University Entrepreneurship and the Public Purpose

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Universities, like other complex institutions, adjust their goals and practices to changes in the broader political and economic environment within which they function. Over the past decade, a number of factors have been responsible for producing a closer coupling between academic and corporate institutions. The result has been a merging of corporate and university values for both the faculty and the institutions.

Some view this as a positive sign. They argue that faculty and curriculum can become stale, irrelevant, or outdated if they are too insulated from wordly affairs. Many advantages are cited in promoting closer ties between the academic and industrial sectors, not the least of which is opening up new funding sources to the university. It is also argued that the country as a whole benefits from university-industry partnerships because of improved technology transfer (Bearn, 1981). Too many useful inventions and discoveries remain unrealized because they are not brought to the attention of the innovation sector. According to former Presidential science advisor George Keyworth, unless universities and industry work more closely, the United States' industrial competitiveness will decline precipitously (Keyworth, 1982).

Universities have also begun to emulate the private sector by adopting management practices and efficiency criteria, by profiting from faculty discoveries and inventions, and in a few instances by direct investment in commercial ventures. Also, the concept of the "corporate liaison program," which allows universities to earn income by providing companies with privileged access to faculty research, has gained wide acceptance.

The distinction between universities and corporate institutions in mission, mode of operation, and public purpose has been widely recognized (Abelson, 1982). Bartlett Giamatti, when President of Yale University, highlighted the differences as follows: "the academic imperative [is] to seek knowledge objectively and to share it openly and freely; and the industrial imperative [is] to garner a profit, which creates the incentives to treat knowledge as private property" (Giamatti, 1982, p. 1279).

Cooperative agreements between the academic and business sectors can sometimes result in uneasy compromises. In the past several years there has been considerable debate about the proper boundaries for these contractual arrangements. The debate has been spurred by a new generation of financial and research partnerships, perhaps most visible in the area of biotechnology.

I shall argue that these linkages have created an entrepreneurial atmosphere that has begun to alter the ethos of science. Norms of behavior within the academic community are being modified to accommodate closer corporate ties. In addition, there are more subtle losses to society when the leading faculty in entire disciplines have financial interests in the commercialization of research.

To gain a better grasp of these changes, the paper will proceed as follows. First, I shall explore a metaphor that conceptualizes the university as an institution with multiple personalities in dynamic equilibrium. Second, I shall identify several factors external to the

university that are responsible for producing closer ties between academia and industry. Third, I shall sketch out three areas of potentially adverse consequences which follow. Finally, I shall examine one of these impacts, namely the long-term social consequences of the melding of corporate and academic cultures, by examining the case of biotechnology.

The University's Multiple Personalities

It is useful to think of the university as an institution with multiple personalities. Each personality symbolizes a distinct form of institutional identity with its own goals and responsibilities. Conflicts that arise over university-industry connections often reflect more deeply rooted tensions among these multiple forms of identity.[1]

- **Classical Form:** Knowledge is Virtue. In its classical personality, the university is viewed as a place where knowledge is pursued for its own sake. The problems of inquiry are internally driven and bound by the norms of university cooperation.
- **Baconian Ideal:** Knowledge is Productivity. The main function of the university is to provide personnel and intellectual resources for economic and industrial development. The pursuit of knowledge is not fully realized unless it can contribute to productivity. The responsibility of the scientist begins with discovery and ends with application.
- The **Defense Model:** Knowledge is Security. University laboratories and the scientists who manage them are viewed as critical resources for national defense. Universities differ in their willingness to undertake military research. Policies restricting classified or weapons research represent a barrier to the fulfillment of this model.
- The **Public Interest Model:** Knowledge is Human Welfare. According to this view, the role of the university is to solve major human health and welfare problems such as dread diseases and world hunger. Professors are viewed as a public resource called upon to tackle complex medical, social, economic, and technological problems.

