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

Testimony of:

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Introduction

Chairman Lipinski, Ranking Member Ehlers, and members of the Committee, my name is Keith Crandell and I am co-founder and managing director at ARCH Venture Partners, an independent, seed and early stage venture capital firm. ARCH focuses on commercializing the breakthrough ideas of leading academic researchers in the fields of life science and physical science. We do this by developing these innovations into products and building industry-leading companies to bring them to the marketplace. Since our formation in 1986, we have been founders or leaders in the first round of venture capital investment in more than 120 companies.

ARCH, whose name is derived from The Argonne National Laboratory/ University of Chicago Development Corporation, was formed to commercialize innovations from the namesake university and laboratory, which the university owns and operates. Prior to ARCH, very little commercialization of research had taken place at either institution. In our first five years, we raised a $9 million fund and used it to found 12 companies. Successes from this initial batch include The EveryDay Learning Company, developer of the number one reform elementary mathematics curriculum in the U.S., Aviron, developer of the cold-adapted, nasal aerosol flu vaccine for children, and Nanophase Technologies which The Economist has identified as the very first nanotechnology company.

Overall, the founders' equity in those initial 12 start-up companies and the licenses ARCH completed during that time have generated over $30 million. Currently, ARCH Venture Partners is investing its seventh fund.

In addition to my responsibilities as a venture investor, I am a former director of the National Venture Capital Association (NVCA), of which my firm is a member. Based in Arlington, VA., the NVCA represents the interests of more than 425 venture capital firms in the United States. These firms comprise more than 90 percent of the venture industry's capital under management.

It is my privilege to be here today to share with you, on behalf of the venture industry, our perspective on how we can improve the transfer of breakthrough ideas and technologies from research institutions to entrepreneurs and investors who can build them into products and companies and bring them to the marketplace.

The Role of Venture Capital in the Innovation Life Cycle

I would like to share a brief overview of the role of venture capital (VC) in the innovation life cycle. For decades, the venture capital industry has dedicated itself to finding the most innovative ideas and bringing those ideas to market. Venture capitalists raise money from institutional investors and their firm partners for the express purpose of identifying and investing in the most promising ideas, entrepreneurs, and companies. We only choose those with the potential to grow exponentially with the application of our expertise and venture capital investment. Often these companies are formed from ideas and entrepreneurs doing work in university and government laboratories – or even someone's garage. Many of these ideas would never see the light of day were it not for venture investment.

Once a VC has identified a promising opportunity, he conducts thorough due diligence on the entrepreneur or scientist, the technology on which the opportunity is based, and the potential market. For a venture capitalist to invest in a new idea, the discovery must be proven at least to a reasonable point. Often times, the venture capitalist will delay an investment until further research or commercial validation is successfully completed. Put another way, most venture capitalists invest in applied research – not basic research. For those discoveries that have moved through the basic research process or have a functioning product which passes muster with their firm, we make an investment in exchange for equity ownership in the business. Often at this point, no company has been formed to manufacture and market the product, so the VC takes a lead role in establishing one. Venture capitalists also generally take a seat on the company's board of directors and work very closely with management to build the company and bring the innovation to market.

The innovation process is long and characterized by significant technological, market, and entrepreneurial risk. A venture capitalist typically holds his venture investment in an individual company for at least 5 - 10 years, often longer, and rarely much less. During that time he continues to invest follow-on capital in those companies that are performing well; he may cease follow-on investments in companies that do not reach their agreed-upon milestones. The ultimate goal is what VCs refer to as an exit – which is when the company is strong enough to either go public on a stock exchange or become acquired by a strategic buyer at a price that ideally exceeds our investment. At that juncture, the venture capitalist "exits" the investment, though the business continues to grow and innovation continues to take place.

