The Technology Transfer Dilemma

Preserving morally responsible education in a utilitarian entrepreneurial academic culture

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Abstract: 'Research, teaching, and service' is growing to include business. With unbridled enthusiasm, academicians bring discoveries to market instead of having them sit fallow in the public domain. Dilemmas have emerged. Academic scientists underwrite their work with public funds and employ a utilitarian labor force, namely, students seeking an education. The benefits from a successful business are significantly higher than in academic ventures, so the temptation increases to abrogate professional responsibilities and loyalties in favor of personal gain. Safeguards are needed for the institution and its students while simultaneously permitting the development of scientifically, socially, and economically important discoveries.

Keywords: *technology transfer, entrepreneurial activity, ethics, graduate education.*

1. Reassessing the Bayh-Dole 'Technology Transfer' Act

> *Four years ago, one of my former students asked, "Do you know how we tell what kind of mood the boss is going to be in? Well, we check the stock market page to see how his company is doing that day."*

Perhaps this remark will not strike you as unusual until you realize that a chemistry graduate student made it about his research advisor. Many faculty members in the basic sciences, like their colleagues in the medical school, have expanded their traditional responsibilities for research, teaching, and service to include business. I do not mean scientific consulting, lecturing, or authoring books; I mean everything from simple licensing to personally owning or operating a start-up company built on patenting the intellectual properties or proprietary technologies generated in the academic research labora-

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tory. The call for applied research (Stokes 1997), academic entrepreneurial activity, and technology transfer is growing and becoming more widespread (Gwynne 1997), not only in the United States but also worldwide. Against a 50-year backdrop of the research university in the United States, I will use issues raised by 20 years of academic entrepreneurship in the U.S. as a case study to illustrate the serious conflicts that have resulted when the concerns of higher education mix with those of business. As I will specify later, safeguards for our educational institutions as well as for our students have only begun to be created in response to the problems that I will address in this paper. As the inevitable growth in entrepreneurial activity continues, perhaps the lessons being learned in the U.S. can provide guidance for others.

Historically, this story begins with the development of the 'research university' in the United States. For the first time, the U.S. government supported significantly the work of academic scientists during World War II (*e.g.*, The Manhattan Project). Following the war, the presidents of Harvard University (James Bryant Conant) and M.I.T. (Vannevar Bush) advocated permanent mechanisms for government support that could turn the intellectual power of the U.S. college and university faculties towards conducting basic research (Graham & Diamond 1997). Founded in the late 1940s, the National Institutes of Health (NIH) and National Science Foundation (NSF) were a direct result of Bush's persuasive argument. The contract between the universities and the government was implicit: public funding begets public knowledge. As the 1970s closed, this contract became cumbersome. Significant academic discoveries in the biotechnology area, although they could be patented, went largely undeveloped because the U.S. patents derived from public funding were held in the public domain, and companies could simply not afford to spend millions of dollars developing technologies that were in the public domain. Patent exclusivity is the only way to earn back the money from one's investment. With the 1980 Bayh-Dole "technology transfer" Act (Public Law 96-517, H.R. 6933) the promise of the government-academia partnership set out by Vannevar Bush 35 years earlier was fulfilled. With this legislation, it was now possible for individual academic scientists and/or their institutions to hold exclusive rights to privatize academic discoveries, thus allowing (as the argument went) the development of significant and life-saving advances.

Using simple financial measures, the growth of technology transfer in higher education has been successful. In 1980, royalties paid to Harvard University barely reached $24,000; in 1994, that number had grown to $5.75 million (Katterman 1995). In 1997, Moscovitch of BankBoston estimated that the 232 billion dollar revenues produced by the 4,000 companies founded by MIT graduates and faculty would constitute the equivalent of the 24th largest economy in the world, and employ 1.1 million people (Gwynne 1997). Be-

tween Fiscal Years 1995-1999, U.S. universities signed 10,477 license or option agreements with industry, 12% of which were start-up companies for which faculty members were the chief financial and/or executive officer (Reinhart 2001). Yet, although these efforts are encouraged by legislated national policy, namely the Bayh-Dole Act, feedback from students and faculty lead to cautionary tales about the dark side of this increasingly significant aspect of academic life.

