RESEARCH CORPORATION
for SCIENCE ADVANCEMENT

Global Perspective

2019 Annual Report

“Science knows no country, because knowledge belongs to humanity and is the torch which illuminates the world.”

Louis Pasteur,
chemist and microbiologist

Science can provide mechanistic insights into the most challenging riddles we can ask about anything in the universe. It can also lead to practical answers for the major problems shared by all of humanity. Because so many of the questions facing us today are global or beyond global — the spread and cure of disease, the production and storage of energy, climate change, access to clean water, and the detection of non-terrestrial life — it makes sense to find ways to engage scientists from different nations.

Throughout its history, Research Corporation for Science Advancement has focused primarily on supporting scientists within the United States. Yet, we also recognize our global connections dating back to the doctoral training in Germany of RCSA's founder, Frederick Gardner Cottrell. That linkage with Germany has been strengthened in recent years with the partnership between the Cottrell Scholar program and the German-American Fulbright Commission, resulting in the appointment of two Cottrell-Fulbright Scholars each year and in an annual new faculty workshop in Germany led by Cottrell Scholars.

That partnership also resulted in the highly entertaining International Science Slam competition organized by the German-American Fulbright Commission at the July 2019 Cottrell Scholar Conference in Tucson (see the Cottrell Scholar Conference page on our website for the video!)

For many years, RCSA funded scientists in Canada, but eligibility was restricted to domestic applicants a decade ago during the financial crisis. We have now restored eligibility in our programs to scientists at institutions in Canada. Past Cottrell Scholars based in Canada can once again apply for Cottrell Plus Awards, faculty completing their third year as independent teacher-scholars on the tenure track can apply for the Cottrell Scholar Award, and early-career scientists in Canada can be nominated to be Scialog Fellows.

At Scialog meetings, we are also looking beyond North America for themes and participants when doing so can introduce new and important opportunities for discovery. This was the case, for example, in holding the third Time Domain Astrophysics meeting in 2018 on the European Space Agency's release of GAIA data.

These global interactions are critically important. Many outstanding scientists in this country were born and grew up overseas, and scientists often move among several countries for their training, positions, and collaborations.

Although RCSA is able to focus support on only a fraction of the globe, we aim to include a global perspective in our scientific programs and communities and are working to provide more inclusive ways to bring together scientists from around the world.

Daniel Linzer
President & CEO
Research Corporation for Science Advancement

2019 Awards

In 2019 Research Corporation for Science Advancement supported early-career scientists at American colleges and universities through two major efforts: the Cottrell Scholar Program and Scialog.

The **Cottrell Scholar Program** is designed to develop outstanding teacher-scholars recognized by their scientific communities for the quality of their research programs, innovation in education, and potential for academic leadership. In 2019, Cottrell Scholar Program funding included $2.4 million for initial Cottrell Scholar Awards, which provide subsequent eligibility for competitive Cottrell Plus Awards ($470,000 in 2019) and Cottrell Scholars Collaborative Awards ($100,000 in 2019).

Scialog promotes dialogue and community-building to catalyze transformational science through collaborative interdisciplinary research. In 2019 RCSA awarded $825,000 to early-career faculty for scientific research through the Scialog Collaborative Innovation Awards. The contributions of partner philanthropies toward Scialog awards brought this total to $2.9 million.

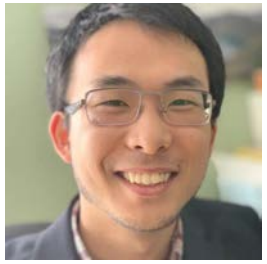
Cottrell Scholar Awards

$100,000 is awarded to each scholar for a total of $2,400,000.

Victor Acosta

Department of Physics and Astronomy, University of New Mexico

Hyperpolarization and Detection of Nuclear Magnetic Resonance Using Nitrogen Vacancy Centers in Diamond



Dennis Cao

Department of Chemistry, Macalester College

Cationically Supercharged Electron Acceptors

Robbyn Anand

Department of Chemistry, Iowa State University

Extracting Kinetic Rate Constants from Bipolar Electrochemistry: AC Voltammetry of Electrically Coupled Faradaic Reactions

Caitlin Casey*

Department of Astronomy, University of Texas at Austin

Diverse Perspectives: The Impact of Dust and Gas on Cosmic History and Equity-Minded Inquiry-based Astronomy

**Funded by Lyda Hill Philanthropies*

Gordon Berman

Department of Biology and Physics Graduate Program, Emory University

Information Bottlenecks and the Neural Control of Behavior in Fruit Flies

Jonathan Foley

Department of Chemistry, William Paterson University

Polaritonic Chemistry with Hybrid Nanoparticles

Benjamin Hunt

Department of Physics, Carnegie Mellon University

Broken Symmetry and Spin-Triplet Pairing in Two-Dimensional Superconductors

Laura Lopez

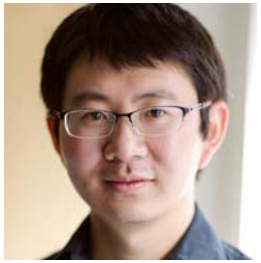
Department of Astronomy, The Ohio StateUniversity

Assessing Stellar Feedback in Massive Star-Forming Regions

Ryan McGorty

Department of Physics and Biophysics, University of San Diego

Optical Microscopy of Sheared Phase-Separating Soft Matter Systems



Chenfeng Ke

Department of Chemistry, Dartmouth College

Smart Supramolecular 3D Printing Materials with Synchronized Molecular Motions

Ellen Matson

Department of Chemistry, University of Rochester

Metal Oxide Clusters as Models for Investigating the Role of Oxygen Vacancies in Small Molecule Activation