The nature of our industry is that many companies do not survive, yet those that succeed can do so in major ways. Our asset class has been recognized for building a significant number of high-tech industries including the biotechnology, semiconductor, online retailing, and software sectors. Within the last several years, the venture industry has also committed itself to funding companies in the clean technology arena. This includes renewable energy, power management, recycling, water purification, and conservation. Many of the young companies that we fund serve as the de facto R&D pipeline for larger corporations as, in many cases, the technology of venture-backed start-ups is usually far more advanced than the product-line extensions that receive priority in a corporate R&D environment. This phenomenon is especially true in the life sciences and software sectors, where venture-backed companies are regularly acquired for their technology and intellectual property. We believe this dynamic will ultimately become the reality in the energy and clean tech sectors as well. My partners and I are extremely proud of the work that we do each day because we are creating the future.

Historically, venture capital has differentiated the U.S. economy from all others across the globe in terms of job creation and innovation. According to a 2009 study conducted by the econometrics firm IHS Global Insight, companies that were started with venture capital since 1970 accounted for 12.1 million jobs (or 11 percent of private sector employment) and $2.9 trillion in revenues in the United States in 2008. Such companies include historic innovators such as Genentech, Intel, FedEx, Microsoft, Google, Amgen, and Apple. These companies have brought to market thousand of innovations that have improved and, in the case of the life sciences sector, actually saved millions of lives. It is almost inconceivable that these monumental advances were once small ideas tucked away in a lab or a living room. But we assert that the next great innovation is today an idea waiting somewhere. We are committed – along with the government – to finding and funding it. Our country's future depends on it.

The ARCH Methodology

ARCH Venture Partners works with leading researchers at the earliest possible point in their work to identify breakthrough ideas. We then evaluate market potential and technical risk, develop intellectual property strategy and bring in experienced entrepreneurial advisors with relevant industry and technology experience. In fact, our ability to integrate proven and successful technologists and entrepreneurs from previous ARCH portfolio companies into subsequent generations of start-ups and introduce them to existing networks of contacts is one of the most valuable things ARCH brings to the table.

In addition to assisting in product development and strategy, ARCH also works with its portfolio companies to recruit managers and board members, identify corporate partners, increase awareness of non-equity sources of financing from governmental agencies, and develop an overall business strategy. Periodically, ARCH partners have stepped into operating roles in portfolio companies in the roles of executive chairman of the board or interim CEO to enable continued progress even when management changes have been required.

As part of this process, ARCH actively solicits participation from other investors – a practice that venture capitalists call “syndication.” This considerably strengthens the financial position of the company by helping to insure that it can access capital until it achieves positive cash flow. Just as importantly, participation from additional investors provides extra reserves of expertise, experience and contacts for the company to tap as it grows.

Finally, ARCH shares its considerable experience in the initial public offering process and in trade sales – the two most common outcomes, or “exits,” for successful venture-backed start-ups – with its portfolio companies to make these processes more efficient and maximize the value of their exits for all stakeholders.

ARCH does not expect researchers to become the chief executives of the start-ups their innovations spawn. In fact, we have found that they prefer to stay in their laboratories and continue their groundbreaking research while serving as advisors, consultants, and board members to the start-up. The consensus of the founders and investors is almost always to recruit top entrepreneurial talent to lead the start-up full time as soon as possible.

Challenges Facing Knowledge and Tech Transfer from Universities to the Private Sector

The technology transfer process at leading universities can be broken down into three primary and interrelated functions: record keeping and compliance, patenting and licensing, and spinning off start-ups based on those patented innovations.

Most universities have adequate programs in place to carry out record-keeping and compliance. In some cases, this function also includes raising technology transfer awareness broadly in the university community.

