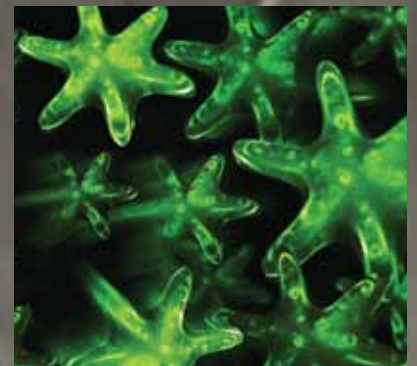
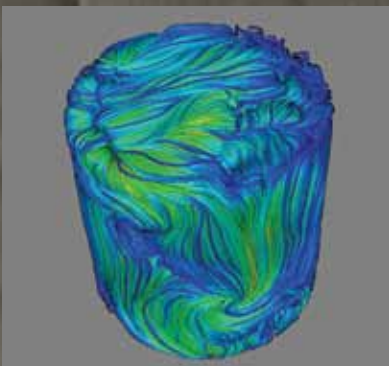


2012
Annual Report:
Research
Corporation for
Science
Advancement
1912-2012

100 Years Funding Research and Supporting
Early Career Scientists



Cover Photo: RCSA Founder
Frederick Gardner Cottrell, 1924

Rayleigh-Benard Convection

An image of the Rayleigh-Benard Convection that shows the streamlines (i.e., the path a particle would take if placed there) for a cylindrical convection container (diameter = depth here). The fluid is air (Prandtl number = 0.7) and the flow is turbulent (Rayleigh number = $5 \cdot 10^7$). The color corresponds to the speed of the fluid at that point, so blue is for lower speed and yellow is for higher speed. The image is from research done by Janet Scheel (CCSA 2008), Assistant Professor of Physics, Occidental College.

Ring Nebula

In this composite image, visible-light observations by NASA's Hubble Space Telescope and infrared data from the ground-based Large Binocular Telescope in Arizona reveal a dramatic view of the well-known Ring Nebula. Credit: NASA, ESA, C.R. Robert O'Dell (Vanderbilt University), G.J. Ferland (University of Kentucky), W.J. Henney and M. Peimbert (National Autonomous University of Mexico). Credit for Large Binocular Telescope data: David Thompson (University of Arizona).

V₂O₅ Nanostars

V₂O₅ nanostars with octahedral symmetry are prepared using VO as a template through a combination of chemical vapor transport and hydrothermal recrystallization. Sarbajit Banerjee (CS 2010), associate professor, Department of Chemistry, University of New York at Buffalo, will be modifying these materials by intercalating cations to facilitate photocatalytic water splitting. The six arms provide sites for tethering quantum dots that can harvest light and then inject holes into the modified V₂O₅ nanostructures.

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Milestones

Renowned scientists who received research support from RCSA include:

Robert Goddard

the father of modern rocketry

Ernest Lawrence

inventor of the cyclotron atom smasher

Isidor Rabi

whose discoveries led to magnetic resonance imaging (MRI)

Grote Reber

a pioneer of radio astronomy

Robert Van de Graaff

creator of the Van de Graaff generator

Robert Woodward

prominent 20th-century organic chemist

Dudley R. Herschbach

contributor to our understanding of chemical reaction dynamics

John Atanasoff

builder of the first digital computer

Thomas R. Cech

discoverer of the catalytic properties of RNA molecules

Carl Wieman

member of the team that produced the first Bose-Einstein condensate

Ei-ichi Negishi

member of the team that developed palladium-catalyzed coupling in chemistry

In medicine, RCSA funds helped:

Barnett Rosenberg

discoverer of the anti-cancer drug Cisplatin

George Beadle

discoverer of the role of genes in regulating biochemical events within cells

Edward Kendall

synthesizer of cortisone

Carl Djerassi

developer of the first oral contraceptive

Frederick Gardner Cottrell, who had been a brilliant physical chemist at the University of California, Berkeley, founded Research Corporation on February 16, 1912. Cottrell, a true progressive in the early 20th-century sense of that term, dedicated the proceeds of an invention, his electrostatic precipitator, to the nascent foundation. The precipitator was the first successful device to remove ash and other particulate matter from industrial smokestacks. It eventually came into widespread use. Subsequently, Cottrell spent much of his life identifying and supporting scientists with great ideas, especially those early in their careers. When these ideas occasionally became commercially viable, a few scientists returned the favor, designating Research Corporation the beneficiary of their patent rights, thus building the foundation's endowment.

In 1937 the foundation entered into an agreement with MIT to manage all of the school's scientific patents; agreements with other institutions followed. Research Corporation became America's first technology transfer organization. The Internal Revenue Service eventually took issue with a nonprofit foundation operating a potentially profit-generating business and this function was discontinued in 1987 with the spin-off of a wholly independent business, Research Corporation Technologies.

Over the years, Research Corporation has supported the work of 18,000 scientists, including the early career research of 40 scientists who became Nobel laureates, the first in 1934 and the most recent in 2010.

RCSA has provided early career support for teacher-scholars in the physical sciences at major research universities, primarily undergraduate universities, and liberal arts colleges in all 50 states.

From the 1940s through the 1970s, the foundation supported pioneering research through its Williams-Waterman Fund for the Combat of Dietary Disease. The Fund's accomplishments include pioneering the enrichment of flour, cornmeal and other cereal grains internationally.

In 1950 Rachel Brown and Elizabeth Hazen, research partners in mycology at the New York State Department of Health, developed the antifungal drug nystatin. RCSA helped them patent and license their discovery as Mycostatin. The profits from this drug were given to RCSA to create the Brown-Hazen Research Fund to support independent research projects in mycology from 1956 to 1978.

In 1992 RCSA became a partner in the international consortium that built the Large Binocular Telescope in Arizona, one of the most advanced telescopes in the world.

The foundation created a nonprofit corporation to manage the collaboration of more than 100 scientists and engineers and to raise private and agency funding for construction of the Large Synoptic Survey Telescope in Chile. Site excavation began in earnest in 2011 with construction expected to take five years.

For more information: please go to www.rescorp.org.

Or contact: Research Corporation for Science Advancement
4703 East Camp Lowell Drive, Suite 201, Tucson, Arizona 85712
Phone 520.571.1111 Fax 520.571.1119

Leadership Comments



James M. Gentile
President and CEO

In early January 2013 James M. Gentile retired as Research Corporation for Science Advancement (RCSA) president and CEO to return to his academic roots as a professor and dean of the sciences at Hope College in Holland, MI.

The RCSA Board of Directors appointed former RCSA Vice President Jack Pladziewicz to serve as interim president and CEO effective January 14, 2013.

Gentile joined RCSA in 2005 after 29 years as a professor and dean at Hope College. Highlights of his eight-year tenure at RCSA include: the creation of Scialog[®], a major, multi-year, grant program designed to accelerate breakthroughs in 21st-century science by funding scientists to pursue transformative multi-disciplinary collaborative research, addressing crucial issues facing society; continued support for the hugely innovative LBT and LSST telescopes; the celebration in 2012 of RCSA's centennial—100 years of advancing science in America; and his tireless advocacy of excellence in science education and dissemination of best practices in teaching and research to help America maintain its scientific and technological preeminence.

Interim President Jack Pladziewicz first joined RCSA as a program officer in 2003 and served as the vice president from 2008 until his retirement in 2010. Before joining RCSA, he was professor of chemistry and department chair at the University of Wisconsin-Eau Claire where he was on the faculty from 1973 to 2002 and is now professor emeritus.

The Arc of Discovery and RCSA's Challenge for Funding Research in the 21st Century



Jack Pladziewicz
Interim President

We are proud of our history of funding scientists for 100 years. As we have learned, it can take many decades to see the full impact of funding innovative, early career scientists.

The arc of discovery—the timeline from the pursuit of an untested, curiosity-driven idea of no apparent practical value to the development of a phenomenal, highly impactful technological device—is often forty years or more. These advancements are founded on decades of curiosity-driven inquiry by hundreds of scientists—true exploration and discovery of the unknown purely for the sake of knowing. It rests upon the belief in the value of knowledge for its own sake.

For example, curiosity-driven research was the foundation of the modern-day medical MRI, which was first available commercially in the 1980s, 50 years after the start of Isidor Rabi's molecular beam experiments at Columbia University. Between 1931 and 1940 RCSA funded Rabi five times at the start of his career at Columbia—in 1931 for molecular beam research; in 1937, 1938, 1939 and 1940 for research on the magnetic dipole moment of the atom. These experiments culminated in his observation of nuclear magnetic resonance—the work led to the Nobel Prize for Rabi in 1944 “for his resonance method for recording the magnetic properties of atomic nuclei.”

Likewise RCSA funded Felix Bloch four times—in 1939 for his low-voltage generator and in 1946, 1947 and 1948 for nuclear induction and its application to polarized neutrons. RCSA also funded Edward Purcell, in 1946 and 1948, for research on resonance absorption by nuclear magnetic moments. They shared the Nobel Prize in 1952 “for their development of new methods for nuclear magnetic precision measurements and discoveries in connection therewith.”

Magnetic resonance imaging (MRI) is founded on this basic research that, at the time, had no known commercial value.

RCSA also funded Robert Goddard in 1923. Three years later he launched the world's first liquid fuel rocket: leading 46 years later, in 1969, to “one small step for man, one giant leap for mankind” and the multifaceted and broad-reaching technological advancements that came with space travel.

Many other examples of RCSA's initiation of the arc of discovery are highlighted in this centennial year report... and the “arc” is just beginning for many of our more recent awards—stay tuned! Moreover, funding the innovative ideas of early career scientists aids in the development of their careers and those of their students, building the intellectual capital required for further discovery.