Katherine Mirica

Department of Chemistry, Dartmouth College

Multifunctional Porous Scaffolds for Monitoring Neurochemicals

Emily Levesque

Department of Astronomy, University of Washington

New *Perspectives on Dying Stars*

Charles McCrory

Department of Chemistry, University of Michigan

Selective Electrocatalysis by Polymer-Encapsulated Catalysts: the Role of Charge and Substrate Transport on Catalytic Efficiency

Alison Narayan

Department of Chemistry, University of Michigan

Biocatalytic Reactions for Selective, Sustainable Synthesis and Engaging Graduate Student Instructors for Improved Outcomes in Organic Chemistry

Kerstin Perez
Department of Physics,
Massachusetts Institute
of Technology
Closing in on Sterile Neutrino Dark Matter with NuSTAR

Shahir Rizk
Department of Chemistry
and Biochemistry,
Indiana University at
South Bend
Reversible Self-assembly of Bio-responsive Nanostructures

Weichao Tu
Department of Physics
and Astronomy,
West Virginia University
Understanding the Rapid Dropout of Killer Electrons in Earth's Radiation Belt with a New and Comprehensive Model

Paul Raston
Department of Chemistry
and Biochemistry,
James Madison University
Laser Spectroscopic Investigation of Atmospherically Important Complexes at Ultra Low Temperature

Tristan Smith
Department of Physics
and Astronomy,
Swarthmore College
Fundamental Tests of Gravity across Time, Space and Mass

Christina Vizcarra
Department of Chemistry,
Barnard College
Small Molecule Inhibition of Formin Proteins: Specificity and Mechanisms of Action

Emily Rauscher
Department of Astronomy,
University of Michigan
Exo-Cartography: Resolving Three-Dimensional Images of Extrasolar Worlds

Kana Takematsu
Department of Chemistry
and Biochemistry,
Bowdoin College
Moving Multiple Charges with Light in Derivatized Naphthalene Photoacids

Justin Wilson
Department of Chemistry
and Chemical Biology,
Cornell University
Capturing the Heavy Alkaline Earth Elements: Ligand Design to Sequester Radioactive Strontium, Barium, and Radium

Cottrell Scholars Collaborative Award

At the annual Cottrell Scholar Conference, faculty are encouraged to devise collaborative projects to enhance science education and scientist career development. Through this Cottrell Scholars Collaborative program, RCSA funded four projects in 2019 at $25,000 each.

Communicating Science: 12 Profound Scientific Breakthroughs

Lead Cottrell Scholar: **Kathryn Haas**
Department of Chemistry, Saint Mary's College

Collaboration with additional Cottrell Scholars: **Olalla Vázquez**, Department of Chemical Biology, Philipps-Universtät Marburg; **Carla Fröhlich**, Department of Physics, North Carolina State University; **Amanda Hargrove**, Department of Chemistry, Duke University; **Rigoberto Hernandez**, Department of Chemistry, The Johns Hopkins University; **Adam Leibovich**, Department of Physics and Astronomy, University of Pitsburgh; **Ryan McGorty**, Department of Physics and Biophysics, University of San Diego; **Scott Shaw**, Department of Chemistry, University of Iowa; **Rory Waterman**, Department of Chemistry, University of Vermont.

Also with: **Krista Hoeffel**, Saint Mary's College; **Yana Vaynzof**, Universität Heidelberg; **Ute Hellmich**, Johannes Gutenberg Universität Mainz; **Hongbin Zhang**, Technische Universität Darmstadt; **Dominik Munz**, Friedrich-Alexander-University Erlangen-Nürnberg; **Brandon Echter**, Science Friday; **Ashley Donovan**, American Chemical Society.

Establishing a Network for Effective Interventions in STEM Classrooms: Fanning the FLAMES

Lead Cottrell Scholar: **Thomas Solomon**
Department of Physics and Astronomy, Bucknell University

Collaboration with additional Cottrell Scholars: **Louise Charkoudian**, Department of Chemistry, Haverford College; **Michael Dennin**, Department of Physics and Astronomy, University of California Irvine; **David Forbes**, Department of Chemistry, University of South Alabama; **Carla Fröhlich**, Department of Physics, North Carolina State University; **Jennifer Heemstra**, Department of Chemistry, Emory University; **Michael Hildreth**, Department of Physics, University of Notre Dame; **Shahir Rizk**, Department of Chemistry and Biochemistry, Indiana University, South Bend; **Jennifer Ross**, Department of Physics, Syracuse University; **Tristan Smith**, Department of Physics and Astronomy, Swarthmore College; **Kana Takematsu**, Department of Chemistry and Biochemistry, Bowdoin College.

The Cottrell Emerging Scholars Program: Enhancing the Successful Transition of Underrepresented Postdoctoral Scholars into the Professoriate

Lead Cottrell Scholar: **Keivan Stassun**
Department of Physics and Astronomy,
Vanderbilt University

Collaboration with additional Cottrell Scholars: **Darren Johnson**, Department of Chemistry and Biochemistry, University of Oregon; **Adam Leibovich**, Department of Physics and Astronomy, University of Pittsburgh; **Grace Stokes**, Department of Chemistry and Biochemistry, Santa Clara University.

Development of the "Enhancing Science Courses by Integrating Python (ESCIP)" Network

Lead Cottrell Scholar: **Grace Stokes**,
Department of Chemistry and Biochemistry,
Santa Clara University

Collaboration with additional Cottrell Scholars: **Jonathan Foley**, Department of Chemistry, William Paterson University; **Claude-André Faucher-Giguére**, Department of Physics and Astronomy, Northwestern University; **Dusan Keres**, Department of Physics, University of California, San Diego; **Tyler Luchko**, Department of Physics and Astronomy, California State University, Northridge; **Chad Risko**, Department of Chemistry, University of Kentucky; **Christine Vizcarra**, Department of Chemistry,
Barnard College.

