

COLUMBIA | ENGINEERING

The Fu Foundation School of Engineering and Applied Science



1864–2014

**CELEBRATING 150 YEARS OF EXCELLENCE IN
EDUCATION, RESEARCH, AND INNOVATION**

Today, we are in the midst of a global Engineering Renaissance, where engineering solutions are revolutionizing and expanding our ability to provide energy, water, food, shelter, sanitation, mobility, medicine, and communication to the world—transforming modern cities to smart cities, opening up communication channels that connect people in all pockets of the world in ways never anticipated even 10 years ago, and creating novel technologies to enable highly individualized and personalized medicine. In each of these endeavors, and in so many others, The Fu Foundation School of Engineering and Applied Science is at the forefront of bringing creative solutions to some of society's most intractable problems.



This Renaissance moment is placing engineering at the center of pan-disciplinary research and innovation. Engineering has always incorporated developments in other disciplines and today engineering is itself influencing and, indeed, charting a new direction for other disciplines. We cannot think of the future of medicine, journalism, business, policy, science, the social sciences, even the arts and humanities, without considering the role of engineering.

From its inception, the faculty and alumni of the Columbia School of Mines and its successor schools have played a pioneering role in defining and advancing academic disciplines; confronting the complexities of society's greatest challenges; and fostering excellence and leadership in education, research, and innovation.

As part of the commemoration of our sesquicentennial, we have selected 150 groundbreaking contributions of our faculty, alumni, and students that illustrate the impact of the School in New York City, in the nation, and in the world. The achievements contained here reflect only a portion of the ever-expanding body of research and creative innovations for which our School is known.

The contributions of Columbia engineers and applied scientists have had profound impacts never imagined at the time of their first pursuit: Charles F. Chandler, the School's first dean, improved the quality of urban life by bringing sanitation, medical care, and clean drinking water to New York City, ushering in the modern city; Herman Hollerith's punch card and tabulating system was a precursor to computation and data science; William Barclay Parsons was a global engineer whose international construction remit lives on in the firm he founded, Parsons Brinckerhoff; Michael I. Pupin's inventions ranged from enabling medical X-rays to advancing long distance telephony; Edwin H. Armstrong's inventions included the regenerative circuit, the super-regenerative circuit, the superheterodyne receiver, and FM radio; Elmer Gaden discovered a process to mass produce antibiotics; mineral engineer Herbert Kellogg championed environmental awareness within the mining industry; and Richard Skalak, a pioneering biomedical engineer, brought engineering mechanics to blood flow, significantly expanding the fields of biomechanics and biomedical engineering.

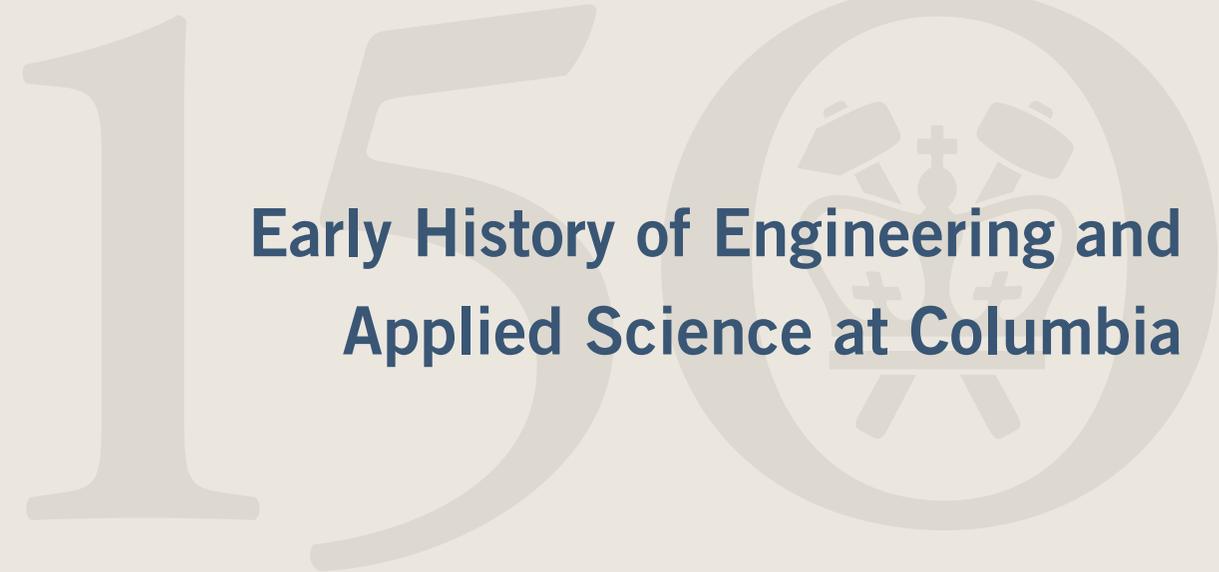
While we reflect on this selection of contributions and achievements of Columbia engineers over the past 150 years, their deep impact on our society becomes very clear. As we begin our next 150 years, this great legacy serves as a foundation for an even greater future, one that pushes disciplinary frontiers, confronts complex issues, engineers innovative solutions to address the grand challenges of our time, and educates the next generation of leaders for tomorrow.

Mary C. Boyce

Mary C. Boyce

Dean of Engineering

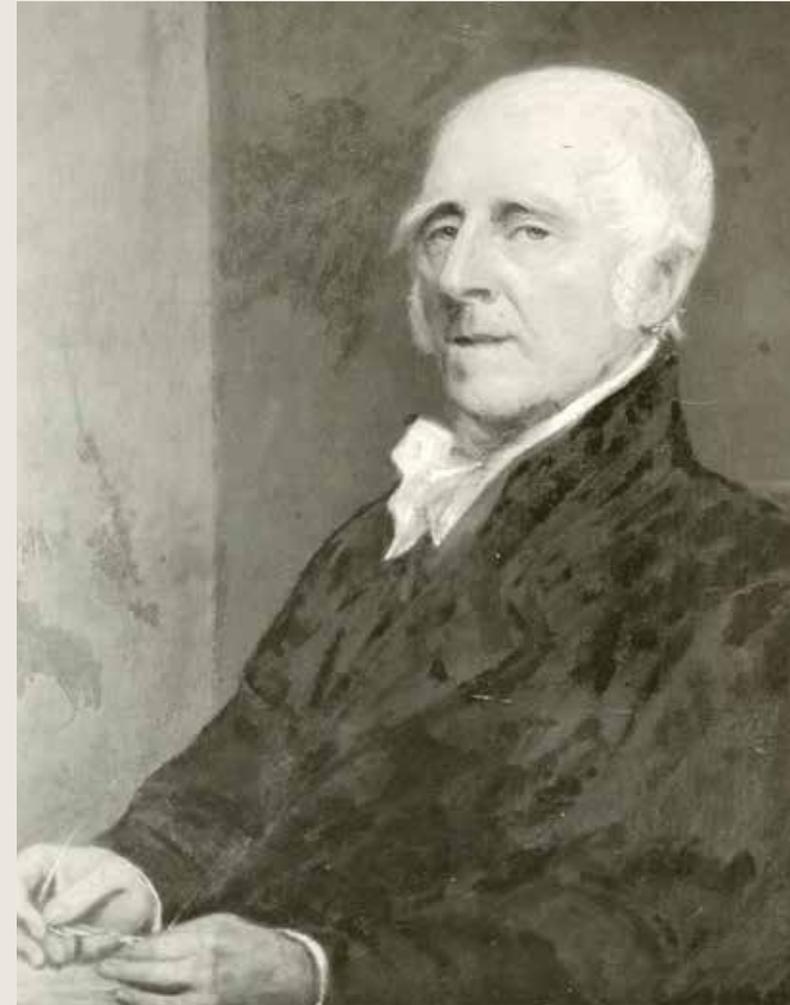
Morris A. and Alma Schapiro Professor





1754

Announcing the opening of King's College, the forerunner of Columbia, founding President Samuel Johnson declares that the school will instruct "in the arts of numbering and measuring, of surveying and navigation ... in the knowledge of all nature in the heavens above us, and in the air, water, and earth around us, and the various kinds of meteors, stones, mines, and minerals ... everything useful for the comfort, the convenience, and elegance of life."



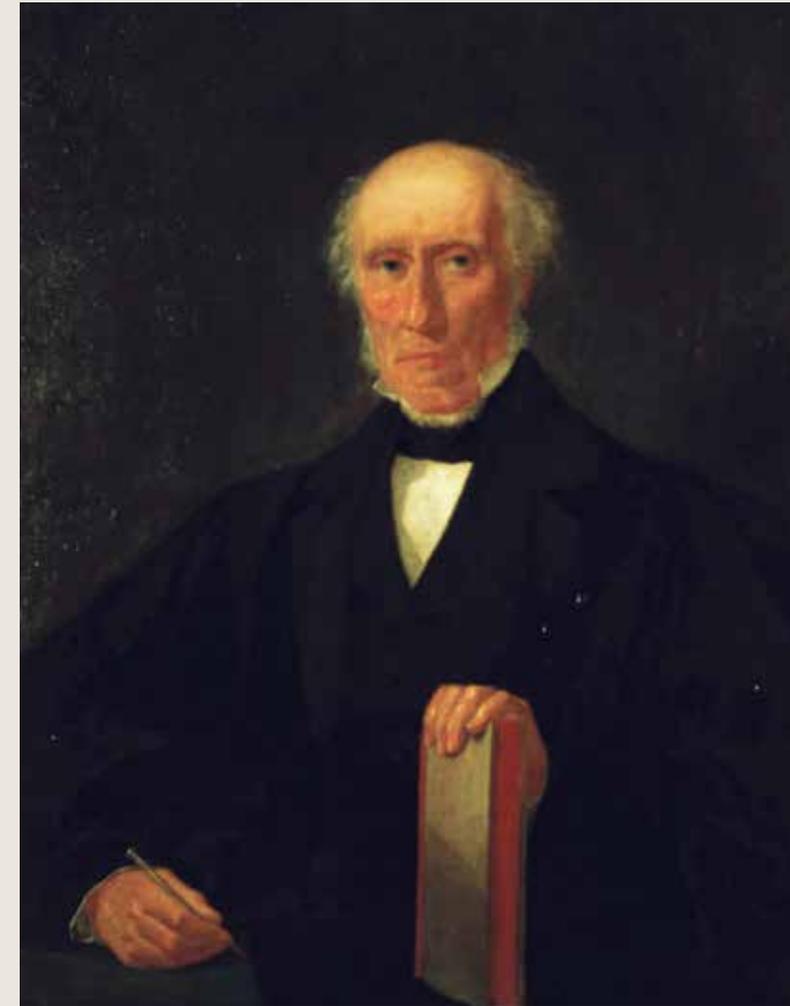
1768

John Stevens, who goes on to play an important role developing steamships and railroads, as well as U.S. patent law, graduates from King's College.

Courtesy of the New York Society Library

1786

Graduating with Columbia College's first class, DeWitt Clinton becomes the driving force in building the Erie Canal (1817 to 1825), the largest American engineering project of the early 19th century.



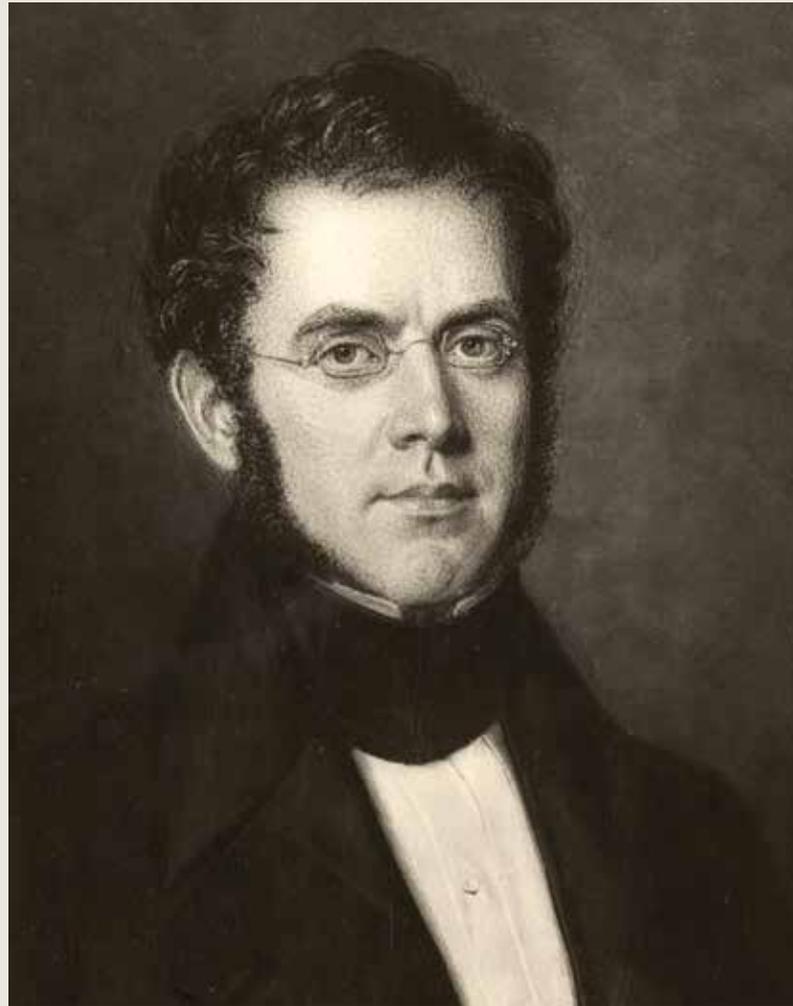
Portrait of James Renwick by John Whetten Ehninger
Courtesy of Art Properties, Avery Architectural & Fine Arts Library

1820

James Renwick Sr., Class of 1807, a scientist and engineer, is appointed professor of natural philosophy, where he teaches courses in experimental chemistry and engineering. He authors several books, including *Treatise on the Steam Engine* (1830), and the textbooks *Outlines of Natural Philosophy* (1822), *Elements of Mechanics* (1832), and *First Principles of Chemistry* (1840), among the first works on these subjects to be published in the United States. He is memorialized by the Renwick Professorship of Civil Engineering.

1823

Horatio Allen graduates from Columbia, going on to assemble America's first steam locomotive, consult on the Brooklyn Bridge, and later lead the American Society of Civil Engineers (ASCE).



1852

Alfred W. Craven, a graduate of the Class of 1829, becomes one of the 12 founders of the American Society of Civil Engineers. He is responsible for building the large reservoir in Central Park, the enlargement of pipes across High Bridge, and, from 1849 until 1868, serves as engineering commissioner overseeing the Croton Aqueduct.

1863

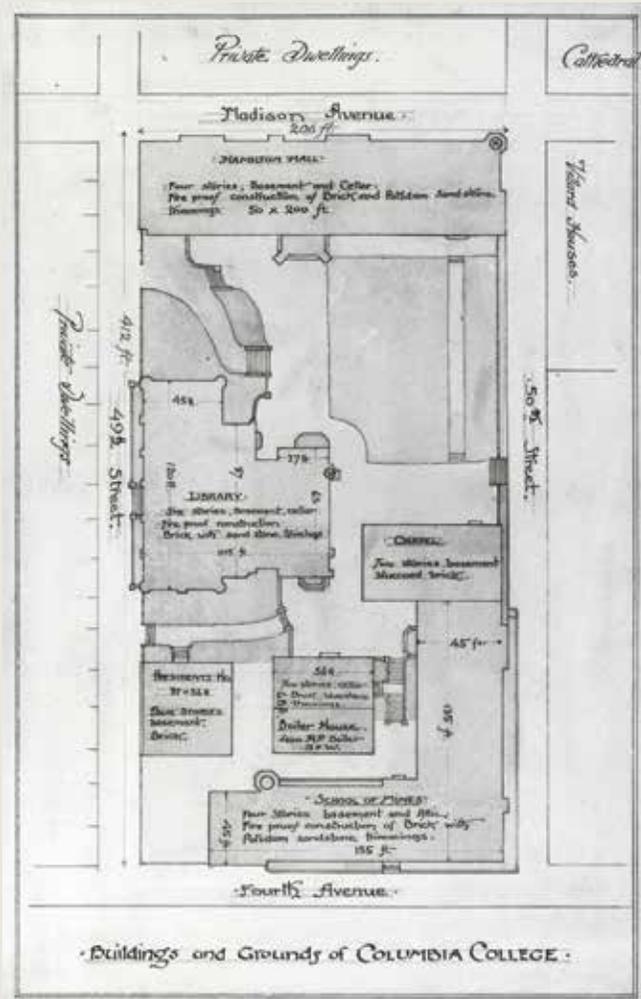
Thomas Egleston Jr., a Yale graduate trained in Paris, proposes a school of metallurgy and mining in New York City, and Columbia College Trustee George Templeton Strong champions his idea among the other Trustees.



**Establishment of a School
within Columbia Focused on
Engineering and Applied Science**

1864

On November 15, the Columbia College School of Mines opens in a building on Madison Avenue with a faculty of three: mining expert Thomas Egleston Jr., Civil War veteran Francis L. Vinton, and chemist Charles F. Chandler.





1869

Columbia School of Mines institutes an influential degree program in civil engineering.



1875

Columbia awards its first PhD degree to Elwyn Waller, Class of 1870, in analytic chemistry. School of Mines graduates are awarded Columbia's first 30 PhD degrees, in such academic fields as mathematics, architecture, physics, chemistry, geology, paleontology, and astronomy, as well as engineering, mechanics, mechanical engineering, surveying, mining, mineralogy, metallurgy, and applied chemistry.



1877

Columbia has an early history of attracting and educating international students. Liberian-born James R. Priest (front, center), thought to be the first black student at Columbia, graduates from the School of Mines. Luiz de Souza Barros from São Paulo, Brazil, is also a member of the class, shown on the left under the '77.



1877

Students in the Class of 1878 become the first to engage in special summer programs to learn about mining and surveying, an activity that continued every summer until 1966. The first program was conducted at a mining site in Pennsylvania and included three Japanese students, Kiugo Nambu, Yothinosuke Hasegawa PhD1880, and Nawokichi Matsui PhD1880.

1882

Professor Frederick R. Hutton MS1876, PhD1881 teaches the School's first courses in mechanical engineering. He goes on to found the Department of Mechanical Engineering, which in 1897 welcomed four students into a four-year program.



Courtesy of The Wellesley Archives

1886

Graduating from Columbia with highest honors, Winifred Edgerton becomes the first woman to receive a PhD in mathematics from an American institution and the first woman graduate of Columbia. An 1883 mathematics and astronomy honors graduate of Wellesley, she calculated the orbit of the Pons-Brooks comet of 1883, which helped her gain access to the telescope at Columbia.



1889

Columbia establishes the School of Electrical Engineering with a two-year graduate program as part of the School of Mines. Francis Bacon Crocker, Class of 1882, far right, and Michael I. Pupin, Columbia College Class of 1883, far left, teach the first class of 14 students and begin instructing undergraduates two years later. Crocker goes on to co-invent one of the nation's first helicopters while Pupin earns 34 patents during his lifetime.



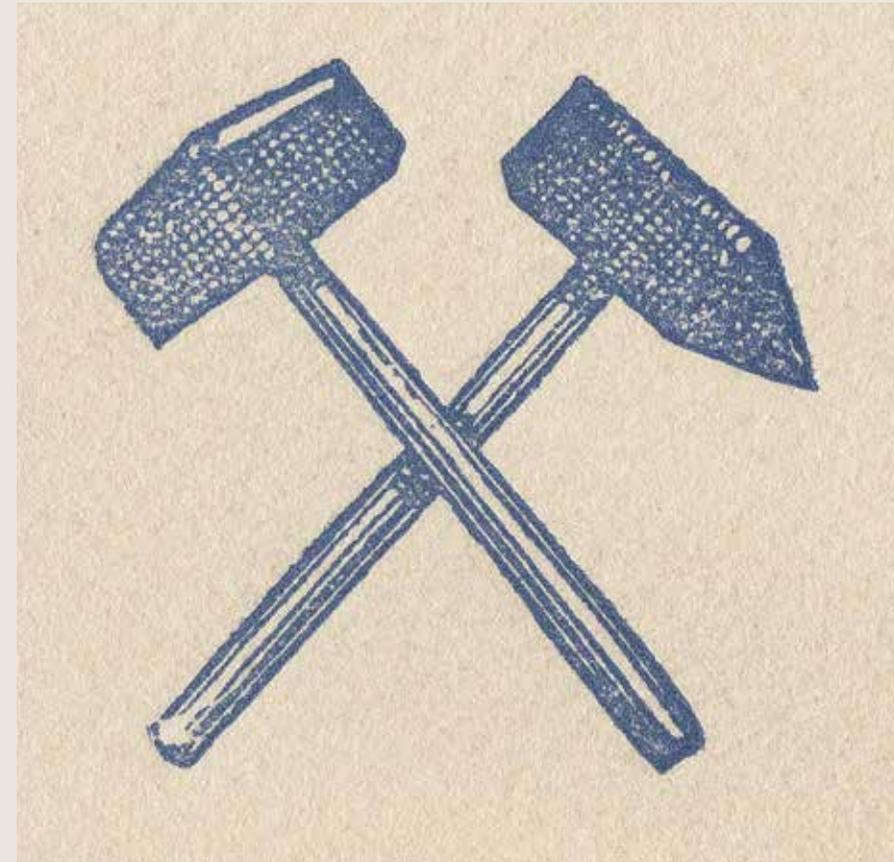
1890

Herman Hollerith, Class of 1879, PhD 1890, invents punch cards and a tabulating machine to process the huge amount of data collected by hand for the 1890 census, reducing processing time from several years to a few months. Regarded as the “father of modern automatic computation,” Hollerith’s company becomes one of four to merge and form a company that, in 1924, changes its name to International Business Machines (IBM).

Courtesy of the Library of Congress

1892

Bridges and canals expert William H. Burr becomes founding chair of the Department of Civil Engineering and begins consulting extensively on public works in New York City and beyond. Burr goes on to help oversee the construction of the Panama Canal.



1892

Columbia School of Mines accounts for 402 of the 871 graduates of the 16 mining schools in the U.S.

1896

Professor Michael Pupin, Columbia College Class of 1883, develops a process for X-rays that reduces exposure from hours to seconds and maps buckshot in the hand of an injured patient. Three years later, he significantly advances long-distance telephony with his patented loading coils, also known as “Pupin coils,” and, at the request of President Woodrow Wilson, helps develop sonar during World War I.

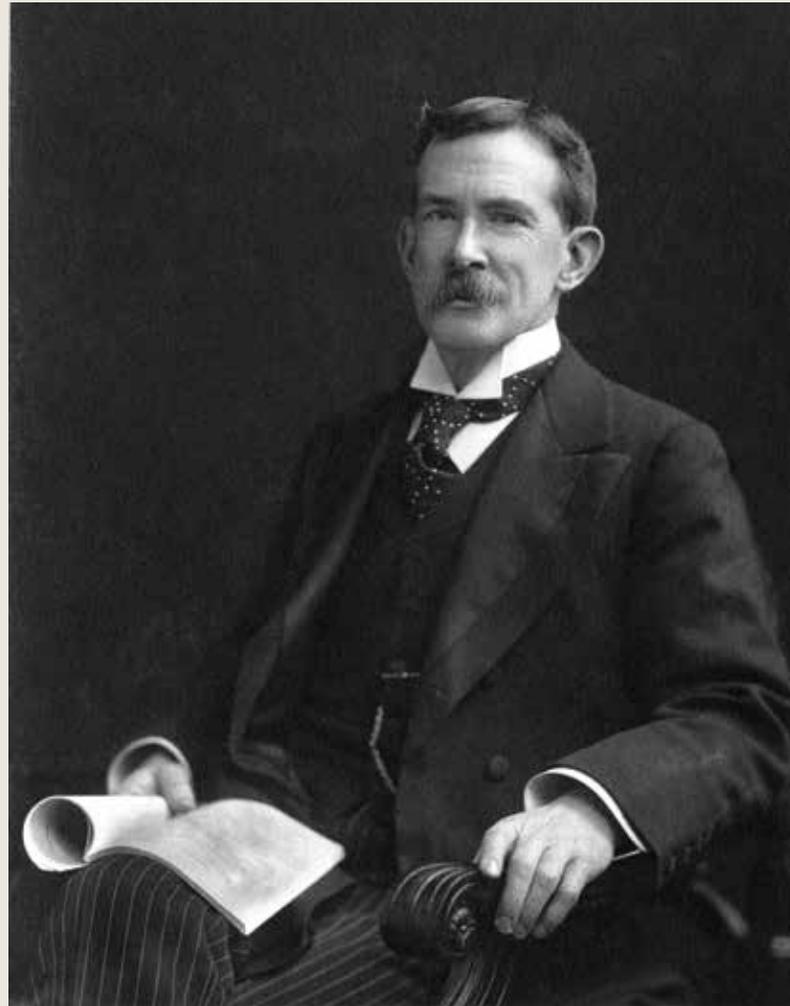


1903

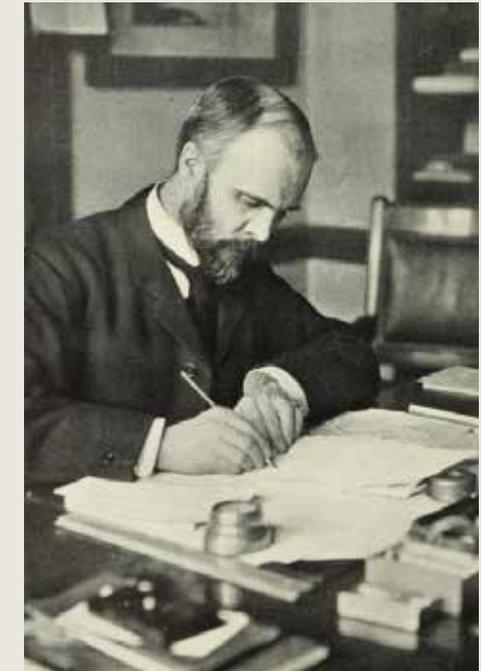
“Camp Columbia,” 400 acres of land near Bantam Lake in Litchfield, Connecticut, becomes the site of summer courses for students, a requirement that continues for some majors until 1966. The property is sold to the state of Connecticut in 2000 and is now Camp Columbia State Park.

