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# PART 7

## Academic Science and Industrial Development

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The ongoing debate over “academic capitalism,” university/industry collaborations, and the commercialization of university performed research continues to be controversial. Proponents of academic capitalism argue that it is the only way to keep entrepreneurial-minded faculty from fleeing to the private sector, and ensures continued access to modern laboratory facilities that are needed for graduate education. The opposition counters that business-preoccupied schools are “selling their soul,” and abandoning their pedagogical mission to the detriment of their students. The following four chapters provide views from inside and outside the Ivory Tower.

Larry L. Leslie, Ronald L. Oaxaca and Gary Rhoades of the University of Arizona provide Chapter 23. Their paper discusses academic capitalism, which they describe as a college or university’s “deployment of their only real asset, the human capital of their faculty, for the purpose of enhancing their revenues.” In order to evaluate academic capitalism, the authors apply resource dependency (RD) theory to their analysis of institutions of higher education. RD theory states that “internal organizational activities are influenced primarily through the actions of external resource providers.” Leslie et al., also provide an analysis of academic capitalism at the institution, department, and individual levels. They conclude that while RD is important at universities, and at the individual level, its effects “appear somehow to be mitigated at the department level.

In Chapter 24, Lita Nelsen of the Massachusetts Institute of Technology (MIT) discusses the increase in university/industry collaborations. Nelsen, the director of the Technology Transfer Office at MIT, presents the viewpoint of a large, private, research oriented university. In her chapter, she addresses two types of technology transfer: industrial research collaborations, and technology licensing. She believes there is a problem with collaborations, manifested in a psychological dynamic: “The more we work together, the more apparent the differences become; the more we need each other, the more frustrated we get with each other.” In addition, there are cultural differences between the two, the largest being the “the hierarchical orientation of the university and the teamwork orientation of industry.” Although there are barriers to collaborations, Nelsen proposes that they can be overcome if you

“keep in mind the basic mission of the university, and that money is a route to that mission, not its reason for being.”

Steven G. Zylstra draws on his experience at the Arizona High Technology Industry Cluster, to write about technology transfer and commercialization of university performed research. He explains that 25 percent of Arizona’s gross state product is centered on the states’ high-technology cluster, and many of the companies that participate in the cluster collaborate with the state’s three large public universities. However, there was “an industry perception of onerous university policies,” which limited collaboration necessitated improvements in technology transfer and intellectual property rights. Zylstra’s chapter provides an overview of the steps that the Arizona Board of Regents took to correct these problems. He writes: “The expected results from this arduous and long, but very successful, effort has improved university/industry collaboration through more sensible agreements. Both the universities’ and the public’s interests are preserved, and in fact the inventor’s interests are also preserved.”

Part 7 closes with a reprint from an article that created quite a stir when it appeared in *The Atlantic Monthly*. Eyal Press and Jennifer Washburn’s paper, “The Kept University,” was the recipient of the 2000 “Science in Society” award for journalism in a magazine from the National Association of Science Writers. In their article, the authors argue that universities are straying from their educational mission, and emulating for-profit corporations. Press and Washburn cite the drop in public support for education and the passage of the Bayh-Dole Act in 1984, as the main reasons academic administrators have turned to the private sector. They write, “The goal of the legislation was to bring ideas out of the ivory tower and into the marketplace, by offering universities the opportunity to license campus-based inventions to U.S. companies, earning royalties in return.” It worked, and “revolutionized university-industry relations.”

Press and Washburn fear that an “Academic-Industrial Complex” has been created which engenders scientific secrecy and conflict of interest. Universities have begun buying equity stakes in companies that may profit from their research, as well as developing their own brand-name products. They write, “If these activities appear to be out of keeping with the university’s nonprofit educational mission, that’s because they are.”

# 23 Technology Transfer and Academic Capitalism

Larry L. Leslie, Ronald L. Oaxaca, and  
Gary Rhoades

This chapter stems from a book co-authored with Sheila Slaughter, *Academic Capitalism: Politics, Policies, and the Entrepreneurial University*.<sup>1</sup> Although technology transfer issues were central in that book, this chapter will discuss other issues, beginning with a definition of academic capitalism.<sup>2</sup> The term simply refers to college and university deployment of their only real asset, the human capital of their faculty, for the purposes of enhancing their revenues.<sup>3</sup> In the book, we define academic capitalism as “institutional and professorial market or market-like efforts to secure external moneys.”<sup>4</sup>

In the United States at least, academic capitalism is an “accelerating trend” rather than a “new event.” When we conducted our initial U.S. interviews in 1991–92, the typical reaction to our inquiries could be summarized by a response made by a university hydrologist to my inquiry about entrepreneurship in his unit. “What’s new?” was his comment. In other countries, such as Australia, Canada, and the United Kingdom, one could argue that academic capitalism had its “coming out” only about a decade ago, two at the most, although of course entrepreneurial professors and academic units have existed for much longer. Now, academic capitalism seems to characterize higher education in virtually all of the OECD (Organization for Economic Cooper-

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ation and Development) countries and is expanding to central and eastern Europe.<sup>5</sup>

To us, the most interesting questions related to academic capitalism are why is it accelerating, and what are the impacts upon institutions of higher education (IHE)? These questions serve as the focus of this chapter.

### Academic Capitalism at the Institutional Level

When we wrote *Academic Capitalism*, we devoted a chapter to exploring the first question. We had been observing changes in institutional revenue patterns in the United States for more than a decade, specifically the relative decline in state government support. What I had not known, until on a trip to Australia on a Research Fulbright (to study technology transfer between universities and the national economy, coincidentally) was that this pattern was not unique to the United States. In Australia we learned that the federal government was pushing universities to take a greater role in promoting national economic growth, in part by providing incentives for the universities to collaborate with industry and with various branches of government. Later, we became more aware that these patterns were not unique to either country.

In that same chapter, we presented both changes in revenue and expenditure patterns for institutions of higher education in Australia, Canada, the United Kingdom, and the United States over time. Consider the U.S. data for public IHE the state appropriations declined from 44.0 percent of all support in AY 1980-81 to 37.3 percent in AY 1990-91, representing a decline of \$6.4 billion.<sup>6</sup> Meanwhile, support shares from tuition and fees increased, as did shares from private gifts, grants, and contracts as well as from sales and services. Clearly, U.S. public IHE had not sat idly by while revenues from their chief resource supplier, state governments, had declined in relative terms.

At about the time of our departure for Australia, my colleague, Gary Rhoades, brought to my attention Pfeffer and Salancik's *resource dependency theory* (1978), which holds that internal organizational activities are influenced primarily through the actions of external resource providers: in short, "He who pays the piper calls the tune." Degree of resource-provider influence is a function of the relative magnitude (share of organizational funds) of the exchange and of the *criticality* of the resource to the recipient (Pfeffer and Salancik, 1978; Pfeffer 1982). According to resource dependency (RD) theory, important revenue

changes destabilize organizations, which address budget shortfalls by pursuing, leveraging, and substituting other revenue sources. An important corollary of RD theory is that organizations often are shaped as much by the pursuit of marginal monies (less than ten percent of total revenues) as by much larger, base budgets.

