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EDITORIAL: PROCEEDINGS OF THE THIRD ANNUAL CONFERENCE OF THE NATIONAL ACADEMY OF INVENTORS

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The National Academy of Inventors (NAI) held its third annual conference on March 6–7, 2014 at the headquarters of the United States Patent and Trademark Office (USPTO) in Alexandria, VA. Approximately 250 inventors and academic leaders attended the conference, which featured presentations and panel discussions by more than 35 distinguished scientists and innovators. This special issue of *Technology and Innovation* includes select articles stemming from conference presentations, as well as articles on a special section related to pharmacy and one general submission related to nonexistent compounds and the development of innovation.

Key words: Technology; Innovation; Invention; Academia

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A highlight of the conference included the presentation of the 2013 class of the NAI Fellows with trophies, certificates, and rosette pins honoring their accomplishments as inventors by US Deputy Commissioner for Patent Operations, Andrew Faile. More than 80 of the 143 top scientists and innovation leaders elected as 2013 Fellows were in attendance. The names and institutions of all NAI Fellows are on permanent display at the USPTO.

With the induction of the 2013 class, there are now 244 NAI Fellows worldwide representing 131 universities and nonprofit research institutes. Members of the 2013 class represent many prestigious awards and distinctions; among them are 26 presidents and senior leaders of research universities and nonprofit research institutes, 69 members of the National Academies (NAS, NAE, IOM), five inductees of the National Inventors Hall of Fame, six recipients of the US National Medal of Technology and Innovation, two recipients of the US National Medal of Science, nine Nobel Laureates, five Lemelson-MIT prize recipients, and 23 AAAS Fellows.

The conference also afforded interesting presentations, some of which appear in this issue of the journal. We present nine articles, including five selected from conference proceedings, three in the pharmacy section, and one in the general section. In the conference section, the lead article by Molella and

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Smith describes the 1995 formation of the Lemelson Center for the Study of Invention and Innovation at the Smithsonian Institution's National Museum of American History. The center is uniquely poised to become the nation's premiere resource for the history of invention and innovation. The Lemelson Center's *Places of Invention* exhibition, scheduled for 2015 at the National Museum of American History, asks the question: "What is it about some places that spark invention and innovation?" This article frames the response in historical terms on the nexus of place, invention, and creativity. It presents six case studies, including Hartford, CT, late 1800s; Hollywood, CA, 1930s; Medical Alley, MN, 1950s; Bronx, NY, 1970s; Silicon Valley, CA, 1970s–1980s; and Fort Collins, CO, 2010s. It concludes that invention hot spots are born out of a mix of creative people, readily available resources, and inspiring ecosystems.

In the second article, Comedy frames the inventor as invisible hero who valiantly and often anonymously discovers, invents, innovates, and produces novel products and services that lead to economic development. An ecosystem nurturing and protecting invention is of utmost importance. An early sign of such intent was the establishment of the forerunner to the USPTO in 1790 by none other than Thomas Jefferson, a renowned inventor himself. It is important to note that in the US, the original patent office was established more than a century before other institutions of capitalism were founded, including the Federal Reserve System (1914), the Federal Deposit Insurance Corporation (1933), and the Securities Exchange Commission (1934). The US invention culture was formed early with intent, and the outcome speaks for itself. As the author notes, Alan Kay, among others, has often spoken on the notion of "the best way to predict the future is to invent it."

James et al. discuss alternatives in the treatment of tissue and organ failure. Such treatments currently rely heavily on autografts and allografts. While successful in some cases, they remain risky due to the peril of disease transmission, immune rejection, and the shortage of donor organs. An alternative approach relying on biomaterials and biomolecules to fabricate functional tissue substitutes provides promising technologies to mitigate complications in existing methods.

In PowerBridgeNY, Becker et al. address the challenges of forming startup companies based on university intellectual property (IP). While many universities try to turn research discoveries into businesses, a company based on university IP will often fall into the "valley of death"—the stage after the feasibility of an idea has been demonstrated (proof of concept) but before it is commercialized. Traditionally, venture capital firms expect to cash out within 5–7 years. In some industries such as clean energy, however, the time horizon to navigate the valley of death is significantly longer. The authors detail the establishment of a consortium of research institutions in New York funded by the New York State Energy Research and Development Authority (New York University, City University of New York, Columbia University, Stony Brook University, Brookhaven National Laboratory, and Cornell University). The consortium provides early stage support infrastructure during both the proof-of-concept and valley-of-death stages of technology development with the goal of producing successful clean energy startup companies in downstate NY.