Let me be clear: entrepreneurship is not merely another category of work to put alongside consulting or authoring. I collect money from consulting and authoring, and this is indeed a direct consequence of my work as a faculty member and my stature and experience in the academic community. It is tied to my scholarship. For a faculty entrepreneur, a critical ethical crossroads is reached when decisions made to support a healthy business venture are not aligned with the decisions needed to maintain a healthy academic environment (Gibbons 1989, Cech & Leonard 2001). This difference runs to the core of what a university means. The fallout from encouraging academic entrepreneurship without a strong set of safeguards is potentially devastating, not only in research universities but also at institutions whose teaching missions are being compromised by the pressure to conduct more research.

Technology transfer activities are diverse, and they can encourage practical, inventive, and important faculty work. Academic researchers are encouraged to patent and pursue the fruits of their research labors rather than having them languish undeveloped because industry cannot afford to invest millions of dollars in the unprotected public domain (Branscomb & Keller 1998). Another reason that institutions embraced this move, perhaps, was because of the perception that federal funding had reached its practical limit, and the difference in future needs would have to be made up by privatization (Kreeger 1997). Thorny dilemmas for higher education have resulted. Encouraging faculty members to combine "science and business, nonprofit and profit", Ellen Goodman (2001) wrote in her March 1 editorial of *The Boston Globe*, is also mixing "altruism and chumphood". In her criticism of academic entrepeneurship, Goodman speculates that Jonas Salk might be considered a chump by today's standards for having given away his work on the polio vaccine instead of cutting himself in for a piece of the action. The stories I am using to frame this essay are more modest than the discovery of the polio vaccine because the problems are not isolated grand spikes in an otherwise calm baseline. The stories represent cultural conflict where the decisions that make sense for a business enterprise compromise "the basic scientific approach" needed for discovery (Katterman 1995). They are the troublesome, everyday bellwether warnings that academic entrepreneurial activity is not automatically good for everyone involved in them, and more significantly not automatically good for higher education or its institutions.

Three years ago, a keynote speaker at a national chemical education conference, after having given a wonderful presentation on his biomedical chemical research and its applications, noted that his publicly held company was about to receive results from some important clinical trials. The speaker then advised us that (paraphrasing) 'you might consider getting in now because if the results are what we think they are, our stock will probably triple'. Despite the stock rising over 500% within a few months (and no, I did not buy any), this speaker's behavior, mixing science and insider business trading that rose at least to the level of conflict of interest, left a bitter aftertaste in my mouth.

A fundamental tenet of scholarship has always been the practice of treating discoveries as a shared, community property, especially discoveries supported by public funding. Faculty members have gladly accepted the privileges of being professors in exchange for an implicit culture of mutual gift-giving (Kovac 2001). I deposit what I learn into a shared resource pool that others are free to draw from, build on, and, in exchange, return for others to use. Even as Lee Shulman, President of the Carnegie Foundation for the Advancement of Teaching, and his colleagues seek to broaden the understanding of scholarship to include teaching and service by invoking this historical perspective (Shulman 1993), one must pause to realize that full, rapid, open, and honest disclosure of discoveries is not the universal norm that it once was. James A. Severson (2000), President of the Cornell Research Foundation, disagrees. In his July 13, 2000 testimony before the House Committee on the Judiciary Subcommittee on Courts and Intellectual Property, he maintains that non-disclosure occurs rarely, and that the fundamental question is to "find the best means to protect and disseminate this information for the public good." In many cases, the 90-day delay in submitting publications that follows filing a U.S. patent application is a reasonable compromise between full and immediate disclosure and protection of an intellectual property, although some reports from the academic life sciences cite averages that are twice as long (Gwynne 1997). Research that produces primary information that is commercially viable is not the whole story. In other cases, the hard-sought information, such as an enzyme's structure, is not the primary, marketable goal, but the means by which new drug targets can be designed (relatively easy once you know the enzyme's structure). It behooves the structural biochemists to conceal this structural discovery if they are invested in the drug discovery business.