This theory seemed to fit well with what was occurring in the United States, as well in the other three countries. State appropriations (relative magnitude) were declining and IHE appeared to be making up the shortfalls in other categories.

What about my second question, which also was posited by resource dependency theory? Did shifting resources result in shifting activities within IHE? We already were aware of the relative decline in the allocation of institutional resources to instruction in the United States, and of the increase in the shares being allocated to administration in the other countries and in the other categories of expenditures, the connections also appeared clear: As revenue reliance shifted, so did institutional expenditures, and the shifts were in the expected directions. For example, for the United States over the same 1980–90 time period, the share of expenditures devoted to instruction declined from 35.1 percent to 33.7 percent, while the research share increased from 9.0 to 10.1 percent. Essentially, all the changes were in the expected directions.<sup>7</sup>

Largely from our work in Australia, but also from subsequent work in the United States and the other two countries (Canada and the United Kingdom), we reached a number of conclusions about the effects of the shifting revenue patterns upon IHE. Based upon the Resource Dependency theory we speculated about many more. By the time we finished *Academic Capitalism*, we realized that there was much more to be learned.

In 1996, Ronald Oaxaca, Gary Rhoades, and I received funding from the National Science Foundation (NSF) to explore “The Effects of Changing Revenue Patterns on Public Research Universities.”<sup>8</sup> We had proposed to examine, among a sample of elite, public research universities in the United States, the effects of the revenue shifts, which had continued into the 1990s. Through the three years of that effort, we (along with graduate students) examined the effects at all three institutional levels: the university, the academic unit (department or facsimile), and the individual faculty member. The remainder of this chapter presents the results of that examination.

## The Institutional Level

For her dissertation, Hasbrouck (1997)<sup>9</sup> built causal models, using Higher Education General Information Survey (HEGIS) and Integrated Postsecondary Education Data Systems (IPEDS) FY1982–83 and 1992–93 financial data for 175 public four-year institutions, to test the relationships among the shifting revenue and expenditure patterns. She constructed her models not only to test resource dependency, but also to consider explanations from economic theory: viewing internal resource allocation as a means of optimizing organizational utility. In keeping with resource dependency theory, whether expressed in dollar or percentage terms, instructional expenditures—the area presumably of greatest interest to state legislators and students—consistently and strongly were predicted by state appropriations and tuition and fees, as would have been expected, but also modestly by gift, grant, and contract revenues. Primarily, however, gift, grant, and contract revenues were targeted on research, as would have been expected. In fact, in all expenditure categories, resource dependency was supported. In other words, all else held constant (*ceteris paribus*) the expenditure patterns suggested that the principal wishes of resource providers such as political leaders and students, who supply the appropriations and tuition and fee funds, were satisfied.<sup>10</sup>

Hasbrouck also considered the changes that had occurred between FY83 and FY93, that is, whether time-series results were consistent with the cross-sectional results.<sup>11</sup> Virtually all of the results were consistent.

In summarizing her findings, Hasbrouck (1998, p. 8) reinforced resource dependency explanations: “Were a particular revenue source to decline either absolutely or relatively, one would presume that expenditures for that revenue’s related activity might also decrease.” She observed, however, that some revenue substitution might occur; for example, she noted that both tuition and fees and appropriations revenues supported instruction. She also concluded that other theories no doubt play some role in determining how institutions allocate their resources internally.

## The Department Level

For their dissertations Gary Ward (1997)<sup>12</sup> and Paul D’Sylva (1998)<sup>13</sup> analyzed two different data sets to examine effects of shifting revenue

patterns at the department or facsimile level.<sup>14</sup> This level of analysis is particularly important because this is where the production activities of IHE largely are carried out. In fact, the institution-level analyses are important primarily as background; if institution-level financial dynamics are not transmitted to the operating-unit level, one might argue that there is little organizational consequence.<sup>15</sup>

Ward and D'Sylva addressed different aspects of department-level functioning in different ways. Ward (1997) focused on whether departmental research expenditures per faculty member and as a percent of total spending varied in regard to undergraduate student credit hour (SCH) production and number of class sections offered. He examined differences by faculty status (e.g., tenure/tenure track), academic field and institutional sector, and public and private institution. The low explained-variances (about 25 percent) in his ordinary least squares (OLS) results were instructive. More noteworthy were the small effects of departmental research activity on instructional productivity: The slightly more SCH produced by research-active departments was counterbalanced by their slightly fewer class sections offered. Overall, Ward concluded that departmental instructional variables, such as percent of tenure/tenure-track faculty within the department and instructional spending variability, were far more important in explaining instructional productivity than was the volume of research activity.

As was the case for Ward, what drove D'Sylva's study (1998) was the popular concern that "university faculty devote too much of their human capital to research at the expense of teaching." (p. 15) In seeking explanations for resource allocation, D'Sylva (1998) compared departmental "rates of return"<sup>16</sup> to instructional productivity, research productivity, and departmental quality with the income production (allocation) function of departments. His reasoning was as follows:

If changes in the institution's resource dependencies drive internal resource allocations, then the rate of return [sic] for these variables should reflect the priorities of those upon whom the universities are dependent. Alternatively, if internal factors drive this process, then the optimization of inputs with respect to the utility function of the institutions will dictate the relative return for the outputs of teaching, research, and departmental quality. (p. 91)

D'Sylva's *overall* result was that departmental returns to teaching exceeded those to research. Among the four fields of science, the findings

for two years showed greater returns to teaching productivity, compared with research productivity, in five of eight cases. Mean “returns” were 108 percent and 40 percent for teaching and research, respectively. Only in the life sciences did his results show a greater return to research than to teaching; the margin of difference favoring returns to teaching over research was greatest within the social sciences and the physical sciences. D’Sylva was led to conclude that “The perception that instruction has been displaced by research as the priority in the allocation function of public universities was not supported by the results.” (p. 165) In other words, departments could and did increase their revenues by teaching more. In his discussion D’Sylva pointed out that, although apparently secondary to instruction, research effects were important to departments, as reflected in the contribution of research to unit revenues. The 40 percent return rates in both years of his data support this view.

The lack of evidence found by Ward in regard to the effects of variations in research activity on instructional productivity plus D’Sylva’s results generally showing much greater “returns” to instruction than to research bring into question the common perception that research universities favor research over instruction, at least at the department level. Coupled with the fact that variations in revenue changes at the university level can be connected causally with expenditure changes, the Ward and D’Sylva findings suggest that departmental dynamics may be somewhat unique among the three university levels.

Our field work gave us several important insights into the apparent discrepancies. For example, interviews with department heads revealed that there is substantial and consistent cross-subsidization of activities at the department level. Apparently, departments act in ways to mitigate external influences. Also, institutional leaders often attempt to insulate or buffer production units from external forces. Interviews with faculty members revealed that some faculty simply refuse to be leveraged into entrepreneurial behavior. Next, when we review our results for individual faculty members we will both gain additional insights and learn of additional incongruities (between the findings for departments and for their individual faculty members).