The second function concerns the management of the university's patent portfolio and the completion of license agreements for both established and start-up companies. Currently, the quality of the patenting process varies greatly from university to university. Constrained resources at the technology transfer office, a lack of commercial application knowledge by those who staff it, and an unwillingness to aggressively defend broader claims by the person who filed the patent can lead to challenges for start-ups interested in commercializing the innovation. In some cases, groundbreaking innovations have received only narrow patent coverage. Start-ups are particularly vulnerable to these vagaries of the system because patents offer one of the few advantages a small company has against larger, stronger, and more established competitors. While some standard licensing agreement templates have considerably simplified the license agreement process for university offices in recent years, many universities continue to spend too much time negotiating them. This is wasted time for start-ups because they cannot begin the process of attracting management and investment or start product development until the license is complete and the economic terms are known.

The third and most important function focuses on spinning off high-potential start-up companies based on their patented and licensed innovations. This is the most critical step in the commercialization process, but it can be a difficult, frustrating, and potentially thankless task for the technology transfer staff involved.

Sadly, university technology transfer offices often function as second-class citizens in bureaucracies designed primarily to serve the faculty, educate students, and handle institutional administration. As a result, these offices frequently lack resources and have difficulty attracting, retaining, and motivating the level of talent required to facilitate rapid and efficient commercialization. While universities often reward top faculty for generating outstanding research or garnering grant funding, they rarely ever reward transfer officers for their commercialization efforts – no matter how heroic. In fact, the researchers themselves maintain a role and ownership incentives in a start-up, but the technology transfer executives typically do not receive a similar ownership incentive – even when they essentially help found the company. Sometimes, the only way they can get this stake is to leave the university.

The role of the “start-up” staffer is further complicated by a heightened degree of negative scrutiny - “fish bowl” effect, of sorts – often present at public institutions. It works like this: if a start-up is successful, the staffer may be blamed for giving away the lab’s “crown jewels” for too little economic value or charged with favoritism toward the successful group after the fact. If a start-up fails, critics assail the staffer for the tremendous time and effort that yielded nothing. If the staffer believes a leading scientist’s innovations cannot commercially justify his efforts, he may incur the wrath of a powerful faculty member. Instead of providing motivating incentives, this dynamic discourages talented staffers from giving their best effort and hurts the commercialization process.

The fish bowl effect raises another troublesome challenge: conflict of interest, and how to deal with it. It should be understood that the type and size of conflicts of interest arising from the commercialization process are not always predictable. Commercialization involves human beings moving with incomplete information into unknown territory. These conflicts should be managed not from expectations of zero defects, which is impossible and counterproductive, but from one of exemplary disclosure, oversight, review and management of conflicts when they arise.

Technology Transfer and Geographic Variance

Let me set aside the acute challenges at the university transfer office and speak more generally about the transfer process. Successful transfer, or spin off systems require three basic components: 1) leading researchers with breakthrough ideas, 2) successful entrepreneurial managers and, 3) experienced and successful seed and early stage investors. These interdisciplinary teams of scientists, managers, and investors have been a hallmark of successful high growth companies in the United States for decades.

In Northern California and in the Boston area, these three components exist in abundance across a number of different fields and industry sectors. Outside of these well-established venture capital hubs, some regions have assembled these components for single industry sectors. Examples include the medical devices sector in Minneapolis, MN, biotechnology in Seattle, WA, and communication technology in Austin, TX.

Throughout most of the rest of the United States, many academic institutions have leading researchers with breakthrough ideas. The other two critical components – experienced and successful entrepreneurs and seed and early stage investors – remain in short supply. In many cases, those who are on the scene are not coordinating their creative activity. The critical challenge for these geographies is to round out these other two components so that they can assemble the high-performance, interdisciplinary teams I described earlier.

Best Practices and Recommendations for Effective Commercialization

The process of commercializing technology is a system with many interdependent parts. It also tends to work differently at universities than it does at the national laboratory system. Despite these differences, there are a number of principles and practices for success that stretch across the commercialization spectrum. I originally developed these to share with the Department of Energy for improving their process of technology commercialization at the national labs, but I think they are relevant to our discussion today.