Two years ago, another former undergraduate student wrote to me worried about his future. Although he was excited to enter the job market, he could not talk about his unpublished results because he was bound by non-disclosure until the patents made their way through the system. Adding to his dilemma,

> *any delay of publication gave the group a lucrative head start on subsequent research. I once asked, early on, about how his thesis work was going. He laughingly retorted that we could discuss it, but then he would have to kill me.*

In her editorial, Goodman (2001) does not suggest that faculty members need to take a vow of poverty, but cautions that significant and enforceable safeguards need to be developed to prevent systemic abuse. This is an excellent strategy. While Bayh-Dole has accomplished its best goals, to move good ideas into the marketplace, its crucibles, the academic research laboratories, bear important, fundamental differences compared with their industrial counterparts. Goodman invokes Salk to remind us that creative work can and should have greater reward than financial gain, including altruism and sheer intellectual curiosity. Taking this one step further, one needs to consider that students are doing the work that generates the intellectual property in academic laboratories, and that the conditions, stipulations, and assumptions underlying their work differ dramatically when compared with scientific employees in the private sector. More significantly, entrepreneurship has pushed some academic researchers to cross a moral boundary that jeopardizes the responsible education of undergraduate and graduate students.

> *Last year, yet another student whose research director recently founded a biotech company wrote about her discouraging graduate school experience: "…this unhealthy environment is a direct result of a faculty member who is 'stretched too thin'... I've heard older students say many, many times that 'It didn't use to be like this.'" According to a press release for potential investors, this award-winning faculty member is also nationally ranked as an "R&D Star."*

It is time to assess the consequences on higher education of certain trends that appear to be occurring as a result of the Bayh-Dole Act (Russo 2000). The debate on this topic typically circles around its impact on faculty and the institution (Cech & Leonard 2001), and ignores the student. As an illustrative case, consider the first of two point-counterpoint editorials, in which Fred Reinhart (2001a), Director of the Wayne State University Technology Transfer Office, argues that the opportunity to develop the practical applications of faculty work in biotechnology are motivating for steering investigators towards important problems. University of Michigan Biology Professor John Vandermeer (2001), in his counterpoint, worries that the ubiquitous drive by institutions to create the Silicon Valley of biotechnology is a fool's errand. Everyone is trying to do it, unlike when Stanford was able to take advantage of an intellectual vacuum in high technology. Most of these efforts,

Vandermeer speculates, will squander precious resources only to end in a dot-com-like demise of the majority of the players with nothing to show for their efforts.

Interestingly, Reinhart ends his essay with the stronger words of caution as he zeroes in on the moral dilemma. "Public oversight and responsible management," he concludes, "is absolutely critical." This is Reinhart's dilemma: How do we preserve the benefits from Bayh-Dole, while simultaneously preventing investigator-entrepreneurs from "sliding into abuses, tainting the research endeavor and letting the ends justify the means"? Bayh-Dole was argued on classical Utilitarian principles. Important biomedical discoveries could not be developed and brought to market, so the benefit to humanity was at risk. Universities would also benefit directly from a new revenue stream that flowed straight from established systems of public funding. Populist democrats in the U.S. did argue from the beginning that curtailing public disclosure of government funded discoveries was a problem, heralding some of the concerns for placing basic science at risk, but this was a minority view in 1980 (Branscomb & Keller 1998, p. 223). More recently, the National Research Council, which is the advisory body of the National Science Foundation (Bunk 2000), cautioned that Bayh-Dole, while originally peripheral to the actions of science, might create "substantial long-term consequences on the nature of the basic research enterprise". Cech and Leonard (2001) summarize the abuses, or "hidden dangers" from academic entrepreneurs as using university-paid time and resources for personal gains, causing colleagues to pick up the slack for work and responsibilities not done in favor of business pursuits, selecting student projects based on feeding the business interests, and diminishing the tradition of open discourse.