Also with **Hongbin Zhang**,
Technische Universität Darmstadt

2019 Cottrell Scholars Conference

Cottrell Plus Awards

As their faculty careers advance, Cottrell Scholars are eligible to apply for Cottrell Plus Awards to support their research and teaching, and are eligible for recognition through Cottrell Plus prizes: FRED, SEED, and the new STAR and IMPACT awards. FRED is the highest award ($250,000) for a project that has potential to transform research. SEED awards are competitive grants to launch new projects in research ($50,000 each) or education ($25,000 each). STAR (excellence in Science Teaching and Research) and IMPACT (recognizing the work of Cottrell Scholars who have had a national impact in science through their leadership and service activities) each award $5,000 to winners.

Sarah Reisman

FRED

Professor of Chemistry, Division of Chemistry and Chemical Engineering,
California Institute of Technology

$250,000 is awarded for a high-risk, high-reward project with the potential to transform a significant area of research. The 2019 FRED Award was made to Sarah E. Reisman, Professor of Chemistry, Division of Chemistry & Chemical Engineering, California Institute of Technology, for her pioneering efforts to advance new methods to optimize catalytic reactions. Her research proposal calls for using the emerging concept of "input design machine learning" (an approach to artificial intelligence) to develop new chemical reactions that can be catalyzed by metals, in particular by nickel.

Herbert Fertig
SEED
Department of Physics, Indiana University
Disorder and Interactions in Moire Butterflies

Thomas Vojta
SEED
Department of Physics, Missouri University of Science & Technology
Fractional Random Walk Approach to Serotonergic Fibers

Sarah Keller
STAR
Department of Chemistry, University of Washington

Boyd Goodson
SEED
Department of Chemistry and Biochemistry, Southern Illinois University
Investigating Hyperpolarized 131Xe as a Potential Neutron Scattering Target in Searches for New Physics Beyond the Standard Model

Erica Carlson
SEED
Department of Physics and Astronomy, Purdue University
Understanding Surface Probe Images in Strongly Correlated Quantum Matter via Machine Learning

Andrew Ellington
STAR
Department of Molecular Biosciences, University of Texas at Austin

Stephen Bradforth
STAR
Department of Chemistry, University of Southern California

Keivan Stassun
IMPACT
Department of Physics and Astronomy, Vanderbilt University

Scialog Collaborative Innovation Awards

Through the 2019 Scialog Collaborative Innovation Awards program, RCSA along with partner foundations provided a total of $2.9 million in seed funding for cutting-edge research on four topics: Advanced Energy Storage, Chemical Machinery of the Cell, Time Domain Astrophysics, and Molecules Come to Life.

The Scialog program was created in 2010 by RCSA, which oversees its administration. Scialog—short for "science + dialog"—funds early-career scientists to pursue transformative research with their fellow grantees on crucial issues of scientific inquiry.

In 2019, the Alfred P. Sloan Foundation, the Gordon and Betty Moore Foundation, and the Heisings-Simons Foundation served as co-sponsors. Additional support was provided by the Kavli Foundation and the Flinn Foundation.

Scialog initiatives are a multi-year thematic investment in which 50 early-career Scialog Fellows, facilitated by 10 leading scientists, convene annually to discuss cutting-edge multidisciplinary themes and propose high-risk collaborative projects.

The following pages include a breakdown of 2019 Scialog funding by conference theme.

Advanced Energy Storage Year 4

Goal: To catalyze theorists, computational scientists, and experimentalists across multiple disciplines to collaborate on developing new and innovative projects to accelerate fundamental science driving advances in energy storage.

Awards Funded by the Sloan Foundation

Shoji Hall, Department of Materials Science and Engineering, Johns Hopkins University; **Iryna Zenyuk**, Department of Chemical and Biomolecular Engineering, University of California, Irvine; **Zachary Ulissi**, Department of Chemical Engineering, Carnegie Mellon University

Data-Driven Discovery of Bifunctional Metal Air Battery Cathodes

Matthew McDowell, School of Materials Science and Engineering, Georgia Institute of Technology; **Partha Mukherjee**, Department of Mechanical Engineering, Purdue University; **Neil Dasgupta**, Department of Mechanical Engineering, University of Michigan

Recharge, Re-liquify, Re-wet (Re3): Self-Healing Interfaces for Solid-State Batteries

Joaquin Rodriguez-Lopez, Department of Chemistry, University of Illinois at Urbana-Champaign; **Zheng Li**, Department of Mechanical Engineering, Virginia Institute of Technology; **Alexander Urban**, Department of Chemical Engineering, Columbia University

SurPhase: Elucidating a Self-Coating Mechanism for Improved Cathode Performance

Total: $495,000

Awards Funded by RCSA

Yan Yao, Department of Electrical and Computer Engineering, University of Houston; **Neil Dasgupta**, Department of Mechanical Engineering, University of Michigan; **Alexander Urban,** Department of Chemical Engineering, Columbia University

A Porosity-free Sodium Glass Electrolyte Formed at Room Temperature: Integrated Experimental and Theoretical Approach

Joaquin Rodriguez-Lopez, Department of Chemistry, University of Illinois at Urbana-Champaign; **Veronica Augustyn**, Department of Materials Science and Engineering, North Carolina State University; **Jahan Dawlaty**, Department of Chemistry, University of Southern California

DIRECT: Designer Interfacial Reactivity via Electrostatically-Enhanced Charge Transfer

Yan-Yan Hu, Department of Chemistry, Florida State University; **Jordi Cabana**, Department of Chemistry, University of Illinois at Chicago; **Brent Melot**, Department of Chemistry, University of Southern California

Solid Electrolytes with Dual Li-and F-ion Conductivity to Overcome the Tyranny of Gravimetric Capacity

Total: $495,000

Chemical Machinery of the Cell Year 2

Goal: To catalyze breakthroughs in our understanding of chemical processes in the living cell that will lead to a new era of advancement in cell biology.