### The Level of the Individual

Although our field work included collection of additional department expenditure and productivity data from the universities directly

plus interviews with department heads regarding departmental resources and related productivity issues, most of our data about individual faculty members were obtained from Time Budget Analysis interviews.<sup>17</sup> We believe the data from those interviews to be unusually valid. (See the Appendix.)

Faculty member time allocations were divided first among teaching, research, and service; then among the various subcategories of each. (See the codes in the Appendix.) Joint-production time allocations were recorded in cases where an activity served more than one purpose. *Time allocations were controlled for quality.* We reasoned that the amount of time spent on an activity had no value independent of the quality of the effort. Our control for instruction was teaching-evaluation data; for research the controls were publications and external grant funding; for service we used seniority at one's institution. Our research questions centered on the interrelations among faculty time allocations. For example, is there a relationship between time spent on research grants and on instruction?

Our best estimate is that the average faculty work week is about 57 hours.<sup>18</sup> An average academic work day entails 4.2 hours spent on instruction, 3.2 hours spent on research, and a balance of 2.5 hours spent on service (including "administration" and "colleagueship"), for a typical work day of nearly ten hours. Including weekends, this works out to approximately 57 hours for a typical academic work week. When we "double count" to include joint-production time, the work day expands to almost 11 hours. This "extra" hour of joint-production time allocates approximately 0.4 hours each to instruction and research, with a residual 0.1 hours or so going to service. Thus the bulk of joint-production time is spent integrating research and teaching activities. Perhaps most notable is the finding that on average faculty spend considerably more time on instruction (4.25 hours, or 43 percent of their typical day) than on research (3.1 hours, or 31 percent of their typical day).

For our estimates of various relationships among faculty time use and associated outcomes, we employed a variety of econometric models, all of which control for other variables in the equations; that is, all results are for the "all else equal" case.<sup>19</sup> One question of particular interest to faculty members is how their time allocations, controlled for quality of effort, impact their salaries. Overall, the only two statistically significant time-use variables are the interactions of research time with published articles and published chapters in books. An additional hour

(of average quality) spent each academic day for the academic year on research raises the annual salary by \$665.85. This contrasts with an additional hour spent on instruction (of average quality), which *reduces* one's annual salary by \$118.77 or on service (of average quality), which raises the annual salary by \$373. While these last two estimates are not statistically significant, these figures do support a common suspicion about the relative ranking of the rewards for instruction, research, and service. (Although the return to *quality* of teaching was positive, as measured by the student evaluations of teaching, the relationship was not statistically significant.)

Some of the most interesting findings relate to differences among the five fields of science. For example, other things equal, being in an engineering department is associated with more time spent in instruction and less time spent in research, compared with physical sciences departments. A faculty member in engineering spends 1.5 hours more per day on instruction and 0.8 hours less per day on research than a comparable colleague in a physical sciences department (the "comparison group"). Differences in patterns of instructional "production functions" emerged as we conducted our interviews. Generalizing, physical science professors tend to teach fewer and larger classes in a "lecture" format, compared with engineering professors, who appear to spend more time working out solutions to problems assigned to students and problems in examinations, and in grading examinations.

External grant and contract funding has a negative and statistically significant effect on time spent in instruction, and positive and statistically significant effects on time spent on research and on service. Having an external grant leads to a reduction of about one hour per day spent on instruction and an increase of about one hour on research and 0.8 hours on service, yielding a net increase of about 0.8 hours per academic work day. These results for individuals certainly are consistent with RD theory and with Hasbrouck's (1997)<sup>9</sup> central finding that expenditure patterns are largely predictable from revenue patterns.

Planning to retire within five years has a negative and statistically significant effect on time spent on research. Of course, all results are for the "all else equal" condition, so this result holds constant a counter-effect of academic rank: *ceteris paribus*, relative to assistant professors, full professors are far more likely to spend *more* time on research. In our interviews we find not only that those planning for or contemplating retirement within five years engage in less research and publication,

on average, but that they often agree to do more teaching in order to let their younger colleagues spend more time on the research activities that will benefit them and their units in the long term.

The presence of external grant or contract funding has a positive and statistically significant effect on the probability of engaging in joint production, supporting the notion of the interrelatedness of teaching and research, since this is the most common form of joint production. In fact, from our results one could go so far as to say that academic research often *depends upon* joint production, especially upon the education of graduate students. At the sample mean, having external grant or contract funding increases the probability of joint production by 19.9 percentage points.

## Discussion

Although resource dependency appears to be an important concept at the university and at the individual faculty-member levels, resource dependency effects appear somehow to be mitigated at the department level. We think that the department or “unit” level is the most interesting and is the most important to policy because this is where the production activities, the instruction, the research, and the service of the university, largely are produced. On the one hand, the unit-level results are consistent with the major finding at the institutional level: Primarily, money appears to be expended for the purposes intended by the resource provider. However, the internal dynamics of department-level expenditures are far more complex in their understanding. Our interpretation of our results, *en toto*, is that, within the constraints demanded or generally “expected” by resource providers, departments possess and exercise substantial discretion in how the various resources are deployed, with that discretion being exercised in ways that further enhance revenue streams and accomplish the central work of the department. This “work” is broadly defined by departments and their faculty. To be sure, it includes meeting the terms of grants and contracts, but it begins with serving students and serving them well, not simply because university resources are allocated in some correspondence with the quantity of teaching performed, but more so because of a strong sense of professional and personal responsibility to students. These conclusions were especially clear from our interviews. Faculty work also includes providing substantial service to the department, the college, the university, and the academic profession of which faculty are a part.

Returning to the important resource dependency question, we found only modest evidence of major *departmental* destabilization. In a word, most departments “coped,” without the necessity of major internal change. Among the 165 departments in the sample, there was a substantial number of departments characterized by a dynamic environment; the life sciences were the best example. Generally, these departments tended to be notably more entrepreneurial and closer to the market than were departments in the other four fields of science. However, this life sciences dynamism appeared to be more a matter of entrepreneurial *opportunity* than of departmental resource destabilization and necessity. Only in scattered departments in other fields of science was financial stress clearly noted. Most often these were departments that viewed themselves as being at risk because their functions relatively were not central to the university mission. For example, some education departments stood out in this regard; in contrast units such as mathematics, and economics departments appeared to consider themselves secure because of their central role in providing service courses and in offering “core” majors.

All this is not to say that departments fail to respond to the changing resource environment; those responses were widespread and existed in several forms. Most directly, departmental substitutions of self-generated funds for state funds were evident in the majority (62 percent) of cases. Our questions as to whether substantial revenue reductions in state support had effected the substitution yielded several solid examples, with substitution values amounting to 2.3 percentage points for a ten percentage point reduction in state support.

Units were quite selective in how and where they chose to compensate for declines in their budget bases (i.e. block-grant support from the state). For example, departments were *less* rather than more likely to subsidize such costs as their operating budgets, travel, and secretarial support when budget bases were eroded. *Negative* elasticities were almost twice as large in these areas (4.5 compared to the 2.3 above). Departments were, however, willing to draw upon self-generated revenues to support shortfalls for equipment and support for graduate students, suggesting perhaps that the determining factor in providing self-support was *ability*, not willingness. Grant and contract agencies often permit, even encourage, the use of grant and contract funds to purchase these items and provide support in these areas.

