurs, key big Ag and food industry companies, and thought leaders. When we launched the first installment of the Ag Showcase in May of 2009 we had an unproven fledgling product that we hoped to build into a "must-attend" gathering. The matrix on the left side of the screen shows you some of the numbers from last year compared to 2009. Terrific growth! However, a bunch of important people meeting for a couple of days a year – while nice – is not a significant outcome in my book. The visual on the right side tries to highlight some of the measurable RESULTS, or as my 16-year-old son calls them – the SO WHAT'S.

Here are some more SO WHAT'S.

The first building of what has been designed as a three building research park opened in June of 2009. Today, 16 enterprises employing 270 people call the BRDG Park home. Of those 16 entities, 9 are what we refer to as "home grown"; the other 7 relocated to the Park because they recognized the unique opportunity it offers. Of these 7 "imports" 4 of them moved to our Park from other locations in the U.S. and 3 of them from abroad.

In these next couple of slides I would like to highlight some of the growth and successes in 2013 of four of our BRDG Park tenants.

The first is NewLeaf Symbiotics, which established a presence in BRDG a little over a year ago. The NewLeaf founders, Tom Laurita and Steve Kahn, are from Camden, Maine and Boston, Massachusetts, respectively. Steve and Tom are 2012 Ag Showcase presenting company alums. They closed their initial round of financing in January of 2013. They acquired another BRDG tenant, Intuitive Genomics, in the 4th quarter of last year, and are expected to double their staff in 2014 and treble their footprint at BRDG.

The next company that I'd like to highlight is Symyco. Symyco's founders, the Malhotra family, are from Delhi, India, and are 2011 Ag Showcase presenting company alums.

The next company to highlight is MoGene. MoGene is an example of a home grown company established by former Monsanto and Washington University researchers.

The final company that I will highlight is Conagen. Conagen was founded by Danforth Center Investigator Oliver Yu in 2010. Conagen is funded by Chinese investors and focuses on the production of high value plant compounds for food, nutrition, pharmaceutical, and industrial applications. We look forward to continued success and growth from all four of these companies.

Finally, I want to leave you with this message; Unlike the results of a research institute like the Danforth Center, these BRDG Park results are easier to measure (jobs, investments, products sold...) so in many ways I have an easier job than Jim during the State of the Center address. However, if I leave you with only one takeaway message from my portion of this morning's address, it should be:

There would be no BRDG Park without the Danforth Center. Without a well-funded, well-staffed Danforth Center, the BRDG Park would have a vastly diminished value proposition.

Thank you all for your continued and unwavering support.