1903

Professor Henry Marion Howe authors *Iron, Steel, and Other Alloys*, the first comprehensive survey of the scientific literature on the metallurgy of steel, and later becomes recognized as one of the creators of the science of metallurgy.



Courtesy of The New York Public Library



1904

New York's first underground subway line is launched; chief engineer for the Interborough Rapid Transit Co. is William Barclay Parsons, Class of 1882. Parsons also serves as chief engineer of the Cape Cod Canal, chief surveyor of China's 1,000-km railway from Hanchow (modern-day Wuhan) to Canton, and a University Trustee. His engineering firm, now Parsons Brinckerhoff, is today one of the world's largest global companies developing the built environment.



1905

Columbia University Trustees approve a new curriculum in chemical engineering, the first integrated curriculum of its kind and soon the basis of similar offerings at other universities.



1907

A new building designated “School of Mines,” financed by mining investor Adolph Lewisohn, opens on the University’s new Morningside campus and remains the home of the department for half a century.

1911

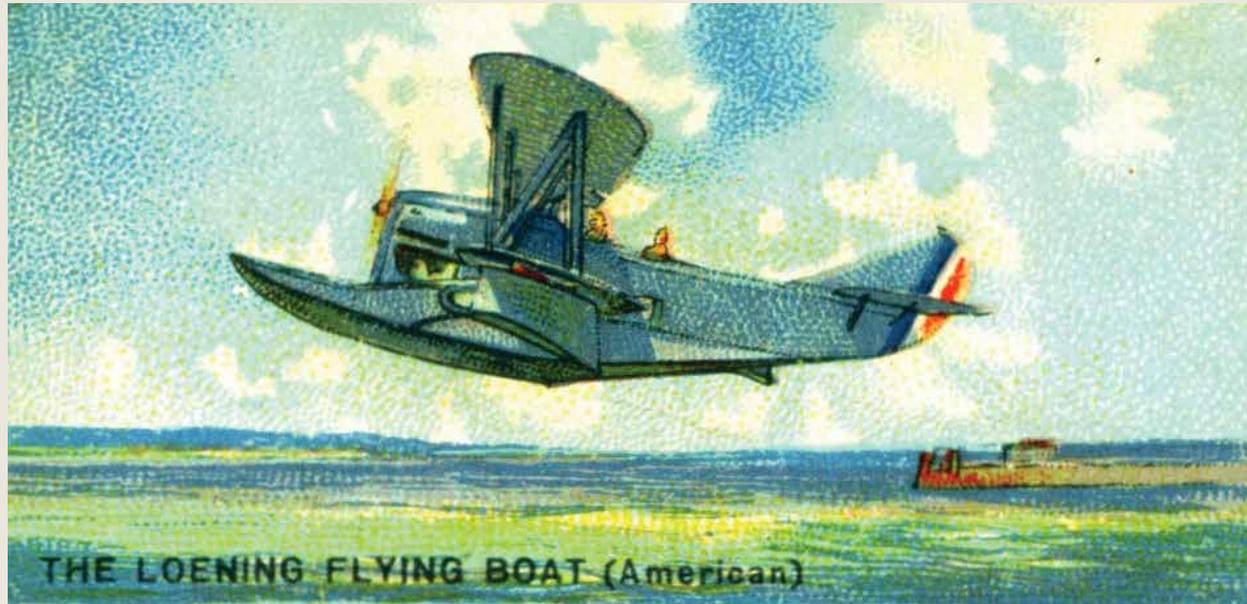
David Steinman earns his PhD degree in civil engineering.

He goes on to become one of the nation's most sought-after bridge experts, responsible for many bridges, both nationally and internationally, including the Henry Hudson Bridge, for which he uses the steel truss arch design he proposed in his PhD thesis.



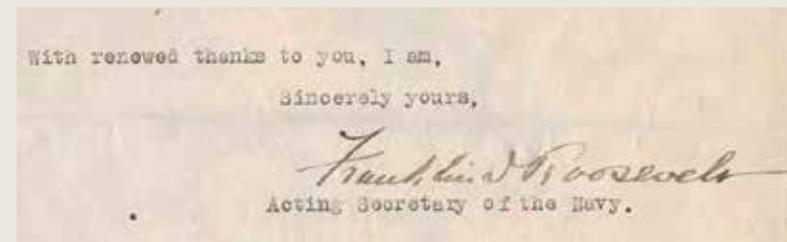
1913

Edwin Howard Armstrong, Class of 1913, joins the faculty and pursues a patent for his regenerative circuit, allowing better reception of weak radio signals. Later, serving in World War I, he develops the superheterodyne radio receiver, the basis of many modern communications devices.



1913

Aircraft expert Grover Loening, Columbia College Class of 1908, MS1910, engineers the first “short-hulled flying boat,” going on to create several novel designs for airplanes, including monoplanes.



1913

On the eve of World War I, the School launches a postgraduate program for naval officers led by Mechanical Engineering Professor Charles Edward Lucke PhD1902, an authority in internal combustion engines. In 1919, Franklin D. Roosevelt, acting secretary of the Navy, praises Dr. Lucke and all Columbia Engineering professors involved in the program, and expresses appreciation for “Columbia’s splendid contribution to the winning of the war.”

1915

Columbia Trustees approve the creation of the new Department of Chemical Engineering, distinct from the existing Department of Chemistry. Professor Daniel Dana Jackson serves as founding chair.



Courtesy of the Chemical Heritage Foundation Collections



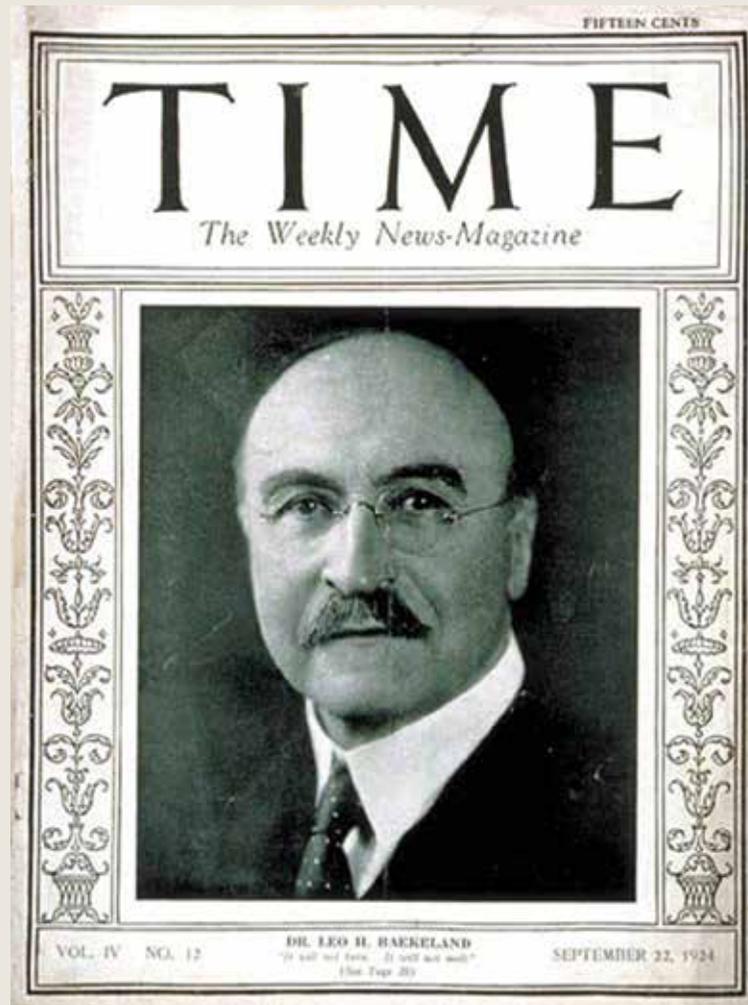
Courtesy of the Library of Congress

1915

Walter Rittman PhD'14, a leading chemical engineer with the U.S. Bureau of Mines, patents a revolutionary new method for cracking petroleum based on his PhD research. Through his process, he finds that gasoline is formed best at moderate to low temperatures under high pressure.

1917

Plastics pioneer Leo Baekeland, inventor of Bakelite, receives a special appointment to teach at Columbia, beginning a rich tradition in polymeric materials.



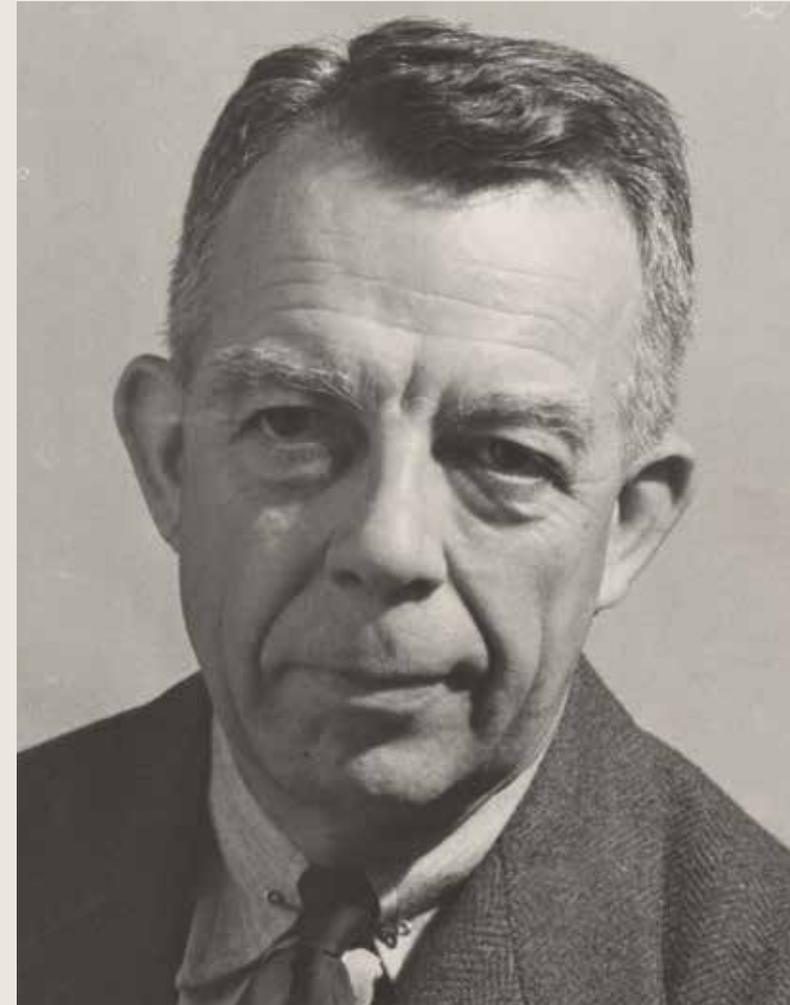
1920

Walter Rautenstrauch, a longtime member of the Mechanical Engineering faculty, creates and chairs a new Department of Industrial Engineering, one of the first of its kind in the country. He goes on to cofound the Committee on Technocracy, part of a movement promoting central planning administered by technical experts and engineers.



1923

Colin Fink joins the faculty and soon develops the chromium plating process that becomes standard, establishing a strong foundation for the School's continuing strength in electrochemistry.



1927

Mineral engineering authority Arthur F. Taggart writes the authoritative *Handbook of Ore Dressing*. In 1945, he updates and expands it to include the latest scientific and technological advances in the field, renaming it *The Handbook of Mineral Dressing: Ores and Industrial Minerals*, which becomes known as “the mineral processor’s bible.”



1928

IBM installs punch card tabulators and sorters in Hamilton Hall, enabling sophisticated computation across disciplines.



1929

Donald M. Burmister, a renowned expert in geotechnical engineering, begins a legendary career on the faculty of the Department of Civil Engineering and Engineering Mechanics, researching soil and pavement design, and consulting on projects, including the New York World's Fair.



1929

Admiral Hyman G. Rickover, the “father of the nuclear navy,” graduates with a master’s degree in electrical engineering and goes on to oversee the launching of the world’s first nuclear-powered submarine, the USS *Nautilus*, in 1955.

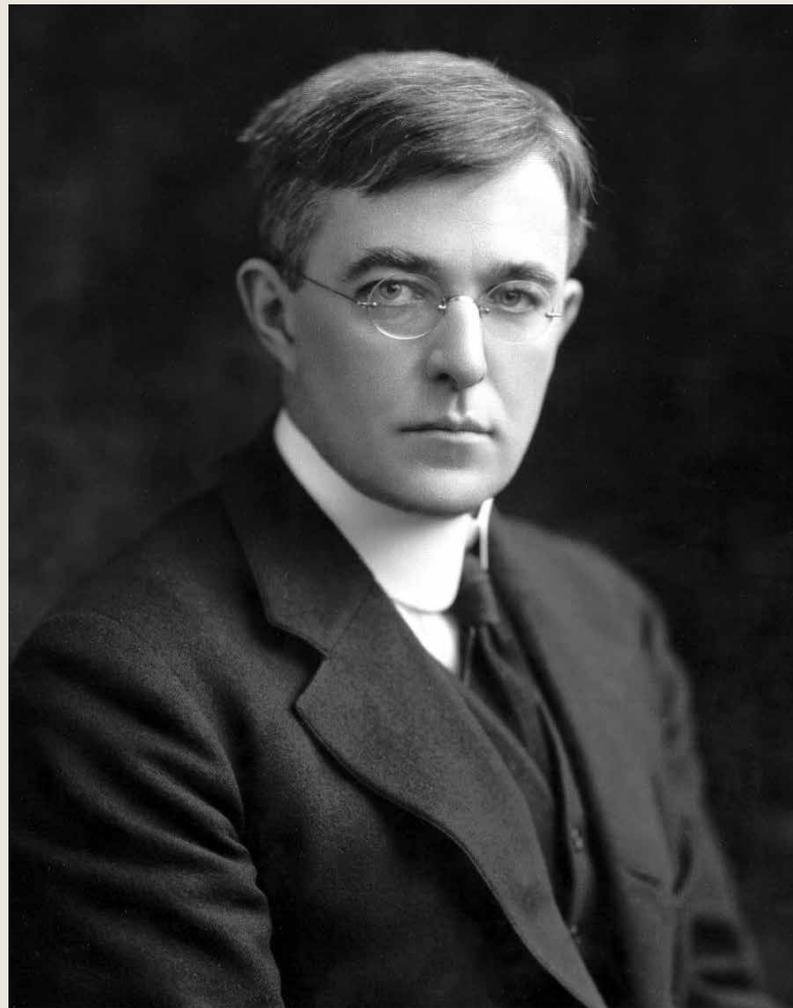


1932

Menelaos D. Hassialis '31CC begins 47 years on the faculty, consulting on the Manhattan Project, patenting many innovations, and building a global community of mining engineers. He goes on to become the first chair of the Henry Krumb School of Mines, from 1959 to 1967.

1932

Irving Langmuir, Class of 1903, the first to apply the term “plasma” to ionized gases, receives the Nobel Prize in Chemistry for his advances in surface chemistry.

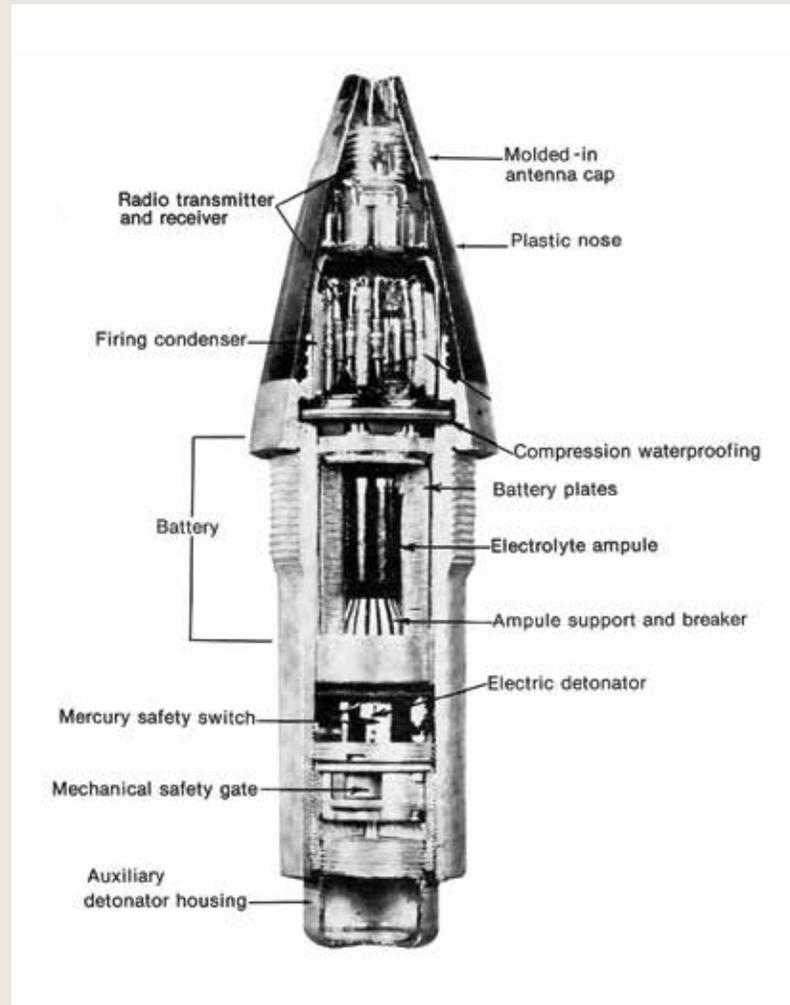


1933

Edwin Howard Armstrong, Class of 1913, invents wideband frequency modulation (FM) radio, an advance that paves the way for television. In 2003, Philosophy Hall, the site of the invention of FM radio, is named to the Registry of National Historic Landmarks.

1936

Raymond D. Mindlin BS'31 joins the Civil Engineering faculty and goes on to be considered one of the most outstanding elasticians of his time. In 1946, President Harry Truman awards him the Medal for Merit for his work developing the radio proximity fuse, a detonator used extensively in World War II. He is elected to the National Academy of Engineering in 1966 and receives the National Medal of Science from President Jimmy Carter in 1979.



Courtesy of U.S. Navy



1937

Poroelasticity pioneer Maurice A. Biot joins the Civil Engineering faculty, concentrating on aeronautical problems and fluid mechanics, developing the three-dimensional aerodynamic theory of oscillating airfoils, patenting an electrical analog flutter predictor based on a simple circuit design that simulates aerodynamic forces, and coauthoring *Mathematical Methods in Engineering* with Theodore von Kármán.

1939

Jewell M. Garrelts MS'33, who later becomes chair of the Department of Civil Engineering, helps design the Rainbow Bridge over Niagara Gorge and goes on to design many other significant bridges, including the Marine Parkway Bridge over Rockaway Inlet in Queens, St. Georges Bridge over the Chesapeake and Delaware Canal in Delaware, and many bridges on the New England Thruway.



1941

William W. Havens MS'41, PhD'46 begins to work on the Manhattan Project with James Rainwater, who later receives the Nobel Prize in Physics, building a neutron spectrometer that tests theories of nuclear structure with great precision. Havens joins the faculty of Applied Physics, develops spectrometers that pave the way for nuclear power and nuclear physics, and serves as executive secretary of the American Physical Society for 25 years.

1943

Columbia Engineering opens its doors to women and Gloria Reinish (nee Brooks), a sophomore transfer, enrolls, graduating with the Class of 1945 as an electrical engineering major. She receives her MS from Columbia in 1948 and later returns to earn a doctorate in bioengineering in 1974, after which she begins a career at Fairleigh Dickinson University, where she becomes chair of the Electrical Engineering Department and founding chair of its bioengineering program.



1946

Hans H. Bleich (center), an authority in structural mechanics, comes to Civil Engineering for a lengthy tenure studying various structures and designing skyscrapers, bridges, and observatories. In 1978, he is elected to the National Academy of Engineering.

1946

Herbert H. Kellogg BS'41, MS'43 signs on to teach mineral engineering and, in 44 years at Columbia, becomes a prominent researcher and passionate advocate for developing the mining industry's environmental awareness. He is elected to the National Academy of Engineering in 1978.



8-47(6)

First Meeting of the Eastern Association for Computing Machinery, Columbia University, New York, Sept. 15, 1947 - Brief Summary of Talk

Sept. 22, 1947

THE PILOT MODEL OF EDVAC - BY T. KITE SHARPLESS

Edart ✓
Thomas ✓
Kane ✓
Leahy ✓
Walker ✓

please return to Mr.

As you know, the Moore School of Electrical Engineering is under contract to Army Ordnance to make a second electronic digital calculator, EDVAC. In March, the Franklin Institute asked the school for a working exhibit in this field. About the same time we wanted to test out thoroughly certain features of EDVAC. So we rapidly put together some panels of equipment, and made the Pilot Model of EDVAC, or, as it is sometimes called, SHADRACH.

1. Organization. Essentially, the pilot model consists of the following:

- (1) An input mechanism, consisting of a word generator, a teletype transmitter, and a hand key;
- (2) An arithmetic unit able to add, subtract, and multiply;
- (3) A memory, consisting of 8 mercury tanks, each holding 8 words (i.e., each containing 8 registers) and each word consisting of 32 pulses;
- (4) A shuttle, consisting of a memory of 1 word, used to furnish the arithmetic unit with the other number of the pair of numbers to be operated on;
- (5) An output mechanism, consisting of 13 neon lights, and an oscilloscope; and
- (6) A control mechanism, either automatic or manual.

A pulse time is one microsecond. A word consists of the presence or absence of 32 successive pulses. A minor machine cycle is 32 microseconds. The time for addition is two minor cycles, or 64 microseconds.

2. Temperature of Mercury. The temperature response of mercury in a memory tank was adjusted for by making the frequency of the clock oscillator a function of the mercury temperature as discussed in my paper on mercury tank memories. Reference: "Mercury Delay Lines as Memory Units," in (1) Proceedings of Harvard Symposium on Large Scale Digital Computers (not yet published as far as I know) or (2) Electronics (to be published soon).

3. Coding and Control. Instruction coding was of the four-address kind: A, B, C, D, Type. The word "Type" refers to type of order. The possible types of orders are: adding; subtracting; multiplying; comparing (i.e., determining which of two numbers is larger); reading in; writing out. The addresses refer to the memory positions, or registers, which are numbered from 1 to 4.

1947

The Association for Computing Machinery (ACM), the world's largest educational and scientific computing society, is founded in a meeting at Columbia, where it was originally named the Eastern Association for Computing Machinery. Attendees include faculty from IBM's Watson Scientific Computing Laboratory at Columbia University. The first computer courses at Columbia are taught by Watson Lab scientists.