Although our stated purpose in our proposal to NSF was to examine the effects of revenue changes upon academic departments, we found it necessary to examine the institutional and individual levels as well. By considering all three levels, we gained many important understandings about the operations of public research universities in a period of fiscal flux, understandings that we would have missed with the single focus. Our sense is that academic departments are adaptive organisms; even the effects of external markets are not clearly and consistently translated into incentive structures and internal resource allocation patterns promulgated by deans and central administrators. Academic departments are also responsive organisms. We saw evidence of departmental responses even to *perceived* but nonexistent university policy changes; we saw overwhelming departmental response to very minor financial incentives, strongly supporting Pfeffer and Salancik's (1978) "rule of ten percent." We saw little that concerned us about the effects of the changing revenues of research universities, save the effects of the decline in shares coming from state governments in block-grant form.

Departments do not appear to be shifting their emphases away from teaching and toward research, when viewed *en toto*. In fact, many institutions and departments evidence a marked increase in attention devoted to undergraduates, instruction, and curriculum reform. Nevertheless, as shares of state support decline, departments, colleges, and institutions are forced (or decide) to cross-subsidize activities from other sources (e.g., instruction from research grants and contracts). In many ways this is not a healthy situation for either the research or the instruction functions. In the long run, the patterns we observed may compromise the quality and integrity of research and instruction in public universities.

## Appendix

### Time Budget Analysis

Time Budget Analysis (TBA) is a powerful technique for gaining accurate assessments of how individuals spend their time. Because the TBA interviewees are not aware of the researcher's purposes and because interviewees who misrepresent their activities soon find themselves in webs of inconsistencies, it is very difficult for them to falsify their answers. A brief overview of how TBA is conducted will illuminate.

After the passing of pleasantries, the interviewer asks the respondent, in this case the faculty member, to recall what he or she was doing "at this time yesterday." Usually, the respondents begin slowly, trying to remember where they were and what they were doing. But with a few cues from the interviewer, invariably the respondents recall the events. Suppose the faculty member responds, "Oh yes, I come in later on Tuesdays; I had just dropped off my daughter at school and was on the way into the office." From this, the interviewer begins to develop with the interviewee a mind-set of care as to details. The interviewer will follow up by saying something like, "Are you sure? What time did you arrive? Does that confirm your sense of the timing?" Most often, the faculty member will continue with something like the following: "I arrived about 8:15, stopped by the department office, and then came right up to my office." To this the interviewer would say, "Okay. Let's be more specific. I need you to be sure of the timing. Was it 8:15 or might it have been 8:05 or 8:10 that you arrived? And how long were you in the department office? Did you speak with anyone? How long did you spend there? What did you do there? After you left that office, did you stop anywhere else? Did you see anyone else on the way up to your office?" Then, "If you saw someone or stopped to do something else, who or what was it? What was involved? What was the nature of that interaction or action?"

The interviewer is attempting to accomplish two primary objectives. S/he is seeking to develop a sense on the part of the faculty member that accuracy and detail are important, that the faculty member should use

precision as s/he continues to describe his/her activities of the previous 24 hours. The interviewer also is seeking to obtain information about the specific nature of the faculty member's activity. For example, our first level of categorization of faculty time allocation is among instruction, research, and service; however, we are interested in finer discriminations as well, such as whether a research interaction with a student deals with the student's own research or with a research project that is a joint effort of the faculty member and the student, and whether the student is an undergraduate or a graduate student. Let's assume that the student is a graduate student and that the interaction is about a research project for which the faculty member has NSF funding and on which the graduate student is assisting. We classify the faculty member's time "Instruction, grad, out-of-class (IGO)." However, joint production is involved, because from the faculty member's perspective his/her own research is involved; therefore, the time is classified also as "Research, Public Funded (RXPu)."

Ordinarily, with the early cues as to care and detail, the faculty member requires few additional cues or prompts to yield valid responses at the level of specificity required.

## Faculty Interview

### Time Budget Analysis Codes & Introduction

#### 1. INSTRUCTION

- a. IG—Grad, in-class
- b. IU—Undergrad, in-class
- c. IGO—Grad, out-of-class
- d. IUO—U-grad, out-of-class
- e. IGC—Contact, Graduate
- f. IUC—Contact, Undergrad

#### 2. RESEARCH

- a. RAD—Administration
- b. RD—Departmental
- c. RXPu—Ext Spt, Public
- d. RXPvt—Ext Spt, Private
- e. RI—Internal Supported
- f. RP—Procurement

#### 3. SERVICE

- a. SCP—Consulting Pvt
- b. SCG—Consulting Gvt
- c. SP—Public Service
- d. SO—Other

## Introduction: Faculty Interviews

Introduction: I am \_\_\_\_\_. I am a \_\_\_\_\_ at the University of Arizona. I am here to interview you regarding a National Science Foundation project dealing with science policy. To avoid the possible biasing of your responses, I would prefer not to say more; however, if you have questions, at the end of the interview I will be happy to answer any questions. Okay?

This interview usually takes a little less than 1 hour and is in two parts. The first part is a time budget analysis; the second part involves 6 or 7 specific questions.

Before beginning, it is important that I say that the information will be used for statistical purposes only. The anonymity of the respondents and of their departments and their universities will be strictly respected.

Two other matters. May I have a copy of your vita? (The long version! Must get grants listed!) Perhaps you would want to start printing it while we talk. Also, again assuring you of total confidentiality, may we have your permission to obtain your teaching evaluations? (Get signature on form.)

**Note to interviewer:** If this interview occurs on Monday, obtain data beginning 24 hours previously (Sunday). At the end of the 24-hour Time Budget Analysis, ask: Would you please give me just a brief overview of your work-related activities for Friday night and Saturday?

**Note to interviewer:** You must probe for “joint production” activities. The most common type is when a faculty member interacts with students about research. Usually, the time is coded both RX and IGC or IUC. Also, make notes about any “new type” of entrepreneurial activity.

Given that, it is now \_\_\_\_\_ o'clock. What were you doing at this time yesterday?