Awards funded by the Gordon and Betty Moore Foundation

Caitlin Davis, Department of Chemistry, Yale University; **Elizabeth Read**, Department of Chemical and Biomolecular Engineering, University of California, Irvine; **Kamil Godula**, Department of Chemistry, University of California, San Diego

Metabolite Pools: Where are they, who's using them, and can we?

Alice Soragni, Department of Orthopaedic Surgery, University of California, Los Angeles; **Matthias Heyden**, School of Molecular Sciences, Arizona State University

ProFIDs: Probes to Fold the Intrinsically Disordered

Bin Zhang, Department of Chemistry, Massachusetts Institute of Technology; **Brian Liau**, Department of Chemistry, Harvard University; **G.W. Gant Luxton**, Department of Genetics, Cell Biology, and Development, University of Minnesota

Reconstructing Time-resolved Single-cell Genome Organization

Rongsheng (Ross) Wang, Department of Chemistry, Temple University; A**bhishek Singharoy**, School of Molecular Sciences, Arizona State University; **Alison Ondrus**, Division of Chemistry and Chemical Engineering, California Institute of Technology

Seeing the Forces of Life

Maxim Prigozhin, Department of Molecular and Cellular Biology, and Department of Applied Physics, Harvard University; **Xin Zhang**, Department of Chemistry, and Department of Biochemistry and Molecular Biology, Pennsylvania State University; **Jefferson Chan**, Department of Chemistry, University of Illinois at Urbana-Champaign

Small-Molecule Cathodophores for Multicolor Electron Microscopy

Ronit Freeman, Department of Applied Physical Sciences, University of North Carolina at Chapel Hill; **Alexis Komor**, Department of Chemistry and Biochemistry, University of California, San Diego; **Davide Donadio**, Department of Chemistry, University of California, Davis

Understanding the Dark Side of the Genome

Total: $956,250

Year 1 Award Made in 2019, co-funded equally by the Flinn Foundation and RCSA

Laura Sanchez, Department of Pharmaceutical Sciences, University of Illinois at Chicago; **Judith Su**, Departments of Optical Sciences and Biomedical Engineering, University of Arizona

Identifying and Detecting Diseases Prior to Physical Presentation of Symptoms

Total: $110,000

Time Domain Astrophysics Year 4

Goal: To accelerate our understanding of stars and their life-cycles, as well as to promote innovative projects based on new emerging datasets from Gaia and other space-based surveys that are likely to be disruptive for astrophysics.

Awards funded by the Heising-Simons Foundation

Andrew Mann, Department of Physics and Astronomy, University of North Carolina at Chapel Hill; **Jackie Faherty**, Department of Astrophysics, American Museum of Natural History; **Siyi Xu**, Gemini Observatory, HI

Dancing Degenerates: Ages of Brown Dwarfs from White Dwarfs

Gail Zasowski, Department of Physics and Astronomy, University of Utah; **Joshua Pepper**, Department of Physics, Lehigh University

Inferring Stellar Population Ages from Integrated Light Curves

James Davenport, Data Intensive Research in Astrophysics and Cosmology Institute, University of Washington; **Timothy Brandt**, Department of Physics, University of California, Santa Barbara

A Galactic Census of Eclipsing Binaries

Jennifer van Saders, Institute for Astronomy, University of Hawaii; **Keith Hawkins**, Department of Astronomy, University of Texas at Austin**; Andrew Wetzel**, Department of Physics, University of California, Davis

Aging Gracefully: Stellar Ages Across the HR Diagram and Their Implications for Galactic Archaeology

Total: $550,000

Awards funded by RCSA

Robyn Sanderson, *Department of Physics and Astronomy, University of Pennsylvania;* **Sukanya Chakrabarti,** *School of Physics and Astronomy, Rochester Institute of Technology;* **Daniel Huber**, *Institute for Astronomy, University of Hawaii*

Beyond Gaia: Expanding the Dynamical Map of the Milky Way with Asteroseismic Distances

Simone Scaringi, Department of Physics and Astronomy, Texas Tech University; **Yue Shen**, Department of Astronomy, University of Illinois at Urbana-Champaign; **Claude-André Faucher-Giguére**, Department of Physics and Astronomy, Northwestern University

Discovering Quiescent Supermassive Black Holes in NGC Galaxies with TESS

Total: $330,000

2019 Year in Review

January: Cottrell Scholar (2016) **Aaron Romanowsky**, Department of Physics & Astronomy, San Jose State, has co-authored 28 papers acknowledging Research Corporation, including two published in Nature, and has garnered nearly $1.2 million from six external research grants since receiving his award. He has also launched a program to mentor undergraduate students from underrepresented backgrounds in making the transition to doctoral programs in physics and astronomy.

An interview with Cottrell Scholar (2010) Scialog: Molecules Come to Life Fellow **Jennifer Ross**, Department of Physics, Syracuse University, was published on the APS website Physics. In a brief Q&A, she discussed her interest in microtubules, the highly dynamic polymer structures that form part of the cellular cytoskeleton providing structure and shape to the cytoplasm of eukaryotic cells, some bacteria and some archaea.

Cottrell Scholar (1997) **Gina MacDonald**, Department of Chemistry & Biochemistry, James Madison University, led a group formed at the 2015 Cottrell Scholar Conference in creating a video for postdocs and graduate students interested in becoming faculty members at research-intensive primarily undergraduate institutions. The effort was funded by a grant from the Cottrell Scholar Collaborative.

Scialog: Advanced Energy Storage Fellows **Emily Ryan**, Boston University, and **Partha Mukherjee**, Purdue, both professors of mechanical engineering, published "Mesoscale modeling in electrochemical devices—A critical perspective" in Progress in Energy and Combustion Science. The pair began talking about the need for a review paper on mesoscale modeling of electrochemical systems at their first Scialog conference.