1.) Insistance on Objectivity and Transparency in Commercialization Reporting. The improvement of the technology commercialization process should begin with improved annual metrics that accurately reflect start-up company activity. Institutions should focus on tracking economic value created, capital raised and jobs created, instead of counting, invention disclosures, licenses, patents, and CRADAs (cooperative research and development agreements). These latter metrics are at best indirect and incomplete measures of technology commercialization. Tracking near-term cash is also problematic, as it creates an incentive in the lab to overload pre-revenue start-ups with large licensing fees – which strip the start-up of precious dollars needed to advance the commercialization of the technologies.

2.) Assembly of Capable Commercialization Teams: Each institution should assemble a cadre of successful experienced entrepreneurial managers, venture capitalists, and entrepreneurial researchers to share their best practices, network, and experience with the next generation of researchers. Successful early stage companies do this when they organize business and scientific advisory boards to gain insights in development efforts and to suggest ideas to overcome challenges. Adopting this practice at the technology commercialization office level starts this essential process even earlier.

3.) Focusing Commercialization Resources on Breakthrough Ideas. The creation of new companies based on breakthrough ideas from leading scientists involves a small percentage of the research talent at a given institution (the top 1 percent). Entrepreneurial services, funding, and support should be focused on the top scientists with the breakthrough ideas. We have found that peer scientists with successful entrepreneurial experience make the best judges.

4.) Make Time for Researcher Consulting. Top scientists (perhaps called Commercial Fellows) should be allocated at least one day per week for consulting with start-ups. This practice is typical at leading private research universities but less common at the national labs.

5.) Adopt Common Sense Conflict of Interest Policy. Researchers should be able to fully participate in the entrepreneurial process without unnecessary encumbrance from archaic conflict of interest policies. The standard of conduct for scientists involved in entrepreneurial activity should be "actual conflict" – not the "appearance of conflict" standard in place at some institutions today. The appearance standard allows mid-level managers with program responsibilities to quash entrepreneurial activity (e.g., veto researchers’ ability to provide consulting to start-ups, serve on boards or advisory boards, and take equity stakes) by merely pointing to less-than-substantive violations of the standard. Procedures and policies for handling actual conflicts (such as the well-established disclosure, oversight and review process at many universities) should be put in place to afford the commercialization-oriented researcher the fullest opportunity to participate in the commercialization process, as well as due process and the opportunity to appeal conflict determinations to objective authorities outside the lab's direct chain of command .

6.) Ensure Investor and Entrepreneur Access to Leading Lab Researchers. Investors and entrepreneurs should have the ability to "walk the halls" of research institutions, meet scientists, attend seminars, build relationships, and discuss ideas and opportunities with lead researchers. This already happens today at the best research universities, but it should happen everywhere – including non-classified areas of the national labs.

7.) Improve the Intellectual Property Protection and Practices. Encourage exclusive licenses based on performance and embrace the notion that intellectual property licensed to investor-backed start-ups will likely need to be exclusive in order to attract investment capital. This practice is already in place at the top research universities, and should expand to all commercialization-focused institutions.

8.) Streamline the license negotiation timeline. As I mentioned earlier, time is precious for start-ups. The licensing process should be completed in 90 days. The time and effort used to extract a license from a university or national lab is wasted when the real challenges the new company faces are building a business or attracting capital or management or developing a product or finding a customer. Often universities and laboratories require the approval of too many separate quasi-independent entities.

9.) Improve the Breadth and Commercial Relevancy of Patent Claims. There is too much emphasis on counting quantity and not enough on the quality and commercial importance of the patent claims made by universities and labs. Claims should be filed with an eye toward the eventual needs of the companies to whom the institution plans to license them.

10.) Investor backed companies should be allowed to more fully compete and participate in the SBIR program as they did prior to 2003. SBIR provide a need source of capital to entrepreneurial companies and disqualifying entrepreneurial companies that take investor capital from participating in the SBIR program makes the new company less likely to seek the capital it needs to commercialize innovations and create jobs and economic value. This is particularly damaging to entrepreneurial companies seeking capital in remote geographies.