While it is easy to recognize the impact of Nobel Prize winners, we know that their advances were built on the shoulders of hundreds of other scientists whose work provided the scientific foundation for their successes. This spirit was evident when Cottrell made his gift of his electrostatic precipitator company to start Research Corporation in 1912. He specifically stated that no one can take credit (nor should benefit financially in an extraordinary

way) from advancements that were built on the work of so many others. This relationship is implicit in the words of J. Paul Flory (1974 Nobel Prize in Chemistry) when he said: “Knowledge in depth and breadth is the prerequisite to discovery lest the spark of genius find nothing to ignite.” That “knowledge” comes from the experiments and observations of many other scientists over preceding decades.

As other funders have appeared, RCSA has evolved from funding throughout a scientist’s career to highly selective early career funding. As we look to the future, the challenge is to continue to be catalytic and impactful in initiating the arc of discovery, but in a very different funding environment than the one that faced the foundation early on. When RCSA started—before the existence of federal agencies and other private foundations dedicated to funding science—it was nearly alone on the science funding landscape. Today federal funding of research totals nearly \$140 billion, including over \$30 billion for basic research; with private foundations providing more than \$2 billion more.

As RCSA selects a new president and does strategic planning for its future, it is focused on re-examining where we can have impact, what the most important science funding problems are and where it has a “comparative advantage” relative to other funders. As a small foundation, our ability to have an impact is directly related to our ability to be selective in who and what we fund. RCSA sees its role as a catalytic one, to fund testing of early stage exploratory research ideas of early career academic scientists and thereby catalyze the advancement of fundamental knowledge, provide the starting point for future technology and build the intellectual capital necessary for the United States to remain the world leader in science and technology. The arc of discovery can only be initiated if funders like RCSA continue to take chances on untested, curiosity-driven ideas without the expectation of financial reward.

Finally, I’d like to say thank you to Past President Jim Gentile on behalf of RCSA for his fine work in leading the foundation from 2005 through its centennial year. Dr. Gentile successfully continued RCSA’s tradition of a small foundation “punching above its weight.” We wish him great success as he returns to Hope College as dean of natural and applied sciences.

Jack Pladziewicz
Interim President and CEO

100 Years of Funding Research and Supporting Early Career Scientists

2012

For the past 100 years, Research Corporation for Science Advancement has followed the vision of its founder, Frederick Gardner Cottrell.

In this Centennial year RCSA continued Cottrell's mission by funding the most promising and creative research of early career scholars in astronomy, physics, chemistry and biochemistry. In 2012 RCSA awarded 55 individual grants and funded 11 collaborative teams representing 40 scholars. Details on scholars, their research and collaborative projects are in this report.

The foundation launched its Centennial with the announcement of the John P. Schaefer Award at a lunch in Tucson on February 16, 2012, followed by a Gala celebration and a congressional briefing in Washington, D.C., on Wednesday, March 14, and two events in New York in May.

RCSA remains steadfast in its 100-year commitment to advance the American scientific enterprise and support academic-based research that has the potential to yield breakthrough discoveries.

Celebrating 100 years of achievement in supporting science, Smithsonian National Air and Space Museum, March 14, 2012



Washington, D.C., Gala

RCSA held its official 100th birthday party March 14, 2012 in the soaring entrance to the Smithsonian Institution's National Air & Space Museum, in Washington, D.C. The celebration, with more than 300 guests, among them Nobel laureates and current leaders in science, science policy and academia, took place under a canopy of historically important aircraft, including Charles Lindbergh's *Spirit of St. Louis*, suspended from the museum's lofty ceiling. Robert Goddard's first rocket was in the room, significant because RCSA provided a \$5,000 grant to the Smithsonian, which in turn funded some of Goddard's early work.

The black-tie event featured keynote speaker Norman Augustine, former CEO of Lockheed Martin and director of the influential *Gathering Storm* reports on American science and math education; Nobel laureates Dudley Herschbach and Carl Wieman; Ralph J. Cicerone, president of the National Academy of Sciences; Bassam Z. Shakhshiri, president of the American Chemical Society; Beverly Tatum, president of Spelman College; John P. Schaefer, former RCSA president; Gayle P.W. Jackson, RCSA board chair; and James M. Gentile, RCSA president and CEO. Ira Flatow, producer and host of *Science Friday* on NPR, was the master of ceremonies.

Mission

Mission Statement

RCSA is a foundation for the advancement of science that provides catalytic and opportunistic funding for innovative scientific research and the development of academic scientists, which will have a lasting impact on science and society.

Centennial Honorary Committee

Co-Chairs

Ralph J. Cicerone

President, National Academy of Science

Charles M. Vest

President, National Academy of Engineering

Honorary Committee

Bruce Alberts

Editor-in-Chief, *SCIENCE*; former President of the National Academy of Sciences

Paula S. Apsell

Senior Executive Producer, *NOVA* and *NOVA Science NOW*

Norman R. Augustine

Former Undersecretary of the U.S. Army; former President & CEO Lockheed Martin; leader in Rising Above the Gathering Storm initiative

Larry Bock

Executive Director, USA Science & Engineering Festival

Don V. Budinger

Founder and former President of Rodel, Inc. & Chair of the Rodel Foundations

Ursula M. Burns

Chairman and CEO, Xerox Corporation

Thomas R. Cech

Nobel Laureate, Chemistry; University of Colorado; former President of the Howard Hughes Medical Institute

Vicki Chandler

Chief Science Program Officer at the Gordon & Betty Moore Foundation; former Director of the Bio5 Institute at the University of Arizona

Mariette DiChristina

Editor-in Chief, *Scientific American*

Ira Flatow

Producer and Host, *Science Friday*, NPR

The Honorable Ralph Hall, Texas

Chairman House Science and Technology Committee, U.S. House of Representatives

William C. Harris

President and CEO, Science Foundation Arizona

“Good science teaching has never been more important in history than it is now. One of the things research has shown us is that to be a great teacher of science you also have to have a great understanding of what it means to think like a scientist. And that’s really something that’s only possible to do if you are doing science.”

Carl Wieman



Carl Wieman, Nobel laureate, Associate Director of Science, White House Office of Science and Technology Policy

Dudley R. Herschbach

Nobel laureate, Chemistry, Harvard University

Shirley Ann Jackson

President, Rensselaer Polytechnic Institute

Alan I. Leshner

President and CEO, American Association for the Advancement of Science

Shirley M. Malcom

Director, Science Education, American Association for the Advancement of Science

Corey S. Powell

Editor-in-Chief, *Discover*

Ellis Rubinstein

President and CEO, The New York Academy of Sciences

Janet Zucker

Film Producer; Founding member and principal partner in Mann Management

Jerry Zucker

Film Director and Producer

“Science and society have what is essentially a social contract that enables great intellectual achievements, but comes with mutual expectations of benefiting the human condition and protecting our planet. I believe it’s not enough for us to be just scientists; we have a responsibility to be citizens as well. As scientist-citizens we have an obligation to use our skills for the benefit of all.”

Bassam Shakhshiri



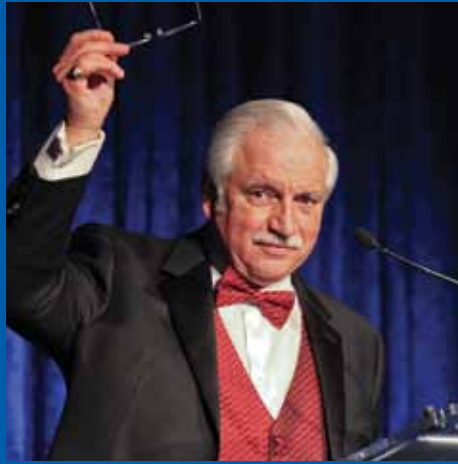
Ira Flatow, *Science Friday* Host and Gala Master of Ceremonies



Bassam Shakhshiri, President, American Chemical Society

“Scientists performing basic research provide... knowledge that could lead to solutions to many of the challenges that face our world today. These challenges include providing affordable healthcare; providing clean, sustainable, affordable energy; protecting us from terrorism; conserving our planet’s natural environment; and building an economy that ensures that everyone who wants a job can have one.”

Norman Augustine



James M. Gentile, President and CEO, Research Corporation for Science Advancement



Beverly Tatum, President, Spelman College



Norman R. Augustine, retired Chairman Lockheed Martin



John P. Schaefer, Past President, Emeritus Board Member, Research Corporation for Science Advancement

“The most important thing really is love... With love you know that whatever disappointments or struggles lie behind or ahead, you are blessed. Beyond talent and energy you can bring passion, vision, commitment to whatever you undertake. You can foster in yourself and others the awareness of opportunity, the fellowship of striving, the joy of discovery, the satisfaction of genuine service.”

Dudley Herschbach



Ralph J. Cicerone, President, National Academy of Science



Gayle P. W. Jackson, Board Chair, Research Corporation for Science Advancement



Dudley R. Herschbach, Nobel laureate, Harvard University

Congressional Briefing

“Science is not just a collection of facts, nor is it something that happens in a laboratory. It happens in the mind. It requires flights of imagination, fancy, inspiration and innovation. And that’s how we should be teaching students.”

James M. Gentile

“Too many of our students drop out of science majors before they’re through. In fact, the attrition rate is astonishingly high—50 to 60 percent... Now that is a national problem, not just a university problem. This is a national problem of the first order.”

Hunter Rawlings III

“So today we must support fundamental research and we must start early to develop our young people... and we must do so in creative and sustained ways. To accomplish this academia, government, industry and the public must work together to improve math and science education from the very beginnings of our children’s lives. The rising generation has the imagination, the commitment and the intelligence to lead in science and engineering and math and technology, if we provide them with the preparation and education they need and deserve.”