February: Cottrell Scholar (2014) and Scialog: Time Domain Astrophysics Fellow **Carla Fröhlich**, Department of Physics, North Carolina State, was named a University Faculty Scholar. Fröhlich's main contributions are the discovery of the neutrino p-process, which for the first time allows physics to explain the observed abundances in the most metal-poor stars, and the prediction of neutron star mass and nickel yields from core collapse supernova simulations.

Laurie McNeil, Bernard Gray Distinguished Professor, Department of Physics, University of North Carolina, Chapel Hill, and member of RCSA's Cottrell Scholar Selection Committee, was named the 2019 Chair of the APS Forum on Education (FEd).

Scialog: Advanced Energy Storage conference

Cottrell Scholar (2006) **Keivan Stassun**, Department of Physics & Astronomy, Vanderbilt University, co-authored a report by the American Astronomical Society on diversity and inclusion in graduate education in astronomy.

Cottrell Scholar (1997) **Mark Moldwin**, Department of Physics & Space Sciences, University of Michigan, Ann Arbor, was selected by the U.S. Department of State and the J. William Fulbright Foreign Scholarship Board as the Fulbright Arctic Chair for 2019-2020. He was to launch a new research program at the University of Bergen's Birkeland Center for Space Sciences studying the coupling of the Earth's upper atmosphere with space.

Cottrell Scholar (2017) and Scialog: Advanced Energy Storage Fellow **Yogi Surendranath**, Department of Chemistry, Massachusetts Institute of Technology, published a paper in Journal of the American Chemical Society that was highlighted in Chemical & Engineering News, Chemistry World and was featured as a frontier research direction in the Department of Energy's decennial report on the Basic Research Needs in Catalysis Science.

Cottrell Scholar (2015) and Scialog: Molecules Come to Life Fellow **Lisa Manning**, Department of Physics, Syracuse University, wrote a commentary for U.S. News & World Report on the importance of women in science. She stressed the importance of the culture of a research group. "Quite a bit of the most exciting work right now is at the intersection of different subjects, driven by high-functioning interdisciplinary teams," she said.

March: The Cottrell Scholar Southeastern Regional Meeting held in Atlanta included short talks from Cottrell Scholars highlighting their integration of research and teaching, a poster session for junior scientists, informal networking, and a panel discussion on career options and the teacher-scholar model.

The National Science foundation funded the CAREER proposal "Quantifying How Peptoids Interact with Lipid Membranes" by Cottrell Scholar (2018) **Grace Stokes**, Department of Chemistry & Biochemistry, Santa Clara University. Her research lab will receive $475,000 over the next five years to conduct nonlinear optical (laser-based) spectroscopy studies of small peptide-like molecules (peptoids) that have therapeutic potential.

Three 2018 Cottrell Scholars from primarily undergraduate institutions received National Science foundation CAREER awards, given in support of junior faculty who exemplify the role of teacher-scholars through research, education and the integration of education and research within the context of the mission of their organizations. The awards—for **Kerstin Nordstrom**, Department of Physics, Mount Holyoke College; **John Gibbs**, Department of Physics & Astronomy, Northern Arizona University; and **Tim Kowalczyk**, Department of Chemistry, Western Washington University—

combined with a fourth 2018 Cottrell Scholar, **Lou Charkoudian**, Department of Chemistry, Haverford College, who received a CAREER award before being named a Cottrell Scholar, represent a stellar achievement for the 2018 Cottrell Scholar class and attest to the quality of the scholars named.

Two 2019 Cottrell Scholars — **Ellen Matson**, Department of Chemistry, University of Rochester, and **Alison Narayan**, Department of Chemistry, University of Michigan — as well as 2017 Cottrell Scholar **Yan Xia**, Department of Chemistry, Stanford, are among 126 early-career scholars named 2019 Sloan Research Fellows. Also named were eight Scialog Fellows in physics and chemistry: (Advanced Energy Storage) **Veronica Augustyn**, Department of Materials Science & Engineering, North Carolina State University; Cottrell Scholar (2019) and (Advanced Energy Storage) **Ellen Matson**, Department of Chemistry, University of Rochester; (Advanced Energy Storage) **Matthew McDowell**, Department of Mechanical Engineering, Georgia Institute of Technology; (Advanced Energy Storage) **Hailiang Wang**, Department of Chemistry, Yale University; (Time Domain Astrophysics) **Courtney Dressing**, Department of Astronomy, University of California, Berkeley; (Time Domain Astrophysics) **Daniel Huber**, Department of astronomy, University of Hawaii; (Time Domain Astrophysics) **Raffaella Margutti**, Department of Physics & Astronomy, Northwestern University; and (Time Domain Astrophysics) **Melissa Ness**, Department of Astronomy, Columbia University.

Scialog: Time Domain Astrophysics conference

April: Cottrell Scholar (2015) and Scialog: Chemical Machinery of the Cell Fellow **Jen Heemstra**, Department of Chemistry, Emory University, began a monthly column in Chemical & Engineering News, the official magazine of the American Chemical Society. She writes about issues related to the teacher-scholar model, managing a research group, graduate student mental health and self-care.

RCSA Senior Program Directors **Richard Wiener** and **Silvia Ronco** wrote an invited "Energy Focus" editorial in ACS Energy Letters about RCSA's Scialog program. The editorial, "Scialog: The Catalysis of Convergence," describes the need for convergence — the integration of basic science research across disciplines.

Cottrell Scholar (2014) **Mircea Dinca**, Department of Chemistry, Massachusetts Institute of Technology, and his colleagues were written up in the March 4 edition of Chemical & Engineering News for work that may soon improve batteries.