1947

Professor John R. Ragazzini MA'39, PhD'41 authors "An Analysis of Problems in Dynamics by Electronic Circuits" in the May issue of *Proceedings of the I.R.E.*, describing the work of Loebe Julie, who builds the world's first modern differential operational amplifier at Columbia. Ragazzini, who oversaw Julie and many exceptional graduate students, is honored by the American Automatic Control Council in 1973 as the recipient of the first John R. Ragazzini Award, established to recognize outstanding contributions to automatic control education.



1947

Sebastian B. Littauer MA'28 (left) joins the Industrial Engineering faculty. First as a teacher and then as department chair, he establishes and promotes operations research at Columbia.

1949

Alfred M. Freudenthal, a pioneer in materials' inelastic behavior, joins the Civil Engineering faculty. Considered the "father of structural reliability," he writes extensively and consults on various public works projects.



1949

Elmer Gaden BS'44, MS'47, PhD'49, the "father of biochemical engineering," authors his groundbreaking dissertation on providing the optimal amount of oxygen to allow greater fermentation energy for penicillin mold to grow and multiply more rapidly. His work forms the basis for mass production of antibiotics, beginning with penicillin.



1949

Lotfi A. Zadeh receives his PhD in electrical engineering and serves on the faculty for 10 years, going on to publish his landmark paper on “fuzzy sets” in 1965. In 1973, he proposes the theory of fuzzy logic and is elected to the National Academy of Engineering.



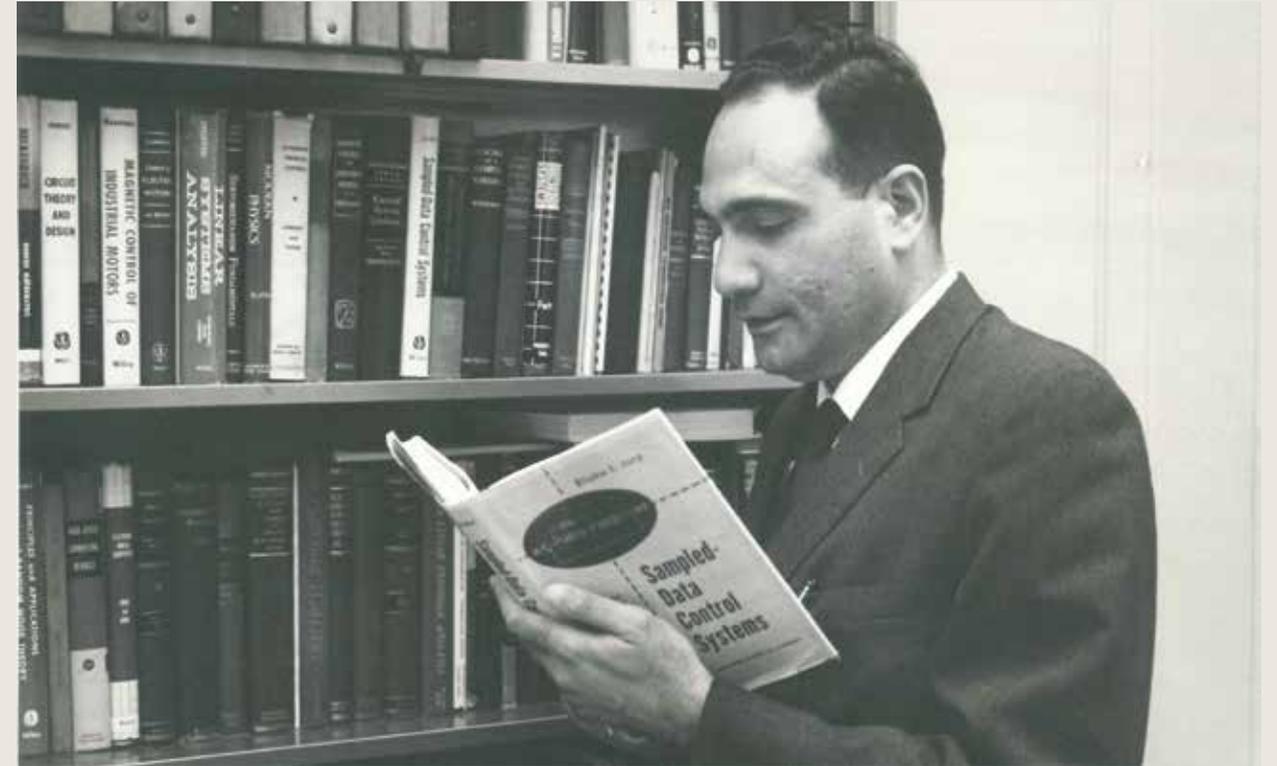
By permission of the Mayo Historical Unit, Mayo Clinic, Rochester, Minnesota

1950

Edward C. Kendall (third from left), Class of 1908, PhD'10, known for his notable contributions to biochemistry and medicine, receives the Nobel Prize in Physiology or Medicine for his investigations of the adrenal cortex and isolation of cortisone.

1951

Economist Seymour Melman PhD'49 begins more than 50 years on the Industrial Engineering faculty, chairing the department and becoming a prominent critic of nuclear weapons and the military-industrial complex.



Courtesy of Kamal Premaratne

1953

As a student in the Department of Electrical Engineering, Eliahu Jury receives the first Doctor of Engineering Science degree ever given at Columbia. Later, he publishes *Theory and Application of the Z-Transform Method* and develops the advanced z-transform.



1954

Statistician Cyrus Derman PhD'54 begins teaching operations research and becomes a driving force in its importance within the School. He receives the John von Neumann Theory Prize from the Institute for Operations Research and the Management Sciences (INFORMS) in 2002 for his fundamental contributions to the fields of performance analysis and optimization of stochastic systems.



Photo by Jane Nisselson

1954

In his PhD dissertation, Ferdinand Freudenstein PhD'54 develops what later is known as the Freudenstein Equation to determine the position of an output lever in a linkage mechanism. He joins the Mechanical Engineering faculty and comes to be known as the “father of modern kinematics.” (Pictured on the left, his spherical four-bar linkage of the crank-rocker type.)

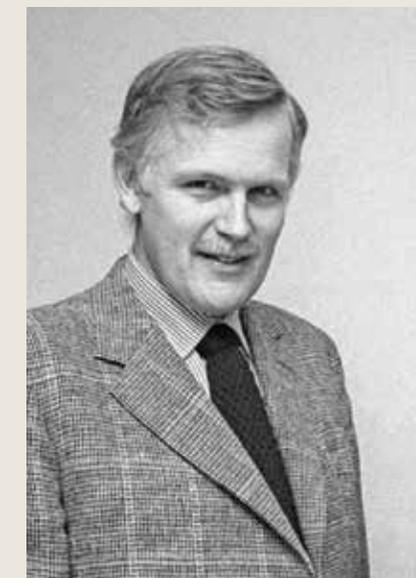
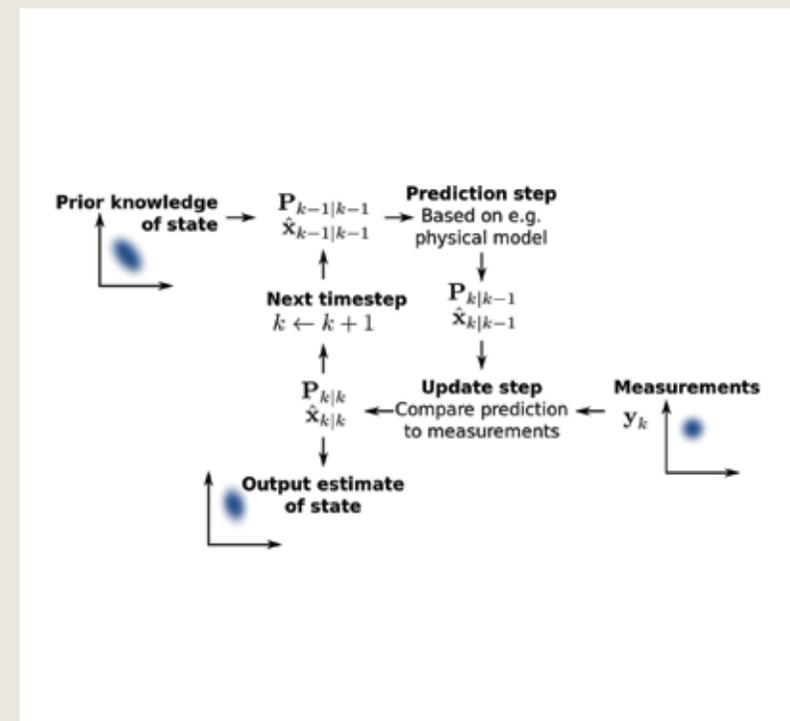




Courtesy of the Radiation Safety Information Computational Center

1957

Nuclear engineering expert Herbert Goldstein joins the Mechanical Engineering faculty and later goes on to join the faculty of Applied Physics and Nuclear Engineering, where he works to increase the public's scientific literacy. His seminal textbook, *Classical Mechanics*, is subsequently translated into nine languages.



Courtesy of University of Florida, Department of Mathematics

1957

Rudolf E. Kálmán receives his doctorate in electrical engineering and goes on to co-invent the Kalman filter, an algorithm with applications ranging from aircraft guidance and weather predictions to econometrics. He is elected to the National Academy of Engineering in 1991.



1958

Upon the death of benefactor Henry S. Krumb, Class of 1898, the Trustees, recognizing his vision and generosity, name the Department of Mining, Metallurgy and Mineral Engineering the Henry Krumb School of Mines.



1958

Chemical Engineering Professor Edward F. Leonard is among the first to pursue path-breaking research in the engineering and design of artificial organs. In 1965, he goes on to lead the first bioengineering program at Columbia and today is developing a wearable dialysis system based on microfluidics.

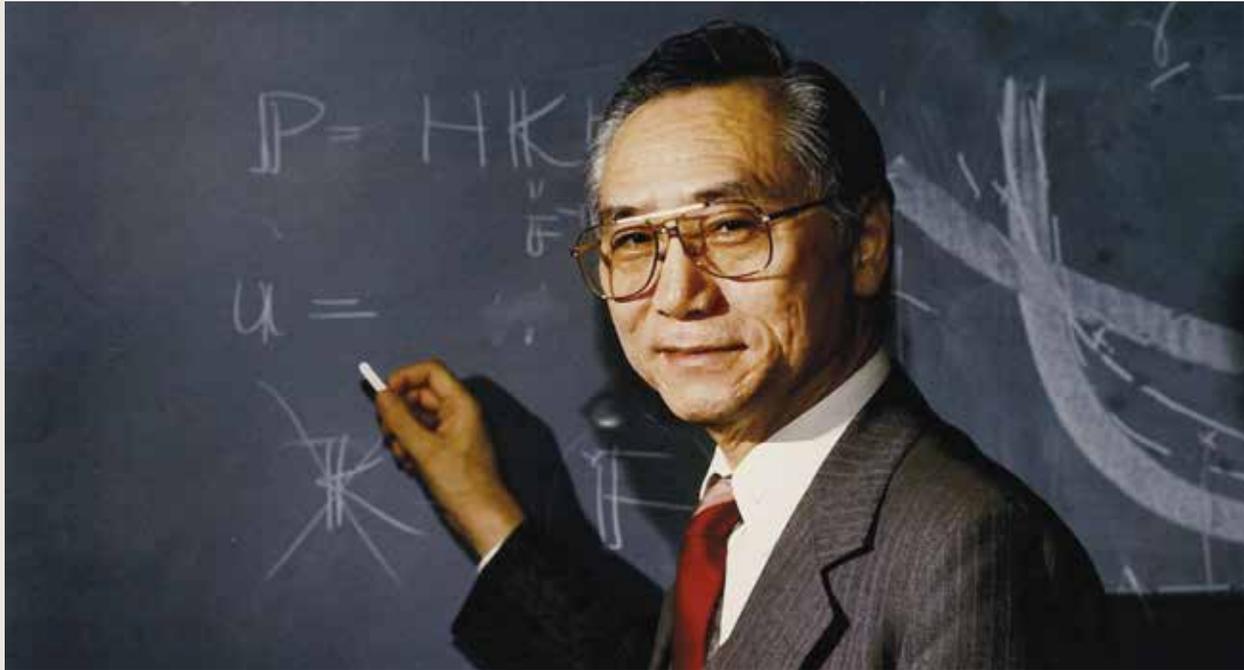
1959

Morton Klein MS'52, EngScD'57, among the first to apply quantitative methods to industrial engineering and a giant in operations research, coauthors the seminal text *Probability and Statistical Inference for Engineers*.



1960

Professor Bruno A. Boley of the Department of Civil Engineering and Engineering Mechanics, a leading expert in structural mechanics, elastic stability, and thermal stresses, publishes *Theory of Thermal Stresses*, a highly regarded text still in publication, and is later elected to the National Academy of Engineering for research and teaching in applied mechanics, particularly on thermal stress analysis and dynamical problems.



1960

Professor Masanobu Shinozuka PhD'60 of the Civil Engineering faculty begins to establish himself as a leading authority in earthquake and structural engineering, especially in field theory, risk-assessment methodology, and structures resistant to disasters, and is subsequently elected to the National Academy of Engineering for his work in random vibration and related applications to safety and reliability of structures.



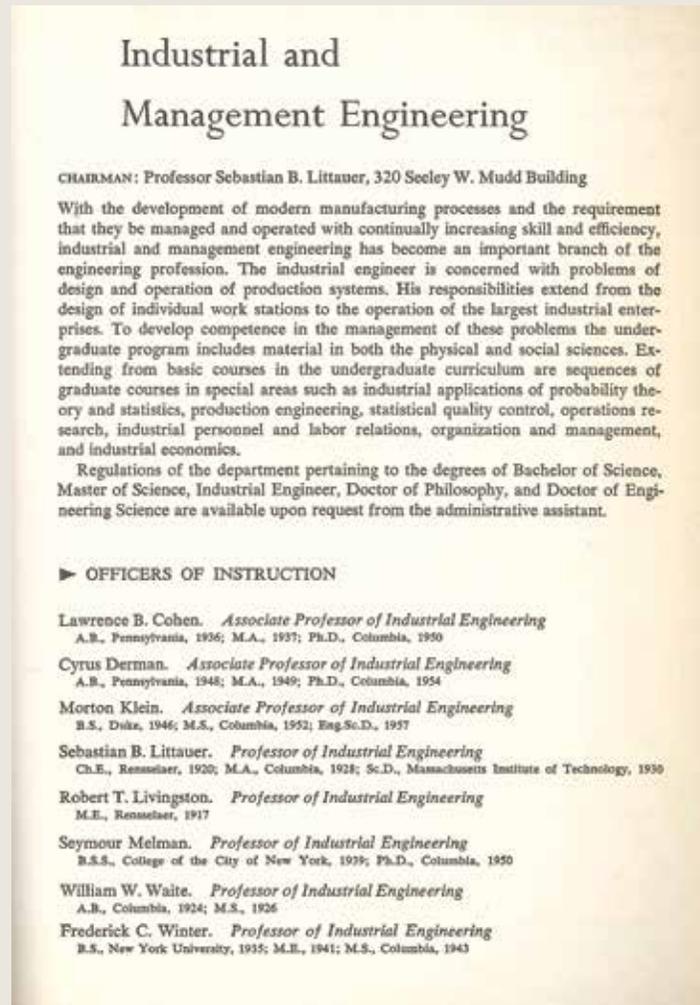
1961

The Seeley W. Mudd Building opens as the new home of Columbia Engineering, bringing together engineering and applied science faculty who had been in two separate buildings on the Morningside campus.

1961

The Department of Industrial Engineering becomes the Department of Industrial and Management Engineering, and establishes one of the country's first degree programs in operations research.

Recognizing that operations research has become central to managing complex enterprises, the department is renamed the Department of Industrial Engineering and Operations Research (IEOR) in 1978.

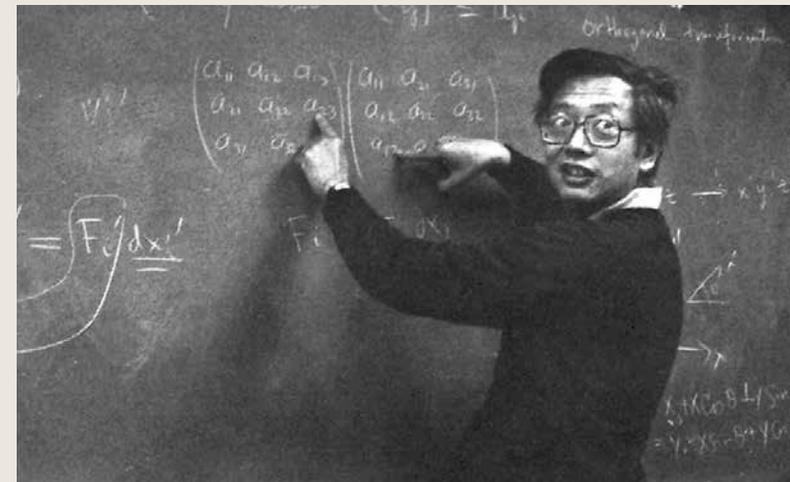
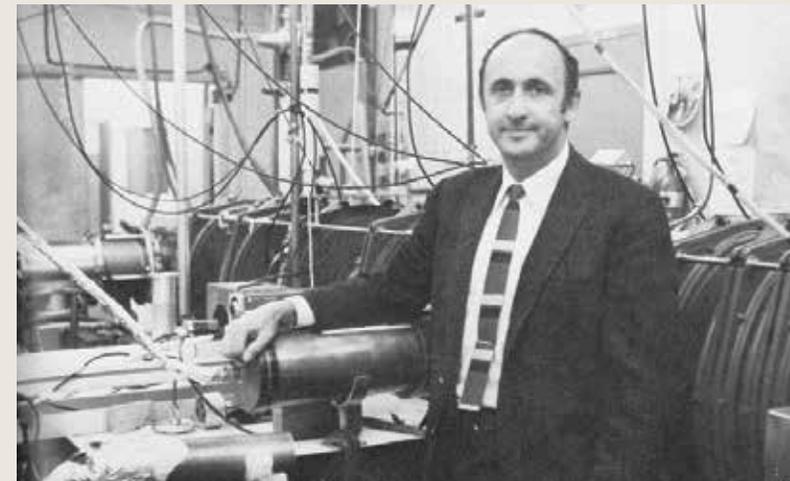
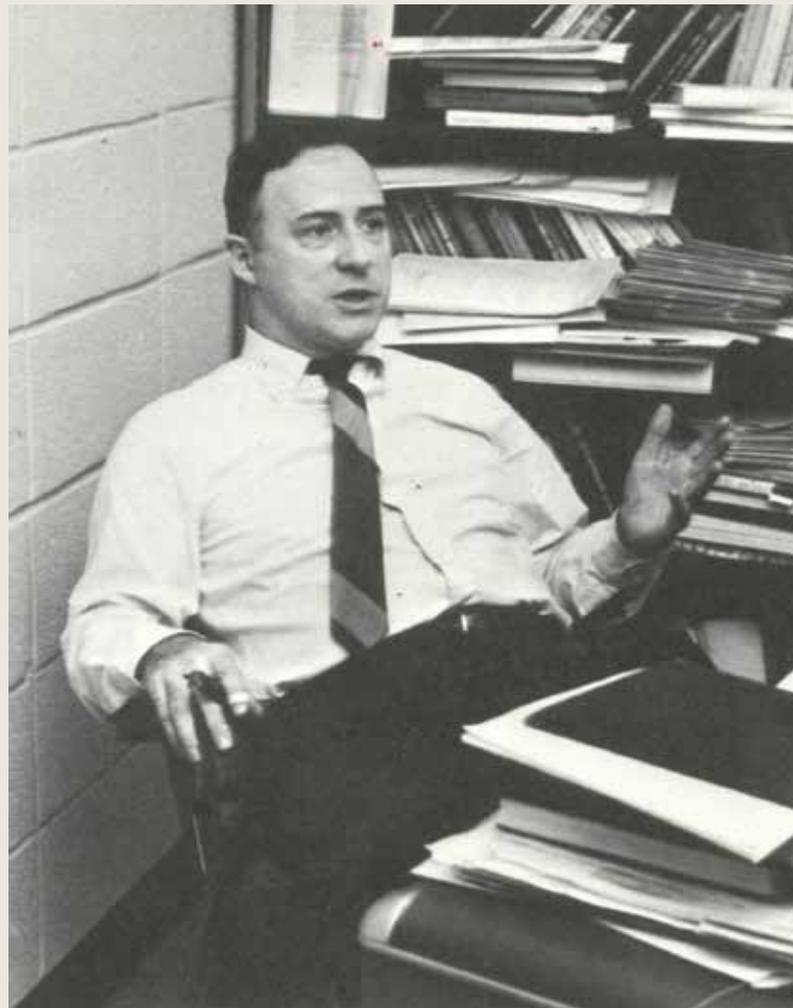


1961

Joseph Engelberger BS'46, MS'49, known as the "father of industrial robotics," partners with inventor George Devol to pioneer the Unimate robot for use on assembly lines and other industrial applications, as well as many other robotics. He is elected to the National Academy of Engineering in 1984.

1961

Professor Morton B. Friedman of the Department of Civil Engineering and Engineering Mechanics, a mathematician and pioneer of the boundary element method, develops Engineering Mathematics, a series of courses for students seeking to apply mathematics to problems in engineering and applied science.



1961

Professors Robert Gross and C. K. Chu lead efforts to establish the Plasma Physics Laboratory to research high-temperature and fusion plasmas. The laboratory becomes an influential University research center in fusion energy, with leading national and international collaborations. Professor Chu goes on to develop finite difference approximations of the equations of fluid dynamics and coins the now-standard phrase, “computational fluid dynamics.”

1963

The Strength of Materials Laboratory is established by a generous endowment from Robert A. W. Carleton, Class of 1904, an Egleston Scholar and builder of numerous subway and rail tunnels in New York City.



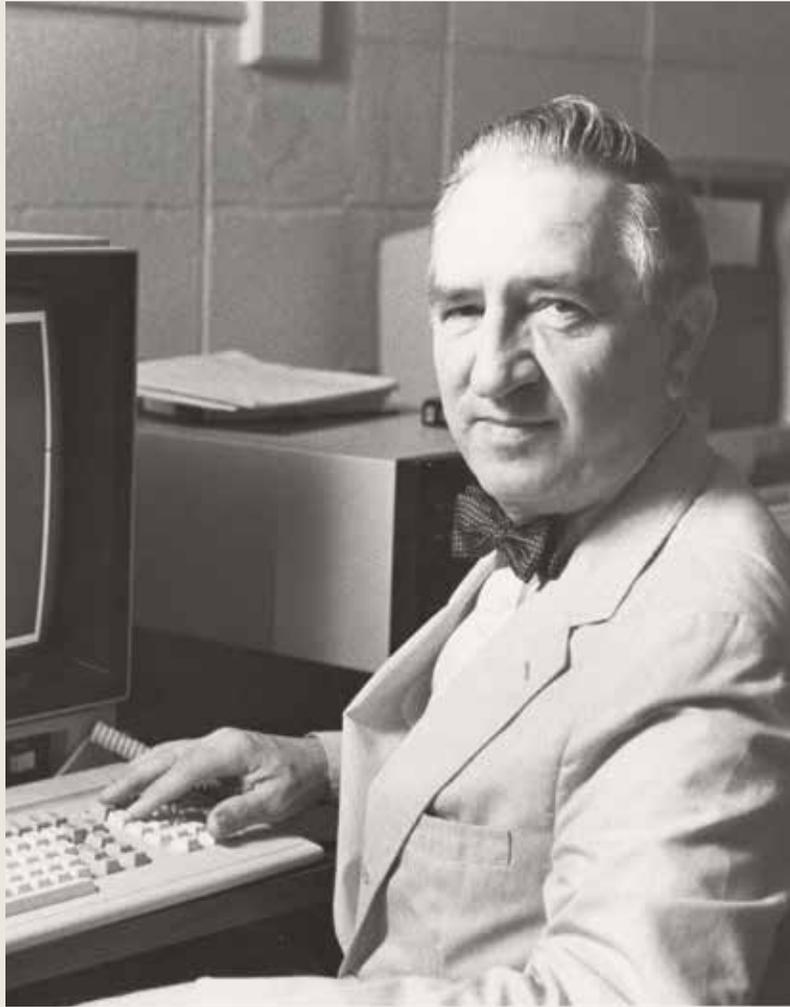
Courtesy of Ileana Grams-Moog; Likeness used with permission of Moog Music, Inc.

1964

Robert Moog BS'57 demonstrates his groundbreaking music synthesizer, the first voltage-controlled subtractive synthesizer played via keyboard, to an audience of audio engineers.