Roles for the National Science Foundation in the Innovation Ecosystem

Basic research sponsored by the National Science Foundation (NSF) is highly regarded by seed and early stage venture capital groups because of the NSF's long-term view, interdisciplinary research approach, careful program selection, and rigorous peer review. NSF also generally involves top researchers and their research programs are highly original in nature. These characteristics provide a strong basis for a new start-up companies.

In addition to continuing to fund such research, I believe the NSF can play a number of important roles within the innovation ecosystem in the U.S.

First, the foundation can help expand the innovation ecosystem – particularly in those geographic regions that possess the top-flight research component I discussed earlier but lack the seasoned entrepreneur and investor components necessary to complete the transfer process. The NSF should fund the formation of public-private partnerships at these research institutions to focus exclusively on indentifying start-up opportunities and building the interdisciplinary teams required to build innovations into successful, high-growth companies. The NSF may be uniquely suited to facilitate these partnerships because of its relationships with leading scientists, many of which have had successful start-ups emerge from their labs. The public-private partnership model also addresses the "fish bowl" challenge for technology transfer officers because the partnership does not report to the administration of the university or lab and can also act as an advocate for the entrepreneurial scientist on the conflict of interest issues.

Second, the NSF can rethink the artificial separation of basic and applied research. To paraphrase an entrepreneurial chemist from Argonne National Laboratory some years ago: there are plenty of great basic research problems with commercial significance – if you are looking for them. The point is this: if generating an eventual commercial application is one desired goal of basic research, then it makes sense to design the program architecture to allocate incremental resources to identify, investigate, and validate the commercial implications of basic research from the very beginning. It's simply never too early to start this complimentary investigation process. It can help inform the direction of more applied research, strengthen intellectual property, and provide a platform to interest entrepreneurs and seed capital. This is a particularly acute problem in physical science research where, for example, new innovations in materials science can have diverse applications spanning everything from drug delivery to computer displays to aerospace.

For these reasons, it's better to make a scientist fully aware of the real potential and constraints for a commercially relevant breakthrough and lay the groundwork for a start-up early on, rather than ask him to perform basic research in a commercial information vacuum for years and then, after the program is complete, try to retrain him as an entrepreneur and begin the process of commercially validating the innovation.

Finally, the NSF could encourage leading researchers to include summaries of these commercial investigations of their work and what paths those applications could take when submitting their work for publication. On a parallel track, the foundation could encourage leading academic journals to ask for or even require such summaries.

Conclusion

I'd like to conclude my testimony by reiterating that the "innovation ecosystem" in the U.S. remains the envy of the world. It has harnessed the brilliance of our researchers, the ingenuity of our entrepreneurs, and the savvy of our investors to power economic growth, save countless lives, and change the way we live those lives each day. However, it is a delicate system steeped in risk and beset by challenges in today's economic environment.

As members of this unique public-private partnership, we must do everything we can to remove or mitigate those challenges to the system that are under our control. Encouraging and adopting the best practices for knowledge and technology transfer at universities and the national labs that

I outline in this testimony would move us in the right direction. So, too, would increasing the role of NSF in those ways that I've described.

This brings me to a larger point: The federal government has played a vital role in the success of the U.S. innovation model through innovation-friendly policies and incentives. Now, however, many foreign governments have begun to emulate these policies and create innovation ecosystems of their own. If successful, these competing ecosystems could draw talent and resources away from ours. To maintain our innovation advantage, we must rededicate ourselves to what made our system successful and address those areas that pose the greatest threats. This means increasing support for basic R&D, improving math and science education, supporting high-skilled immigration and patent reform, and improving access to capital through forward-thinking tax policies. Without action on these fronts, the United States may find itself in the unfamiliar role of innovation backwater – rather than the destination of choice for the world's most gifted researchers and entrepreneurs.

I want to personally thank you for the opportunity to discuss these important issues with you today. And to thank you for your service to our country in your capacity as Members of Congress.