Cottrell Scholar (2003) **Daniel Crawford**, Department of Chemistry, Virginia Tech, has been named University Distinguished Professor for his groundbreaking work in theoretical and computational chemistry. Crawford is also the founder and director of the Molecular Sciences Software Institute, a $19.4 million National Science Foundation-funded initiative that serves as a nexus for scientists, educators and corporations in computational molecular science.

Cottrell Scholar (1996) and RCSA Board of Directors member **Catherine Murphy**, the Larry Faulkner Endowed Chair and professor of chemistry at the University of Illinois Urbana-Champaign, is the 2019 Remsen Award winner. The award, presented by the American Chemical Society Maryland Section, is named after Ira Remsen, The Johns Hopkins University's first chemistry professor and second president. Murphy studies the synthesis, surface chemistry and optical applications of gold nanorods.

Cottrell Scholar (2012) **Will Dichtel**, RCSA's 2018 FRED Award winner, spoke at the opening session of the ACS National Meeting in Orlando. Dichtel, the Robert L. Letsinger Professor of Chemistry, Northwestern University, spoke on "Removing Organic Pollutants from Water Using Polymers Derived from Corn."

May: Wayne State University Professor of Chemistry **Andrew Feig** joined RCSA as a Program Director. A Cottrell Scholar since 2002, Feig co-founded the Cottrell Scholars Collaborative New Faculty Workshop in collaboration with Prof. **Rory Waterman**, chemistry, University of Vermont, and the American Chemical Society. At RCSA he will focus primarily on the expansion of the Foundation's Scialog program into areas in which the physical sciences can contribute new perspective on challenges in life and biomedical sciences.

The fourth-annual Scialog: Time Domain Astrophysics conference was held May 9-12 in Tucson, Ariz., with more than 40 early career scientists, about 20 of whom attended for the first time, and about half a dozen senior scientists acting as discussion leaders. The focus at this meeting is on recent data releases from TESS and ZTF that provide tremendous opportunities to open new research horizons. The event was sponsored by RCSA as well as the Kavli Foundation and the Heising-Simons Foundation. Keynote speakers were **Thomas Barclay**, NASA Goddard Space Flight Center and UMBC, who discussed "Time Domain Astronomy across the Sky with TESS," and **Kathryn Johnston**, Columbia University, who discussed the revolution in our understanding of our galaxy enabled by large stellar surveys.

June: Scialog: Molecules Come to Life Fellows **Paul Blainey**, Department of Biological Engineering, MIT, and **Seppe Kuehn**, Department of Physics, University of Illinois, have published results of their Scialog project in the journal Proceedings of the National Academy of Sciences. Blainey and Kuehn and colleagues, including another Scialog Fellow, **Jeff Gore**, Department of Physics, MIT, discuss their platform to automatically construct and test synthetic communities of microbes from a set of input species at a scale of ~100,000 communities per day.

Cottrell Scholar (2018) **A. Meredith Hughes**, Department of Astronomy, Wesleyan University, had a paper on the vertical distribution of dust in debris disks accepted in the Astrophysical Journal with an undergraduate, **Cail Daley**, as first author.

July: **Silvia Ronco**, senior program director at RCSA, was elected 2020–2021 president of the Council on Undergraduate Research. Recognized for her work in STEM research and education, she has held previous leadership roles within CUR, both within the CUR chemistry division, and on the executive board. The organization supports faculty development for high-quality undergraduate student-faculty collaborative research and scholarship. More than 700 institutions and close to 13,000 individuals belong to CUR.

Cottrell Scholars (2009) **Rory Waterman**, Department of Chemistry, University of Vermont, and (2003) **Brian Stoltz**, Department of Chemistry & Chemical Engineering, Caltech, and RCSA Senior Program Director **Silvia Ronco** are among this year's crop of American Chemical Society members named

ACS Fellows for their exceptional contributions to the science or profession of chemistry and volunteer service to the ACS community.

Six Cottrell Scholars are among 2019 recipients of the Presidential Early Career Award for Scientists and Engineers, the highest honor bestowed by the United States government to outstanding scientists and engineers who are beginning their independent research careers and who show exceptional promise for leadership in science and technology. Honorees included: (2015) **Luis Campos**, Department of Chemistry, Columbia; (2017) **Nate Gabor**, Department of Physics & Astronomy, UC-Riverside; (2016) **Tom Maimone**, Department of Chemistry, UC-Berkeley; (2017) **Monika Schleier-Smith**, Department of Physics, Stanford; (2015) **Eric Toberer**, Department of Physics, Colorado School of Mines; (2017) **Yogi Surendranath**, Department of Chemistry, MIT.

Cottrell Scholar (2015) **Emily Balskus**, Department of Chemistry & Chemical Biology, Harvard, is one of three scientists named a 2019 Laureate of the Blavatnik National Awards for Young Scientists. She is investigating how gut microbes affect human health.

The 25th Annual Cottrell Scholar Conference was held in Tucson with about 170 science educators, including 24 newly named Cottrell Scholars. It was the largest Cottrell Scholar Conference to date. The theme was "communicating science." Keynote speakers include **Katie Orenstein** of the OpEd Project and **Brandon Echter** of Science Friday. The second evening of the conference featured a trilateral Science Slam with six early career scientists—German, Russian and U.S.—passionately discussing their research before a live audience. The event, complete with rock music and stage lighting, was hosted by Fulbright Germany, RCSA and the Deutsch-Russisches Forum and was part of the Year of German-American Friendship. The competition was won by American **Rui Wang**, bioengineering, UC San Diego, who studies regeneration by the freshwater cnidarian hydra under the supervision of Cottrell Scholar (2016) **Eva-Maria Collins**.

Cottrell Scholars (2018) **Sean Roberts** and (2016) **Mike Rose**, both of the Department of Chemistry, University of Texas at Austin, received a $1 million grant from the W.M. Keck Foundation to develop an innovative new coating for silicon solar cells that they hope will reduce solar panel heat losses.