1969

Professors Richard Skalak, pictured, and Shu Chien, MD, of the College of Physicians and Surgeons, pioneers in biomedical engineering, produce groundbreaking work in the mechanics of blood flow, bone growth, white blood cell responses to infections, and biological implications and responses to implants. For his work on the mechanics of blood flow, cell membranes, biorheology, and modeling of growth, Skalak is elected to the National Academy of Engineering in 1988.

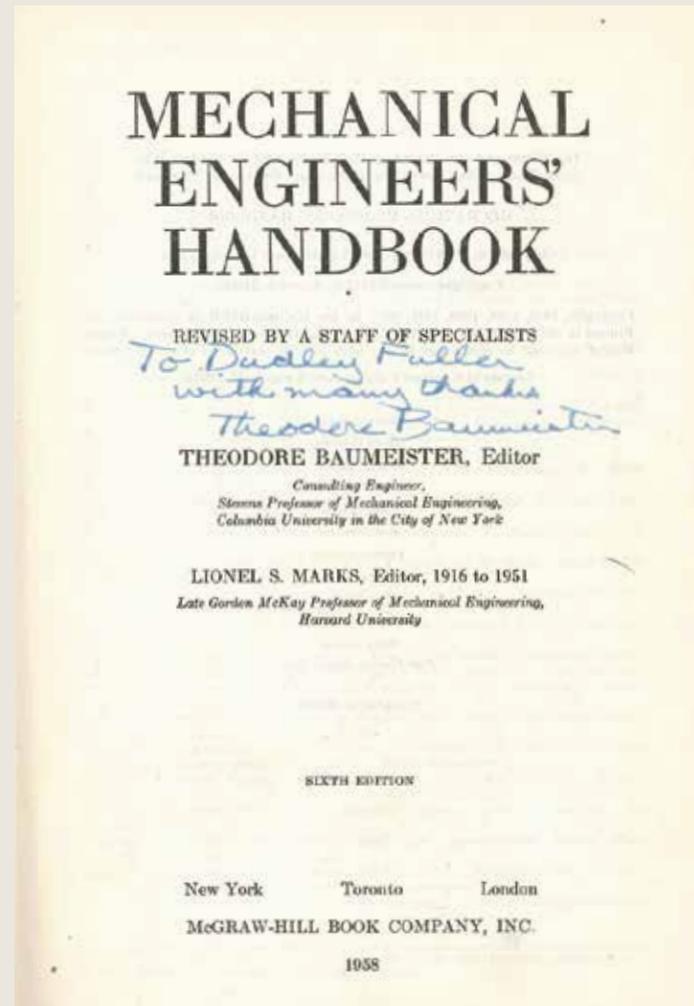


1974

Professor Charles Bonilla, founder and director of the Nuclear Heat Transfer Research Facility, is the inaugural recipient of the Kern Award from American Institute of Chemical Engineers (AIChE) for his outstanding contributions to the field of heat transfer.

1975

Theodore Baumeister, longtime editor of the classic handbook *Marks' Standard Handbook for Mechanical Engineers*, currently in its 11th edition, receives the Egleston Medal for his work in metals and machinery.



Jack Manning/*The New York Times*/Redux

1976

Electrical Engineering Professor Cyril M. Harris, hailed by *The New York Times* as “the pre-eminent acoustical engineer in the United States,” redesigns the acoustics of Avery Fisher Hall at New York City’s Lincoln Center. During his career he fine-tunes the sound at more than 100 of America’s highest-profile musical venues.



1978

Dean Peter Likins founds the Applied Physics and Nuclear Engineering (APNE) Department by combining the Plasma Physics Committee, an interdepartmental doctoral program, with the existing Division of Nuclear Science and Engineering, which had been aligned with the Mechanical Engineering Department. It later becomes Applied Physics (AP) in 1990, and Applied Physics and Applied Mathematics (APAM) in 1998.

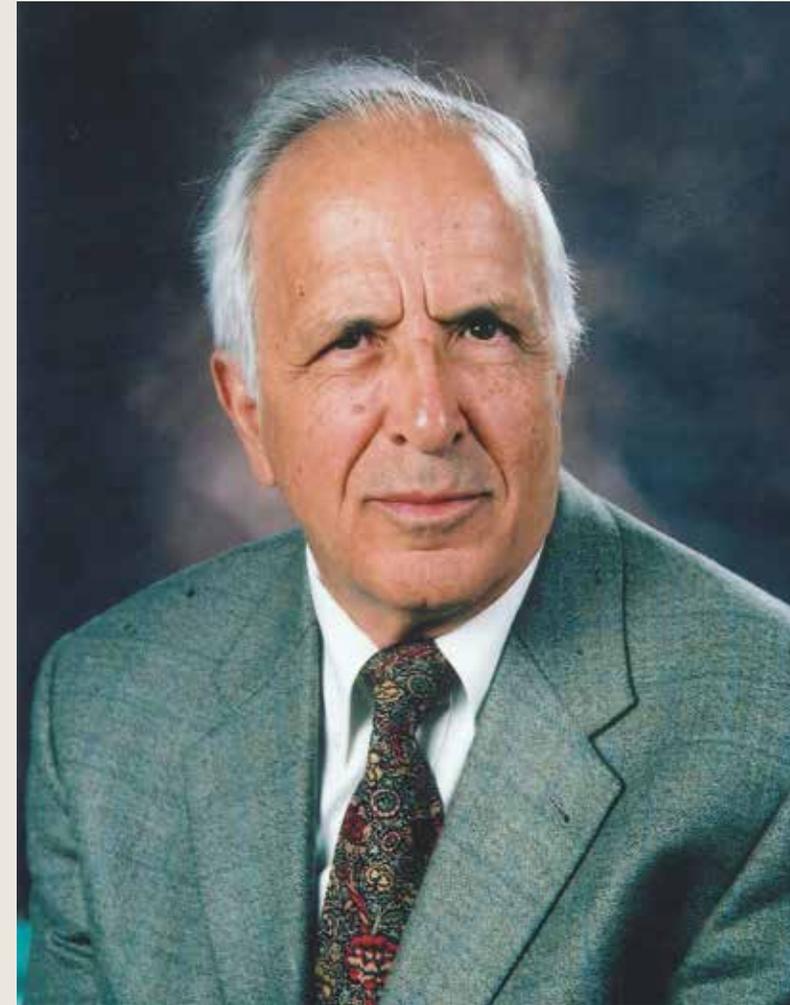


1979

Joseph F. Traub PhD'59, Carnegie Mellon University department head, becomes founding chair of the Department of Computer Science. In 1985, he is elected a member of the National Academy of Engineering, and, in 1995, with Spassimir Paskov PhD'94, demonstrates that quasi-Monte Carlo methods with quasirandom samples beat random Monte Carlo methods for real-world financial computation.

1980

Civil Engineering Professor Mario G. Salvadori authors *Why Buildings Stand Up*, one of 15 works he writes on architecture, structural engineering, and applied mathematics. In 1983, he is elected to the National Academy of Engineering and, four years later, founds the Salvadori Center to teach science and mathematics to inner-city students. In 1997, he receives the Founders Award from the National Academy of Engineering.



1983

Copper expert Nickolas J. Themelis, professor of extractive metallurgy, is elected to the National Academy of Engineering for contributions to metal production technology, specifically in copper smelting. He later founds the Earth Engineering Center (EEC) and Waste to Energy Research and Technology Council, an international consortium concerned with materials and energy recovery from solid waste.

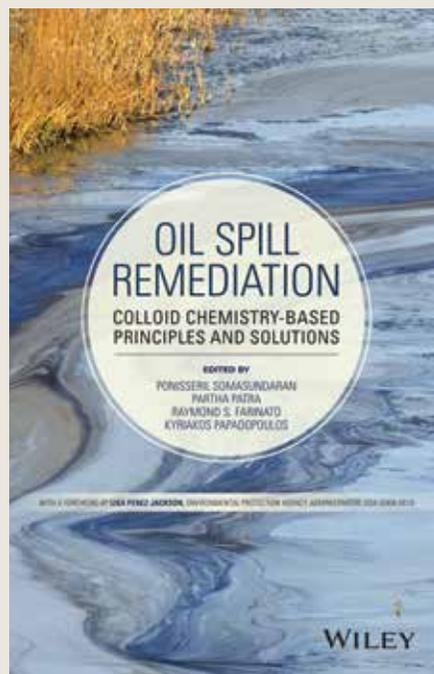
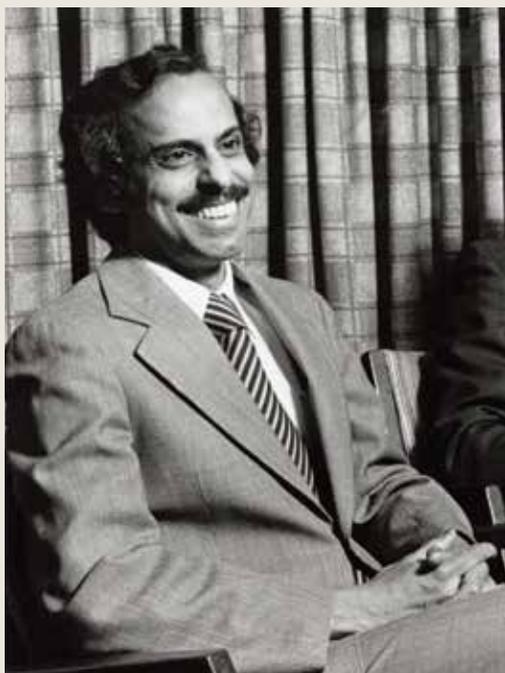
1984

Three department faculty members are named to the Institute of Electrical and Electronics Engineers (IEEE) list of top 10 electrical engineering educators of all time: Michael Pupin and Jacob Millman (top, left to right) and Mischa Schwartz (bottom, left), while Edwin H. Armstrong is included in their list of top 10 technical contributors.



1985

The Center for Telecommunications Research is established with National Science Foundation funding. Led by Professor Mischa Schwartz, a National Academy of Engineering member, and Professor Thomas Stern, it provides the foundation for many of the School's modern research initiatives in data, graphics, voice, and video.



1985

Professor Ponisseril Somasundaran is elected to the National Academy of Engineering. An expert in colloids and surfaces, he is cited for making major advances in mineral flotation, fine particles processing, and enhanced oil recovery. In 2014, he coauthors the first book to address oil spill remediation from the perspective of physicochemical and colloidal science, *Oil Spill Remediation: Colloid Chemistry-Based Principles and Solutions*.

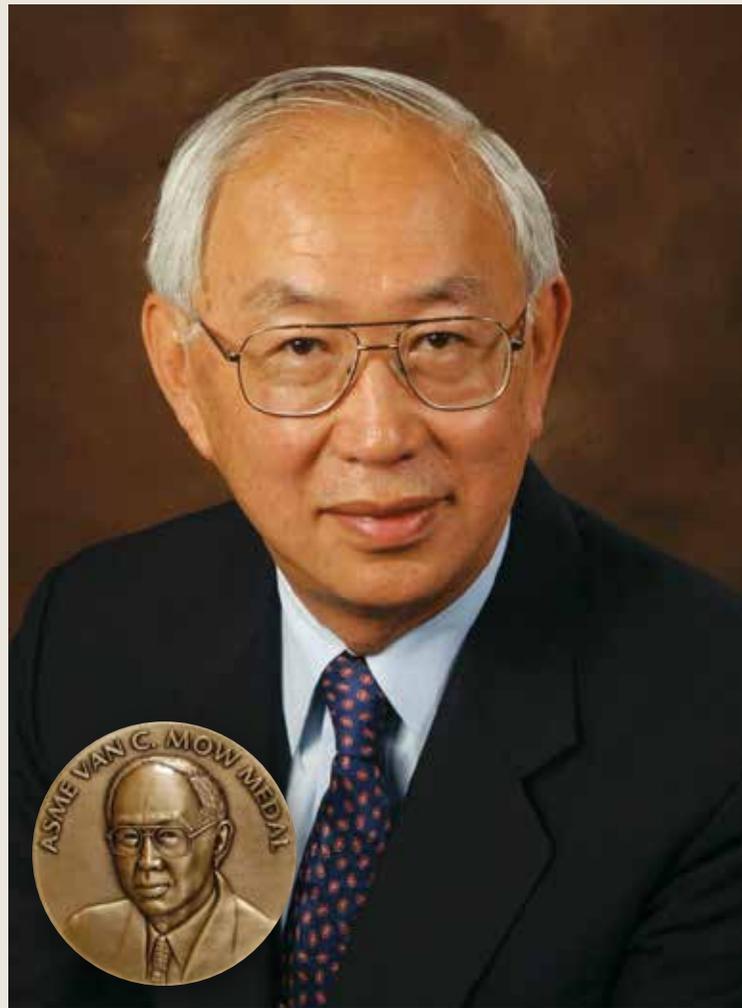


1985

Professor Salvatore Stolfo builds the 1023-processor DADO parallel computer that forms the basis of the first nationwide speech recognition telephone answering system. He goes on to invent “data-mining” intrusion detection systems technology broadly used in the antivirus industry and to invent Symbiote, the world’s first host antivirus security.

1986

Professor Van C. Mow, a pioneer in the field of biomechanics, becomes the first joint faculty appointment between the College of Physicians and Surgeons and Engineering School, establishing the first engineering laboratory at the Columbia Medical Center. He is elected to the National Academy of Engineering in 1991 and to the Institute of Medicine in 1998. In 2000, he becomes founding chair of the Department of Biomedical Engineering. In 2005, the American Society of Mechanical Engineers (ASME) establishes the Van C. Mow Medal for Excellence in Engineering, and in 2014, he receives the ASME Medal.



Medal courtesy of ASME

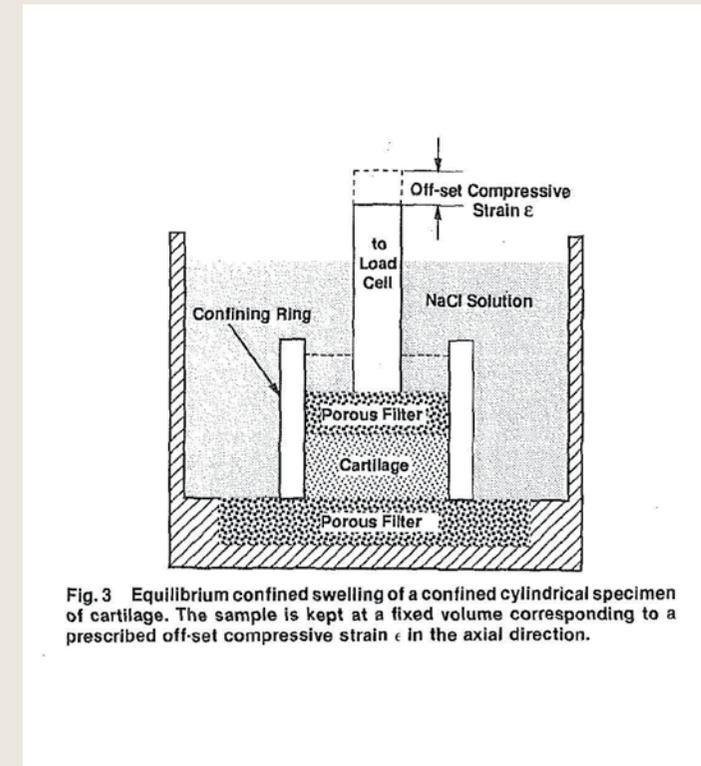
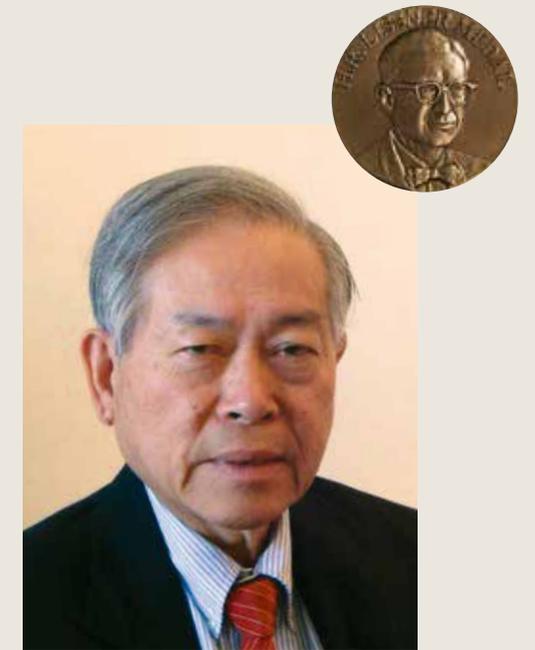


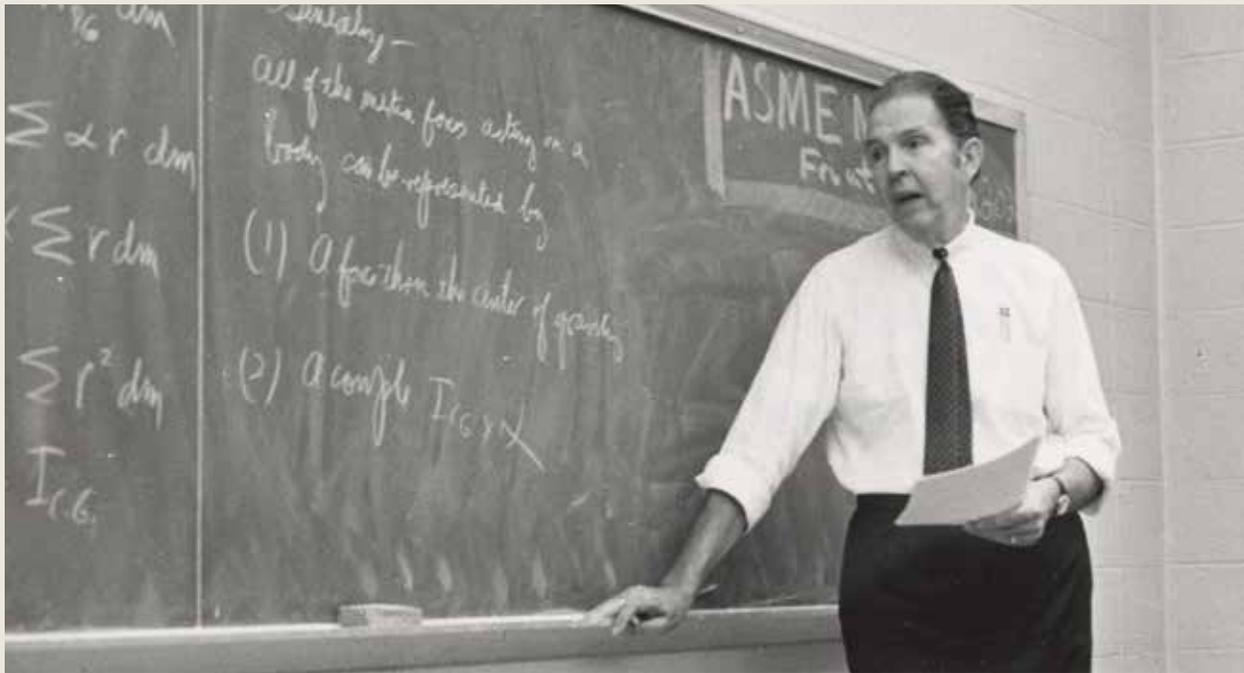
Fig. 3 Equilibrium confined swelling of a confined cylindrical specimen of cartilage. The sample is kept at a fixed volume corresponding to a prescribed off-set compressive strain ϵ in the axial direction.

Courtesy of ASME

1987

W. Michael Lai joins the faculty of Mechanical Engineering and the College of Physicians and Surgeons, going on to formulate triphasic theory for modeling charged hydrated biological tissues and, in 2001, he receives the Lissner Medal from the American Society of Mechanical Engineers (ASME).





1988

Mechanical Engineering Professor Dudley Dean Fuller MS'46, world-renowned tribologist and inventor of the hydrostatic bearing, receives the Franklin Institute Award for his research studying surfaces and fluid lubrication and for establishing tribology as a field. He was previously awarded the ASME Mayo D. Hersey Award in 1971 and the Tribology Gold Medal from the Institution of Mechanical Engineers in 1978.



1988

Professor Gertrude Neumark patents the process of nonequilibrium doping that greatly advances light-emitting and laser diodes, enabling diverse technologies, including sharper laser printers, increased-capacity DVDs, and better display screens.

1989

Professor Kathleen McKeown becomes the first woman to be granted tenure in the School. An expert in computational linguistics, she and her Natural Language Processing Group go on to develop Newsblaster, a system that automatically identifies, sorts, and summarizes the day's top news stories.



1991

The research of Professor Dimitris Anastassiou and doctoral student Fermi Wang PhD'91 forms part of a key MPEG-2 patent that is instrumental in implementing international video standards broadly used in digital video, DVD, and Blu-Ray. In 2013, he wins the SAGE Bionetworks/DREAM Breast Cancer Prognosis Challenge for developing a new computational model that is highly predictive of breast cancer survival.

1992

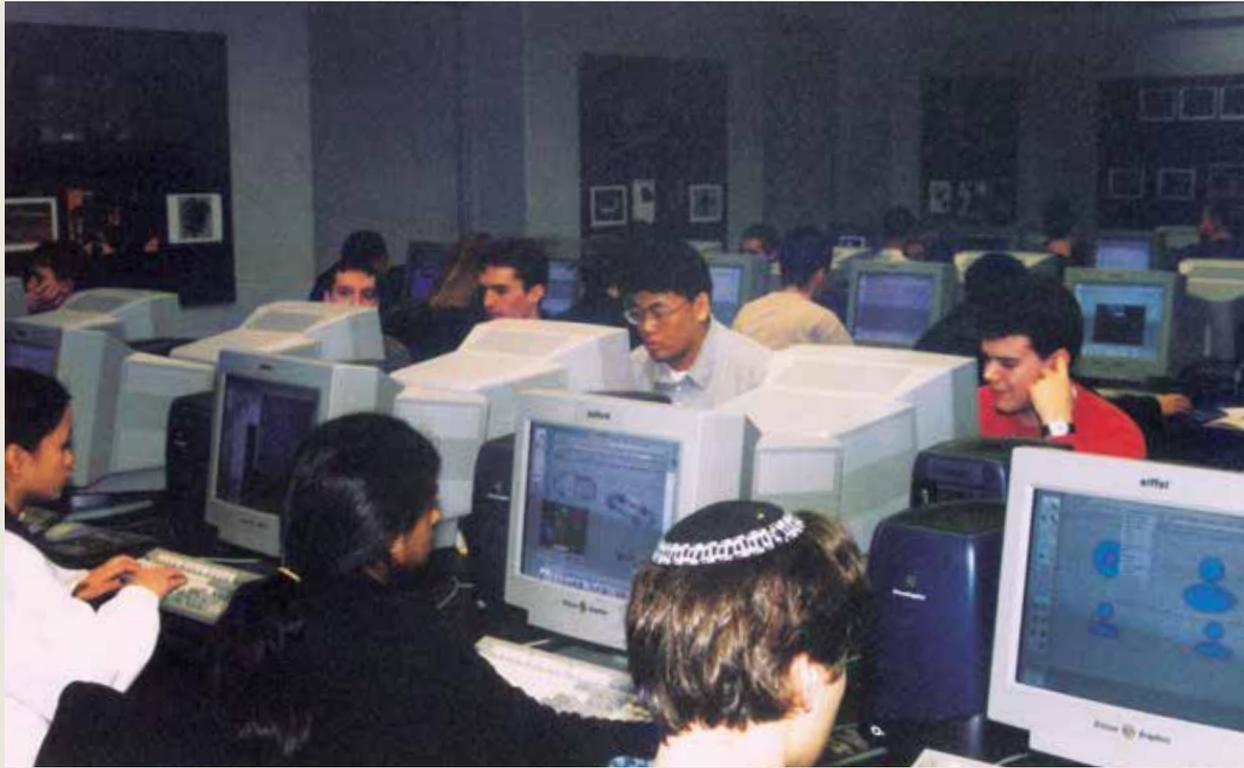
The Morris A. Schapiro Center for Engineering and Physical Science Research (CEPSR) opens, providing new laboratory space and a clean room, with skywalks connecting the new building to the Mudd Building, housing Engineering faculty, and Pupin Hall, housing Department of Physics faculty.



Photos Courtesy of NASA

1992

NASA astronaut Kevin P. Chilton MS'77 pilots the maiden voyage of Space Shuttle *Endeavour*, going on to pilot the Space Radar Laboratory Mission in 1994 and to command the 1996 mission to the Russian space station Mir.



