Statement of

W. Mark Crowell

Before the

House Science and Technology Committee

Subcommittee on Research and Science Education

on

"From the Lab Bench to the Marketplace: Improving Technology Transfer"

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Chairman Lipinski and Ranking Member Ehlers, thank you for the opportunity to testify before the House Science and Technology Subcommittee on Research and Science Education on the important topic of enhancing technology transfer in order to more effectively translate research discoveries from the lab to the market.

My name is Mark Crowell. As of about two weeks ago, I am the Executive Director and Associate Vice President for Innovation Partnerships and Commercialization at the University of Virginia. I believe that the University of Virginia is at the forefront of research universities in advancing an institution-wide innovation agenda that works across traditional silos and boundaries, that embraces outward-facing partnerships, and that is committed at every level to leveraging its innovation capacity and to translating its research discoveries for the public good and for economic development impact. Indeed, I joined U.Va. to share and help lead the university's vision for transforming the way ideas flow from universities to the world. If future generations are to enjoy peace, prosperity, and a clean and sustainable environment in this nation, there is nothing more important than long-term investments in research universities, because research universities are the innovation engines of the United States.

I am a 23-year member of the technology transfer profession. Prior to joining the University of Virginia, I was the Vice President for Business Development at The Scripps Research Institute in La Jolla, California, and Palm Beach, Florida. From 1987 until 2008, I led the technology transfer, economic development and industry research programs at Duke University (1987-1992), North Carolina State University (1992-2000), and the University of

North Carolina at Chapel Hill (2000-2008). I also served as President of the Association of University Technology Managers, or AUTM, during 2005, and still serve on the Board of Directors of the AUTM Foundation, AUTM's fund-raising and business development arm. AUTM is a global organization of more than 3,500 technology transfer professionals and is dedicated to promoting and supporting technology transfer through education, advocacy, networking and communication.

In my 21+ years of experience in Research Triangle Park, North Carolina, I witnessed the technology transfer profession evolve from a function of secondary importance into a key component of the teaching, research, public service, and engagement missions of the region's universities. In the early days of my career, this activity was largely about counting invention disclosures, filing patents when the university could afford to do so, avoiding risks, and hoping for financial windfall while praying your institution and your faculty avoided making front-page news as a result of various conflicts. Concepts of market pull, entrepreneurship, translational research, proof-of-concept funding, and equity stakes were not yet part of the vernacular of the technology transfer scene. The technology transfer function of the 1980's and much of the 1990's was largely reactive, non-market driven, and completely separate from concepts like regional economies and innovation ecosystems. Let me stress, however – this description is the "old mythology" of university technology transfer and these perceptions do not reflect the current reality. Government policy today should not be guided by outdated perceptions of the past.

Fast forward through the 1990's to today and the profession – and practice – is markedly different. Technology transfer offices in research universities are sophisticated business and

innovation development engines, and the people who run them are highly skilled and come from a broad array of fields. Yes, we still deal with invention reports, patent filings, conflict of interest management, and government reporting – but we also write business plans, raise and administer proof-of-concept and pre-seed capital funds, network with entrepreneurs, train faculty and students in entrepreneurship, partner with private companies and non-profits to leverage the innovation capacity of our institutions, develop research parks, and help recruit the best and brightest faculty and students to our campuses and retain them at our institutions.

As a result of the changes and evolution highlighted above, the innovation and technology transfer functions operating in research universities are an increasingly important component of regional economies. They play critical roles in developing the innovation ecosystems needed to support, nurture, grow and retain the entrepreneurial companies that will be the primary source of wealth creation and new jobs in today's knowledge economy. The impact can already be seen in regions acknowledged to be leaders in technology-based economic development. The example I know best is Research Triangle Park, but similar stories are available or are evolving in other regions where research universities are ramping up their innovation and partnership activities.

Research Triangle Park was launched in 1959. In its first thirty years of life, the economic development model followed successfully by RTP's leaders was the old-fashioned "big game hunt" model – i.e., identifying and recruiting corporate headquarters, government agencies, or major divisions of existing companies. Notable successes in RTP during this time period were IBM, Glaxo, Burroughs Wellcome, and the National Institute of Environmental Health Sciences. By 1989, there were 60 firms and 30,000 employees; most of the firms were

medium to large-sized companies or divisions of companies. Despite this success in company attraction, there was very little technology transfer infrastructure in the region's universities during this period – and very little in the way of a start-up pipeline or entrepreneurial culture.