## Endnotes

1. Slaughter, Sheila A. and Leslie, Larry L. *Academic Capitalism: Politics, Policies, and the Entrepreneurial University*. Johns Hopkins University Press, Baltimore, MD; 1997.
2. We are presently working on a mid-range theory of the concept.
3. See pp. 10–11 of *Academic Capitalism*.
4. See p. 8 of *Academic Capitalism*.
5. Since about 1998, the Salzburg Seminar has been bringing together U.S. and Western European academics with leaders from Central and Eastern European universities, for the purpose of “university reform” in the latter. The major instrument of reform has been seen as the generation of non-state revenues, such as tuition and private sector contracts and grants. The Western academics follow up with advisory visits to the latter’s campuses. Concomitantly, the World Bank has promoted these instruments of reform through competitive loans to these governments.
6. In other words, if the 44.0 percent share of 1980–81 had been maintained, public IHE would have received, in 1990–91, \$6.4 billion more than they did in fact receive.
7. That is, as expectations could be inferred from the implicit and explicit desires of the resource providers. For example, the increase in gift, grant, and contract revenue was associated with increasing research activity. See *Academic Capitalism*, pp. 86–87.
8. NSF Grant Number 9628325. The Government has certain rights in this material. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.
9. Hasbrouck, N. *Implications of the Changing Funding Base of Public Universities*. Ph.D. Dissertation. University of Arizona, Tucson. 1997.
10. Hasbrouck also reported evidence of institutional utility maximization: the “higher” the institution’s Carnegie classification, ceteris paribus the lesser the allocation to instruction. Further, she found evidence of fungibility, or “cross-subsidization,” that is the allocation of money from gifts, grants, and contracts to instruction.
11. She employed fixed-effects regressions, again using the OLS and binary logic approaches.
12. Ward G. T. *The Effects of Separately Budgeted Research Expenditures on Faculty Instructional Productivity in Undergraduate Education*. University of Arizona, Tucson. 1997.
13. D’Sylva, A. *Examining Resource Allocation within U.S. Public Research I Universities: An Income Production Function Approach*. University of Arizona, Tucson. 1998.

14. Ward utilized the University of Delaware departmental data base developed under a grant from the Fund for the Improvement of Postsecondary Education (U.S. Department of Education), and D'Sylva employed the *Data Exchange* files of the Association of American Universities (AAU).
15. In fact, Stocum and Rooney (1997. Responding to Resource Constraints: A Departmentally-based System of Responsibility Center Management. *Change Magazine*. 29, 5: 51–57.) report that even when resource consequences are experienced at the college level, departmental consequences can be buffered departmentally.
16. D'Sylva uses this term loosely here. In our discussion of his work herein, we utilize the more general term "return," which we think will prevent possible misunderstanding among readers knowledgeable about "rate of return studies."
17. Our stratified sample of faculty members consisted of three faculty members drawn randomly from within each of three departments drawn randomly within each of five fields of science within each of eleven public, AAU universities. The universities were selected for geographic balance after choosing two of the eleven for their financial difficulties and special financial management strategies, respectively. Combined with the department head interviews, our sample was 60 interviews within each of the eleven universities.
18. To obtain a mean value for the week, we drew a sample of 29 subjects of those for whom we had Saturday and Sunday data, calculated mean values for each day, and added this time to the previously estimated 50-hour work week.
19. For a full description of the estimating techniques and the results see Larry L. Leslie, Gary Rhoades, and Ronald L. Oaxaca, *Effects of Changing Revenue Patterns on Public Research Universities*, A Report to the National Science Foundation, Grant Number 9628325, The University of Arizona, Tucson, July 1999. Copies of the report may be obtained from the University of Houston Law Center, the Institute for Higher Education Law & Governance, IHELG Monograph 99-10.



# 24 The Entrepreneurial University

Lita Nelsen

This chapter will discuss the increase in university/industry collaboration from the viewpoint of a large, private, research-oriented university. Universities need this collaboration, especially since federal and state funding are both decreasing as a source of money to support the operation of the university.

Technology transfer is about more than licensing. There are many sources of technology transfer. Perhaps the most important one is the body that actually embodies the science and technology that we have discovered and are teaching: the graduating student. The two types of technology transfer addressed here are industrial research collaborations and technology licensing.

## Industrial Research Collaborations

The survey by the Association of University Technology Managers (AUTM), which admittedly is not as complete a study of university funding as you can get from the National Science Foundation, shows \$13.7 billion in 1998 federal funding and \$1.97 billion in industrial funding. The total funding was \$21 billion because of all the state funding. Industry now contributes ten percent of the research university's funding. This survey however did not include research hospitals and universities that are not research-oriented.

To put this into perspective, my university, the Massachusetts Institute of Technology, went from about seven percent in industrial fund-

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*Lita Nelsen is director of the Technology Licensing Office at the Massachusetts Institute of Technology. This article is based on remarks delivered at the 25th Anniversary AAAS Colloquium on Science and Technology Policy, held April 11–13, 2000, in Washington, DC.*

ing in the early 1980s to now over 22 percent. We show a large influx of industrial funding, currently over \$80 million a year. We see a lot of increase at other places too. The numbers from 1996–98, which include the United States, Canada, and others, show a compounded 10 or 12 percent increase in industrial funding per year. We are seeing quite a trend.

My university currently has about \$80 million a year from industry, which is a little over 20 percent of our campus research. From the viewpoint of universities and industries learning to work together, it looks like a good thing. But there is a problem. The problem is manifested in a psychological dynamic. The more we work together, the more apparent the differences become; the more we need each other, the more frustrated we get with each other.

A big difference between the two sides has come from the reason industry funding is growing. Twenty years ago, industry funding of universities was quasi-philanthropic. It was done for all sorts of vague reasons. Industrial funding kept the corporate name around the university and helped establish relationships with professors. Industry could afford the funding and liked the benefits. But after the downsizing of the 1980s, and many industries shutting down their basic research labs in the early 1990s, industry woke up and realized they were profitable, but they had nothing in the pipeline. They did not have their central research labs anymore, and they were not going to rebuild them. In addition, technology was moving so fast that even in those industries that had not shut down their central research labs (like pharmaceuticals) knew they could not do it all themselves. So they went to the universities now, not philanthropically, but as a business deal. They needed new technology, and the universities were a source of that technology. University research could help fill industry's new-product pipeline. Industry gave more money to the universities, acknowledged a greater need of the universities, and also expressed that they would demand more of the universities. It was not just philanthropy anymore.

Now industry comes to a university and says, we're paying for it, we own it, and we ought to get to tell you what to do. Issues come up such as ownership of intellectual property, direction of research, ownership of data, and control of publication. The university sees its reason for being as education and dissemination of knowledge. Research is a mechanism for education and for discovering the knowledge they want to disseminate. Industrial sponsorship of research is seen as part of this mech-

anism rather than an objective. Both sides get positive benefits: The universities educate students who will go out to work for industry and industrial investments improve the transfer of discoveries to the public.

But the company comes back and says again that they are paying. The university replies that the company is paying for only a small part of the research. Industry is embarking on a temporary voyage on a river of knowledge and research that the university has built up. Industry is tapping in to this river for only a limited amount of time. The relationship between the university and the company is temporary. The university values the relationship, but the university is thinking about the long term.

Given these two very different perspectives, how do we learn to work together? We are all participating in a transition period of two cultures that have occasionally only visited with each other and now have to live together. You start with two very fundamental differences in who you are. The university has primarily societal responsibility and open-ended goals, and industry has clear, straightforward, capitalistic, profit and loss goals, which are driven by specific objectives and an eye to shareholder value. The university is used to doing unpredictable research: You go where the most interesting question is, not where you are most likely to come to the end most quickly. The university expects no promises with a long-term orientation.

I came to the university from industry and one of the things that surprised me the most is that faculty are frequently working on things that take 10 to 15 years to come to fruition, even the ones working in rapidly changing fields. But, generally, industry is oriented toward the shorter term. It cannot wait that long. Companies will be broke, merged, or gone by then.