While the effects of entrepreneurial activity on scientific practice are important, the consequences for educating students responsibly should be paramount in these discussions. Academic scientific researchers have increasingly dominated a powerless and dependent labor force, namely, students seeking an education and advanced degrees, so the problem of student exploitation, while not new, has become acute (Golde & Dore 2001). The potential benefits for faculty members from entrepreneurial activity, what Professor Carl Djerassi (Stanford University) calls participating in intellectual polygamy (Morell 1989), changes the equation to favor Utilitarian, or even Ethical Egoist ideals. The financial gain from a successful business venture is significantly higher than from a successful academic venture, and the faculty member and the institution are the direct beneficiaries. Tenure spares the faculty member from assuming any real risks, so safeguards may not have been a high priority initially. Students, however, are assuming and perhaps being subjected to the greatest risk, and we may all pay the greatest price, from placing them in a system dominated by a faculty distracted and dissuaded

from their primary duties as educators. If academic scientific practice is compromised, then the system of education embedded in that practice suffers; students of science are harmed if their education as scientists is flawed. If students have no option for learning (or earning their degrees in their area of scientific interest) than by becoming the means by which an entrepreneur materially benefits, then we must accept a new academic cultural norm for exploitation.

> *This year, upon returning from visiting a prospective graduate school, one of our students was strongly turned off when entrepreneurship trumped science. "During my graduate school visits I talked to a number of professors, all excited about their work and used the potential applications of their work to either science as a whole or to humanity as a cure for some ailment. However, a select few (and one professor in particular) seemed more concerned with where the work his lab did ended up. He made a point to tell us where all of his projects ended up in terms of FDA [Food and Drug Administration] trials and so on, and spent a good 30 minutes of our time discussing the local 'tech' scene. He then went on and on about how much venture capital was available in the area, how he had a meeting with some venture capitalists recently, and how his own company is using research and results out of his own lab. This really annoyed me because I got the feeling that most of his research projects were selected based on whether or not they would be able to be carried over to his own company. Why would someone trying to find a place to do interesting research care about where the molecules end up? Graduate students are not allowed to make money from their thesis research anyway. Not once did he bring up the actual work his lab does, which is actually pretty interesting."*

2. Four cultural conflicts in higher education

In what might begin to be called 'the good old days', time for teaching and service were neglected in order attend to the demands of research. Institutions are now grappling with issues significantly more complex than how many days per month a faculty member can spend consulting. After having built a research enterprise that requires so much time, faculty members who are under self-inflicted or institutional pressure to start up a business will inevitably have to short-change their research obligations in order to satisfy this new master, and teaching and service will suffer even more (Finn 1998). The greatest irony is that entrepreneurship could seriously undermine the

basic research activity and the concomitant education of students that allowed it to develop in the first place.

Guidelines are emerging in response to these complex and sensitive issues. MIT, for example, uses a "Conflict Avoidance Statement" that asks its entrepreneurial faculty to ensure that funding lines remain clean, that students are not involved in company projects, that there is no delay or restriction on publication of research results, and that differentiation can be made between the research done by the company and the research done on the MIT clock (MIT 2001). The National Institutes of Health have installed new rules to safeguard the sharing of tools and materials (Marshall 1999), although a new Heath and Human Services regulation targeting conflicts that arise from an academic institution's financial interest in a company conducting gene therapy experiments has proved to be controversial (Marshall 2001). The Howard Hughes Medical Institute (HHMI) has put a 5% limit on the interests that a faculty member may hold in a company, disallowed consultation with a company with whom a faculty member actively collaborates, and requires that the scope of the academic-industrial interaction being carefully delimited (Cech & Leonard 2001).

Conflicts of interest arise for faculty members in at least four areas when business interests collide with academic obligations. These are not new conflicts, but ones that require new standards of behavior for faculty members who assume an entrepreneurial role.