From the mid 1980's through the mid 1990's, investments in the technology transfer infrastructure in RTP were increased. The three universities launched, or rejuvenated, their on-campus technology transfer operations, and in 1987 came together to operate the jointly-governed Triangle Universities Licensing Consortium to market and license technologies developed at the three institutions. Concurrently, the state launched or increased its investment in technology-based economic development agencies like the North Carolina Biotechnology Center – which then initiated programs to partner with local universities to facilitate technology transfer and business development mechanisms and resources. The Council for Entrepreneurial Development, a non-profit RTP-based organization whose mission is "to identify, enable and promote high growth, high impact companies and to accelerate the entrepreneurial culture of the Research Triangle and North Carolina," was founded during this period as well.

The investment in technology transfer infrastructure and in a regional innovation ecosystem paid enormous dividends for the region's economy. By 2002, RTP had more than 150 firms – two and a half times the number just 13 years earlier – and RTP jobs totaled more than 45,000, a 50% increase from 1989. 52% of these companies had less than 10 employees, and 86% had fewer than 250 employees. About one-third of the firms in RTP are, in fact, start-up companies. It appears that the RTP of today is actually RTP II – a second generation research park with a much more robust innovation and entrepreneurial base of economic activity than the first version of RTP, or RTP I – whose foundation was built upon a theory and practice of

economic development ("big game hunting") no longer seen as viable or effective in generating jobs and investment. The growth and evolution of RTP from 1989 to 2002 from a corporate headquarters destination to a start-up hotspot was likely the result of a confluence of a number of factors – but there is no doubt that the enhanced attention on technology transfer and commercializing research discoveries contributed significantly to the park's evolution into a business model which is much more sustainable than that followed previously.

As technology transfer and innovation management within academic institutions have become more important regionally and more ingrained into the missions and role of the research university, the scale and focus of technology transfer have changed in numerous ways. As noted earlier, the practice of technology transfer still involves the basic invention management, patenting and licensing functions which have always been part of the technology transfer operation. But the following are examples of sophisticated educational, financing, and business development functions now seen in many such operations:

(1) Start-up company formation and support – Innovation management professionals in universities increasingly participate in dynamic business development activities. According to AUTM's most recent survey, 595 new companies were formed in 2008 alone. Start-up companies often are the best means to champion the translation and commercialization of an early stage discovery, as well as to create regional economic impact. University personnel increasingly seek partnerships within their innovation ecosystem (e.g., science and engineering faculties, business and law schools, local entrepreneurial support organizations, venture capital firms, economic development

agencies, regional innovation centers and incubators, and so forth) in order to form, launch, and nurture the development of start-up companies.

(2) Translational research, entrepreneurship and innovation training (and experiential learning) for students and faculty across the institution – At the University of Virginia, we, like many universities, hold business plan competitions as well as "business concept" competitions (focusing on pre-commercial innovation assessment and translation). We also offer a course in BioInnovation that spans engineering, business, biology, architecture, and medicine. In addition, post doctoral researchers were brought into the technology transfer offices at Scripps and at UNC for 9 month internships to begin to grow a pipeline of academic scientists who are trained in translational research, business development and transactional aspects of commercialization – and to enhance the number of well-trained scientists with business development expertise needed to sustain and grow innovation ecosystems. Similarly, monthly seminar series with networking social events are found at U.Va. and UNC and offer a venue to bring together faculty, postdocs, graduate students, and the local entrepreneurial and business development communities in ways which catalyze relationships, networks, and business development opportunities. With support from the Kauffman Foundation, an exciting course sequence called "Launch the Venture" was created in UNC's Kenan-Flagler School of Business – co-sponsored and co-taught by personnel in the technology transfer office – to expose would-be faculty entrepreneurs to a sophisticated and highly successful course sequence designed to teach and implement the steps necessary to build investment-worthy business plans around technologies and services suitable for the development of new companies.

(3) Pre-seed and seed capital – It is well documented that institutional venture capital has moved further downstream in the technology development continuum and that early stage ideas emerging from academic laboratories find it increasingly difficult to attract pre-Series A investment capital necessary to form a company, attract management, and conduct the early stage development necessary to advance a technology aggressively toward commercialization. At the University of Virginia, we recently held our second annual U.Va. Venture Summit. In each of its first two years, the U.Va. Venture Summit has attracted venture capital funds managing – in the aggregate – more than $15 billion. 100% of the eight U.Va. companies presenting in year one of the Venture Summit received funding. In another approach, in the late 1990's, NC State University formed "Centennial Venture Partners" with $10 million from the university's endowments to invest in start-up companies affiliated with the university. Over a period of almost three years, Centennial Venture Partners invested in about 15 university-affiliated companies – and those companies leveraged Centennial's $10 million to bring in more than $140 million in follow-on funding. Other institutions across the country are developing their own approaches to access, raise, partner, or bootstrap early stage sources of risk capital so critical to the creation of entrepreneurial ventures.