The concept of multiple institutional personalities helps draw attention to the fragility of their interrelationships and the potential for conflict among the distinct values and responsibilities associated with them. The equilibrium in which these personalities coexist in universities is subject to change as a result of external forces. Recent interest in creating closer ties between the corporate and academic sectors reflects a greater emphasis on the Baconian identity, whereas the Defense Model is being aggressively promoted by those advocating the Strategic Defense Initiative (SDI). In both cases, external forces are contributing to a shifting balance in the academic culture, away from the classical and public interest models.

External Factors Promoting University-Industry Partnerships

The success of Japan's industrial economy has been explained in part by the country's efficiency in exploiting new technology for industrial purposes. Alternatively, the declining competitive position of the United States has been attributed to its failure to bring new technological ideas quickly enough into industrial application. George Keyworth, speaking as Presidential Science Advisor, noted that "most academic and federal scientists still operate in virtual isolation from the expertise of industry and from the ex-

perience and guidance of the marketplace" (Keyworth, 1983, p. 609). He attributed the separation of academia from industry as a "root cause" of the sluggishness of the economy.

In response to the challenge to improve innovation in American industry, both Congress and the Executive have supported policies designed to create closer collaboration between universities and the private sector. For example, new federal patent legislation, passed in 1980, gave universities and small businesses greater incentives to exploit faculty discoveries arising from federal grants by relaxing criteria for federal approval of licensing agreements between universities and private businesses. In the same year, a revision in the tax laws created the Research and Development Limited Partnerships (RDLP), a financial instrument for attracting R&D capital to university campuses. The RDLP structure provided for special tax shelters and high investment income. The Office of Productivity, Technology, and Innovation (OPTI), created in 1981, promoted the use of RDLPs at universities as a means of generating alternative sources of research capital and accelerating the transfer of federally funded technology. Finally, the Economic Recovery Tax Act of 1981 allowed a 25% tax credit for 65% of a firm's payments to universities to support basic research. The law also permitted a larger deduction for charitable contributions of equipment used in scientific research (Johnson, 1982).

The new structural forms for stimulating industry investment in university research were part of an overall plan for reindustrializing the U.S. economy. The strategy of "privatization" – put simply, less government and more private initiative – has been applied to every phase of American life from social programs to the government's own printing office (Smith, 1985). To achieve its goals, the Reagan administration sought lower taxes and presented Congress with reductions in most major domestic budget categories, including scientific research (defense-related research, in contrast, was increased). Anticipating reductions in research budgets and facing a more favorable environment for collaboration, universities moved easily into agreements with the private sector. Some of the largest financial collaborations took place in electronics and biotechnology (Norman, 1982; Zinder & Winn, 1984; Kenney, 1986).

Potential Negative Impacts

The potential adverse impacts of corporate-university collaborations can be divided into three general areas: those diluting the goals of science; those conflicting with the mission of the university; and those having deleterious societal outcomes.

A number of questions have been raised concerning the goals of science. When academic science draws more of its funding from the private sector will that skew the fundamental research objectives? Will scientists with entrepreneurial ties lean toward research programs with a greater commercial emphasis? The only study attempting to answer these questions was based on a survey of biomedical scientists. After questioning over 1200 faculty in 40 major universities in the U.S., Blumenthal and his colleagues concluded that "faculty... who were receiving industry support tended to publish more, patent more, earn more, serve in more administrative roles, and teach as much as faculty without industry funds" (Blumenthal et al., 1986b, p. 1364). They also found, however, that faculty with industry support were significantly more likely to report that their choice of research topics had been affected by the likelihood of commercial application. Most biotechnology faculty interviewed who do not receive industrial support believe that there has been a skewing of research toward the applied area, but the Blumenthal study

was not sufficiently fine-grained to determine the extent to which the research agendas of academic entrepreneurial scientists had shifted, if at all.

The second area of impact is the university. Much of the debate about university-industry ties has focused on how this will change university mores. Will the academic ethic that has nourished free and open inquiry give way to a new ethic of corporate-sponsored research? Will universities be a major producer of trade secrets? Will professors be judged on their ability to attract revenue-generating projects?