Rui Wang won the Science Slam.

Cottrell Scholar (2016) and Scialog: Chemical Machinery of the Cell Fellow **Dmytro Kosenkov**, Department of Chemistry & Physics, Monmouth University, published two papers in 2018 with multiple undergrad coauthors acknowledging Research Corporation. One is in the Journal of Computational Chemistry and the other is in the ACS Journal of Chemical Education.

August: Cottrell Scholar (2015) **Kai-Mei Fu**, Department of Physics, University of Washington, was interviewed in Physics, the online magazine of the American Physical Society. A rising star in condensed matter experimental physics who nearly quit academia due to an "unpleasant" undergraduate research experience, Fu advised undergraduates to reconsider their research topic or group environment before giving up completely on research.

Multiple RCSA family members received awards from the American Chemical Society. Among the recipients: Cottrell College Science Award recipient **Kerry K. Karukstis**, Department of Chemistry, Harvey Mudd College, who received the ACS Award for Research at an Undergraduate Institution, sponsored by Research Corporation for Science Advancement. Scialog Facilitator **Katherine J. Franz**, Department of Chemistry, Duke University, received the Award for Encouraging Women into Careers in the Chemical Sciences. Cottrell Scholar (2002) **Michael J. Krische**, Department of Chemistry & Biochemistry, University of Texas at Austin, received the Award for Creative Work in Synthetic Organic Chemistry. RCSA Board Director and Cottrell Scholar (1996) **Catherine J. Murphy**,

2019 Cottrell Scholars

Department of Chemistry, University of Illinois at Urbana-Champaign, received the Award in Inorganic Chemistry. Cottrell Scholar (2005) **Teri W. Odom**, Department of Chemistry, Northwestern University, received the Award in Surface Chemistry. Cottrell Scholar (2012) **Sarah E. Reisman**, Department of Chemistry, California Institute of Technology, received the Elias J. Corey Award for Outstanding Original Contribution in Organic Synthesis by a Young Investigator. Cottrell Scholar (1997) **Kevan M. Shokat**, Department of Cellular & Molecular Pharmacology, Howard Hughes Medical Institute and University of California, San Diego, received the Alfred Bader Award in Bioinorganic or Bioorganic Chemistry. Cottrell Scholar (2017) and Scialog: Advanced Energy Storage Fellow **Yogi Surendranath**, Department of Chemistry, Massachusetts Institute of Technology, was the preceptor, and A**nna Wuttig**, University of California, Berkeley, was the student receiving the Nobel Laureate Signature Award for Graduate Education in Chemistry.

Cottrell Scholar (2004) **Seth Cohen**, Department of Chemistry & Biochemistry, UC San Diego, joined the Defense Advanced Research Projects Agency (DARPA) as a program manager, focusing on the interface of bioinorganic and medicinal chemistry, as well as advanced materials.

Cottrell Scholar (2014) **Shannon Boettcher**, Department of Chemistry & Biochemistry, University of Oregon, was among 44 international researchers in nanoscience and nanotechnology under 45 years old to be named a Young Innovator in NanoEnergy by the journal Nano Research.

Cottrell Scholar (2015) **Tom Markland**, Department of Chemistry, Stanford University, gave the Kavli Emerging Leader in Chemistry

Lecture at the American Chemical Society National Meeting in San Diego. He spoke on "Harnessing the quantum mechanics of the hydrogen bond: From atmospheric science to enzyme catalysis."

Three Cottrell Scholars received Camille Dreyfus Teacher-Scholar awards for research: (2018) **Garret Miyake**, Department of Chemistry, Colorado State University; (2017) **Natalia Shustova**, Department of Chemistry & Biochemistry, University of South Carolina; and (2017) **Timothy Wencewicz**, Department of Chemistry, Washington University in St. Louis. A fourth Cottrell Scholar, (2018) **Louise Charkoudian**, Department of Chemistry, Haverford College, received the 2019 Henry Dreyfus Teacher-Scholar Award.

September: Multiple RCSA-supported scientists were named new Fellows for 2019 by the American Physical Society. Cottrell Scholars named as APS Fellows were: (2012) **Eric R. Hudson**, Department of Physics & Astronomy, UCLA, and (2015) **Lisa M. Manning**, Department of Physics, Syracuse University. Scialog Fellows named as APS Fellows were: **Jasna Brujic**, Department of Physics, New York University; **Michael L. Chabinyc**, Materials Department, UC Santa Barbara; **Alessandra Corsi**, Department of Physics, Texas Tech; **Megan T. Valentine**, Department of Mechanical Engineering, UC Santa Barbara; **Saurabh W. Jha**, Department of Physics & Astronomy, Rutgers University. One recipient of a multi-investigator Cottrell College Science Award is on the list: **Jocelyn Samantha Read**, Department of Physics, Cal State Fullerton.

Cottrell Scholar (2009) **Maura McLaughlin**, Department of Physics, West Virginia University, published a paper in Nature Astronomy that also received coverage on CNN. McLaughlin and associates, working at the Green Bank Observatory in West Virginia, measured the mass of what is thought to be the most massive neutron star yet observed.

Trinanjan Datta, Department of Physics, Augusta University, a Cottrell College Science Award winner, and co-author **Javier E. Hasbun**, Department of Physics, University of West Georgia, completed a new textbook on solid state physics, "Introductory Solid State Physics with MATLAB Applications."

The first publication from a collaboration between a Cottrell Scholar and a Fulbright Cottrell Scholar made the cover of Angewandte Chemie. Cottrell Scholar (2016) **Dmitri Kosenkov**, Department of Chemistry & Physics, Monmouth University, Fulbright Cottrell Scholar (2016) **Olalla Vazquez**, Department of Chemistry, Philipps Universität Marburg, and their associates reported that tetrazine offers considerable promise as a photosensitizer in cellular nuclei, causing cancer cell death upon irradiation.