Shirley Ann Jackson



On March 14 RCSA co-sponsored, with the American Chemical Society (ACS), a congressional briefing in the historic Kennedy Caucus Room of the Russell Senate Office Building. The panel on “STEM Education for an Innovative Workforce” featured a discussion among James M. Gentile, RCSA president and CEO; Bassam Shakhshiri, president of ACS; Hunter Rawlings III, president of the Association of American Universities; Shirley Ann Jackson, president of Rensselaer Polytechnic Institute; and U.S. Sen. Mark Udall, D-CO. The panel was introduced by Madeleine Jacobs, ACS executive director. The discussion focused on improving attraction and retention rates of students to STEM disciplines and on raising the level of science literacy among all students in America’s research universities.

May in New York

To commemorate its 2012 centennial, Research Corporation for Science Advancement joined with *Discover* magazine and the New York Academy of Sciences to sponsor a discussion about world-changing research.

The May 16 *Crazy or Brilliant: Betting on High-Risk, High-Reward Science* event was part of Science in the City, a public series sponsored by the Academy. The wide-ranging conversation was moderated by Corey Powell, editor-in-chief of *Discover*. The panel featured Jon Gertner, author of *The Idea Factory*, recalling the history of Bell Labs; renowned theoretical physicist Brian Greene; technology investment expert Shelley Harrison; and MacArthur Genius Award-winning nanoscientist Michael Lipson.

The discussion, featured in the December 2012 issue of *Discover*, focused on the speakers’ personal involvement in high-risk, potentially high-reward research and the resulting outcomes.

The following evening, May 17, RCSA and the Academy jointly sponsored a dinner and another panel discussion, *Innovation at 100*, on the topic of how venerable institutions, both private and public, stay current and prosper through changing times.

Karin Ezbiansky Pavese, the Academy vice president for innovation and sustainability, was the moderator. Participants included Francine Berman, vice president for research at Rensselaer Polytechnic Institute; Tim Noonan, vice president of Phantom Works Ventures and Boeing Energy; Leemor Joshua-Tor, dean of the Cold Springs Harbor Watson School of Biological Sciences; and Jane Snowden, senior manager for industry solutions and emerging business, energy and environment at IBM’s T.J. Watson Research Center.

The John P. Schaefer Award

Centennial Gala Sponsors

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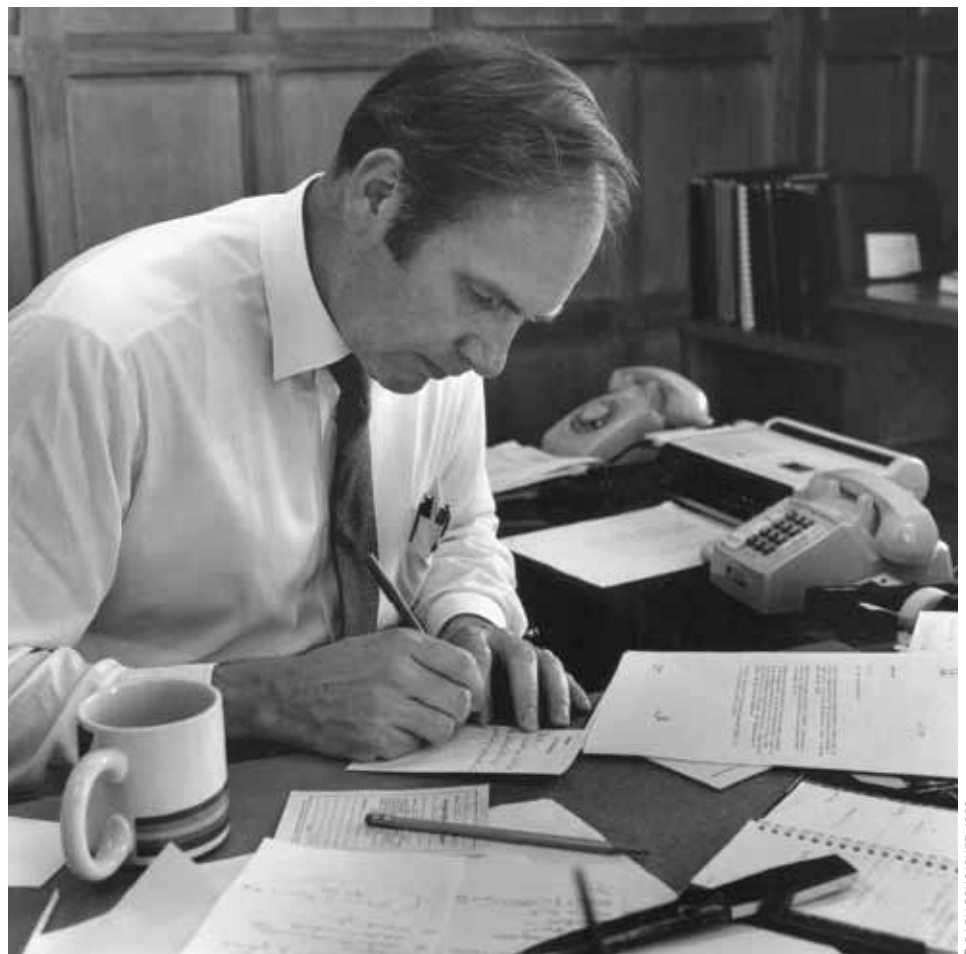
The Accord Group
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Goodman Media
Godat Design
Keegan, Linscott & Kenon, PC
The Mahoney Group
Mesch, Clark & Rothschild P.C. Attorneys
Nextrio

“Research Corporation has an extraordinary history of converting great ideas into practice, encouraging young people to go into science, to make new discoveries, to come up with something that no one has seen before and then turning it over for the benefit of mankind.”

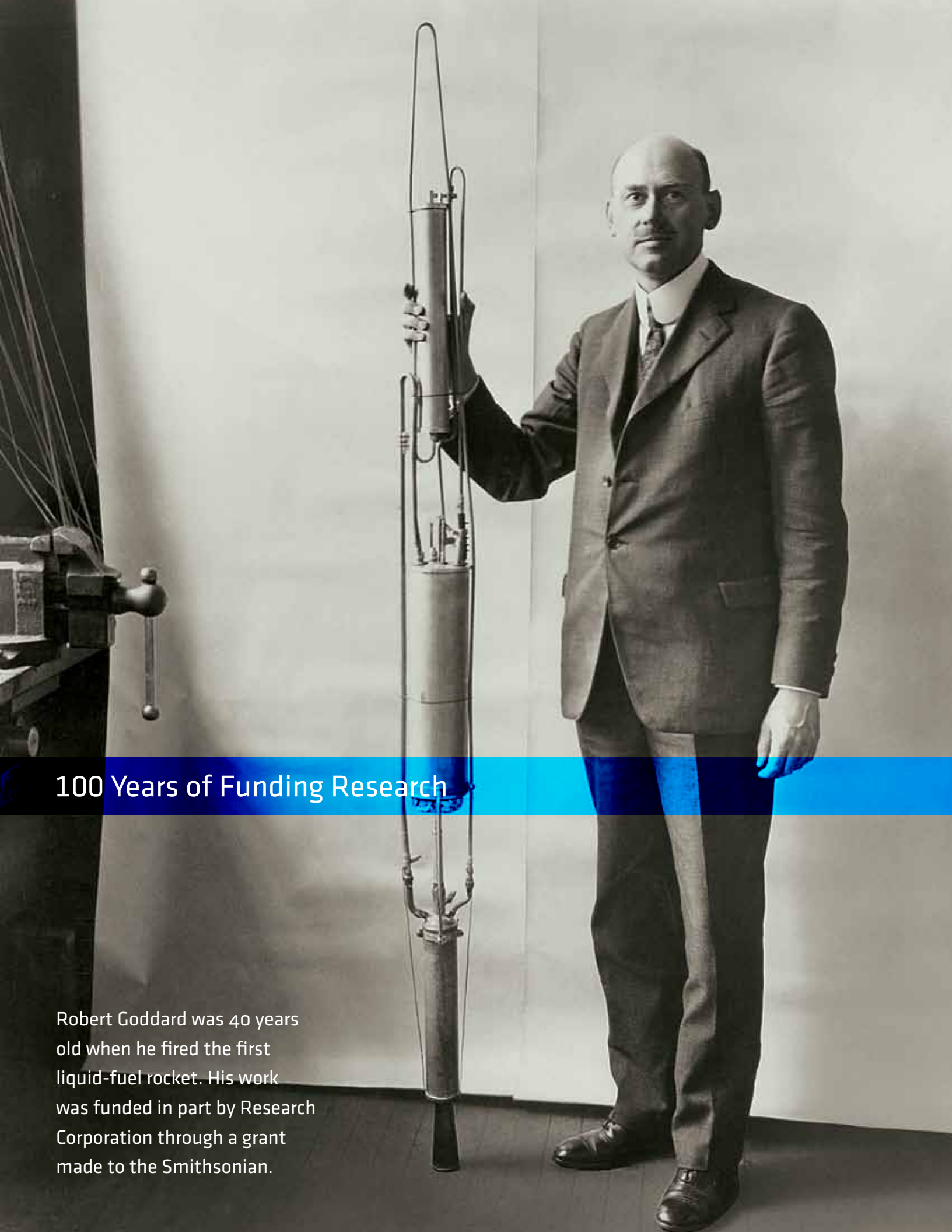
John P. Schaefer

At the opening event of the centennial, February 16 in Tucson, RCSA President James M. Gentile announced that the foundation would revive a distinguished tradition from its history—the awarding of a national prize to a leading scientist for breakthrough discoveries. Originally called the Research Corporation Award, it will be renamed the John P. Schaefer Award—in honor of the former president of the foundation from 1982 to 2005 and of the University of Arizona from 1971 to 1982.