Although the evidence is incomplete, there are clear indications that academic research institutions have accommodated to industrial partnerships at the expense of traditional norms of scientific behavior. First, limited secrecy has replaced the unrestricted flow of information as an approved norm of scientific behavior. Included among the guidelines proposed by Varrin and Kukich (1985) for universities engaged in industry-sponsored research are the provisions that graduate theses containing patentable material may be sequestered for a year and that investigators be allowed to sign confidentiality agreements prohibiting them from divulging sensitive information for up to five years.

Most universities negotiating corporate research agreements have accepted publishing delays or even prohibitions where proprietary information is involved. The trend seems clearly toward practical compromise and away from the ideal of unfettered communication in science. For example, one of the surveys by Blumenthal et al. (1986b) found that increased industry sponsorship of academic research was correlated with increased secrecy in universities. Biotechnology faculty with industry support were four times as likely as those without support to report trade secrets (i.e., information kept secret to protect its proprietary value). One scientist interviewed by Etzkowitz concisely captured this new academic ethic as follows: "informing interested researchers without limit [is] a nineteenth century idea" (Etzkowitz, 1984, p. 8).

Second, universities have shifted their position on faculty entrepreneurship from neglect or even opposition to affirmative support. Several universities have actively invested in faculty enterprises and offered rental space for commercial ventures. According to Etzkowitz: "Some university administrators... are explicitly encouraging their academic staff to participate in industrial enterprises, viewing it as a contribution to economic development and as a means of gaining support for the university" (Etzkowitz, 1983, p. 222). Moreover, universities are increasingly prepared to modify their conflict of interest rules to accommodate commercial ventures (Kenney, 1986). For example, in founding the for-profit biotechnology firm Neogen in 1981, Michigan State University changed its conflict of interest rules to allow professors to acquire equity in the company while simultaneously serving as consultants to it.

In the past, faculty-owned firms were handled discreetly. Most universities had no restrictions against full-time faculty holding managerial positions. The case of Harvard Nobel biologist Walter Gilbert and his relationship to Biogen brought the issue to national attention. However, the debate over the Gilbert-Biogen tie did not extend to a dispute over the basic idea of faculty involvement in commercializing their research. Instead, the issue was the level of faculty involvement: whether full-time faculty should be permitted to serve as principals of firms; whether universities should be allowed to invest in faculty-managed firms; and whether such firms should be permitted to sponsor research on campus.

Varrin and Kukich (1985) recommend a compromise position: a faculty entrepreneur's company should not be permitted to sponsor his or her own research on campus, but the company should be permitted to sponsor other scientists on the cam-

pus, even within the same department. Under this norm, a senior faculty member with managerial responsibilities in a firm might serve the roles of both colleague and client with respect to a junior scientist.

Faculty Entrepreneurship and the Public Purpose

An issue that has received almost no attention in the debate about university-industry partnerships reaches beyond the norms of science and the mission of the university. I am referring to the importance to society of an independent academic sector. Professors are called upon to provide technical expertise and to exercise independent judgment across the range of public policy. Scientists serve on a labyrinth of public advisory committees and risk assessment panels at all levels of government. Every regulatory and funding agency depends upon the use of outside experts. For this process to work effectively in our highly complex technological society it is essential that we secure unbiased, objective advice from individuals who are financially disinterested in the areas in which they are called upon to consult. To take an admittedly hypothetical example, if every nuclear scientist in the academic world were concurrently on the payroll of the nuclear industry, where then would society find its disinterested nuclear experts? What confidence could we have in the objectivity of nuclear risk assessment? If we could no longer rely on the reports and testimony of academic scientists to assist elected officials in regulating nuclear power, we might well provide a cadre of nuclear scientists with public funds to ensure their independence from the nuclear industry.