Cottrell Scholar (2017) **Yan Xia**, Department of Chemistry, Stanford University, was highlighted in C&E News for helping develop a new method allowing chemists to "to precisely place single monomers at any position within a polymer chain made of other types of monomers."

October: Scialog: Time Domain Astrophysics Fellows **Leslie Hebb**, Department of Physics, Hobart and William Smith Colleges, **Suvrath Mahadevan**, Department of Astronomy & Astrophysics, Penn State, and **John Wisniewski**, Department of Physics & Astronomy, University of Oklahoma, have developed and commissioned a novel photometric diffuser at Apache Point Observatory for ultra-high precision ground-based photometry. The Scialog team received a substantial National Science Foundation grant to continue work on this project, which has led to the diffuser being installed and tested on a dozen other telescopes.

Cottrell Scholar (2015) **Katherine Aidala**, Department of Physics, Mount Holyoke College, received of the RCSA-sponsored 2020 APS Prize for Research in an Undergraduate Institution. Aidala,

who also received a Cottrell College Science Award in 2009, was cited for "exceptionally creative and interdisciplinary research using scanning probe microscopy for novel studies of magnetic nanorings, biofilms, and organic semiconductors and for outstanding mentoring of women undergraduates, particularly through research collaborations."

Enrique (Kiko) Galvez, Department of Physics & Astronomy, Colgate University, who was supported by funding from Research Corporation in 1990, 2000 and 2006, received the 2020 APS Jonathan F. Reichert and Barbara Wolff-Reichert Award for Excellence in Advanced Laboratory Instruction.

Cottrell Scholar (2001) **David Hall**, Department of Physics, Amherst College, published an editor's suggestion in Physical Review Letters, which is also featured in Physics, the online magazine from the APS. Hall and colleagues report their observation of the decay of a topological knot defect in a quantum gas.

Stan Whittingham, Institute for Materials Research, Binghamton University, a facilitator for Scialog: Advanced Energy Storage, was awarded the Nobel Prize in Chemistry in 2019 "for the development of lithium-ion batteries."

The second of three Scialog: Chemical Machinery of the Cell conferences was held October 10-13 in Tucson, with 45 fellows and eight senior scientists acting as facilitators. The focus of the meeting was the need for new tools and approaches from chemistry and biology to better understand cellular processes at the molecular and atomic level. The event was sponsored by RCSA as well as the Gordon and Betty Moore Foundation. Keynote speaker was **Holly Goodson**, Department of Chemistry & Biochemistry, University of Notre Dame, who spoke on "What Aspects of Biology are Predictable?"

November: Four Cottrell Scholars were among 443 leading scientists named Fellows by the American Association for the Advancement of Science: (2004) **Vicky Kalogera**, Department of Physics & Astronomy, Northwestern University; (1999) **Stephen Bradforth**, Department of Chemistry, University of Southern California; (2013) **Zachary Schultz**, Department of Chemistry & Biochemistry, The Ohio State University; and (1994) **George Shields**, Department of Chemistry, Furman University.

Cottrell Scholar (2015) **Kai-Mei Fu**, Department of Physics, University of Washington, wrote a Viewpoint in Physics, the online magazine from the APS, discussing a type of diamond defect that recently has been shown to display several desirable properties for a solid-state qubit.

The third Scialog: Advanced Energy Storage conference was held November 14-17 in Tucson, with 57 fellows. The focus of the meeting was the need for fundamental discovery research in chemistry, materials science, engineering, and related disciplines that will lead to new advanced batteries and capacitors with greater energy storage density, longer lifetimes, and which are cheaper, safer, and easier to discharge and recharge. The event was sponsored by RCSA and the Alfred P. Sloan Foundation. Keynote speaker was **Yiying Wu**, Department of Chemistry & Biochemistry, The Ohio State University, who spoke on "How Super is "Superoxide" Battery?"

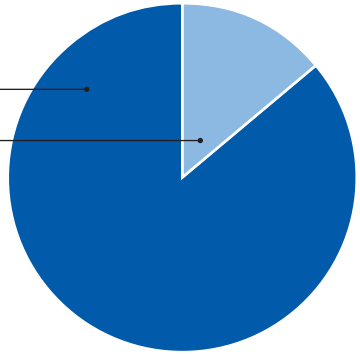
Scialog: Advanced Energy Storage Fellow **Kimberly See**, Department of Chemistry, Caltech, was the 2019 recipient of the prestigious international Science Award Electrochemistry. The award, a joint initiative of Volkswagen and BASF, is aimed at young scientists of excellence. Kimberly was recognized for her outstanding contribution to research into multivalent ion and sulfur batteries.

2019 Financial Summary

Where Our Money Goes

Program Expenses,
Including Grants & Awards 86%

General & Administrative Costs 14%



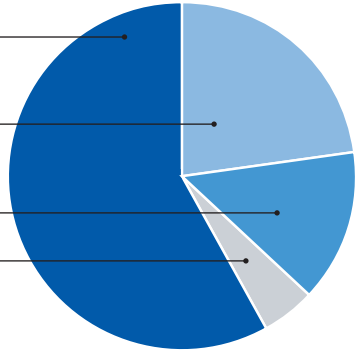
Total Expenses
$7.8 million

Cottrell Scholars Awards **58%**

Scialog Collaborative Awards
(excludes $2 million in partner awards) **23%**

Cottrell Career Advancement,
FRED, & Collaborative Awards **14%**

Discretionary Grants & Special Initiatives **5%**



Grants and Awards
$4.1 million

Net Assets at Beginning of Year **$163.9 million**
Net Assets at End of Year **$188.5 million**

The financial activities of Research Corporation for Science Advancement were audited by Beach Fleischman, PC. For the complete audited financial statements, please visit our website at rescorp.org.

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