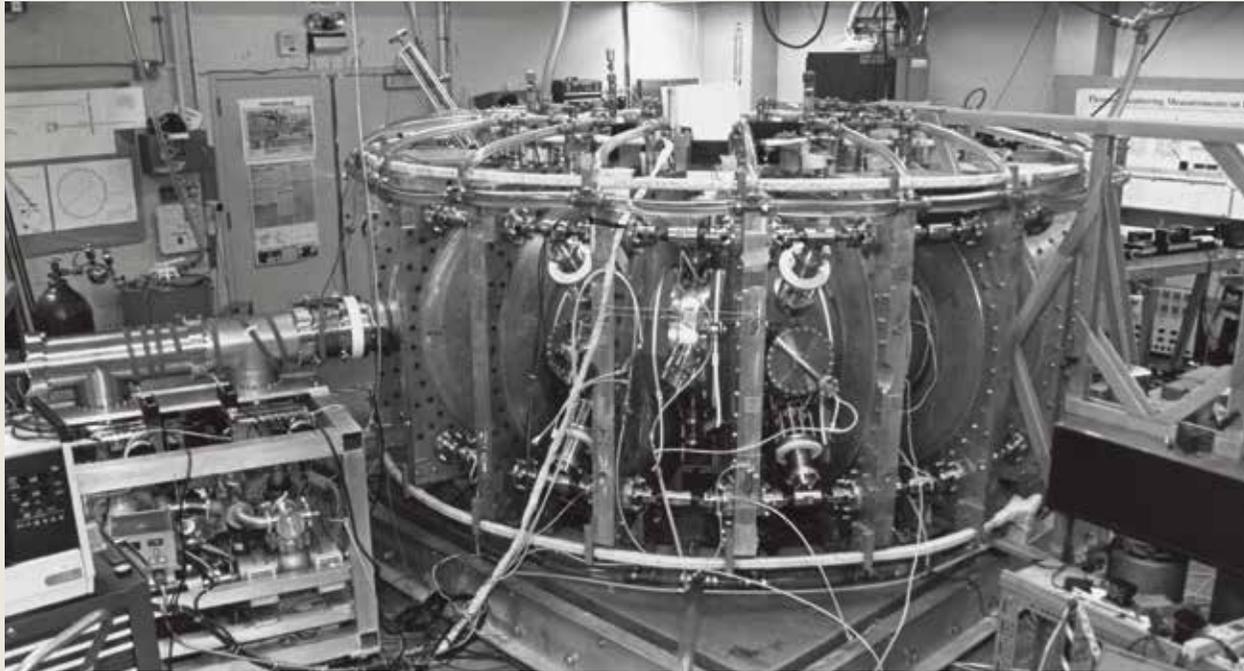
1992

Columbia Engineering becomes part of the National Science Foundation–sponsored Gateway Coalition and develops the first of several new innovative courses designed to introduce first- and second-year students to engineering and applied science.



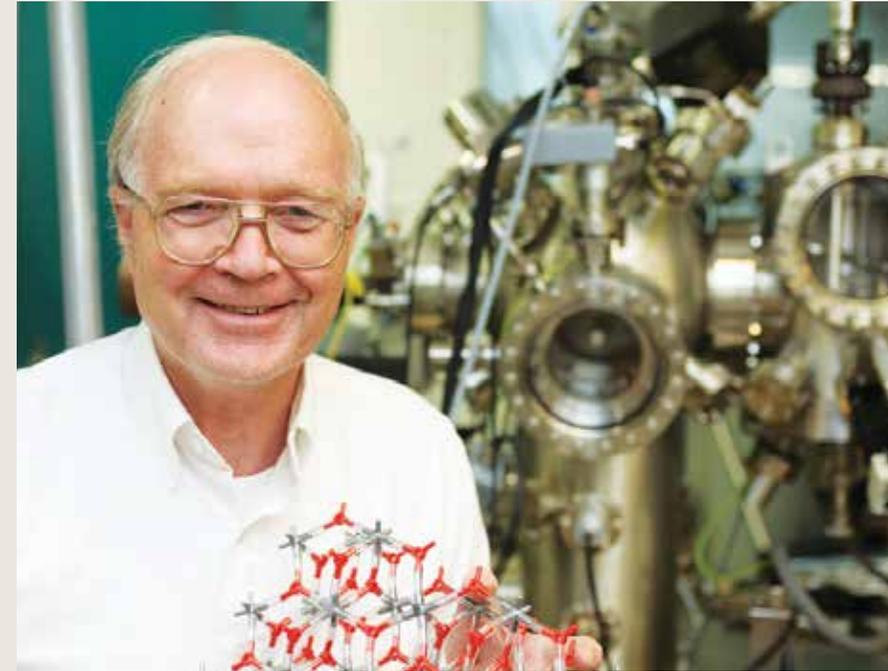
1993

The Center for Applied Probability is launched by IEOR Professors David D. W. Yao and Karl Sigman, with colleagues from the Business School and from Mathematics and Statistics in Arts & Sciences, the first Columbia center to foster collaboration among these disciplines.



1993

Professors Gerald Navratil and Michael Mauel complete the high beta tokamak-extended pulse, the largest of several tokamaks at Columbia, and help demonstrate the first fusion energy production using a deuterium-tritium plasma. In 2002, Professor Navratil brings active feedback stabilization to the General Atomics DIII-D tokamak outside San Diego, a historic leap in fusion energy production that wins the Dawson Prize.

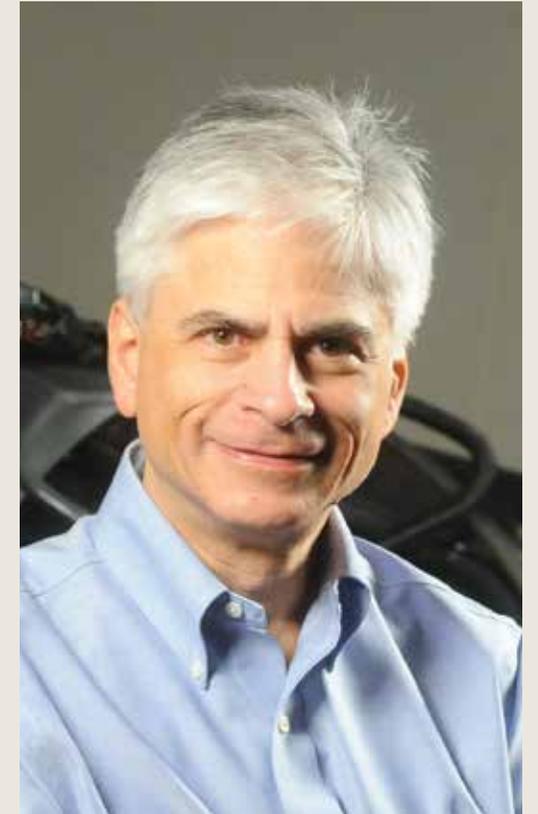
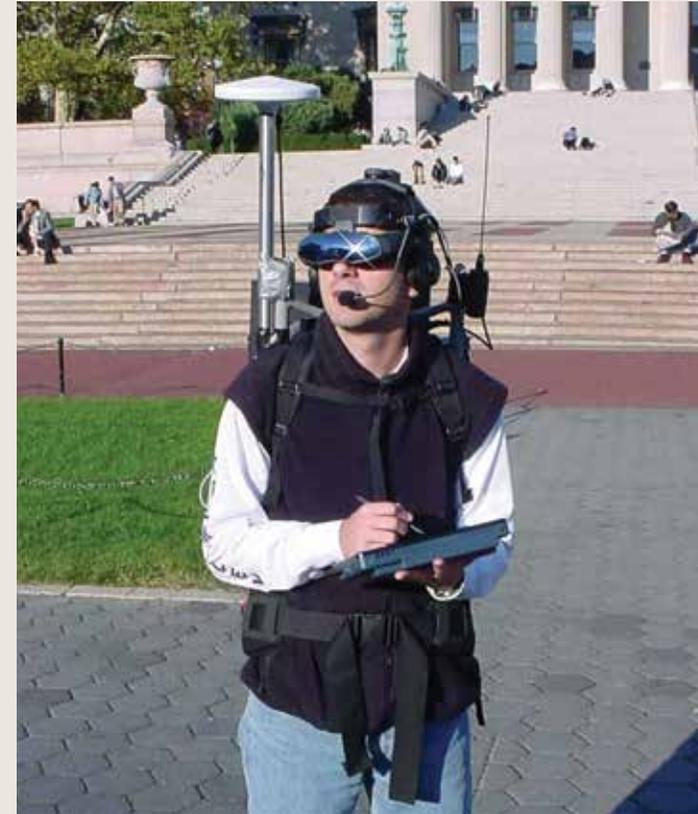


1995

A spinoff from Professor Richard Osgood's lab, RSOFT becomes the gold standard in integrated and nanophotonic simulation tools, and is later purchased by the electronic design software house Synopsis.

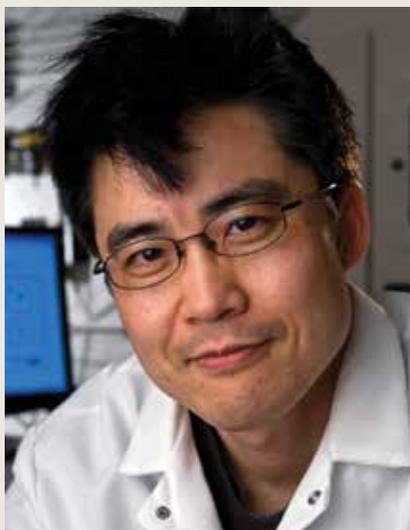
1996

Reinforcing its commitment to the environment, the School of Mines overhauls its curriculum to include an innovative MS program in Earth Resources Engineering and a new undergraduate program in Earth and Environmental Engineering.



1996

Steven Feiner and his lab develop the first outdoor mobile augmented reality system using a see-through, head-worn display, the forerunner of augmented reality apps now ubiquitous on smartphones.



1996

Professor James Im patents a method to produce advanced laser-crystallization of Si films, essential to LCDs and OLEDs, making possible high-resolution screens in products from Samsung, Apple, and others.



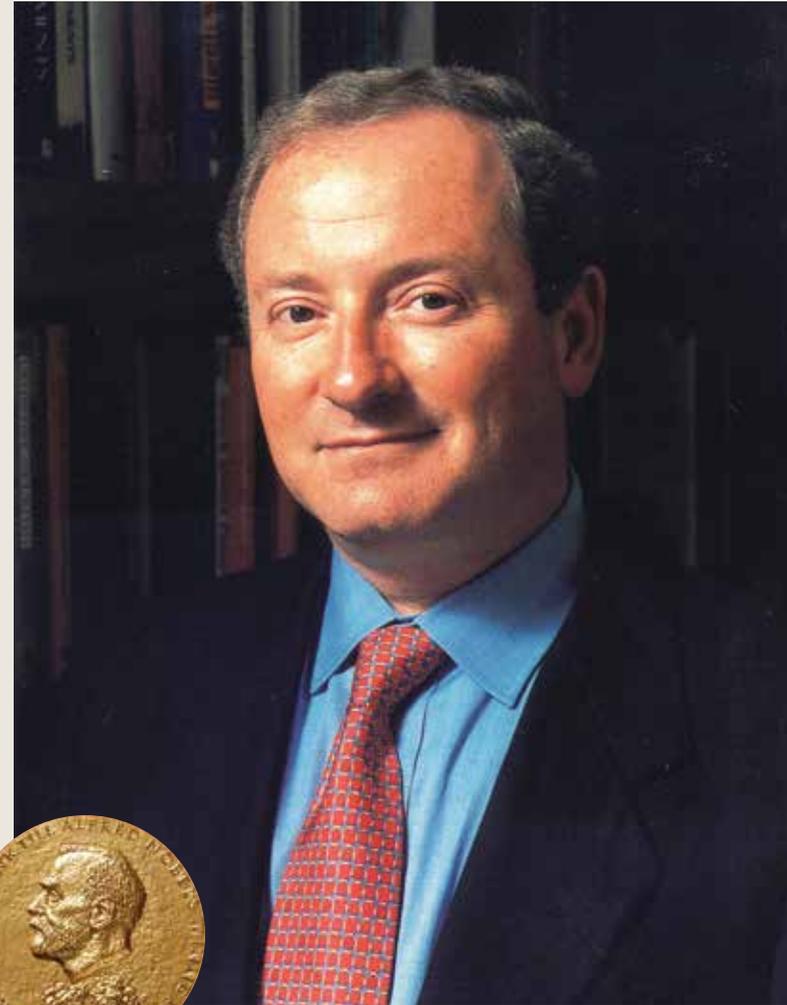
1996

Digital imaging expert Professor Shree Nayar invents the first omnidirectional camera with a single effective center of projection. He is elected to the National Academy of Engineering in 2008, and in 2009, he debuts prototypes of the BigShot camera kit to affordably engage and share science with children in the developing world.



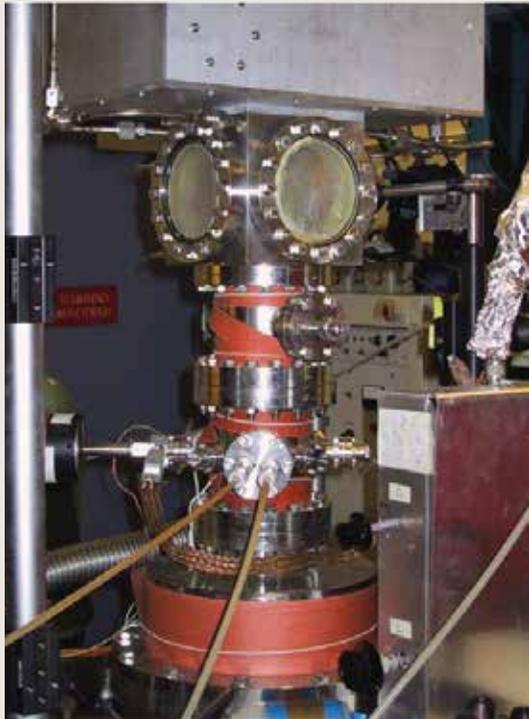
1997

The School celebrates a transformative gift from The Fu Foundation and officially changes its name to The Fu Foundation School of Engineering and Applied Science. Z. Y. Fu and Mrs. Joan Chu Fu are the benefactors supporting this extraordinary gift.



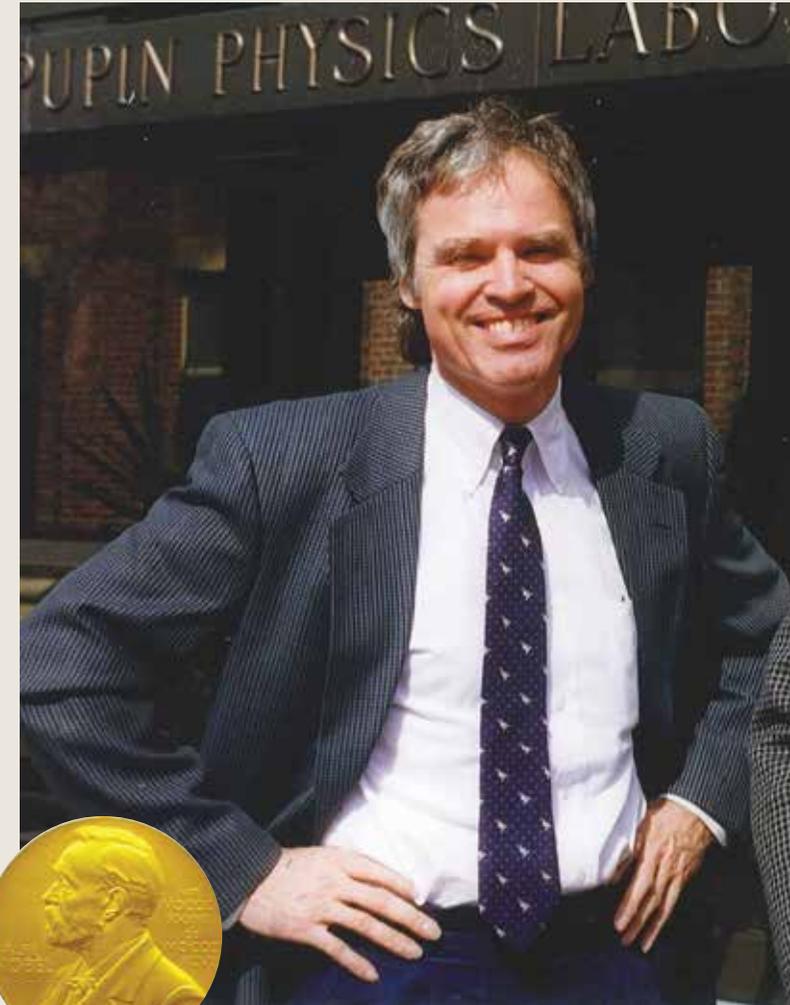
1997

Robert C. Merton BS'66, known for his pioneering contributions to continuous-time finance and for translating finance science into practice, wins the Nobel Prize in Economics for his work in options pricing.



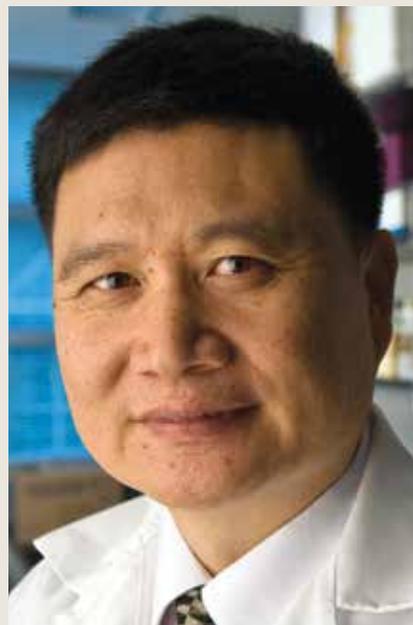
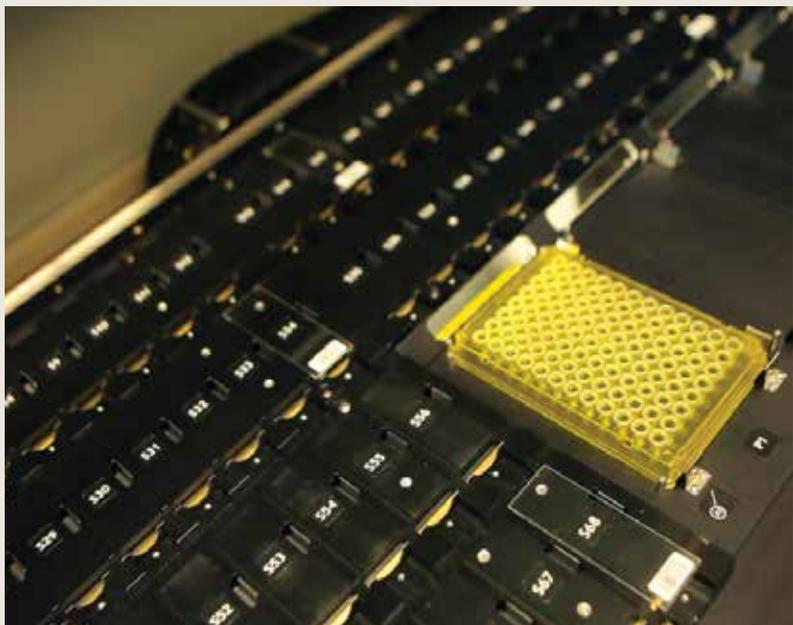
1998

The National Science Foundation establishes the Materials Research Science and Engineering Center on nanostructured materials including nanocrystals, directed by Professor Irving P. Herman of Applied Physics. This helps launch the University effort in nanoscience and nanotechnology, which later extends into major studies of other novel nanomaterials such as graphene.



1998

Professor Horst Störmer wins the 1998 Nobel Prize in Physics for the discovery of a new form of quantum fluid with fractionally charged excitations—the fractional quantum Hall effect. He is elected to the National Academy of Science the following year.



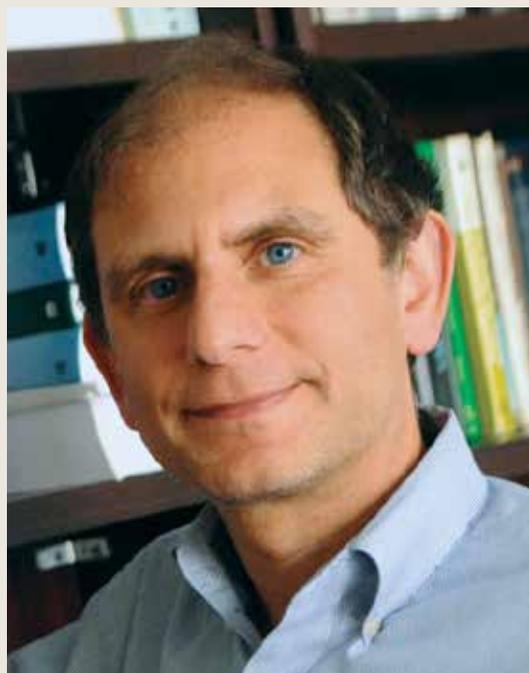
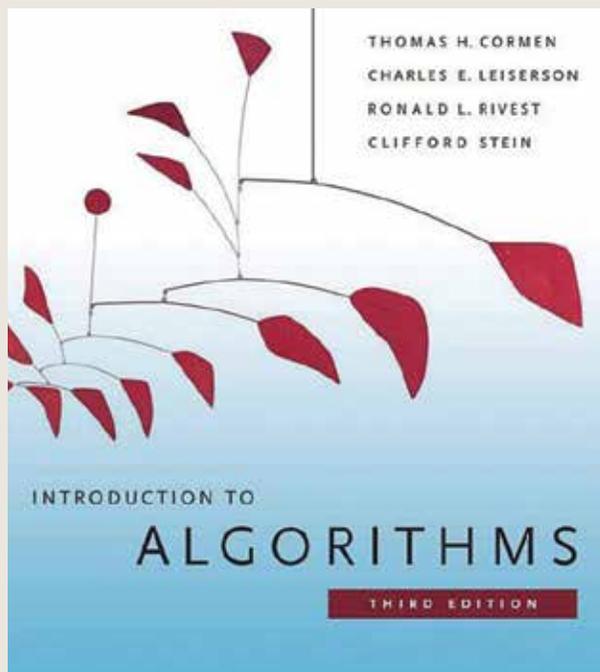
1999

Jingyue Ju joins the Chemical Engineering faculty, developing a four-color DNA sequencing by synthesis platform using cleavable fluorescent nucleotide reversible terminators. His revolutionary technologies make the cost of DNA sequencing significantly more affordable.



1999

Professor Henning Schulzrinne coauthors Session Initiation Protocol (SIP), control protocol for Voice over Internet Protocol (VoIP), now used by nearly all 4G cell phones and IP Private Branch Exchange (PBX) systems, and goes on to serve as chief technology officer of the Federal Communications Commission in 2013.



2001

Clifford Stein becomes the first joint appointment between the Departments of Industrial Engineering and Operations Research (IEOR) and Computer Science. The classic textbook he coauthors, *Introduction to Algorithms*, is translated into 15 languages and goes on to sell more than half a million copies.