This portrait of a commercially monopolized academic discipline is fortunately not applicable to nuclear scientists. But in other fields it may not be so far fetched. In 1969, Union Oil Company's offshore well sprung a massive leak in the Santa Barbara Channel. According to a report by Walsh (1969, p. 412):

> California's chief deputy attorney general...publicly complained that experts at both state and private universities turned down his requests to testify for the state in its half-billion dollar damage suit against Union and three other oil companies.

State officials attributed the difficulty they had in getting expert testimony to the belief that petroleum engineers throughout the California universities "did not wish to risk losing industry grants and consulting arrangements" (Walsh, 1969, p. 412). According to the report, academic scientists and engineers were part of an extensive university-industry "oil fraternity."

There is growing evidence that faculty-corporate relationships in biotechnology are manifesting similar patterns. As early as 1982, Culliton claimed that most of the nation's leading biotechnologists were affiliated with firms (1982, p. 960). In 1984, Zinder and Winn noted that very few hard estimates of faculty participation in commercially-related activities were then available. Since few universities require faculty to report such affiliations, and those that do insist that the information be kept confidential, institutions themselves are not good sources for this kind of information. Zinder and Winn were, however, able to obtain data on faculties at several West Coast universities which indicated that 12-15% of faculty in selected departments had consulting arrangements with the biotechnology industry. The authors claimed that this figure underestimates the actual extent of participation. They also cited testimony before the House Subcommittee on Investigations and Oversight by Natural Resources Defense Council attorney Albert Meyerhoff, who stated that nearly 100% of the top people in biotechnology are tied to firms (Zinder and Winn, 1984).

In the more recent studies by Blumenthal et al., (1986a; 1986b), 800 respondents were identified as working in the area of biotechnology. Among this group, 23% indicated that they were principal investigators on grants or contracts from industrial sources. However, the study provided no data on academic consultantships or faculty participation in biotechnology startups.

In 1984, at a Boston conference on Genetics and the Law, I reported preliminary findings on a quantitative study of professor-industry links in biotechnology. The study involved a data base of academic faculty and scientists at non-profit research institutes who meet one or more of the following criteria with respect to biotechnology firms: 1) serve on the scientific advisory board; 2) hold substantial equity; 3) serve as a principal. Academics who met any of these criteria were defined as "dual-affiliated" for the purpose of the study. The data base consisted of 345 dual-affiliated scientists (DAS) in 50 biotechnology firms. The information was gleaned from company reports and prospectuses. Data were provided on dual-affiliated scientists who are members of the National Academy of Sciences (NAS), who served on NIH study panels, and who were peer reviewers for the National Science Foundation (Krimsky, 1984).

Based upon data on a limited number of firms, I determined that 25% of the NAS membership in categories relevant to biotechnology had formal associations with the industry. I estimated that the figure could exceed 50% by the time all the firms were surveyed. David Baltimore of MIT and the Whitehead Institute responded that the figure is certainly higher than 50% (Milunsky and Annas, 1985). Bernard Davis of the Havard Medical School commented: "The situation, Dr. Krimsky, is worse than you think. The National Academy is a lifetime election with a large fraction of the members past retirement; for active members, it's way over 50% that have such connections" (Milunsky and Annas, 1985, p. 67).

Recently, the data base was expanded by surveying several hundred public and private biotechnology firms, and now comprises about 800 dual-affiliated scientists (DAS). The DAS comprise 30% of the NAS membership in biomedical science (over 100). Several of the leading universities have a sizable percentage of their faculty with commercial ties. Our figures include only scientists who have a "formal affiliation" with a biotechnology firm and exclude individuals who have grants or contracts but are not listed on the firm's roster. Therefore, the DAS data represent a lower boundary of university-industry affiliation. Many private firms do not publish their academic advisors, shareholders. or profiles and affiliations of managers. It is inarguably the case that the most prestigious universities in biomedical sciences have the leading scientists in the field and that the biotechnology industry has heavily contracted the services of these scientists. This fact is illustrated by the number of scientists at four leading institutions (Harvard, MIT, Stanford, and Columbia) who serve on advisory boards of biotechnology firms. The figures reported (see Table 1) are *de minimis* and probably understate the actual number of dual-affiliated scientists.