Public conflict. The privileged life of a faculty member, anchored for the majority on the multi-million dollar decision to grant tenure, includes the obligation to retain the public trust and confidence. Financial resources come to universities through many paths. Certainly those institutions supported wholly or in part by public funds carry the obligation to return this investment. I do not think the situation is less clear-cut for private institutions who, above and beyond public money that might support research and other activities, still retain their obligation to put out responsible and contributing members of our society; this, too, is a matter of public trust (Kennedy 1997). Beginning in the 1940s, the U.S. government asked universities and colleges to commit their enormous creative resources, in exchange for public funds, towards basic research. Unfortunately, the public policy decision to fund research is increasingly seen as an entitlement, and it is beginning to be exploited in the entrepreneurial culture. This consequence from Bayh-Dole should be assessed. Can it really be an appropriate or informed use of taxpayer money, as redistributed by the government through the NSF, the NIH, or even a state legislature, to be treated as no-risk venture capital by individual faculty members in the course of their academic research?

Professional conflict. A faculty member's greatest obligation is educating the next generation, and carrying this out in a fair and timely way is a crucial

responsibility. As a moral precept, 'first, do not harm' is an important way to think about the faculty-student relationship. At institutions that offer advanced degrees, this includes the professional development of graduate students. While a degree of labor exploitation has always been a part of modern scientific practice, the trade-off in the form of a responsible education and professional career options has apparently made this a defensible position. The concern raised by academic entrepreneurial activity is that a responsible education is not being guaranteed. Three issues (call them potential 'harms') stand out. First, as discussed in detail earlier, the process of science is being compromised. Second, responsible mentoring is suffering due to conflicts of interest and simple limitations placed on time management. A third issue is the time it takes to get the Ph.D. There are many reasons why this time has increased over the last decade, but anecdotal evidence suggests that one cause is that productivity from a more experienced graduate student is so high that there is no real incentive for the research advisor to let the person graduate. A new graduate student would not be as productive and a post-doctoral associate would be more expensive. As it is, a test of scholarly character has always been the decision not to hold onto a productive student in the face of competition for resources for research. The entrepreneurial faculty member, who sits at the confluence of what it means to be a 'boss' and what it means to be a 'research advisor', might be more easily tempted into exploiting the available personnel (students) when business success is on the line.

Institutional conflict. If entrepreneurial faculty members neglect their teaching, research, and service in order to do the work of business, then their primary jobs are not being done. This is called dereliction of duty. It is up to colleagues to pick up some of the slack, contributing to increased faculty stratification, while some responsibilities just are not fulfilled at all. In her new book, *Leaving the Ivory Tower*, Barbara Lovitts (Lovitts & Nelson 2001) outlines factors contributing to an alarming attrition from Ph.D. programs, including "increased corporatization and pervasive labor exploitation", and the potential inability of this generation of faculty to replace itself. All the while, excellent future faculty candidates are turned off by what they see around them. While four of the undergraduates whose stories, related above, began graduate school fully intending to pursue a career in academics, two of them changed their minds before the end of their second year. One of them sharply admonished me, saying, "If I were in your position, I would not be encouraging students to enter this system."

Personal conflict. While the self-governance of a faculty body has been substantially turned over to academic administration, individual faculty members are still primarily responsible to themselves. Most of what we do is done without oversight. Perhaps the most difficult dilemmas arise from how to allocate appropriately one's own time and effort. The continuum of what

constitutes appropriate work in carrying out faculty work is filled with gray areas, and we are left with more questions than answers. How is a faculty member to resolve a conflict of interest when the gains from the 'business' aspects of one's work are orthogonal to the best interests of 'research' or the 'university job'? Where would you put your effort if the potential gain of millions of dollars and the responsibility you have for your corporate employees are weighed against the generally thankless academic environment where faculty compete over a meager 3-5% salary program dominated by the stars in the star system?

3. Reaction and Action

These conflicts will ultimately spur reaction and action. Most basic, I think that public funding will return to subjecting all discoveries to open disclosure in the public domain. New legislation is needed to find the right solutions for issues that are not easily handled by U.S. patent laws, such as the structural biology example described earlier. New standards of practice in higher education are needed, perhaps building on the MIT, Howard Hughes Medical Institute, and National Institutes of Health models. Institutions such as the National Research Council, too, are going to respond decisively when the fabric of scientific practice is perceived to be endangered. In his book, *A University for the 21st Century*, former University of Michigan President Jim Duderstadt (2000) characterizes the modern university as a "loosely coupled, adaptive system" housing a "loose federation (or 'holding company') of faculty entrepreneurs" who can end up "deprived of the opportunity to do what they do best – thinking, dreaming, talking, teaching, and writing". Duderstadt suggests that the complex corporate mentality that characterizes the institution has inevitably trickled down to the work of the faculty. In the end, though, he urges research universities "to tap the great source of creativity and energy associated with our faculty's entrepreneurial activity in a way that preserves our core missions, character, and values".