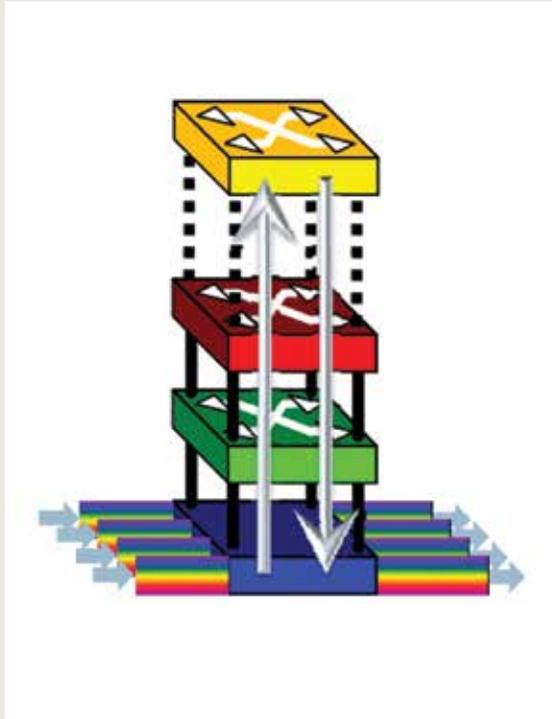
Courtesy of NASA



Photo by Ryan John Lee

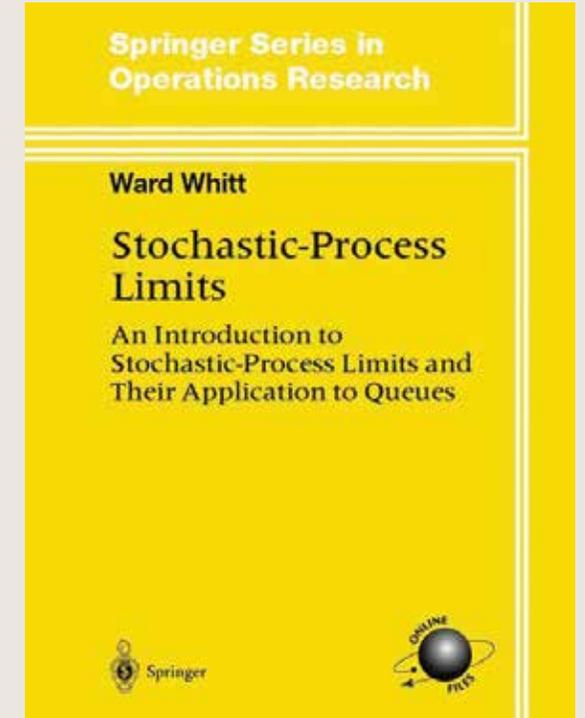
2002

NASA astronaut Michael J. Massimino BS'84 (left in photos) repairs the Hubble Space Telescope, returning in 2009 to make additional repairs. In 2014, he joins the faculty of the Department of Mechanical Engineering as a professor of professional practice. Fellow astronaut Gregory H. Johnson MS'85 pilots the Space Shuttle *Endeavour* in 2008 and again in 2011, its last mission and the penultimate mission of NASA's space shuttle program.



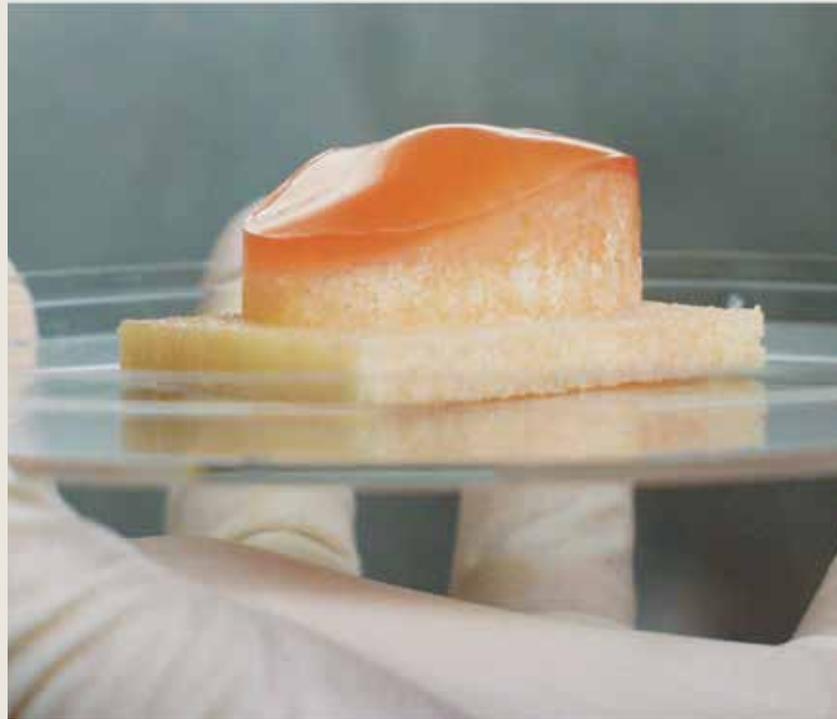
2002

Professor Keren Bergman, an expert on optical interconnection networks for advanced computing, founds the Lightwave Research Laboratory and begins developing a new class of nanoscale photonic interconnect technologies that enable high-performance interconnects for communicating massive volumes of information at nearly the speed of light.



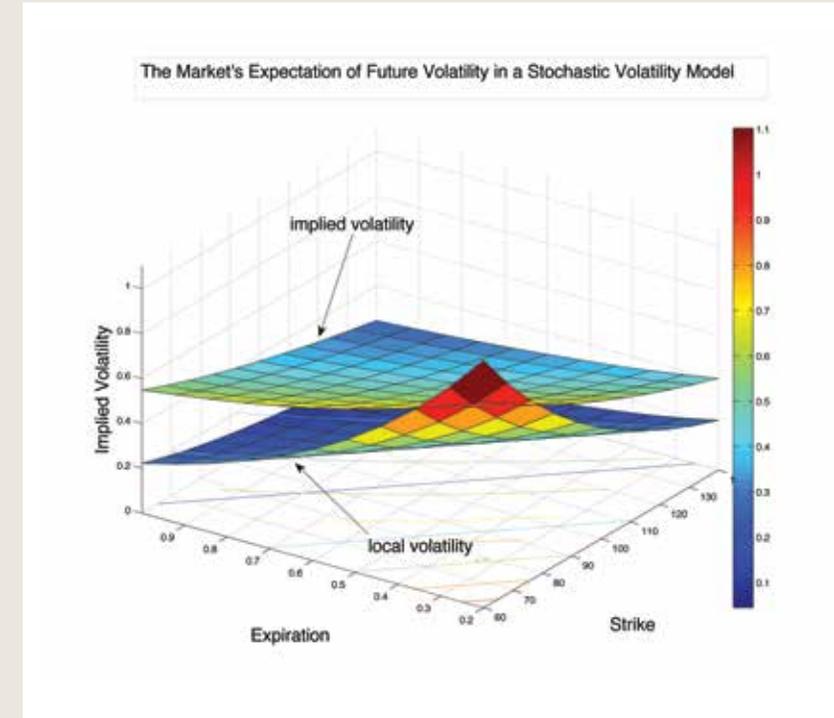
2002

Professor Ward Whitt of the Department of Industrial Engineering and Operations Research, a member of the National Academy of Engineering, publishes *Stochastic-Process Limits: An Introduction to Stochastic-Process Limits and Their Application to Queues*, for which he receives the Frederick W. Lanchester Prize from Institute for Operations Research and the Management Sciences (INFORMS).



2003

Professor Gerard Ateshian BS'86, MS'87, PhD'91, director of the Musculoskeletal Biomechanics Laboratory, is successful in engineering the first human patella tissue construct—in collaboration with Professor Clark Hung—and is elected a fellow of the American Institute for Medical and Biological Engineering (AIMBE).

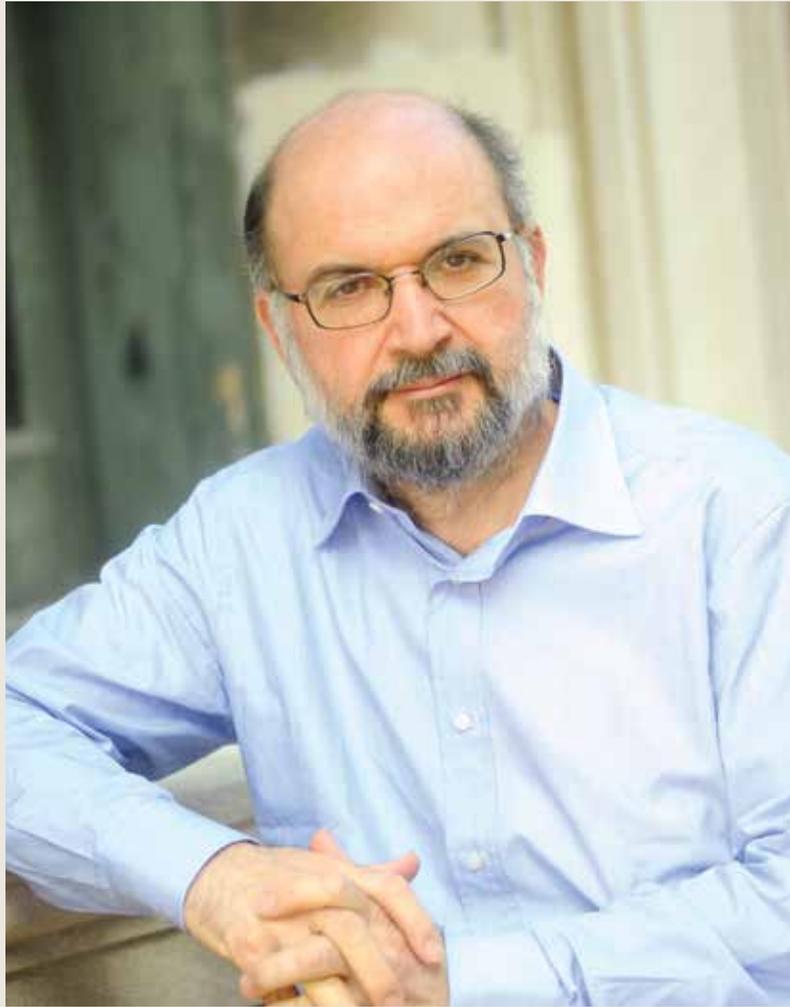


2003

Emanuel Derman, co-inventor of the Black-Derman-Toy interest rate model and a principal at Goldman Sachs, joins the Department of Industrial Engineering and Operations Research. He goes on to help lead the Financial Engineering Program and the Center for Financial Engineering.

2005

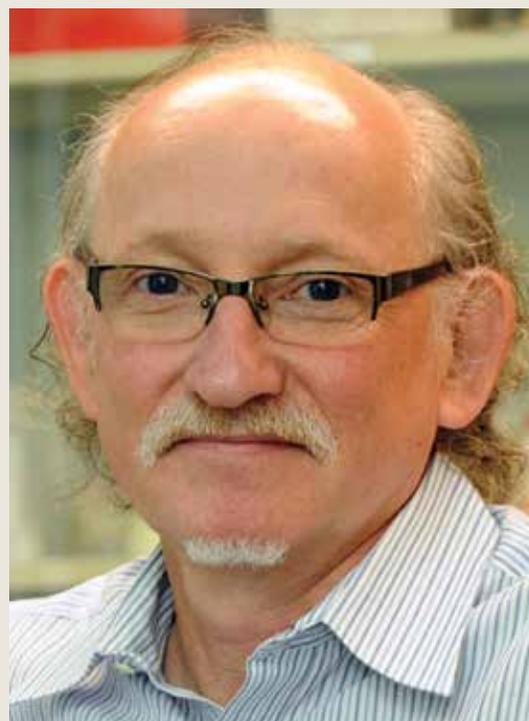
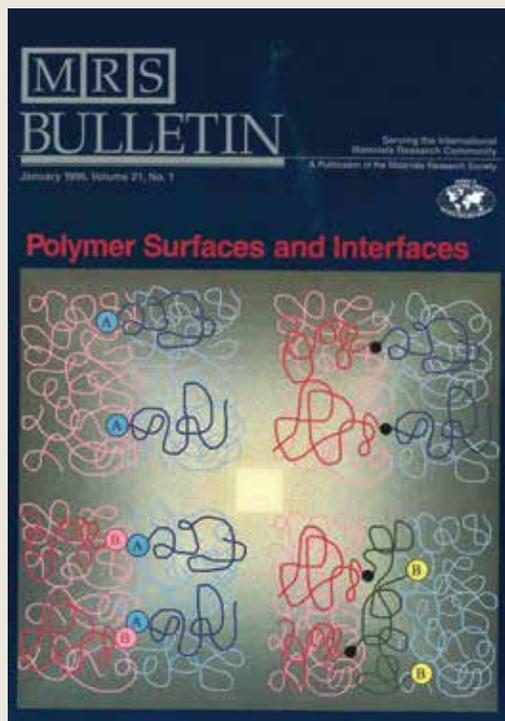
Computer Science Professor Mihalis Yannakakis wins the Knuth Prize “for the significance, impact, and astonishing breadth of his contributions to theoretical computer science,” including major contributions to computational complexity theory, database theory, algorithmic graph theory, and computer-aided verification and testing. In 2011, he is elected a member of the National Academy of Engineering.



2006

Computer Science Professor Xi Chen and collaborators settle the long-standing open problem of the complexity of two-player Nash equilibria, the central solution concept in game theory.





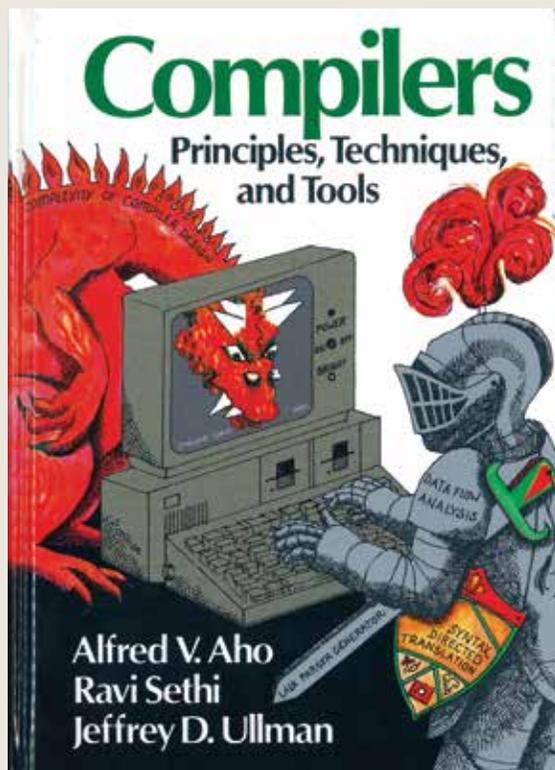
2006

Jeffrey Koberstein, an expert on interfacial and surface properties of polymers and biological materials, is recognized for his outstanding contributions to the field of materials science and engineering by the American Institute of Chemical Engineers (AIChE), which honors him with the Charles M. A. Stine Award.



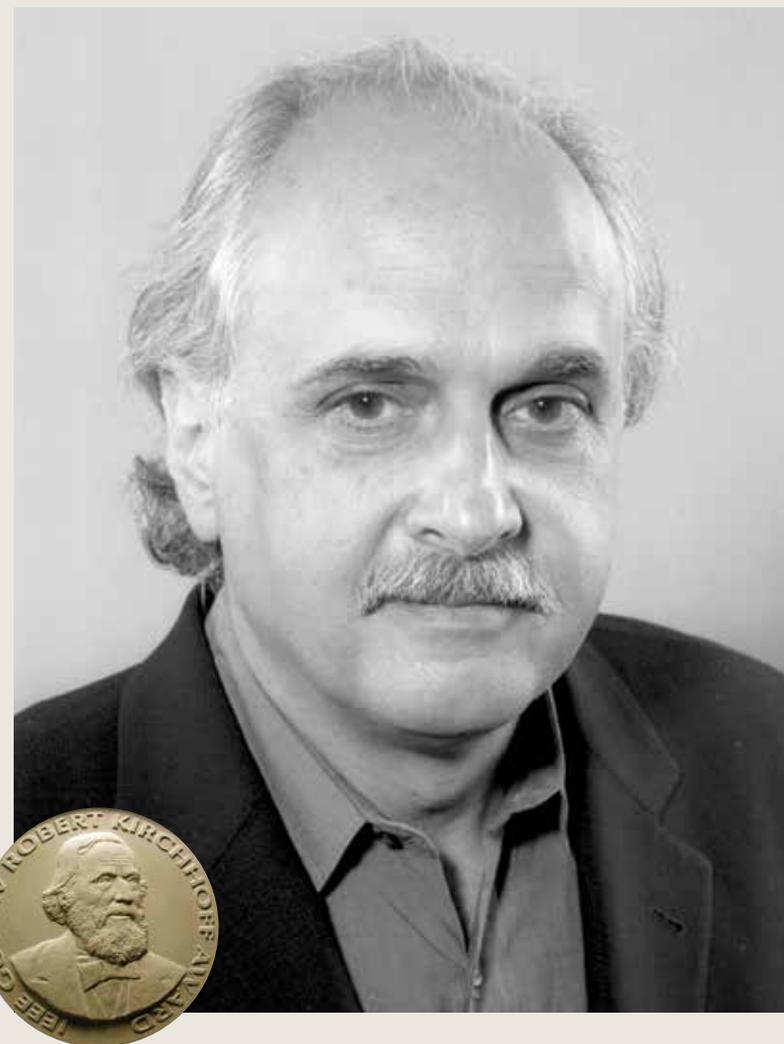
2006

Professor Paul Sajda develops cortically coupled computer vision technology (C3Vision) that links computer vision with human vision, enabling real-time decoding of EEG recognition responses within a few hundredths of a millisecond as the user views rapid serial images.



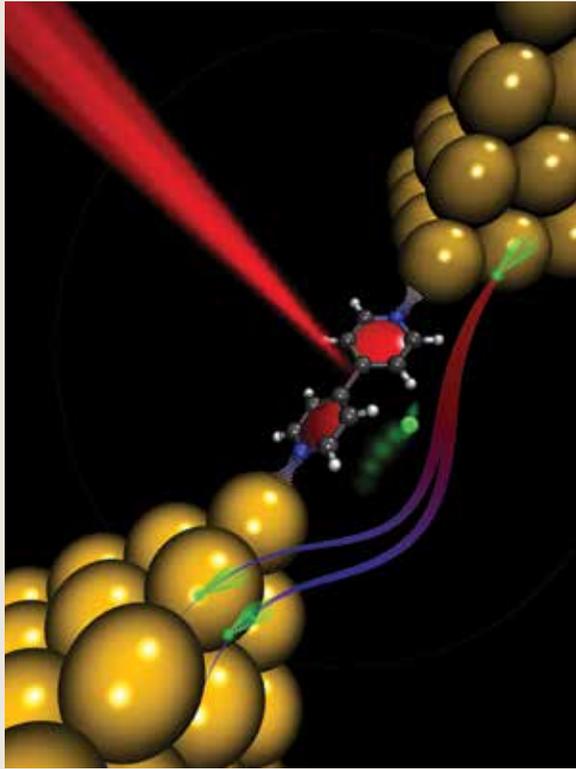
2007

Gussman Professor of Computer Science Al Aho, a member of the National Academy of Engineering, coauthors the second edition of *Compilers: Principles, Techniques, and Tools*, the most cited text on transforming program source code to a lower level representation in which it can be efficiently run.



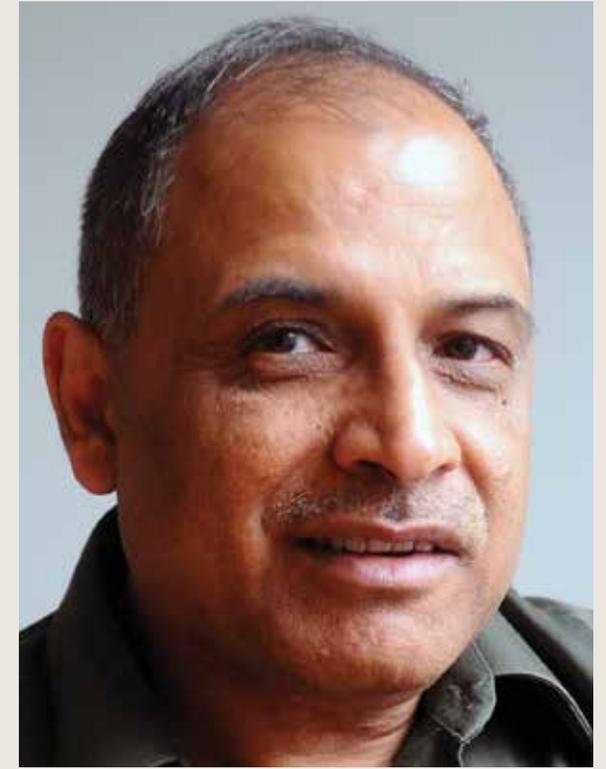
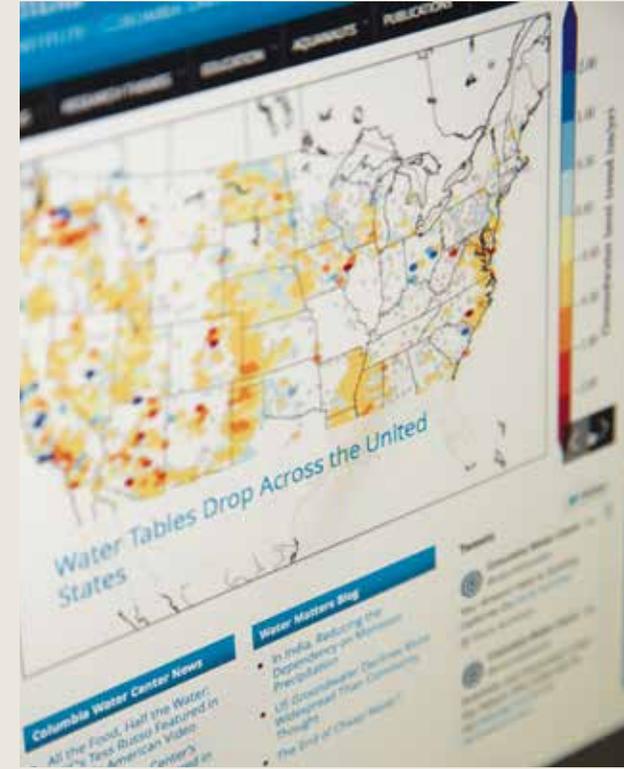
2007

Batchelor Professor of Electrical Engineering Yannis Tsvividis, an authority on analog and mixed-signal integrated circuits, is honored by IEEE with the Gustav Robert Kirchhoff Award, given annually “for outstanding contributions to the fundamentals of any aspect of electronic circuits and systems that has a long-term significance or impact.”



2007

Applied Physics Professor Latha Venkataraman measures how electronic conduction and single bond breaking forces in single-molecule devices relate to molecular structure as well as to metal contacts and linking bonds, laying the groundwork for technological advances at the nanometer scale.

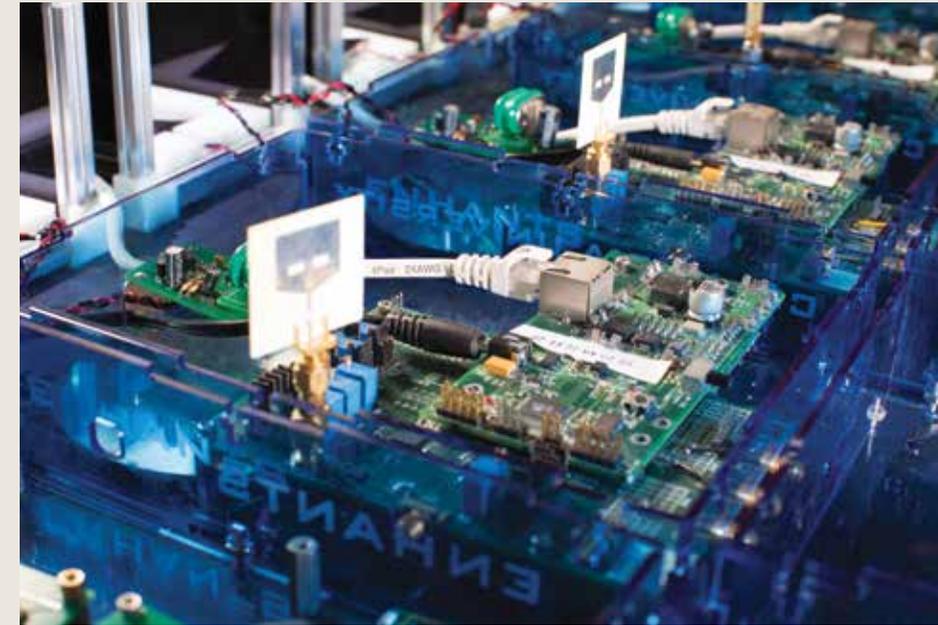
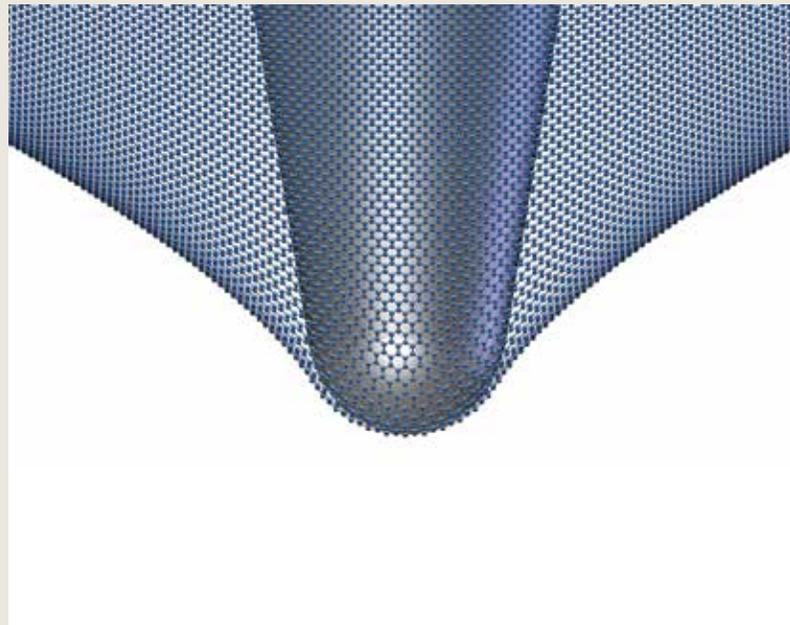


2008

The Columbia Water Center is founded, an interdisciplinary initiative aimed at managing the global crisis of freshwater scarcity, with hydrology and sustainability expert Upmanu Lall as founding director.