(4) Proof of concept and translational research initiatives – The University of Virginia has built several very successful – and culture changing – models for proof of concept investments and scale-up for commercialization. A primary example is the Wallace H. Coulter Foundation Translational Research Partnership, which funds (for about $1 million per year) a project manager and about eight projects per year at around $100,000 each. Results from this activity indicate that there have been twenty new patent

disclosures per $1 million invested, and that 50% of funded projects (over the first four years) have moved to a commercial license deal within two years. Both measures far exceed the standard "metrics" for the commercialization of academic research. Several other similar initiatives are funded at U.Va. and generate similar outcomes and success. U.Va. officials attribute the success of these initiatives to the involvement of a very diverse review board, in-person reviews with the research teams, milestone driven projects, frequent reporting, the "will to kill" projects or re-direct funds if insurmountable obstacles occur, dedicated translational research project managers, and excellent networking in the venture capital and private sectors. Again, similar initiatives are increasingly seen at other institutions around the nation, including a Center for Integrative Chemical Biology and Drug Discovery at UNC-Chapel Hill that partners with basic scientists at UNC to take their drug target discoveries, seeking to de-risk and accelerate the lead identification, proof-of-concept, and optimization process, thereby enhancing licensing and commercial potential.

The areas outlined above are not an exhaustive inventory of the many sophisticated and critical core strategies implemented by university technology transfer officials in seeking to translate basic research discoveries and innovation into products and services, but they do provide a good overview of many of the key "best practices, policies and initiatives" that are key to fueling our innovation economy. They are examples of initiatives that are critical in enabling universities to partner more effectively with industry – and in ensuring that there are pathways for the commercialization of basic research discoveries and innovations so that economic growth, job creation, and social good can occur.

At the University of Virginia, we believe that economic and social well-being in the next global era will be achieved via an evolving paradigm that causally links knowledge creation, innovation, commercialization, societal advancement, and human dignity. We agree with economist Paul Romer, who noted that "no amount of savings and investment, no policy of macroeconomic fine-tuning, no set of tax and spending initiatives can generate sustained economic growth unless it is accompanied by the countless large and small discoveries that are required to create more value from a fixed set of resources." These principles were a focal point in the recent NSF Partnerships for Innovation (PFI) grantee conference, titled *"Innovation Ecosystems for the Creative Economy,"* organized by the University of Virginia and led by Thomas Skalak, U.Va.'s Vice President for Research.

We also believe strongly that enhanced federal funding by NSF and others for proof-of-concept and translational research initiatives of the types described in this statement will lead to the harnessing of what Romer calls the "countless discoveries" by linking the people that make them with other participants in the innovation ecosystem to accelerate innovation, to enhance wealth creation, and to advance societal good. Given the degree to which universities are increasingly acknowledged to be the platform for innovation for America and the world, we believe that this enhanced federal investment in proof-of-concept research is essential to our national innovation ecosystem.

To be more specific, we certainly fully support the President's proposed FY 2011 Budget Request for $12 million for a new "NSF Innovation Ecosystem" component within the Partnerships for Innovation program. But we believe much more investment is needed in order to ensure that proof of concept initiatives – examples of which are highlighted in this statement –

are in place and accessible to capture and translate the innovations emanating from universities nationwide. We urge funding at levels much higher than that noted above – and suggest that perhaps 0.5-1.0% of the NSF budget (and other agencies as well) be allocated to this need. This funding could take the form of Translational Research Supplemental Awards, or *de novo* Translations Concept Grants available for good ideas even if not based on another federal grant. This funding should be accessible to universities in all regions – because talent and innovation exists everywhere. We believe the review process for such funding should be high-touch and market focused, with corporate partner input and development milestones being key components for initial and ongoing funding. We are pleased to note that these recommendations were supported in the "wrap-up" portion of the recent PFI conference on "Innovation Ecosystems" organized by U.Va.

The University of Virginia is committed to an innovation agenda that seeks to create and leverage pathways, partnerships, resources, and strategies for translating its intellectual capital into products and services that benefit society, generate economic growth and wealth creation, and enhance the research and educational experience of its students and faculty. A key component of success in this agenda is our ability to enter into robust, outward facing, high-engagement partnerships with key industry, venture capital, and related entities. These partnerships are local, regional, commonwealth-wide, national, and global – and we seek out and engage in such partnerships in fulfillment of our mission and our commitment to our students, faculty, sponsors, and society. We also see clearly our role in the innovation ecosystem which must be sustained and grown in order to support economic development. Like other universities, we are a critical source of ideas, knowledge, and discoveries – and in a knowledge economy, this is the raw material that fuels the economy. We are good at producing ideas and innovations –

and we wish to partner with companies that are good at productizing, manufacturing, marketing, and distribution.