Duderstadt restates Reinhart's dilemma. Can these goals (as stated in the title: preserving morally responsible education in a utilitarian entrepreneurial academic culture) be met simultaneously? Perhaps, but apparently not easily. Let me review the three responses that currently characterize the situation for faculty who have faced this dilemma, none of which satisfy simultaneously the needs of both higher education and business. First, the simple fact is that nobody can do everything. The *de facto* separation of the research function from the undergraduate teaching function has taken place at many institutions, where temporary, non-tenure track instructors are responsible for a

large fraction of introductory undergraduate teaching. In chemistry, the growth of the so-called "chemical education" community as a separate and distinct group is a testimony to this, including the emergence of Ph.D. programs in chemical education (Coppola & Jacobs, forthcoming). Faculty members who collect salaries predicated on their instructional duties, but who do not actually teach, do not satisfy the needs or demands of responsible education.

Second, and more defensibly, are those faculty members who, upon making discoveries with significant commercial potential, simply leave the university to pursue their new interests. For them, the answer is easy: the conflict between education and business cannot be reconciled, and they make a choice.

Third, some faculty members enter into negotiations with the private sector, turning over their discoveries in exchange for research funding and personnel support instead of personal gain and the loss of time that running a business entails. These faculty members have, in effect, exchanged one source of support (public government funding) for another (private funding). By turning one's research time into a zero-sum game, exchanging one source of support for another does not, in principle, take away from one's other obligations. Fair limitations, clearly defined work boundaries, and shared benefits is a solution most like those being developed at Howard Hughes Medical Institute or the National Institutes of Health. Students in this setting have a better chance to be safeguarded from exploitation while allowing faculty members to pursue entrepreneurial activities.

Faculty members who wish to pursue entrepreneurial activities should certainly be free to do so, but participating significantly in achieving these goals should be clearly recognized as work done outside of time allocated to faculty obligations in research, teaching, and service. For short-term activities, unpaid leaves of absence would work provided one's obligations to research students could be managed appropriately. If entrepreneurial activity reaches a prescribed threshold that would constitute abuse, then the system must be able to respond in ways that preserve academic freedom yet protects the public trust. For instance, higher education already has a job description for faculty whose primary contributions are outside of full-time academic interests. Such faculty members are called adjunct faculty. Faculty members who chose to maintain significant business interests should be required to relinquish the privileges of their academic positions, including tenure, if they are no longer able to handle the responsibilities in the non-entrepreneurial part of their job. An oversight committee is also needed to monitor more closely research students who are mentored by on-leave or adjunct faculty members to prevent exploitation or neglect. Certainly, neither the institution nor the individual faculty member will embrace this option because both of

them must assume risk. Yet, for the same reasons that advisory bodies such as the National Research Council will recommend governance to safeguard science as the more defensible position, advocates for the sanctity and preservation of higher education, and its students, must rise up and be heard loudly and clearly.

Do any of the recommendations in this paper preserve a morally responsible education in the context of entrepreneurial activity? No, of course not; but they do preserve its potential, which is my concluding purpose. Just because the classroom and laboratory are made into safer places for students does not mean that their education is being handled responsibly, but surely it is more difficult to impossible without this guarantee of safety! Certainly, there is a long distance between "safeguarding students from exploitation" and "preserving a morally responsible education", because even the notion of a morally responsible education (Kovac & Coppola, forthcoming) is barely examined and inadequately defined in today's system of higher education. Academic entrepreneurial activity provides an opening to address these issues, though, because it forces us to consider the place of education in higher education, and the defensibility of choices that bring conflicting ideals into focus.

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