Perhaps the biggest cultural difference is the hierarchical orientation of the university and the teamwork orientation of industry. In industry, you are not in it for an individual, you are in it for the corporate outcome. In universities, faculty members practice individualism, with a view toward academic freedom and the honors and rewards systems that reward individuals, not teams.

Industry gets frustrated because they are used to contracts that talk about task statements and performance to tasks, confidentiality, restriction of publication, ownership of intellectual property, and negotiation of indirect cost rates. (I find the latter ridiculous since we ask the same rate that the government asks. The government does not pay full costs; but, with this rate, we are already subsidizing the company.)

You can balance publications and confidentiality. However, the university thinks it must publish because that is part of its reason for being. A second factor in preserving the universities' independence is that academic status depends on fame, not fortune. Fortune follows fame. And publication brings fame.

Other issues are more subtle. Confidentiality limits discussions within the university itself, with other students and other faculty members. And, of course, if a discovery cannot be built on, it is not available for further discovery. The universities have told industry that they cannot do confidential work for industry, but they can use intellectual property to give a company a proprietary position. The university will publish what it discovers, but it will file patents on it or copyrights on the code. The university can allow a company a competitive position through the licenses of the patents.

Generally the universities are not compromising on the ownership of patent rights for a number of complicated reasons. First, technology transfer outside of industry-sponsored research has become an important way in which the university delivers technology to the public. This research is part of the 80 percent of university research that is federally funded. Under the Bayh-Dole Act researchers are entitled to a share of the royalties. Universities, however, cannot discriminate between those researchers working on a federal grant and those working on an industry grant.

Universities also have to make sure that the technology is used, not suppressed. A university will not grant an exclusive license, even to a sponsor, without an assurance of diligence to develop.

The road to hell is mapped with small exceptions. A single concession becomes precedent faster than you can blink. On things like intellectual property ownership, you have to be remarkably consistent, which is what a lot of people learned on the slippery slope of negotiating overheads.

One big question when discussing industry/university collaborations is: Will what you expect to be done get done? One of the funniest phrases in a contract is one that says, "The professor shall." I always say that I am going to sign only if you let me add, "if he damned well pleases," because faculty are not really employees even if legally they may be. The university can make it happen only if the interpersonal, the psychological contract between the university and the principal investigator works. The principal investigator must want to do the project.

On the company side, somebody must be there who really cares and is participating in the dialogue and keeping it on track. My usual

advice to companies is that if they are not getting along with the principal investigator when they are negotiating the agreement, walk away. Not getting on with the administrators is acceptable, because we can compromise. But the company must work well with the principal investigator.

Another important consideration is the issue of indirect cost. We charge industry the same indirect cost as the government overhead rate, which does not cover the full costs. From the perspective of a non-state university, the only sources of making up the difference are tuition and philanthropy. Neither the students nor the philanthropists would appreciate knowing they are subsidizing a private company.

When you explain this to industry they understand it. Provided that you are not negotiating and giving some companies a break on overhead costs and others not. If you explain that it is a clear business issue that this is the way it has to be because we don't have any other money, most companies will understand. (If improperly expressed mathematically, our overhead rates sound high, but they are actually about 40 percent lower than the lowest fully loaded cost in industry.)

So what has happened? In spite of holding the line on indirect costs, we say that we can make it work through interpersonal relationships at the beginning of the programs. We can be actively involved as champions on the side of the company. This way, the company gets more out of the work. The university owns the intellectual property, but we can work out options to exclusive licenses.

In summary, industrial projects must include the following criteria: investor-initiated research only, no confidential research, all projects available for full student participation, freedom of publication and no confidentiality within the university, standard indirect cost rates, university ownership of intellectual property, project-by-project funding rather than departmental funding, and an emphasis on development of technology. At this point we are managing about 200 new industrial projects a year. We have tripled our fraction of industrial research.

## Technology Licensing

The AUTM survey shows that universities are granting over 4,000 new licenses a year. From 1997 to 1998, the number of licenses increased ten percent, and 364 new start-up companies started in fiscal year 1998. The amount of royalties may be \$700 million a year. But if

you divide that by the research budgets of the universities from which it comes, it averages less than two percent. University licenses are not going to replace the declining research budget. License revenue is simply not a major source of revenue, except for the blockbuster inventions.

The proper way to make money in university technology licensing is to get lucky. If anyone will tell me the algorithm for doing so, I would appreciate it greatly. History will show that probably only a couple of dozen inventions in the last 20 years, over the entire spectrum of American universities, are bringing in more than \$5 million a year. That number is smaller today because some of the licenses have expired.

The classic is the Cohen-Boyer-Stanford-UCSF gene-splicing patent. You could not do genetic engineering without that patent. It was widely and exclusively licensed, bringing in about \$300 million, which sounds like a lot of money. But it is \$300 million over 10 to 15 years, or \$20 million a year split between two universities. The \$10 million a year to Stanford University is not even two percent of a \$600-million-a-year research budget. Even if you get lucky, it is not going to make a major impact on the research budget, or on the budget of the university. So why do we do it?

The most important reason is to disseminate technology by getting industry to invest in university inventions and discoveries. I spoke with a group of medical students recently who said that even if you are doing your research for the most philanthropic and idealistic reasons, the only way you are ever going to get any of your results into the patient is by the intervention of industry. There are no medical findings (unless perhaps some from psychiatry) that hit the patient without investment by industry.

University start-ups are the new frontier. They are causing a lot of angst, but also a lot of interest because you can get investment with real commitment to the technology with the potential of the universities taking an equity share instead of royalties. They make a little bit of money, and perhaps worry a great deal about conflict of interest.

What works for us right now is that we have drawn a Chinese wall between the start-up company and the university. We do not take a seat on the board, we do not let the company sponsor research in the faculty member's lab, we do not promise future research coming out of the lab, and we do not do any confidential work. With this, we have started about 230 companies since 1987. We have had almost three dozen go public. We have not made a lot of money, but we have made some. You

can make it work if you keep in mind the basic mission of the university, and that money is a route to that mission, not its reason for being.

We have to be creative in making agreements with industry. We are working with hundreds of companies. The better funded universities have an obligation to hold the line on these old varieties because the universities with less funding find it hard. We have to balance that queasy feeling of unease against cold, hard cash on an example or an exception-by-exception basis. You have got to hold the line theoretically.

A new battleground is coming. It is not the battleground between the individual and the institution in the entrepreneurial universe of institutions and companies. It is between the individual and the institution in the entrepreneurial university. It will come about particularly as we get out of simple inventions and things like courseware, multimedia, and the kind of technology that can be done at home on your laptop rather than in the lab.



# 25 Technology Transfer and Commercialization of University Performed Research: The Arizona Experience

Steven G. Zylstra

Arizona's economy is organized around 11 clusters, with six of them technology-oriented (optics, biotechnology, software, environmental technology, advanced materials, and high-tech). The high-tech industry cluster in Arizona includes aerospace, electronics, semiconductors, computer hardware, telecommunications, and transportation safety. This sector alone represents almost 25 percent of Arizona's gross state product. This is a huge percentage of the State's total economic output, and it is significantly more than the percentage for any other State in the country.