2008

A team, led by Professors James C. Hone (left) and Jeffrey W. Kysar (center), proves that graphene, an atomically thin carbon layer, is the strongest material ever measured. The team continues their groundbreaking work on graphene and, in 2013, with Professor Ken Shepard (right), they create the world's smallest FM radio transmitter.



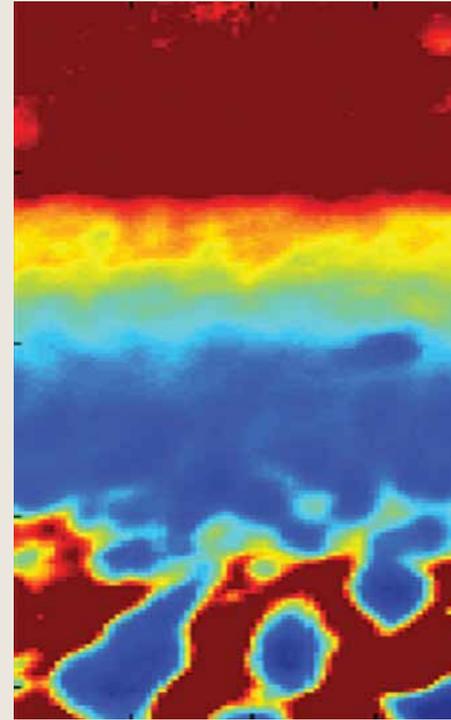
2009

The Energy Harvesting Active Networked Tags (EnHANTs) project developed by Electrical Engineering Professors Peter Kinget, Ioannis (John) Kymissis, Xioadong Wang, and Gil Zussman, and Computer Science Professor Dan Rubenstein, to enable the Internet of Things by providing infrastructure for novel tracking applications, wins the Vodafone Americas Foundations Wireless Innovation competition and, in 2011, receives the IEEE Communications Society Award for Advances in Communication.



2009

Ewing-Worzel Professor Klaus Lackner, a pioneer in the fields of sustainable energy and carbon management, develops a new technology, an air extractor, which mimics the carbon-dioxide-capturing features of the leaf of a tree. His artificial leaves on simulated “trees” capture atmospheric CO₂ and hold the promise of significantly reducing greenhouse gas pollution.



2009

Biomedical Engineering Professor Helen H. Lu receives the National Science Foundation PECASE Award for developing novel “scaffolding” to grow three different tissue types—ligament, fibrocartilage, and bone—within one functional, biodegradable and biocompatible system for orthopedic and reconstructive surgery that ultimately will be replaced by living tissue and become part of the body.



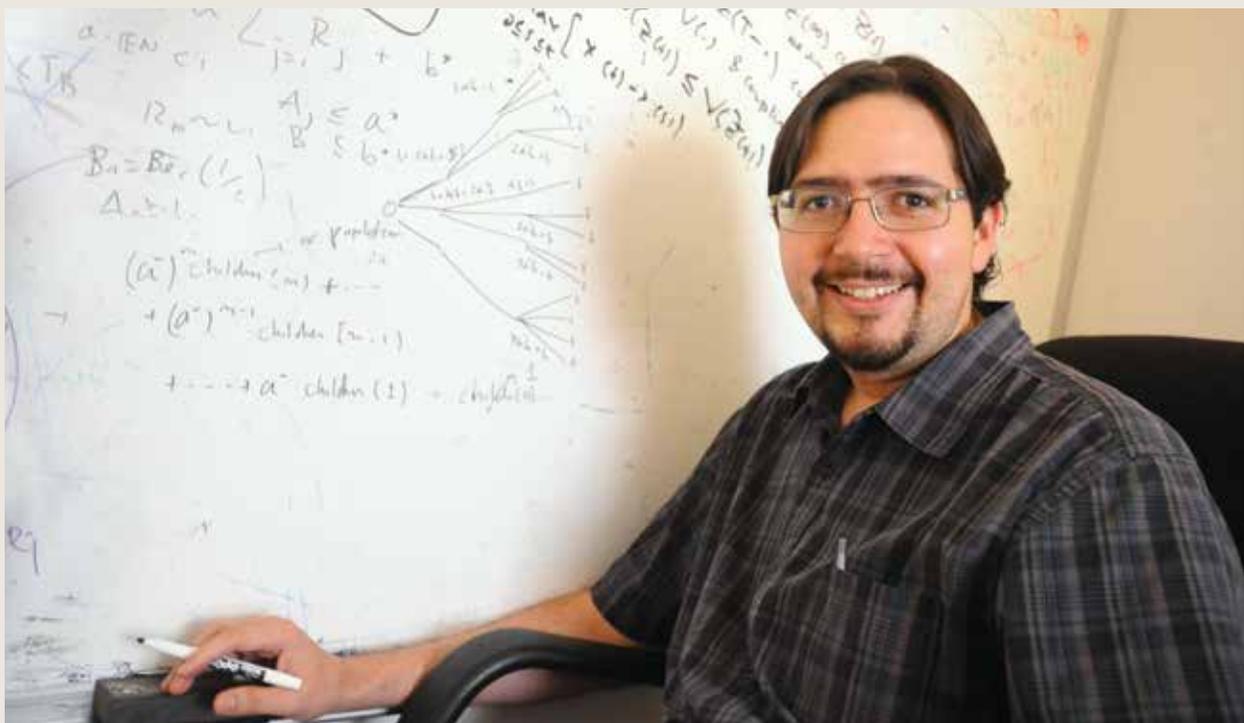
2009

As part of the United Nations Millennium Villages project, Professor Vijay Modi and his research group bring electricity to rural villages in Africa using solar-powered micro-grids with prepaid metering, a system that holds the promise of providing pay-as-you-go electricity for the more than 1.3 billion people in the developing world without access to electricity.



2010

The new Northwest Corner Building opens, serving as a physical and intellectual bridge, linking laboratories and maximizing the ready sharing and exchange of ideas. The building provides research and education space for 250 to 300 interdisciplinary faculty and students in 21 laboratories.



2010

Professor Jose Blanchet, an expert in applied probability and Monte Carlo systems, wins the Erlang Prize in applied probability from the Institute for Operations Research and the Management Sciences (INFORMS).



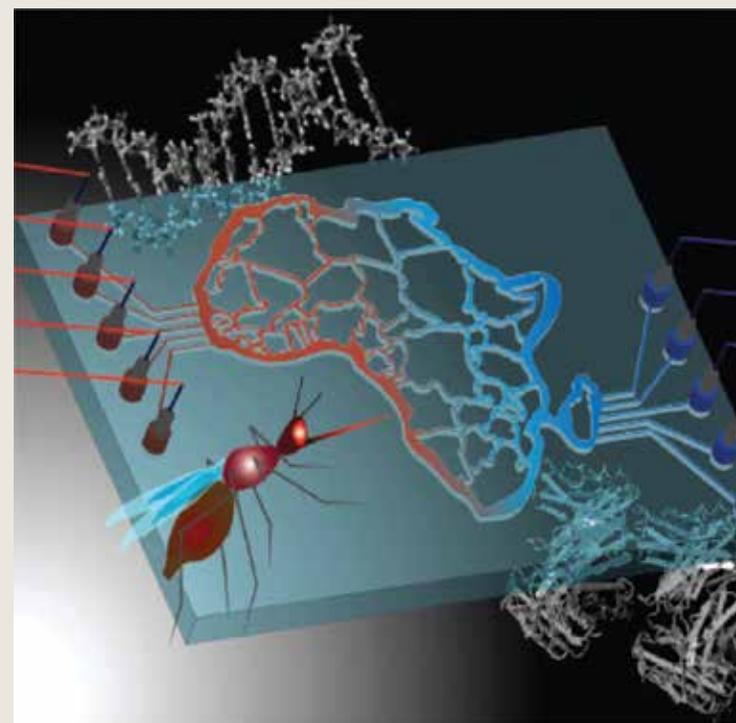
2010

Professor Frank L. DiMaggio BS'50, MS'51, PhD'54 (far right) receives the Raymond D. Mindlin Medal of the American Society of Civil Engineers (ASCE) for his lifetime contributions to the field of constitutive modeling of geomaterials, including developing the CAP model for inelastic constitutive behavior of soils under blast loading.



2010

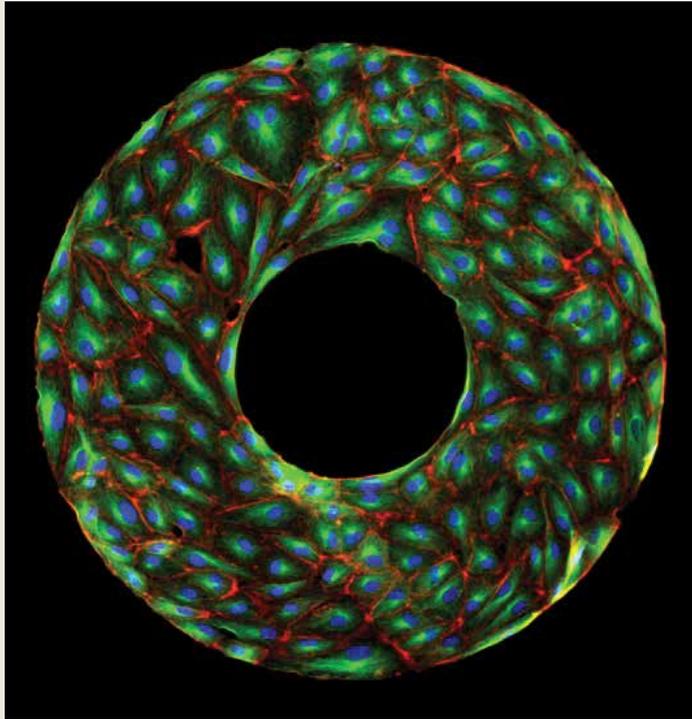
By magnetically levitating a million-ampere superconducting current ring for several hours, Professor Michael Mauel and colleagues demonstrate that plasma physics of planetary magnetospheres can be reproduced in laboratories.



2010

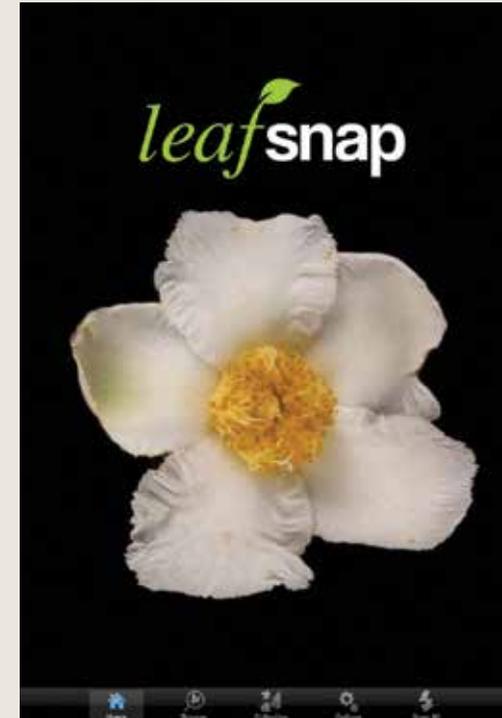
Professor Sam Sia develops a tiny “lab on a chip” that quickly and inexpensively diagnoses HIV and other diseases, producing results in 15 minutes. It is the first rapid HIV test that uses cell phone network or satellite connectivity to automatically synchronize test results with patient health records anywhere in the world, earning him a place as one of *MIT Technology Review*’s “35 Under 35.”





2010

Professor Gordana Vunjak-Novakovic develops a bioreactor system that uses stem cells to grow new bones in the anatomical shape of the original. She goes on to become the first woman at Columbia to be elected to the National Academy of Engineering and, in 2014, is elected to the Institute of Medicine (IOM) of the National Academies.



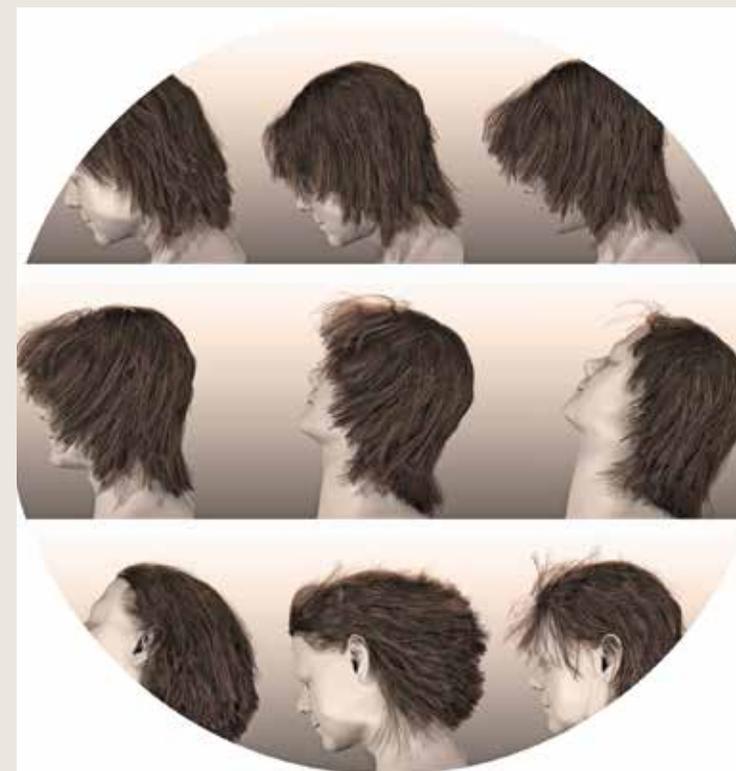
2011

Professor Peter Belhumeur leads the team that creates the award-winning software application *Leafsnap*, the first electronic field guide with visual recognition, downloaded more than a million times to explore flora of New York City and Washington, D.C. He later develops *Birdsnap*, an electronic field guide to birds.



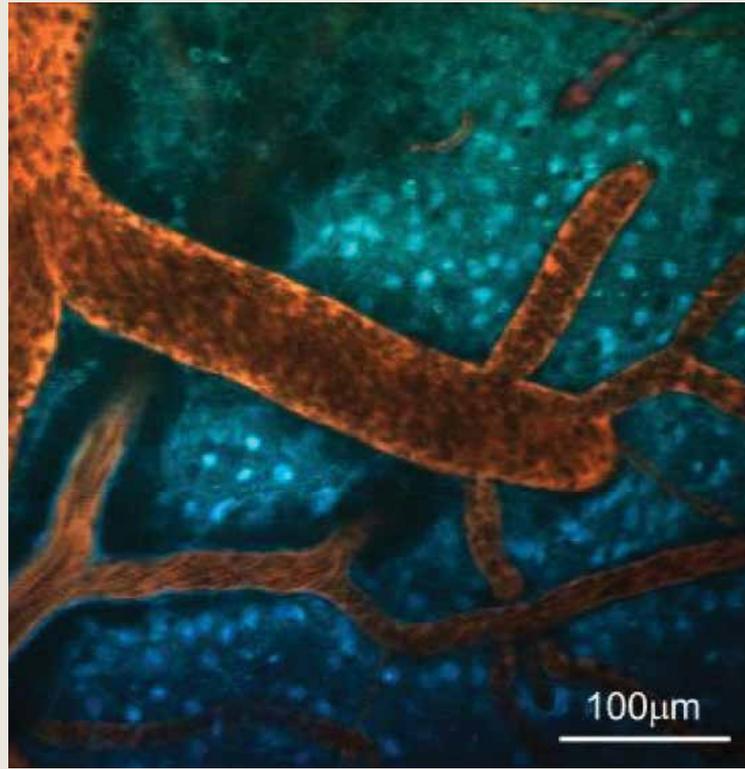
2011

Shih-Fu Chang, Richard Dicker Professor of Telecommunications, is honored by IEEE with its Technical Achievement Award for his pioneering contributions to the field of multimedia analysis and for developing foundational systems of image search.



2011

Professor Eitan Grinspun, head of the Columbia Computer Graphics Group, develops the nascent field of discrete differential geometry (DDG), creating algorithms that provide realistic animation later used in Hollywood blockbusters such as *Frozen* and *The Hobbit*.



2011

Professor Elizabeth Hillman receives the Adolph Lomb Medal for Young Investigators from the Optical Society of America for her research into in vivo optical imaging and microscopy techniques that enable her to study neural activity and blood flow in the living brain.



2011

Professor Julia Hirschberg is awarded the IEEE James L. Flanagan Speech and Audio Processing Award for pioneering contributions to speech synthesis and prosody research. She is cited as one of the architects of the Tone and Break Indices (ToBI) system for labeling human prosodic contours and for innovations in emotional and deceptive speech.

2011

Professor Lorenzo Polvani shows the first link between ozone depletion and climate change in the Southern Hemisphere, which follows his 2008 study suggesting that winds in the Southern Hemisphere will be greatly impacted by the projected recovery of the ozone hole in the latter 21st century.



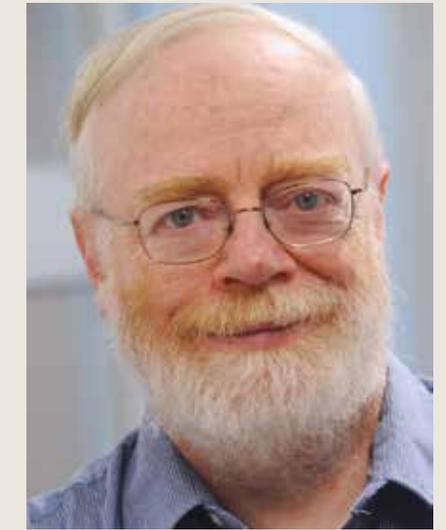
2012

Columbia Engineering, with support from New York City, establishes the University's Institute for Data Sciences and Engineering. Centered around six key sectors—smart cities, new media, health analytics, financial analytics, cybersecurity, and foundations of data science—Institute faculty from Engineering and eight other schools engage in pan-disciplinary data science research and educate tomorrow's data scientists. In 2014, it becomes the Data Science Institute.



2012

Professor Peter K. Allen and colleagues license their Insertable Robotic Effector Platform surgery system, a surgical platform for minimally invasive surgery that incorporates a camera between two robotic surgical arms, replicating human vision, so the surgeon is able to see the operating field as well as if it were a traditional open surgery.



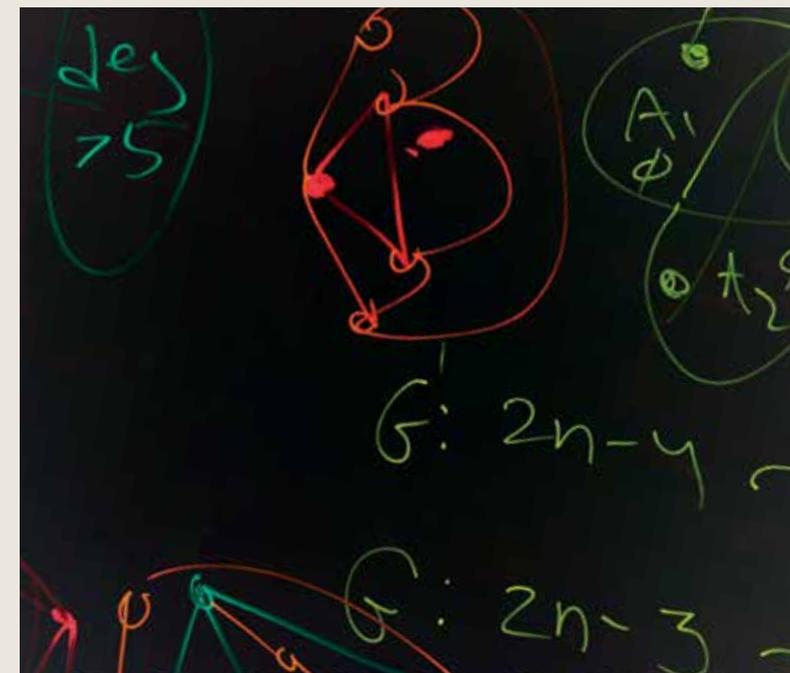
2012

Internet security expert Professor Steve Bellovin '72CC, a member of the National Academy of Engineering and coauthor of one of the first books on Internet security, is appointed chief technologist of the Federal Trade Commission and, in 2014, is elected to the National Cyber Security Hall of Fame.



2012

Professor Jingguang Chen, a pioneer in the development and utilization of synchrotron techniques for catalysis studies under in situ reaction conditions, cofounds the Synchrotron Catalysis Consortium at Brookhaven National Laboratories.



2012

Professor Maria Chudnovsky of the Department of Industrial Engineering and Operations Research receives the prestigious MacArthur “Genius” Fellowship for significant contributions to the field of discrete mathematics, and especially to graph theory. As a doctoral student, she was part of a team of four researchers that proved the “strong perfect graph theorem” and now is considered among the top 10 researchers in graph theory today.

2012

Biomedical Engineering Professor Elisa Konofagou designs a method using focused ultrasound in conjunction with microbubbles to safely and noninvasively penetrate the blood-brain barrier, delivering drugs to regions of the brain affected by diseases such as Alzheimer's, Parkinson's, ALS, and epilepsy.