The \$100,000 award will be jointly endowed by RCSA and the Frederick Gardner Cottrell Foundation, an affiliate of Research Corporation Technologies, and by private donations. The first awardee will be announced in 2014.



John P. Schaefer, 1982



100 Years of Funding Research

Robert Goddard was 40 years old when he fired the first liquid-fuel rocket. His work was funded in part by Research Corporation through a grant made to the Smithsonian.

Cottrell Scholar Award Program

Cottrell Advisory Committee

Seth Cohen (Chair)

Department of Chemistry & Biochemistry
University of California, San Diego

Rigoberto Hernandez

Department of Chemistry & Biochemistry
Georgia Institute of Technology

Teri Odom

Department of Chemistry
Northwestern University

Mats Selen

Department of Physics
University of Illinois, Urbana-Champaign

Jairo Sinova

Department of Physics
Texas A&M University

Bradley D. Smith

Department of Chemistry & Biochemistry
University of Notre Dame

For the last two decades, Research Corporation for Science Advancement has invested significant resources to help young faculty at research universities to become both highly successful researchers and inspiring teachers. The Cottrell Scholar program was created in 1994 as a response to RCSA's perception that teaching and research activities at PhD institutions needed to be more integrated. To tackle this challenging goal, RCSA created a program that calls for research and educational plans, with special emphasis in undergraduate science courses.

Following a rigorous selection process that ends with a recommendation by RCSA's Science Advisory Committee, a new class of scholars is identified annually from a very rich pool of applications. Simply said, the Cottrell Scholar program has become an incubator of outstanding teacher-scholars, early career faculty who conduct cutting-edge research and who are committed to excellence in teaching.

Since the inception of this program, RCSA has honored over 250 Cottrell Scholars in more than 150 research universities across the country. In addition to awards, the program has a large networking component: Scholars gather annually at the summer Cottrell Scholar Conference and work on projects of national interest. In 2011 RCSA launched the Cottrell Scholar Collaborative, a new initiative that encourages collaborations aimed at improving undergraduate STEM teaching among Scholars throughout the year.

The research promise of the community we support is evidenced by numerous 2012 national awards to Cottrell Scholars. For example:

Joshua Figueroa (2010 CS, Chemistry, University of California, San Diego) received a prestigious Presidential Early Career Award for Scientists and Engineers (PECASE) award. PECASE awards highlight innovation in research and commitment to science education.

Early career awards from both Novartis and DuPont identified **Sarah Reisman** (2012 CS, Chemistry, California Institute of Technology) as a leader in natural product synthesis.

Scott Snyder (2009 CS, Chemistry, Columbia University) earned the prestigious Arthur C. Cope Scholar Award from the American Chemical Society.

Over the years a number of Scholars have become national leaders for their excellent science as well as for their educational practices. For example, Mats Selen (1996 CS, Physics, University of Illinois, Urbana-Champaign) played a major role in the educational reform of his department while pursuing research in high-energy particle physics and astrophysics. Selen's activities had a catalytic effect and inspired other departments to follow their lead, as stated by Jairo Sinova (2006 CS, Physics, Texas A&M University) who is now heading a similar departmental reform in his own institution. "Without Mats' help and the wonderful colloquium he delivered to our faculty, many of the reforms that we are undertaking would not have been possible," Sinova said.





Cottrell Scholars Conference 2012

Other Cottrell Scholars have risen through the ranks and taken academic leadership positions. For example, in 2012 Peter Dorhout (1994 CS, Chemistry) became the dean of the College of Arts and Science at Kansas State University, a position that benefits from his broad expertise as a teacher-scholar. Adam Falk (1997 CS, Physics) became the 17th president of Williams College in 2010 and Karen Bjorkman (1999 CS, Astronomy) accepted a position as the dean of the College of Natural Sciences and Mathematics at University of Toledo in 2011.

2012 Cottrell Scholars

Suzanne C. Bart

Chemistry

Purdue University

Uranium Complexes Supported by Redox-Active Ligands for Small Molecule Activation

Erin Carlson

Chemistry

Indiana University

Chemoselective Enrichment Tools for Natural Products Discovery

William Dichtel

Chemistry

Cornell University

Predictable Assembly of Ordered Heterojunctions Using Covalent Organic Frameworks

Kingshuk Ghosh

Physics

University of Denver

Designing Biological Toys: Genetic Switches and Clocks

Seth Herzon

Chemistry

Yale University

Synthetic and Chemical Biological Studies of Lomaiviticins A and B

Eric Hudson

Physics

University of California, Los Angeles

Keeping Time with the Nucleus: A Solid-State Optical Clock Based on a Nuclear Transition

Geoffrey Hutchison

Chemistry

University of Pittsburgh

Molecular Piezoelectrics: Building Responsive Electromechanical Materials From the Bottom Up

Daisuke Nagai

Physics

Yale University

Computational Cosmology in Classrooms and in Research

Sarah Reisman

Chemistry

California Institute of Technology

The Development and Application of Heterocycle Forming Reactions in Natural Product Total Synthesis

Sara Skrabalak

Chemistry

Indiana University

New Synthetic Strategies to Multi-Metal Nanocrystals with Controlled Compositions and Structures

J.D. Smith

Astronomy

University of Toledo

After the Fall—Why Galaxies Die, and How

Cottrell Scholar Collaborative Launches New Faculty Workshop in Chemistry

Thirty-eight chemistry faculty representing 30 universities attended the first New Faculty Workshop, August 8-10, 2012, at the American Chemical Society (ACS) headquarters in Washington, D.C.

The ACS-hosted workshop, which focused specifically on teaching chemistry to undergraduates, was designed and presented by members of the Cottrell Scholar Collaborative. Workshop organizers include project leaders Andrew Feig, chemistry, Wayne State University, and Rory Waterman, chemistry, University of Vermont; committee members Lane Baker, chemistry and biochemistry, Indiana University; Linda Columbus, chemistry, University of Virginia; and William Jenks, chemistry, Iowa State University.

Michael Doyle, chairman of the Department of Chemistry and Biochemistry at the University of Maryland at College Park, presented the keynote address, “Evolution of the teacher-scholar: Advising, diversity, mentoring, research, safety, teaching... Not enough time for everything.” Program officers from National Institute of Health National Institute of General Medical Studies, National Science Foundation Division of Chemistry, Department of Energy and ACS Petroleum Research Fund participated in a panel discussion, moderated by RCSA Program Director Silvia Ronco, titled “Writing the Right Grant for the Right Agency.”

The workshop was designed to aid newly hired chemistry faculty to develop strong research and teaching programs. Sessions focused on implementation of evidence-based teaching practices in the classroom, integrating teaching and research, grant writing, student mentoring and effective time management.

The goal was to develop “teachable tidbits” that help participants move away from lectures and towards engaging students in interactive learning.

A second workshop is scheduled for 2013.

2012 Cottrell Scholar Conference

“Educating 21st-Century Scientists” was the topic of the 18th-Annual Cottrell Scholars Conference, held July 11 to 13 in Tucson, Arizona. Sixty scholar-educators shared their experiences, challenges and initiatives to reform undergraduate science teaching in America’s research universities. The conference was chaired by Rigoberto Hernandez, Chemistry, Georgia Institute of Technology, and RCSA Program Director Silvia Ronco.

Conference Keynote Speakers

- Michael Schatz, Professor of Physics, Georgia Institute of Technology, discussed challenges and opportunities in science education.
- Tobin Smith, Vice President for Policy, Association of American Universities, discussed the AAU initiative to reform undergraduate STEM education.
- Celeste Rohlffing, Deputy Assistant Director, Mathematical and Physical Sciences Directorate, National Science Foundation, presented STEM workforce issues from the NSF perspective.
- Luis Echegoyen, Robert A. Welch Professor of Chemistry, University of Texas, El Paso, discussed carbon materials and the serendipity of discovery.

Collaborative Grants

As a result of discussions and collaborations formed at the July 2012 conference, four teams received Collaborative Grants. The grants and the principal investigators are:

- *Cottrell Repository for Effective Science Teaching (CREST)*
Mike Hildreth, University of Notre Dame
Geoffrey Hutchison, University of Pittsburgh
- *Mobilizing the Forgotten Army: Equipping TAs with Inquiry-Based Instruction Methods*
Jordan Gerton, University of Utah
Michael Schatz, Georgia Institute of Technology
- *Effective Evaluation of Teaching and Learning (EETL)— Searching for New Approaches to R1 STEM Teaching Evaluation*
Stephen Bradforth, University of Southern California
Will Dichtel, Cornell University
- *Cottrell Comic Challenge Project (CCP): A Pilot Program for Attracting and Developing Graphic Talent for a Novel Outreach Project*
Snezana Stanimirovic, University of Wisconsin, Madison
Yadong Yin, University of California, Riverside
Mike Gladders, University of Chicago
Karen Bjorkman, University of Toledo
Sarbjit Banerjee, State University of New York, Buffalo

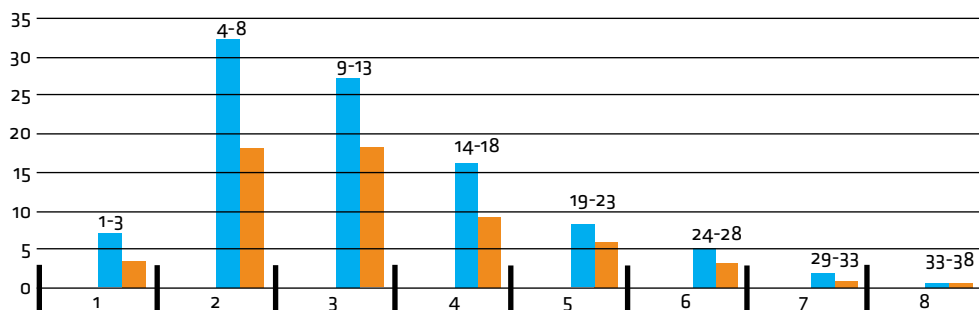
Cottrell College Science Awards



The Cottrell College Science Award (CCSA) program supports high-quality research conducted by early career faculty and their undergraduate students at primarily undergraduate institutions. The principal goal of the CCSA program is to seed a sustainable program of research. Moreover, the program supports the development of outstanding teacher-scholars who bring passion about scientific discovery into their classrooms and laboratories and instill enthusiasm in their students. Through their scholarship, these teacher-scholars make significant contributions to their fields of research.