These data reveal the extent of the transformation in the biological sciences that has taken place since the discovery of plasmid-mediated gene transfer (recombinant DNA). Table 1 shows, for example, that Harvard has at least 60 of its faculty formally connected to 33 separate biotechnology companies, most less than ten years old. Previously, molecular biologists had very little commercial association. During the last decade, however, professors have started their own firms or, more frequently, been appointed advisors to new biotechnology companies. The pattern is similar, although on a somewhat smaller scale, at the other universities surveyed.

Table 1. Scientists with Corporate Affiliations in Biotechnology

Institutions	Number of Academic Scientists on Company Scientific Advisory Boards	Number of Companies Having Academics on their Scientific Advisory Boards
Harvard (all schools)	60	33
MIT	33	24
Stanford	35	19
Columbia	18	14

I have argued elsewhere (Milunsky and Annas, 1985) that heavily commercialized disciplines may be a social liability. It is vital to the public purpose that a critical mass of scientific specialists remain disassociated from industrial ties in areas related to their field of expertise (Krimsky and Baltimore, 1980). In biotechnology, it is questionable whether that critical mass still exists, at least among the leaders of the field. A few quotes from a recent editorial in New York's *Newsday* illustrates that the suspicion of the scientist-extrepreneur runs very deep in the mass media:

> A number of (Genentech's) stockholders are principal investigators in a federally sponsored $31 million clinical trial of a hot new Genentech product called TPA, an anti-blood clot drug. If the study convinces the government that TPA is safe and effective, Genentech will make a bundle...Mount Sinai Medical Center and 16 other hospitals agreed to share in profits that might come from an experimental drug they're testing for the relief of symptoms associated with Alzheimer's disease. And last month, a Harvard scientist presented a paper at an international conference on Lyme disease praising a new method for controlling illness-transmitting ticks. He failed to disclose that he is founder and officer of the only company that markets this method...It's time for the government and academic institutions to stiffen their attitude toward conflict of interest. The public's health depends on unbiased results free of even the appearance of ulterior motives in testing (*Newsday*, October 16, 1987).

In order to avoid even the appearance of impropriety and the self-aggrandizement of expertise, the ties of scientists to commercial institutions related to their research must be publicly disclosed. Disclosure does not solve the problem of preserving a disinterested pool of scientists, but at the very least it is information that a responsible electorate and its representatives will need in order to render informed decisions.

Conclusion

Earlier in this paper, I introduced the metaphor of multiple personalities as a heuristic device for understanding the changing relationships that have evolved among universities, government, and the commercial sector. The metaphor highlights the fragmentation and, at times, the conflict of purpose within institutions of higher learning. By embracing several identities, universities can capitalize on diverse funding sources, can accommodate a faculty that values its freedom of association, and can respond to a national challenge that seeks to foster technology transfer as a means of improving America's global industrial position.

Multiple personalities are adaptive to universities. Each of the four forms of institutional identity serves a function. The identities generally coexist in reasonable balance.

But the rapid commercialization of biology has led some critics, inside and outside of academe, to question the reconstruction of this balance. When the balance is challenged, as it has been in the media and from some sectors of academe, it reminds us that the identity crisis within universities is a reflection of broader societal issues. Each of the institutional "personalities," after all, is derived from a public purpose. Universities cannot serve all purposes maximally and still retain a set of coherent values. However, among its four "Personalities" there is one which is distinctive. Without a strong classical identity, a university loses its unique status in society. It becomes a handmaiden to special interests. This may be the outcome of the social evolution of the university. In such circumstances democratic societies will have to invent surrogate institutions to replace the loss.[2]

Notes

1. For a more extensive discussion, see Krimsky (1987).
2. I wish to thank James Ennis of Tufts University and Robert Weissman of Harvard University for their help in developing the data base from which some of this analysis was derived. Sections of this paper are adapted from Krimsky (1987).

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Biotechnology

Professional Issues and Social Concerns

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