Some companies in Arizona that participate in this cluster are very familiar: Boeing, Intel, and Raytheon. In addition, three State universities participate—Northern Arizona University (NAU), the University of Arizona (U of A), and Arizona State University (ASU). All three of these large academic institutions are public and funded by the taxpayers. Because of this relationship, the high-tech industry cluster began work to improve university-industry technology transfer. This effort was aimed at improving the flow of science and technology from Arizona's academic

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institutions to Arizona-based high-tech firms, thus enhancing the commercialization process of significant new university-derived technologies.

What was the impetus for the need for these changes? Arizona corporations had long-standing grievances regarding excessive costs and other impediments to accessing academic R&D resources in Arizona. There was an industry perception of onerous university policies regarding intellectual property and data rights. In my experience of 16 years in the high-tech realm in Arizona, this issue and the lack of capital were the most consistent expressions of concern and complaint among high-tech companies in Arizona.

Why would we want to change? A less encumbered flow of science and technology from public universities benefits the entire community. Universities gain access to corporate dollars, even as traditional sources of funding diminish. Students gain hands-on, cutting-edge, real-world experience. Corporations are able to commercialize products faster and make the newest technologies available to the public. A vital cycle is involved in this process. As a result of technology transfer, successful companies create new jobs to support new product lines. They attract service firms to the area, and this adds jobs. The presence of these support companies attracts other high-tech businesses to the area and adds even more jobs. This creates growth in the economy, which adds back to the tax base, grows the population, and, of course, increases the number of students for the university.

In 1995, we held the first technology summit in Arizona, principally to look at the issues surrounding technology transfer and to discuss the obstacles to technology transfer. We also discussed the Arizona Board of Regents' and the universities' policies, possible solutions to problems, and ways to enhance collaboration. This event led, for the first time in my observation, to the realization among university representatives of the depth of industry's discontent about these issues. The university officials finally accepted that the problem was real. A working group was established; it included the two vice presidents of research from ASU and the U of A. We knew we had to change more than policy; we had to also change attitudes. And, for the first time, I think, we saw attitudes begin to change.

One of the most significant issues that concerned industry was ownership of intellectual property. We have primarily aerospace and semiconductor industries in Arizona and those particular industries are even more vocal than others are. So that was the first issue we grappled with.

Ultimately the working group recommended to the Board of Regents a way to grant companies full data rights when paying what we call a “fully burdened overhead costs.” Typically, universities have a negotiated overhead rate with the National Science Foundation (at ASU it is 51 percent, at U of A it is 52 percent). But that does not account for all costs. The real costs can be estimated through basic accounting principles. This new provision, for the first time, allowed companies to own title to industry-sponsored research results, if they paid a fully burdened overhead rate. This rate turned out to be about 100 percent at one of the academic institutions, which is almost double the negotiated rate.

The Arizona Board of Regents instituted their initial policy amendment in April 1996. It states that “[at the] University’s discretion [they are not in any way compelled to relinquish data rights] full data rights can be assigned if the sponsor will pay all costs of research including salaries, materials, other direct costs, and fully burdened university overhead.”

Since these changes were instituted, both academic institutions have done a number of sponsored-research projects in which they have granted full data rights or title to the inventions. Following these changes the working group realized that more profound changes were needed because many of the provisions in the policy were outdated. The Arizona Board of Regents agreed and admonished the universities to overhaul the entire intellectual property (IP) policy.

The university representatives began drafting a comprehensive new version of the policy. There were lots of difficult discussions among the three universities. They could not agree among themselves as to what the provisions should be. But after 18 months they released a draft that was presented to industry through the high-tech industry cluster and to faculty at the universities for comment. Industry provided written comments, which were then responded to by the universities. The universities said either that they would change the policy because of the points made, or they could not make a change because of the Bayh-Dole Act or because of tax laws.

Following that, the high-tech cluster and the Board of Regents sponsored a facilitated all-day symposium in November 1998, with the universities and industry. The symposium focused on the draft IP policy. The primary recommendation that came out of that symposium was to form an industry-university working group that would negotiate the sponsored-research elements of the policy. Over the next several months, the technology-transfer representatives and the intellectual

property attorneys from all three universities as well as their counterparts from the corporations worked to develop the wording and to discuss and negotiate every sentence in that section of the policy.

The negotiated policy draft was finalized in February 1999. In June, the Arizona Board of Regents approved this new policy. Arizona now has arguably the most progressive intellectual property policy for public universities in the United States. The hallmark of the new policy is its flexibility. It allows the university the discretion to do a deal. Of course, this requires the universities to have highly qualified experts as their technology-transfer officers because they will be up against such experts who work for the various companies. But we believe, as do the universities and industry, that a new day for industry-university collaboration has emerged in Arizona.

It is important to consider some aspects of the new policy. First, it classifies intellectual property according to the resources used to create it. Therefore, we dealt with only the sponsored-research elements of the policy. Other aspects of the policy were changed as well, but industry was not involved with those. Second, for industry-sponsored research, intellectual property ownership by the sponsor may be granted under prescribed conditions. Universities have the flexibility to make appropriate business decisions. Intellectual property disposition is negotiated on a case-by-case basis in the research contract.

The new policy addresses many issues. First is the issue of the sponsor's ownership of the invention. In the old policy a couple of provisions allowed sponsors to own title to patents, for example. One provision said they could pay a 50 percent assignment fee over and above the costs of the research. That option was not often used. That provision continues under the new policy. In addition, the sponsor will pay an assignment fee only after the intellectual property has been created. Again, the sponsor can own the technology if it pays all costs including the fully burdened overhead.

A second issue is the reassignment for non-use. In the old policy, the university can exercise a reassignment right after two years if the assignee has not and is not making a good faith attempt to commercialize the assigned technology. In the new policy, due diligence milestones are negotiated on a case-by-case basis. Every technology, every situation is very different. The new policy includes a reassignment right exercisable by the university if the sponsor has not made a good faith attempt to meet the negotiated milestones.

The third issue is that of taxpayer benefit from windfall profits. This was not dealt with in the old policy. The new policy includes a windfall provision in which an appropriate royalty rate or payment schedule is included, based on a minimum net sales value or some other agreed-upon threshold or event. The parameters of this provision, such as the windfall threshold and the compensation, will be determined on a case-by-case basis. Again, we have lots of flexibility and discretion, but the university is protected.

The final issue is due diligence requirements in licensing. The old policy did not deal with this. In the new policy, due diligence milestones are negotiated, again, on a case-by-case basis, to include marching rights if the sponsor fails in its due diligence to meet the negotiated milestones. This maintains the spirit of the Bayh-Dole Act by helping to ensure the actual commercial use of new technology developed using public resources for the ultimate benefit of the general public.

The new policy also deals with confidentiality issues and publication. Obviously academic research has to be published. In the case of sponsored research, it is reasonable to expect that the inventor (the university) warn the company what it intends to publish and that ample time is provided for the company to pursue patent protection. That is provided for in the new policy. In the case of confidentiality, the new policy protects, for example, any prior intellectual property or proprietary information that the company has brought to the table, but, again, allows the academicians to publish their work.