An important measure of sustainability is the ability to attract ongoing funding from other agencies. For example, the graph below shows the distribution of 304 National Science Foundation awards given under the Research at an Undergraduate Institution (RUI) program to faculty who are also eligible for the CCSA program (blue bars). The orange bars show the NSF recipients who also received early career grants from the CCSA program. Awards are grouped according to the number of years in their first faculty position. This graph shows a striking correlation between faculty who received an early career award from CCSA and those who received the larger NSF-RUI awards later in their careers. We believe that this is more than a coincidence and that an early career seed grant from CCSA is an important stepping stone to sustained funding for many PUI faculty.

Percentage of NSF-RUI recipients vs. years from the start of faculty position (blue bars: NSF-RUI recipients; orange bars: NSF-RUI plus CCSA recipients)



Examples of Productive Careers with Sustained Funding

Polymer chemist Peter Iovine (Chemistry, University of San Diego) is following a successful upward trajectory with sustained external funding that started in 2004 with a Cottrell College Science Award. A 2008 NSF-CAREER recipient, Iovine was named a Henry Dreyfus Teacher-Scholar in 2012. According to Iovine, “It was the early CCSA funding that has propelled my research career forward. Using the results and publications produced during the award period, I was able to develop a strong NSF-CAREER proposal that was eventually funded.” Iovine adds that multiple individual CCSA awards in his department have contributed to a significantly enhanced research environment and that CCSA-sponsored summer research work has served as the foundation for USD students winning Goldwater Scholarships and NSF Graduate Research Fellowships.

Surface chemist David Patrick (1997 CCSA, Chemistry, Western Washington University) has been able to establish a productive interdisciplinary research

program in surface science. In 2010 NSF awarded Patrick's group a prestigious SOLAR award for collaborative work with WWU colleagues Brad Johnson (Physics), Janelle Leger (Physics) and John Gilbertson (Chemistry), all former CCSA-recipients. Among Patrick's impressive accomplishments are a PECASE award in 2000 and a Henry Dreyfus Teacher Scholar award in 2001.

RCSA's history of helping initiate productive research goes way back. Here are a few examples of current NSF-recipients who started their careers with CCSA funding decades ago:

- Organic chemist Dale Shellhamer (1980 CCSA, Point Loma Nazarene College)
- Analytical chemist Tom Wenzel (1981, 1986 and 1989 CCSA, Bates College)
- Nuclear physicist Paul DeYoung (1986 CCSA, Hope College)
- Bioorganic chemist Moses Lee (1990 CCSA, Hope College)
- Physical chemist Helen Leung (1991 and 1997 CCSA, Amherst College)

In addition, two former CCSA recipients received major professional achievement awards in 2012:

David S. Hall (2001 CCSA), Physics, Amherst College, won the American Physical Society Prize for a Faculty Member for Research at an Undergraduate Institution.

David K. Lewis (numerous grants from 1973 through 1996 CCSA), Chemistry, Connecticut College, received the American Chemical Society Award for Research at an Undergraduate Institution.

Although RCSA provides financial support for these APS and ACS national awards, it plays no role in selection of the winners. Read more about Dr. Hall and Dr. Lewis in RCSA national award section on page 26.



A New Generation of Excellent Teacher-Scholars

RCSA's history of helping develop vibrant research at primarily undergraduate institutions continues today. Examples of CCSA recipients who received prestigious federal awards in 2012 include:

- Organic chemist Timothy Clark (2007 CCSA, Chemistry, University of San Diego), NSF-CAREER
- Organic chemist Jeffrey Johnson (2008 CCSA, Chemistry, Hope College), NSF-CAREER
- Biophysical chemist Casey Londergan (2008 CCSA, Chemistry, Haverford College), NSF-CAREER
- Materials chemist Kate Plass (2008 CCSA, Chemistry, Franklin and Marshall College), NSF-CAREER
- Biophysicist Rae Anderson (2010 CCSA, Physics, University of San Diego), Air Force Young Investigator Award

2012 Cottrell College Science Awards

Multi-Investigator Cottrell College Science Award

Veronica Barone

Physics

Bradley D. Fahlman

Chemistry

Central Michigan University
Mt. Pleasant, MI

*Chemical Unzipping of Doped
Multi-Walled Carbon Nanotubes for
Energy Storage Applications*

Stephanie S. Strand

Biology

Mark J. Snider

Chemistry and Biology

Melissa M. Schultz

Chemistry

College of Wooster
Wooster, OH

*Novel Computational Techniques for
Investigating Gene Interaction Networks
in *Ichthyophthirius Multifiliis* and its
Endosymbiotic Bacteria*

Natalia V. Connolly

Physics

Alistair Campbell

Computer Science

Hamilton College
Clinton, NY

*Microbial Degradation of Pharmaceuticals
and Personal Care Products during
Wastewater Treatment*

Edward J. Crane III

Biochemistry and Chemistry

Jade Star Lachey

Geochemistry

Pomona College
Claremont, CA

*An integrated Study of the Enzymology,
Microbiology and Geology of Sulfur-Based
Respiration: from Molecular Mechanisms
to the Bio- and Geosphere*

Single-Investigator Cottrell College Science Award

Heather Lynn Abbott-Lyon

Chemistry

Kennesaw State University
Kennesaw, GA

*Radiation Induced Prebiotic Chemistry at
Ice-Mineral Interfaces*

Mehnaaz Ali

Chemistry

Xavier University of Louisiana
New Orleans, LA

*Aptamer-Based Biosensors with Co-factor
Modulated Enzyme Signaling*

Mark R. Ams

Chemistry

Allegheny College
Meadville, PA

*Molecular Torsion Balances for Probing the
Distance Dependency of CH- π Interactions*

Tania Betancourt

Chemistry

Texas State University, San Marcos
San Marcos, TX

*Responsive Hydrogels Based on Binary
Nucleic Acid Probes for Molecular Detection
and Triggered Drug Release*

Mishkatul Bhattacharya

Physics

Rochester Institute of Technology
Rochester, NY

*Optomechanical Rotation Sensors:
Theoretically Identifying and
Circumventing the Quantum Limits to their
Sensitivity*

Megan E. Bolitho

Chemistry

University of San Francisco
San Francisco, CA

*Rational Design, Chemical Synthesis, and
Biochemical Evaluation of Small-Molecule
Inhibitors of the LuxS Enzyme*



Michael David Bridges

Chemistry

California State University, Fullerton
Fullerton, CA

*Equilibrium Dynamics and Binding
Kinetics of Intrinsically Disordered Cancer
Proteins by EPR Spectroscopy*

Joseph Carson

Astronomy

College of Charleston
Charleston, SC

*Extrasolar Planet Imaging Studies with the
Hubble and Spitzer Telescopes*

William Reed Collins

Chemistry

Fort Lewis College
Durango, CO

*From Carbon Nanofoams to Nanotubes:
New Approaches to the Chemical Synthesis,
Elaboration, and Application of the [n]
Cycloparaphenylene Family*

Justin Joseph Donato

Chemistry

University of St. Thomas
Saint Paul, MN

*Shedding Light on the Mechanism of Action
of an Enzyme that Confers Resistance to a
Common Antimicrobial Agent*

Klebert B. Feitosa

Physics

James Madison University
Harrisonburg, VA

*Transient Glassy Dynamics of Dense
Emulsions at the Particle Level*

Sharon Jane Gerbode

Physics

Harvey Mudd College
Claremont, CA

*Particle-Scale Dynamics of Impurity Defect
Expulsion in Colloidal Crystals*

David Joel Gorin

Chemistry

Smith College
Northampton, MA

*Selectivity in Complex Contexts: Directing
Chemical Reactions with DNA-Small
Molecule Conjugates*

Benjamin C. Gorske

Chemistry

Bowdoin College
Brunswick, ME

*Synthesis of Peptoid/Thiopeptoid Hybrids
as Polyproline Type II Helix Mimics*

David Hanneke

Physics

Amherst College
Amherst, MA

*Quantum Logic Spectroscopy of Charged
Molecules*

Justin K. Hines

Chemistry

Lafayette College
Easton, PA

*Investigating Potential Amyloid-Membrane
Interactions: The Role of an Auxilin-type
Molecular Chaperone in Yeast Prion
Propagation*

Prashanth Jaikumar

Physics

California State University, Long
Beach Long Beach, CA

*r-Mode Oscillations and Gravitational
Wave Signatures of Hybrid Neutron Stars*

Swapan Jain

Chemistry

Bard College
Annandale-on-Hudson, NY

*Synthesis of Novel Purine Analogs and
Evaluation of their Binding to Xanthine
Phosphoribosyl Transferase (XPT) Mrna*

Jun-Hyun Kim

Chemistry

Illinois State University
Normal, IL

*Construction and Modification of Stimuli-
Responsive Hollow Polymer Nanoparticles
for Targeted Drug-Delivery Vehicles*

Christian E. Laing

Chemistry

Wilkes University
Wilkes-Barre, PA

*Modeling RNA Tertiary Structure
by Merging SHAPE Chemistry with
Comparative Sequence Alignment*