The article by Swamidass describes innovation in a seven-stage model, ranging from idea formation, reduction of the idea into a product, building a business model, finding capital, establishing a startup company, growing the business, and managing the company as it matures. This normative approach to startup formation relies on anecdotes to tell a story for engineers and scientists who the author believes are likely not sophisticated in business formation beyond the creation of the original idea. While alternative models of stages of innovation exist, the author has used this model to his satisfaction to teach the process of innovation, and others may find it useful.

Next, we present three articles in a special section on pharmacy. The article by Groshev et al. reviews the application of nanotechnology in medicine. Application of nanotechnology to healthcare delivery through precise targeting of specific cells and tissue provides for a better understanding of the pathophysiology of disease, effective diagnostics, and therapeutics at the subcellular level. The authors outline how various factors affect the development of nanomedicine, ranging from safety concerns to public perceptions, ethics, and regulatory barriers.

The article by Nelson et al. advocates for the development of nano-based rapid biosensors for detecting sexually transmitted infections in Sub-Saharan Africa. Currently, most sexually transmittable infections can

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be treated by antibiotics and contained if diagnosed quickly. However, inadequate diagnostic tools leave many infected patients undiagnosed and untreated, leading to even more infection cases. The authors note that, to date, research on nano-based biosensor detection of infectious pathogens has not been extended to sexually transmitted infections. Such application promises a low-cost, simple solution for a major public health challenge in Sub-Saharan African countries.

Rapaka et al. discuss nanotechnology's relevance for a variety of health-related fields including pharmacology. They explore determining factors in the future of nanotechnology. Such normative explorations include economic growth, innovation, and government regulation. These factors are not independent, however, as the growth of nanotechnology depends on whether it provides innovative solutions superior in cost, safety, and efficacy to nonnanoscale alternatives and whether government regulation reflects such elements.

The last article in this issue by Martin and Martin appears in the general section of the journal. They posit that the study of nonexistent compounds may provide insights into what inhibits innovation. Among the factors they consider are budget constraints, disinterest in compounds that lack obvious utility, and synthetic challenges, among others.

SPECIAL SECTION EDITORS

Nasser Arshadi, Ph.D., is vice provost for research and professor of finance at the University of Missouri—St. Louis. He received his Ph.D. in Financial Economics from the University of Nebraska—Lincoln. In his capacity as UMSL's chief research officer, he oversees sponsored programs, three interdisciplinary research centers (Center for Nanoscience, Center for Neurodynamics, and Missouri Institute of Mental Health), technology transfer, and economic development activities of the university. He has published extensively in leading economics and finance journals on capital markets and the microeconomics of corporations with an emphasis on assessing and managing risk. He has published two books on financial intermediation (Prentice Hall) and insider trading (Kluwar Academic Publishing). Currently, he is on the editorial boards of *Public and Municipal Finance*, an international journal, and the journal *Technology and Innovation*. He has served as an economist and policy analyst at the Board of Governors of the Federal Reserve System in Washington, DC and as a consultant to the American Bankers Association (Washington, DC), Treasury Management Association (Washington, DC), Securities Industry Automation Corporation (New York City), Deutsche Financial Services (St. Louis, MO), and Commerce Bancshares (St. Louis, MO). He is a member of the board of directors of the Center of Research, Technology and Entrepreneurial Exchange (CORTEX), chairing its finance committee, and the Center for Emerging Technologies (CET), serving on its executive committee.

Eric R. Fossum, Ph.D., is a professor at the Thayer School of Engineering at Dartmouth and Faculty Coordinator of the Ph.D. Innovation Program. While at Caltech's Jet Propulsion Laboratory, he invented the CMOS image sensor used in billions of camera phones, webcams, DSLRs, swallowable pill cameras, dental X-ray sensors, and many other applications. His CMOS "camera-on-a-chip" technology has launched a worldwide explosion in digital imaging and visual communications. He cofounded Photobit to further develop and commercialize the technology, which was eventually acquired by Micron, and later led MEMS-maker Siimpel. He holds over 150 US patents and has published over 260 papers. Honors include induction into the National Inventors Hall of Fame, Space Technology Hall of Fame, and election to the National Academy of Engineering and the National Academy of Inventors. He received the NASA Exceptional Achievement Medal, the IEEE Andrew Grove Award, and is a Fellow of the IEEE. He cofounded the International Image Sensor Society and served as its first president. A graduate of Trinity College and Yale University, Dr. Fossum taught at Columbia and then worked at JPL. He joined Dartmouth in 2010, where he teaches and continues research on image sensors, and is director of the school's Ph.D. Innovation Program. He and his wife have a small hobby farm in New Hampshire, and he enjoys his time on his tractor.

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