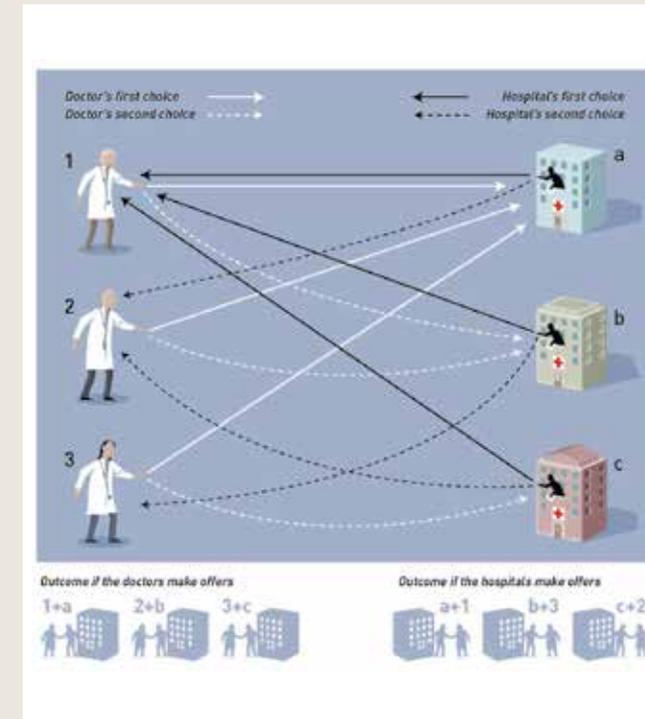
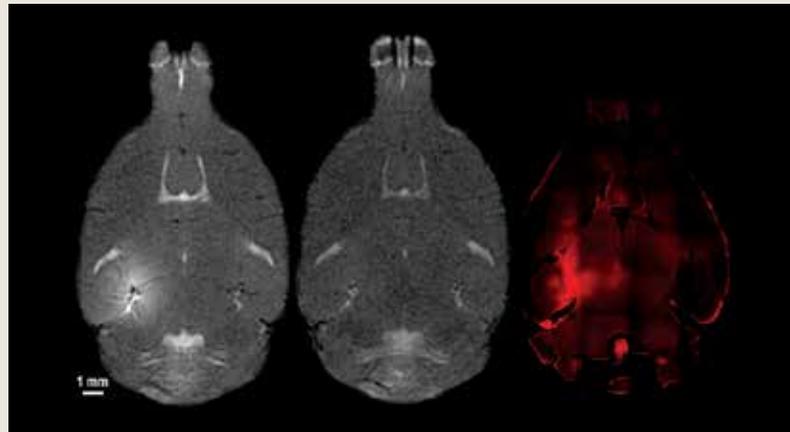
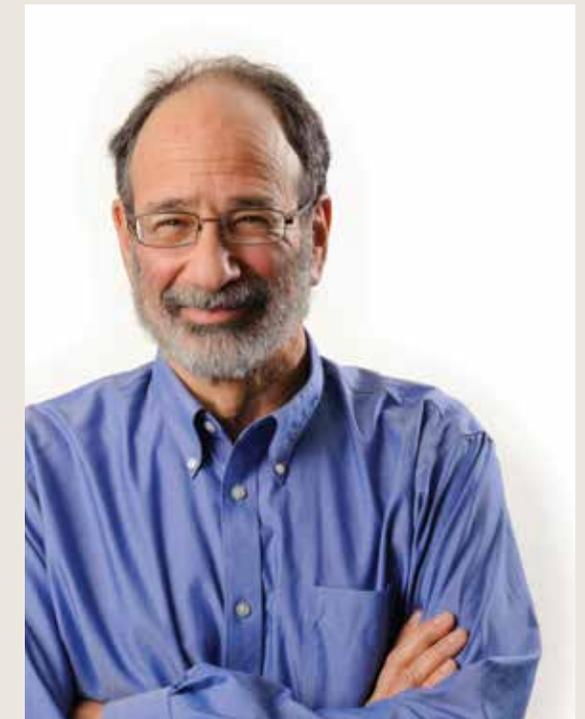
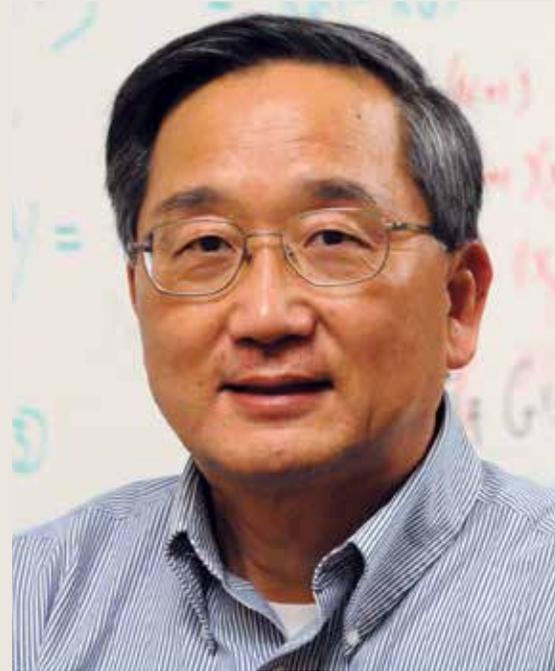


Illustration: © Johan Jarnestad/The Royal Swedish Academy of Sciences
Source: <http://Nobelprize.org>



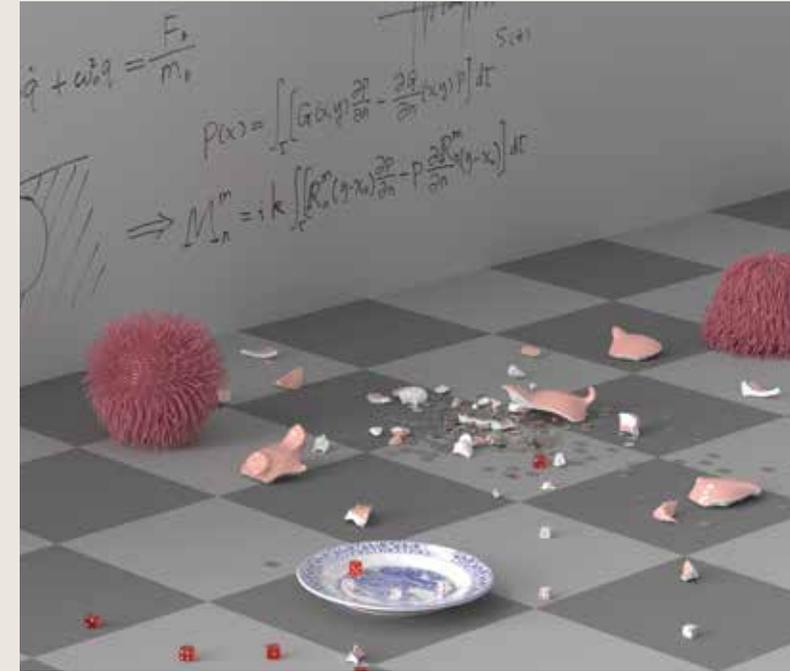
2012

Alvin E. Roth BS'71, known for his pioneering work in the practical design of market institutions, receives the Nobel Prize in Economics for the theory of stable allocations and the practice of market design.



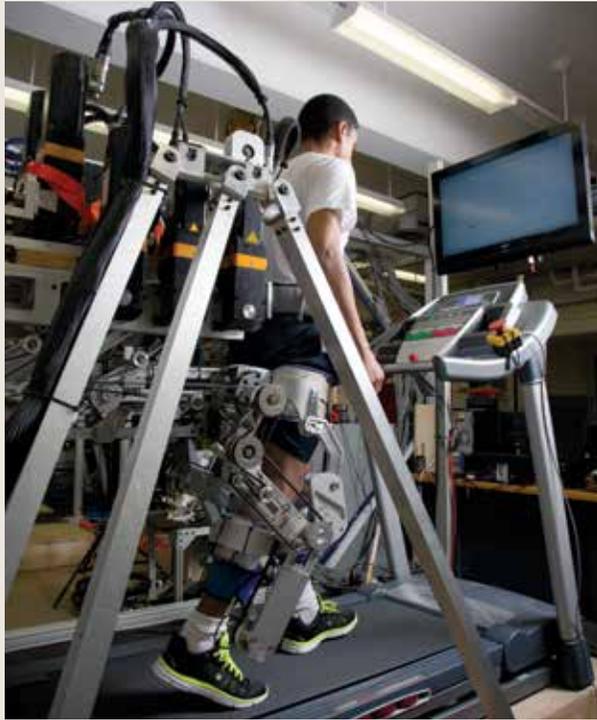
2012

Professors Venkat Venkatasubramanian (left) and David Yao (right) found Columbia's transdisciplinary Center for the Management of Systemic Risk, with researchers from Engineering, the Business School, Mailman School of Public Health, School of International and Public Affairs, Earth Institute, Journalism, and Sociology, working to understand the fundamental mechanisms behind systemic failures in the domains of finance, energy and environment, infrastructure, and public health.



2012

Professor Changxi Zheng develops Precomputed Acceleration Noise that accurately estimates sound due to arbitrary rigid-body accelerations, significantly complementing the standard modal sound algorithm, especially for small objects, and is named one of *Forbes* "30 under 30" for his algorithms.



Photos by Jeffrey Schiffman

2013

Mechanical Engineering Professor Sunil K. Agrawal founds the Robotics and Rehabilitation (ROAR) laboratory, designing intelligent machines, such as robotic exoskeletons, to help in rehabilitation of stroke victims and in keeping people with debilitating motor functions, such as cerebral palsy, safely mobile at home.



2013

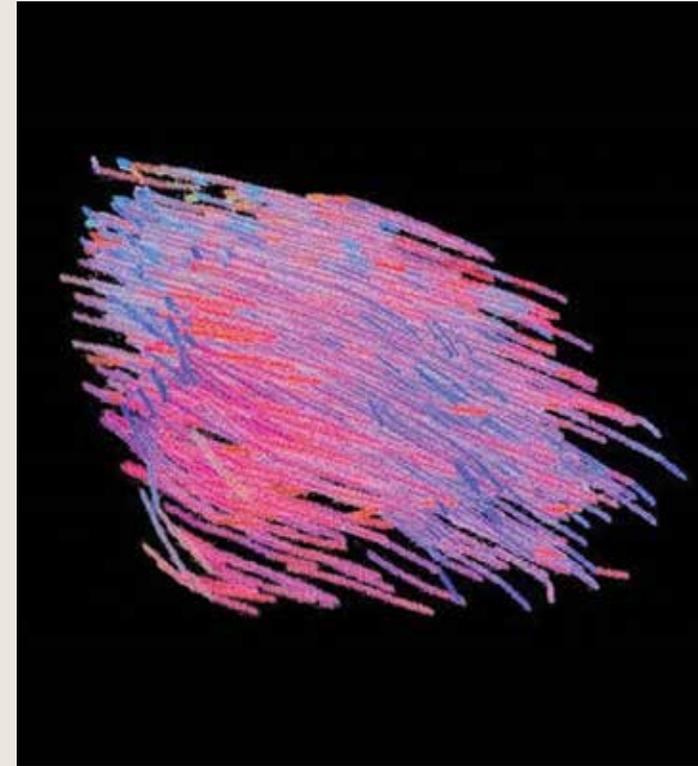
Carleton Professor Jacob Fish forms a new interdisciplinary Multiscale Science and Engineering Center with colleagues from NYU and CCNY to develop the basic science needed to revolutionize engineering practice and scientific discovery, and publishes *Practical Multiscaling*, drawing on his expertise as a pioneer in this emerging field.

2013

Avanessians Professor Donald R. Goldfarb wins the Khachiyan Prize of the INFORMS Optimization Society for lifetime achievements in the field of optimization. He is co-inventor of the BFGS algorithm for solving nonlinear optimization problems and an expert in network flows.

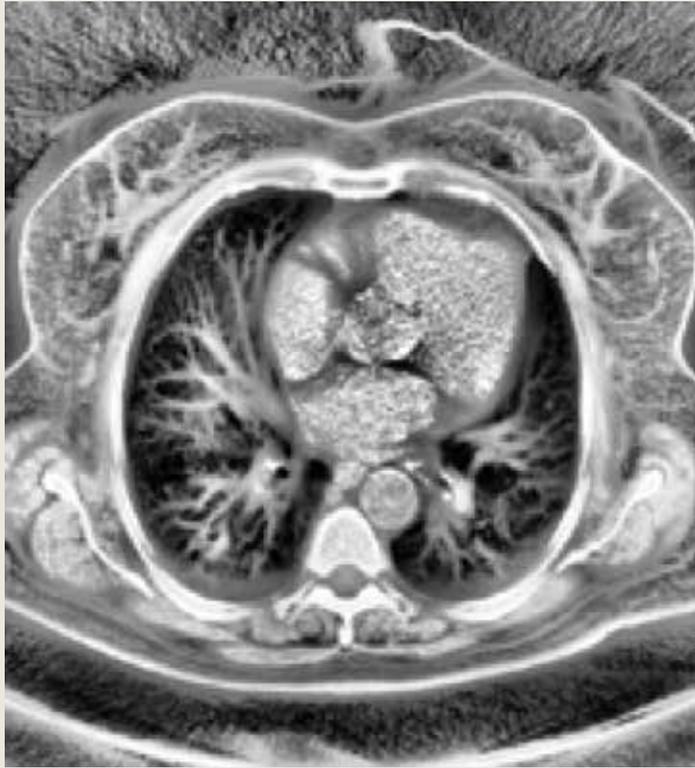


$$B_k p_k = -\nabla f(x_k)$$
$$B_{k+1} = B_k + \frac{Y_k Y_k^T}{Y_k^T s_k} - \frac{B_k s_k s_k^T B_k}{s_k^T B_k s_k}$$



2013

Electrical Engineering Professor Christine Hendon, who is developing high-resolution optical imaging systems and real-time image analysis to improve therapy for heart disease, is selected one of *MIT Technology Review's* "35 Innovators Under 35."



2013

Professor Andrew F. Laine, a pioneer in sophisticated wavelet analysis of medical images and chair of the Department of Biomedical Engineering, is elected president of IEEE's Engineering in Medicine and Biology Society, the world's largest organization of biomedical engineers.



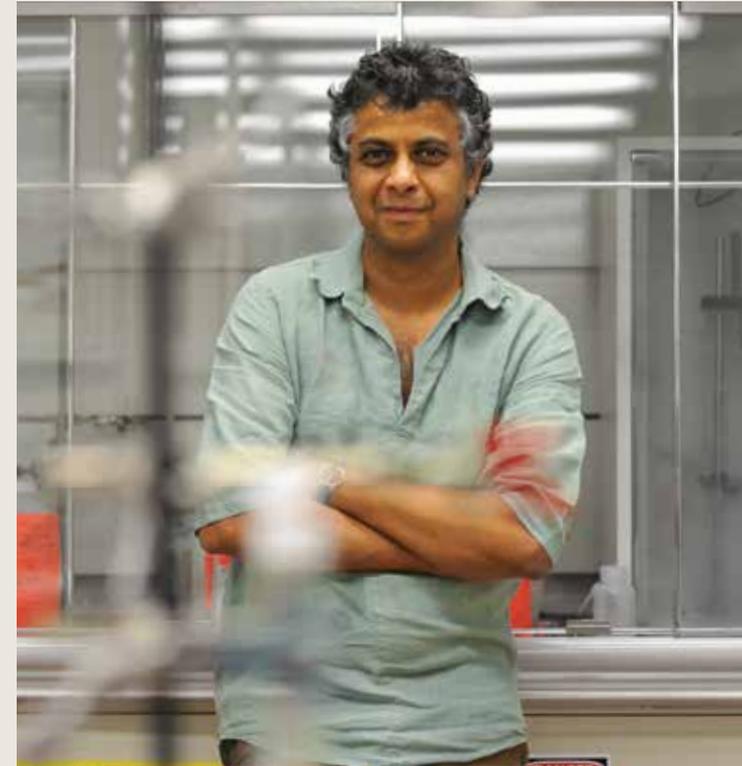
2013

Professor Tal Malkin and her team debut the first practical prototype for a scalable and private database management system, supporting a rich query set including arbitrary Boolean formulas and providing provable security guarantees.



2014

Professor Christopher Jacobs is awarded the Van C. Mow Medal of the American Society of Mechanical Engineers (ASME) for his work in molecular mechanics of cellular mechanosensitivity in bone, his lab being one of the first to show that primary cilia act as mechanical sensors in bone cells.



2014

Professor Sanat Kumar, an expert in nanomaterials and advanced capacitors, collaborates with colleagues to develop a technique that creates high-performance crystals with a structure precise enough to be used in optical circuits that manipulate information encoded in light rather than in electricity.

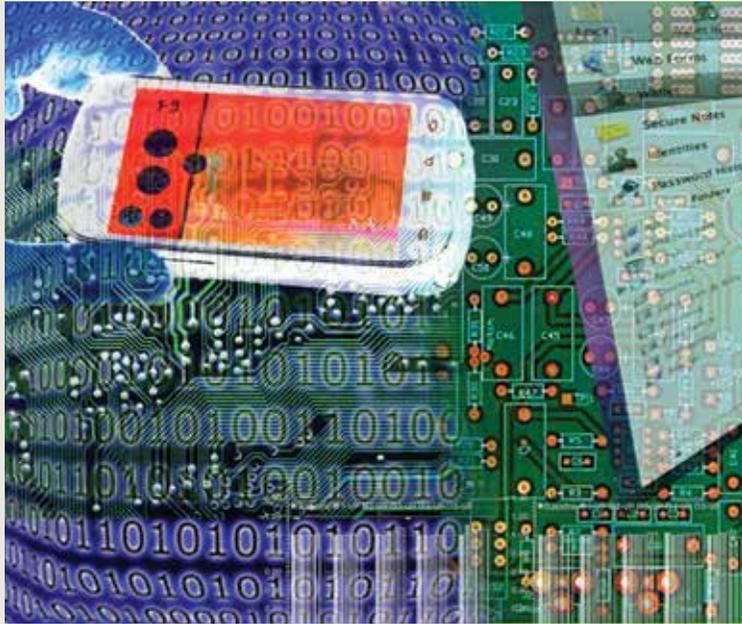


Illustration by Nicoletta Barolini



Photo by Ryan John Lee

2014

Computer Science Professor Allison Lewko develops “program obfuscation,” new encryption methods that make the inner workings of a computer program invisible to an outside observer while preserving its functionality, as part of the NSF Center for Encrypted Functionalities. In 2013, she was named to *Forbes* “30 under 30” for her work.

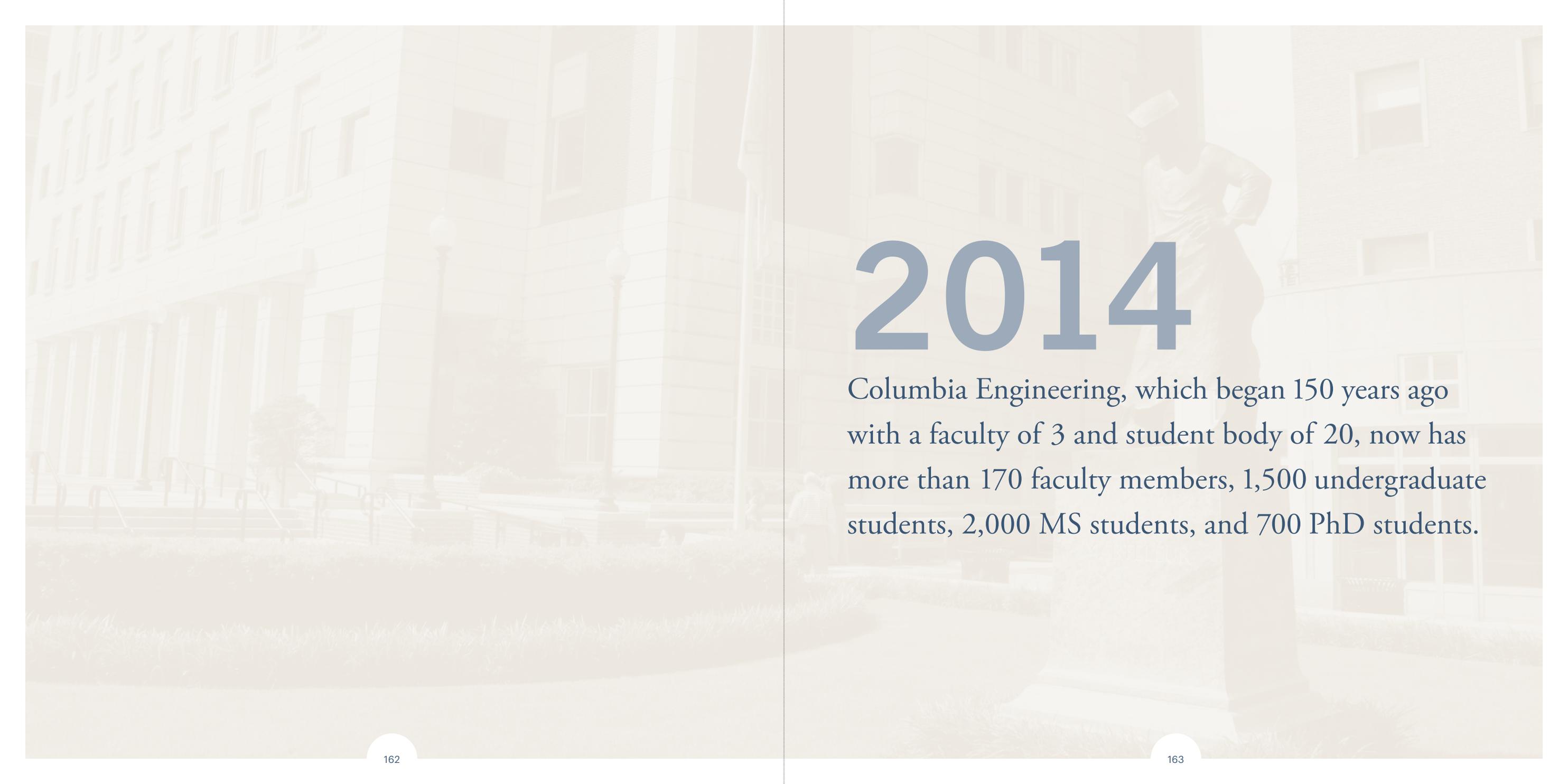


Courtesy of NASA



2014

Professor Adam Sobel, a leading researcher on the physical mechanisms of climate, receives the first AXA Award in Climate and Extreme Weather to study the local dynamics and global patterns of extreme weather events and explore both the societal impacts of these events and possible engineering solutions. He later publishes *Storm Surge: Hurricane Sandy, Our Changing Climate, and Extreme Weather of the Past and Future*, which explains the atmospheric conditions that gave birth to the superstorm and discusses the future impact of climate change.



2014

Columbia Engineering, which began 150 years ago with a faculty of 3 and student body of 20, now has more than 170 faculty members, 1,500 undergraduate students, 2,000 MS students, and 700 PhD students.

Deans of Columbia's School of Mines and Its Successor Schools

- 1.** 1865–1897 Charles Frederick Chandler, former professor of chemistry, Union College
- 2.** 1897–1899 Henry Smith Monroe, professor of mining, School of Mines
- 3.** 1899–1905 Frederick R. Hutton, professor of mechanical engineering, School of Mines
1905–1907 George F. Sever, Acting Dean and professor of electrical engineering
- 4.** 1907–1917 Frederick A. Goetze, former University superintendent of buildings and grounds
- 5.** 1917–1930 George B. Pegram, professor of physics
- 6.** 1930–1946 Joseph Warren Barker, former professor of electrical engineering, Lehigh University
March 1941 James Kip Finch appointed Associate Dean
July 1941–
Aug. 1945 James Kip Finch was effectively Acting Dean since Dean Barker's duties as a special assistant to the Secretary of the Navy during World War II kept him away from the School
- 7.** 1946–1950 James Kip Finch, professor of civil engineering
- 8.** 1950–1969 John R. Dunning, professor of physics
- 9.** 1969–1975 Wesley J. Hennessy, former School of Engineering administrator
1975–1976 Ralph J. Schwarz, Acting Dean and professor of electrical engineering

- 10.** 1976–1980 Peter W. Likins, former professor of civil engineering, UCLA
1980–1981 Ralph J. Schwarz, Acting Dean and professor of electrical engineering
- 11.** 1981–1990 Robert A. Gross, professor of applied physics
1990–1991 Ralph J. Schwarz, Acting Dean and professor of electrical engineering
- 12.** 1991–1994 David H. Auston, professor of electrical engineering and former scientist at Bell Labs
1994–1995 Donald Goldfarb, Acting Dean and professor of industrial engineering and operations research
- 13.** 1995–2007 Zvi Galil, professor of computer science
2007–2009 Gerald A. Navratil, Interim Dean and professor of applied physics
- 14.** 2009–2012 Feniosky Peña-Mora, former associate provost and professor of civil engineering, University of Illinois at Urbana–Champaign
2012–2013 Donald Goldfarb, Interim Dean and professor of industrial engineering and operations research
- 15.** 2013– Mary Cunningham Boyce, former department head and professor of mechanical engineering, Massachusetts Institute of Technology

Official Names of the School of Mines and Its Successor Schools

1864	School of Mines
1896	The School of Mines, Engineering, and Chemistry
1926	The School of Engineering
1961	The School of Engineering and Applied Science (SEAS)
1997	The Fu Foundation School of Engineering and Applied Science

Degrees Conferred through the School of Mines and Its Successor Schools

1864	EM in mining authorized; first granted in 1867
1868	PhB in chemistry authorized; first granted in 1871 (BS in chemistry in 1897)
1869	CE in civil engineering authorized; first granted in 1871
1875	First PhD awarded by Columbia given by School of Mines
1881	PhB in architecture authorized
1886	MetE in metallurgy authorized as separate degree from EM in mining
1887	SE in sanitary engineering authorized; awarded to two students in 1889
1888	EE in electrical engineering authorized
1897	PhB in geology and paleontology authorized
1902	School transferred granting of PhD degrees to Faculty of Pure Science (now Arts & Sciences)
1916	MS degree in engineering first awarded
1923	BS degree for all undergraduates, regardless of department, first granted. Students completing another year of study could choose to receive either older professional degrees of home department or MS degree. Very soon thereafter, vast majority of students chose to receive the MS degree because it connoted graduate study. Older professional degrees were still in use as late as 1954, given by some departments as an undergraduate award.
1950	EngScD (Doctor of Engineering Science) degree authorized

Acknowledgments

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Soulaymane Kachani, Vice Dean of Academic Programs and Professor of Professional Practice, Department of Industrial Engineering and Operations Research

Committee Members

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Raimondo Betti, Professor, Department of Civil Engineering and Engineering Mechanics

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The Fu Foundation School of Engineering and Applied Science

1864-2014