Amy L. Lane

Chemistry

University of North Florida
Jacksonville, FL

*A Genetic-Chemical Approach for
Exploring Biotic Interactions as Activators
of Natural Product Biosynthesis Among
Marine Bacteria*

Amy Lytle

Physics

Franklin and Marshall College
Lancaster, PA

*Investigation of the Effect of
Counterpropagating Light on Perturbative-
Regime Frequency Conversion*

Corina Maeder

Chemistry

Texas State University, San Marcos
San Marcos, TX

*Regulation of the Essential Splicing
Helicase Brr2 by U5 snRNP Proteins During
Spliceosome Assembly.*

Christopher C. Marvin

Chemistry

Hendrix College
Conway, AR

*Visible Light Photocatalytic Oxidation of
Amines to Iminium Ions: Amine Scope and
Mannich Cyclizations with Allyl and Vinyl
Silanes*

**Single-Investigator
Cottrell College Science Award
Continued**

Andrew Mitchell

Chemistry

Illinois State University
Normal, IL

*Toward the Building Blocks for the
Convergent Total Synthesis of
Muironolide A*

Kristine A. Nolin

Chemistry

University of Richmond
Richmond, VA

*Rhenium(V)-Oxo Catalyzed Addition
Reactions*

Abby R. O'Connor

Chemistry

Ramapo College of New Jersey
Mahwah, NJ

*New Ni(II) and Pd(II) Complexes
Containing Hemilabile Pendant Arene
Groups to Catalyze the Polymerization of
Olefins and Polar Monomers*

Shannon O'Leary

Physics

Lewis and Clark College
Portland, OR

*Understanding Noise from Quantum
Interference for a Novel Atomic
Magnetometer*

Lisa E. Prevette

Chemistry

University of St. Thomas
Saint Paul, MN

*Characterization of the Interaction
Between Cell-Penetrating Compounds and
Glycosaminoglycans*

Tatiana R. Prytkova

Chemistry

Chapman University
Orange, CA

*The Protein Structure and Mobility control
of Electron Transfer Reactions in Ru-
Modified Proteins.*

David A. Rider

Chemistry

Western Washington University
Bellingham, WA

*Conducting Polymer/Nanoparticle
Interfacial Layers for Hydrogen Fuel Cells*

Nicholas J. Robertson

Chemistry

Northland College
Ashland, WI

*Synthesis of High Molecular Weight
Polyester and Polyamide Architectures
Derived from Biorenewable Monomers*

Kerry A. Rouhier

Chemistry

Kenyon College
Gambier, OH

*Defining the Role of Arabidopsis
thaliana Methylmalonate Semialdehyde
Dehydrogenase in Lipid Metabolism*

David S. N. Rupke

Astronomy

Rhodes College
Memphis, TN

*Feedback in Major Galaxy Mergers: A
Comprehensive Survey of Wind Structure
and Power Sources*

Nicholas Salzameda

Chemistry

California State University, Fullerton
Fullerton, CA

*Discovery and Optimization of Small
Molecule Inhibitors for the Botulinum
Neurotoxin Type E Light Chain*

Kristin Michelle Slade

Chemistry

Hobart and William Smith Colleges
Geneva, NY

*The Effects of Macromolecular Crowding on
Enzyme Kinetics in the Mitochondria*

Peifang Tian

Physics

John Carroll University
University Heights, OH

*Modeling the Light Propagation in Brain
Tissues using Monte Carlo Simulation
with a Dynamic and Heterogeneous Tissue
Model*

Mike J. Twiner

Chemistry

University of Michigan, Dearborn
Dearborn, MI

*Algal Toxins as Phosphatase Inhibitors:
Identification of New Targets and
Structure-Activity Characterization*

Eric James Watson

Chemistry

Seattle University
Seattle, WA

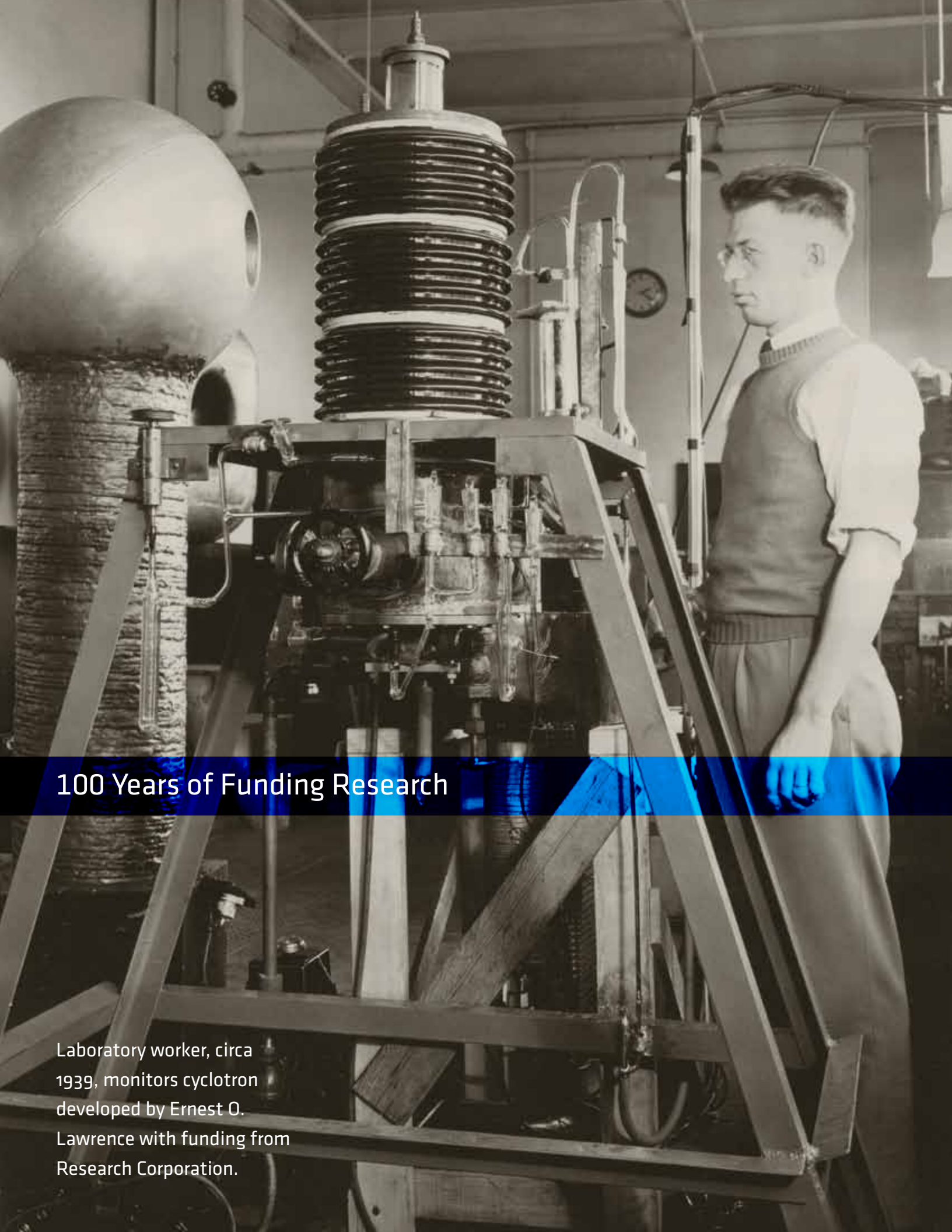
*The Synthesis and Reactivity of Novel
Triple-layer Bimetallic Complexes: Model
Systems for Organometallic Molecular
Wires*

James Wollack

Chemistry

St. Catherine University
Saint Paul, MN

*Enzymatic and Chemical Synthesis of
Strained Ring Containing Proteins and
Oligonucleotides for use in Tetrazine
Cycloaddition*



100 Years of Funding Research

Laboratory worker, circa 1939, monitors cyclotron developed by Ernest O. Lawrence with funding from Research Corporation.

Scialog



The Scialog program has the important but daunting goal of accelerating fundamental scientific breakthroughs which have the potential to overcome global challenges facing humankind. The first Scialog initiative is focused on basic research to enable clean, sustainable, affordable energy for a world rapidly heading toward a doubling of its energy needs by mid-century. The initiative is aimed at accelerating underlying scientific advances on the molecular and nano scales to improve the efficiency and scalability of technologies that use solar energy to produce electricity and fuels such as hydrogen.

The premise of Scialog is simple. A small but well targeted use of resources to fund highly innovative researchers with promising but untested ideas can make a big difference—especially when these researchers are brought together in a unique innovation environment and challenged to form additional collaborations based on ideas that emerge from multidisciplinary dialog in that environment.

Scialog funds ground-breaking research by recently tenured faculty, who are designated Scialog Fellows, at U.S. academic institutions. Scialog Fellows are convened annually, along with other world-class researchers, to share critical feedback on their projects and further develop research ideas. The conferences have an unusual format with a limited number of formal presentations and significant time spent in breakout sessions and other forms of dialog. Participants are challenged to form small teams and write short collaborative proposals “on the spot” for additional seed funding based on new ideas that emerge during the conference.

scialog®

Since 2010, when Scialog was launched, 23 Scialog Fellows have received awards totaling \$2.5 million. In addition, nine teams, composed of Scialog Fellows and other researchers, have received Collaborative Innovation Awards (CIA) totaling \$900,000, based on their proposals written at Scialog conferences.



The program is young and the arc of innovation from the lab bench to commercial industries that change the world can be long. But so far Scialog is helping researchers make important advances.

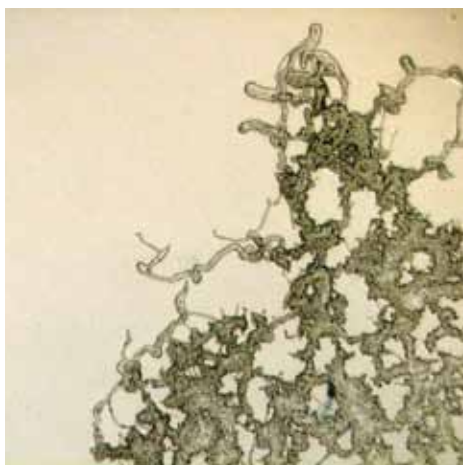
A major goal of the program is to provide seed funding to allow researchers to take a highly innovative idea from the initial untested stage to a level at which the idea’s promise is demonstrated sufficiently to attract substantial additional support. Another important goal is to use dialog among researchers to hit upon additional innovative ideas and create new collaborative teams.

Scialog Fellow Hugh Hillhouse, University of Washington, received a Scialog grant in 2010 to support his study of a new class of thin-film nanomaterials, known as “double-gyroid” quantum wire arrays, in the hope of squeezing more usable energy out of each photon. This year, Hillhouse led a team that won a four-year, \$1.9 million NSF Sustainable Energy Pathways (SEP) grant entitled, “Sustainable Energy Pathway to Terawatt-Scale Solution-Processed Solar Cells from Earth Abundant Elements.” The team included Scialog Fellow Daniel Gamelin and Scialog CIA recipient Christine Luscombe as co-principal

investigators and Scialog Fellow David Ginger as a collaborator, all from the University of Washington. According to Hillhouse, “Scialog played two important roles in our successful NSF SEP proposal. First, the dialog at the conference catalyzed our discussions about the key issues and bottlenecks in solar energy conversion and led to some healthy debate that really honed our NSF SEP. In addition, one of the thrusts in the SEP is an offshoot of the Scialog award.”

Scialog Fellow Ray Schaak, Pennsylvania State University, has taken an important step toward developing efficient artificial photosynthesis. A recent article presenting results of his Scialog supported work on the use of hollow nanocubes for photocatalytic carbon dioxide conversion to methane under solar irradiation was designated as a “Hot Paper” by the editors of *Angewandte Chemie International Edition*. According to Schaak, “Scialog was my entry point into the solar energy conversion field and the connections and interactions from this program continue to lead to new ideas and collaborations, including participation in the NSF-sponsored Powering the Planet initiative.”

Other Scialog projects are showing great promise as well. We don’t know yet if Scialog will attain its goal of catalyzing discoveries that lead to solar energy powering the world. But we do know it is worth trying.



Optical microscope images of bacterial colonies of *Paenibacillus dendritiformis* is taken at 5x magnification. The colonies have been grown on agar plates using a poor nutrient source—one that does not include the peptone that they normally thrive on. These social microorganisms respond to the stressor by growing into intricate patterns with multiscale, fractal structure. The Scialog Fellow collaborative team of Sean Shaheen, Richard Taylor, Frank Osterloh, and Boaz Ilan (2011) is investigating whether such patterns can play a role in engineering solutions to solar energy conversion. (Credits: Antonio Nava and Robert Nawrocki, University of Denver.)

2012 Scialog Conference on Solar Energy Conversion

The Third-Annual Scialog Conference on Solar Energy Conversion was held October 9-12 at Biosphere 2 in Oracle, Arizona. The conference, sponsored in part by the National Science Foundation, included representatives from the Department of Energy, the National Renewable Energy Laboratory, the Joint Center for Artificial Photosynthesis and the Center for Revolutionary Solar Photoconversion.

Keynote Speakers

- Neal Armstrong, Director, Center for Interface Science: Solar Electric Materials, University of Arizona
- Larry “Kaz” Kazmerski, Director, Science and Technology Partnerships, National Renewable Energy Laboratory (NREL)
- Ana Moore, Regent’s Professor of Chemistry and Biochemistry, Arizona State University
- Ramamoorthy Ramesh, Past Director, Department of Energy SunShot Initiative
- Michael Woodhouse, Solar Photovoltaic Technology and Economic Analyst, National Renewable Energy Laboratory (NREL)

Keynote Speakers from Past Scialog Solar Energy Conferences

- Nate Lewis, George L. Argyros Professor of Chemistry, California Institute of Technology, and Principle Investigator, Joint Center for Artificial Photosynthesis (JCAP)
- Arun Majumdar, Director, Advanced Research Projects Agency—Energy (ARPA-E)
- Dan Arvizu, Director, National Renewable Energy Laboratory (NREL)
- Krishnan Rajeshwar, Distinguished University Professor and Interim Associate VP for Research, University of Texas, Arlington
- Tom Peterson, Assistant Director, Directorate for Engineering, National Science Foundation (NSF)
- Eric Mazur, Balkanski Professor of Physics & Applied Physics, Harvard University
- Tom Moore, Regent’s Professor of Chemistry and Biochemistry, Arizona State University
- Roger Angel, Director, Steward Observatory Mirror Laboratory, and Regents Professor of Astronomy and Optical Sciences, University of Arizona

Scialog Collaborative Innovation Awards 2012

- *BaSi₂—A New Earth-Abundant Solar Cell Material*—Jiangeng Xue, University of Florida; Song Jin, University of Wisconsin; and So Hirata, University of Illinois
- *Supramolecular Non-Fullerene Electron Acceptors for Organic PVs—A Pathway Toward 20% Efficient Cells at a Cost Less than \$0.50/W*—Alan Sellinger, Colorado School of Mines; Michael Chabinyc, University of California, Santa Barbara; and Sean Shaheen, University of Denver
- *Photo-induced CO₂ Reduction Using Reverse TCA Cycle Enzymes*—Sean J. Elliott, Boston University and Gordana Dukovic, University of Colorado

Scialog 2012 conference attendees.



Arizona Partners in Science

The Arizona Partners in Science program provides summer research opportunities for Tucson-based high school science teachers in collaboration with University of Arizona faculty. The program is a partnership with the M.J. Murdock Charitable Trust, which funds a similar program in the Pacific Northwest. In addition to their research, the teachers participate in an annual Partners in Science conference. At the conclusion of the two-year program, the teachers are invited to apply for supplemental grants to purchase equipment for their high school classes.

The program attracts high-caliber teachers, including Margaret Wilch (2009 Partners), Tucson High Magnet School, who teaches honors research methods, biology and biotechnology. In 2012 she received an honorary doctoral degree from the University of Arizona, a first for any high school teacher.

Pam Tautz, University High School, received a Partners in Science award in 2010 to research the Scanning Probe Microscopy of Graphene. In 2012 she received a supplemental award to purchase a trinocular metallurgical microscope, a digital camera and other laboratory equipment to continue this research with her high school students.

2012 Arizona Partners in Science Teachers/Mentors

Stephen Murray, Catalina High School

Hermann Fasel, Aerospace and Mechanical Engineering, University of Arizona
Solar Chimney Power Plant Research—Scientific Analysis of Scaled Model

William Golden, Flowing Wells High School

Arvinder Sandhu, Physics, University of Arizona
Preparation and Spectroscopy of Graphene Nano-fragments

Kevin Horton, Cienega High School

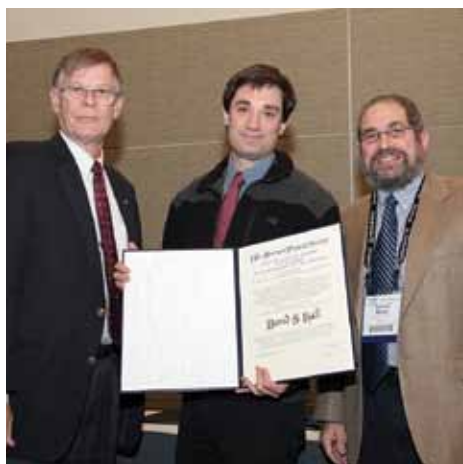
Theodore Price, Pharmacology, University of Arizona
Novel Therapeutics for the Reversal of Chronic Pain

Taralyn Rogers, Mountain View High School (Marana)

Catharine Smith, Pharmacology and Toxicology, University of Arizona
Maximizing the Efficiency of Histone Deacetylase Inhibitors of Non-Hodgkins Lymphoma: PreClinical Studies

RCSA-Funded National Awards

To recognize productive researchers at primarily undergraduate institutions, Research Corporation for Science Advancement sponsors two national awards that are managed by the American Chemical Society and the American Physical Society. Recipients are selected by a rigorous peer review process managed by the two societies.



Amherst College physics professor David Hall, center, with RCSA Program Director Richard Wiener, right, and APS President Bob Byer, left.

David S. Hall, physics, Amherst College, was the 2012 recipient of the American Physical Society Prize for a Faculty Member for Research at an Undergraduate Institution. Hall received a Cottrell College Science Award in 2001.

The prize honors a physicist whose research has achieved wide recognition and contributed significantly to physics, and who has also contributed substantially to the professional development of undergraduate physics students.

Hall was cited for ground-breaking investigations of Bose-Einstein condensates and the dynamics of quantum vortices. Hall and his group of undergraduate researchers invented a new technique for examining the behavior of rotating matter at the coldest temperatures in the universe. The method—which involves an apparatus that refrigerates atoms to billionths of a degree above absolute zero—enabled them to create the first-ever movies of vortex motion in individual Bose-Einstein condensates. And they developed the technique in Hall's campus laboratory.



Connecticut College chemistry professor David K. Lewis, center, with RCSA Program Director Silvia Ronco, right and ACS President Bassam Shakhshiri, left. (Photo courtesy of the American Chemical Society)

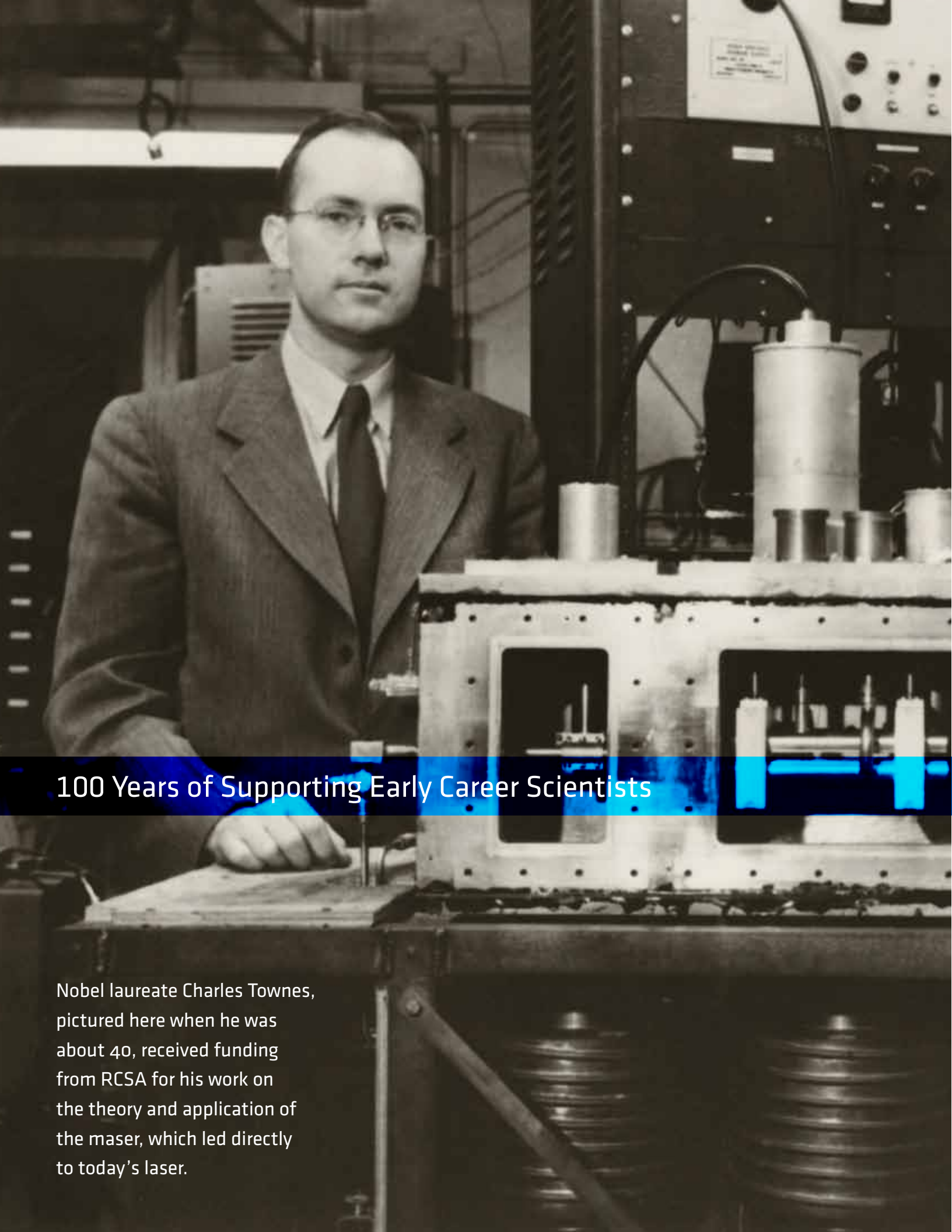
David K. Lewis, Margaret W. Kelly Professor of Chemistry, Connecticut College, received the 2012 American Chemical Society Award for Research at an Undergraduate Institution. RCSA funded Lewis' work numerous times from 1973 through 1996. His research centered on gas phase reaction kinetics; rates and mechanisms of prototype chemical reactions; ultra-high resolution molecular spectroscopy; and physics.

The award honors a chemistry faculty member whose research in an undergraduate setting has achieved wide recognition and contributed significantly to chemistry and to the professional development of undergraduate students.

A black and white photograph of Ernest O. Lawrence, a physicist, leaning over a large, complex piece of machinery, likely a cyclotron. He is wearing a white shirt, a dark tie, and glasses. The machinery is made of metal and has various pipes, valves, and components. The background is dark and industrial.

100 Years of Funding Research

Ernest O. Lawrence was 30 years old when he built the first cyclotron at the University of California, Berkeley. His work was funded by Research Corporation.



100 Years of Supporting Early Career Scientists

Nobel laureate Charles Townes, pictured here when he was about 40, received funding from RCSA for his work on the theory and application of the maser, which led directly to today's laser.

2012 Financial Summary

The financial activities of Research Corporation for Science Advancement were audited by Keegan, Linscott & Kenon, PC. For the complete audited financial statement, please visit our website at rescorp.org.

Where Our Money Goes

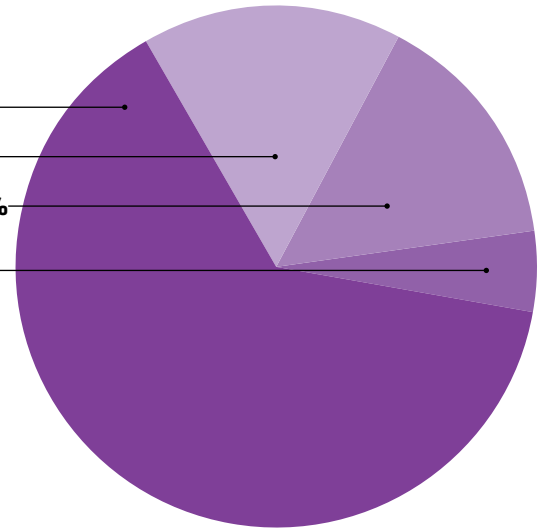
Total Expenses \$7,513,828

Grants, Awards & Programs **64%**

Centennial Programs **16%**

General & Administrative Costs **15%**

Partnership Development
& Fundraising **5%**



Grants and Awards Approved \$3,104,186

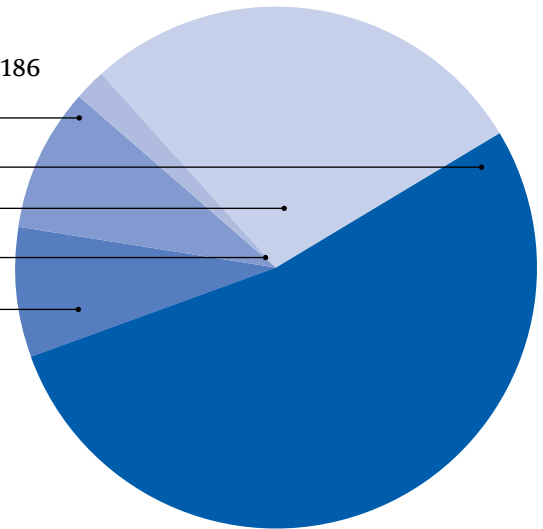
Scialog **9%**

Cottrell College Science **53%**

Cottrell Scholar **28%**

Arizona Partners in Science **2%**

Science in the Public Interest,
Discretionary Grants
& Special Initiatives **8%**



Net Assets at Beginning of Year \$121,789,242

Net Assets at End of Year \$141,324,688

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James M. Gentile

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Robert B. Hallock

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Jonathan Hook

Vice President and Chief Investment Officer of The Ohio State University. A member of the Audit and Finance Committees.

Brent L. Iverson

Chairman of the Chemistry & Biochemistry Department at the University of Texas at Austin. Chair of the Governance and Nominating Committee and a member of the Finance, Science Advancement and Executive Committees.

Suzanne D. Jaffe

President of S.D.J. Associates. Chair of the Strategic Partnership Committee and a member of the Finance and Executive Committees.

Elizabeth McCormack

Professor of Physics at Bryn Mawr College. A member of the Governance and Nominating and the Science Advancement Committees.

Patrick S. Osmer

Vice Provost for Graduate Studies and Dean of the Graduate School of The Ohio State University. A member of the Audit and Governance and Nominating Committees.

David L. Wenner

Retired from a 35 year professional career, most of which he spent with McKinsey & Company, the management consulting firm. A member of the Science Advancement and Strategic Partnerships Committees.

Emeritus Board Members

Robert B. Holland, Jr.

Williams Capital Partners. A member of the Audit and Strategic Partnerships Committees.

John P. Schaefer

President and Executive Chairman of the Board of Directors of REhnu. Director of Edmund Optics. RCSA Past President. A member of the Strategic Partnerships Committee.

Stuart B. Crampton

Barclay Jeomain Professor of Natural Philosophy (Emeritus) at Williams College. A member of the Finance and Science Advancement Committees.

Left to right: G. Scott Clemons, Patricia C. Barron, Patrick S. Osmer, Gayle P.W. Jackson, James M. Gentile, David L. Wenner, Suzanne D. Jaffe, Robert B. Hallock, Robert Holland Jr., Brent L. Iverson, Elizabeth McCormack, John P. Schaefer, Stuart B. Crampton.
Not shown: Peter K. Dorhout, Jonathan Hook



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Gordon & Betty Moore Foundation

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Harvard University

Elizabeth McCormack

Professor of Physics
Bryn Mawr College

Randy Murch

Associate Director, Research Program
Development and Adjunct Professor
Virginia Polytechnic Institute and
State University (Virginia Tech)

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and Applied Sciences
Harvard University

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Project Kaleidoscope (PKAL)

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Chemistry
Brandeis University

Geraldine Richmond

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Professorship in Chemistry
University of Oregon

Joaquin Ruiz

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