Intel, Allied-Signal, MicroAge, Raytheon, Lockheed Martin, Honeywell, Bull, and Simula are a few of the companies that signed a document endorsing the new policy. They committed themselves to do more sponsored research at the three universities as a result of this new policy.

The expected results from this arduous and long, but very successful, effort has improved university/industry collaboration through more sensible agreements. Both the universities' and the public's interests are preserved, and in fact the inventor's interests are also preserved.



## 26 The Kept University

Eyal Press and Jennifer Washburn

In the fall of 1964, a twenty-one-year-old Berkeley undergraduate named Mario Savio climbed the steps of Sproul Hall and denounced his university for bending over backwards to “serve the need of American industry.” Savio, the leader of the Berkeley Free Speech Movement, accused the university of functioning as “a factory that turns out a certain product needed by industry” rather than serving as the conscience and a critic of society. To the modern ear this sixties rhetoric may sound outdated. To many people in the academic world, however, Savio’s words ring truer today than ever. Although our national conversation about higher education remains focused on issues of diversity and affirmative action, nothing provoked more debate on many college campuses last year than the growing ties between universities and business—and nowhere was the debate livelier than at Berkeley.

On the afternoon of April 13, a radiant day last spring, the Berkeley campus hardly looked like a site of protest. Students lay on green lawns, soaking in the sunshine. But inside Room 60 of Evans Hall, a concrete building on the northern edge of campus, the lights were dim and the atmosphere tense. There two dozen faculty members, many of them professors in the College of Natural Resources, had gathered to present the disquieting results of a newly released faculty survey.

The focus of the survey was a controversial agreement that Berkeley had signed in November of 1998 with Novartis, a Swiss pharmaceuti-

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cal giant and producer of genetically engineered crops. Under the terms of the agreement Novartis will give Berkeley \$25 million to fund basic research in the Department of Plant and Microbial Biology, one of four departments within the CNR.

In exchange for the \$25 million, Berkeley grants Novartis first right to negotiate licenses on roughly a third of the department's discoveries—including the results of research funded by state and federal sources as well as by Novartis. It also grants the company unprecedented representation—two of five seats—on the department's research committee, which determines how the money is spent.

That the university had the backing of a private company was hardly unusual. That a single corporation would be providing one third of the research budget of an entire department at a public university had sparked an uproar. Shortly after the agreement was signed, a newly formed graduate-student group, Students for Responsible Research, circulated a petition blasting the Novartis deal for standing “in direct conflict with our mission as a public university.” *The Daily Californian*, Berkeley's student newspaper, published a five-part series on the growing privatization of the university, and a coalition of public-interest groups sent a letter to Berkeley's chancellor, Robert Berdahl, charging that the alliance “would disqualify a leading intellectual center from the ranks of institutions able to provide the kind of research—free from vested interest” that is the hallmark of academic life. Meanwhile, the College of Natural Resources, headed by Dean Gordon Rausser, sent a message to all professors urging them not to speak to the press and to direct any questions to the university's public-relations office. Many viewed this as a hush order.

“We are here to discuss the position of the faculty,” Ignacio Chapela, a professor of microbial ecology, announced as the April 13 meeting began. Chapela, who was then the chairman of the college's executive committee, a faculty governing body, snapped on an overhead projector to display the results of the survey, and declared that the Novartis deal had left the CNR “deeply divided.” While 41 percent of the faculty respondents supported the Novartis agreement as signed, more than 50 percent believed that it would have a “negative” or “strongly negative” effect on academic freedom. Roughly half believed that the agreement would erode Berkeley's commitment to “public good research,” and 60 percent feared that it would impede the free exchange of ideas among scientists within the college—one of Chapela's chief concerns.

“When I came to Berkeley,” Chapela explained to us after the meeting, “the people who brought me here and who were my closest colleagues were largely in the Department of Plant and Microbial Biology. Now I know that anything I say to these people can be turned around and handed over to Novartis. So I just can’t talk to them anymore. If I have a good idea, I’m not going to just give it away.” Chapela, like many critics of the deal, is hardly a confirmed opponent of university-industry relations. Before coming to Berkeley, he told us, he spent three years in Switzerland working for none other than Novartis—then named Sandoz—and he continues to have a relationship with the company. “I’m not opposed to individual professors’ serving as consultants to industry,” he said. “If something goes wrong, it’s their reputation that’s at stake. But this is different. This deal institutionalizes the university’s relationship with one company, whose interest is profit. Our role should be to serve the public good.”

## The Academic-Industrial Complex

Gordon Rausser, the chief architect of the Novartis deal, believes that faculty concerns about the alliance reflect ignorance about both the Novartis deal and the changing economic realities of higher education. When we met with Rausser last year, in his spacious office in the ornate neoclassical Giannini Hall, he insisted that the deal, far from violating Berkeley’s public mission, would help to perpetuate the university’s status as a top-flight research institution. An economist who served on the President’s Council of Economic Advisors in the 1980s, and now operates a sideline consulting business, Rausser contends that Berkeley’s value is “enhanced, not diminished, when we work creatively in collaboration with other institutions, including private companies.” In a recent article in the Berkeley alumni magazine Rausser argues, “Without modern laboratory facilities and access to commercially developed proprietary databases ... we can neither provide first-rate graduate education nor perform the fundamental research that is part of the University’s mission.”

Rausser’s view is more and more the norm, as academic administrators throughout the country turn to the private sector for an increasing percentage of their research dollars, in part because public support for education has been dropping. Although the federal government still supplies most of the funding for academic research (it provided \$14.3 bil-

lion, or 60 percent, in 1997, the latest year for which figures are available), the rate of growth in federal support has fallen steadily over the past twelve years, as the cost of doing research, particularly in the cutting-edge fields of computer engineering and molecular biology, has risen sharply. State spending has also declined. Berkeley Chancellor Robert Berdahl says that California now supplies just 34 percent of Berkeley's overall budget, as compared with 50 percent twelve years ago, and he claims that other state universities have suffered similar cuts.

Meanwhile, corporate giving is on the rise, growing from \$850 million in 1985 to \$4.25 billion less than a decade later—and increasingly the money comes with strings attached. One marked trend is a boom in industry-endowed chairs. Kmart has endowed a chair in the management school at West Virginia University which requires its holder to spend up to thirty days a year training assistant store managers. Freeport McMoRan, a mining company embroiled in allegations of environmental misconduct in Indonesia, has created a chair in environmental studies at Tulane. In its series on privatization at Berkeley, *The Daily Californian* noted that buildings throughout the Haas School of Business were “plastered with corporate logos.” One major contributor to the school is Don Fisher, the owner of The Gap, whose company also happens to be featured as a case study in an introductory business-administration course. Laura D’Andrea Tyson, formerly one of President Clinton’s top economic advisers, is now officially known as the BankAmerica Dean of Haas.

In rushing to forge alliances with industry, universities are not just responding to economic necessity—they are also capitalizing on a change in federal law, implemented nearly two decades ago, that laid the foundation for today’s academic-industrial complex. In 1980, concerns about declining U.S. productivity and rising competition from Japan propelled Congress to pass the Bayh-Dole Act, which for the first time allowed universities to patent the results of federally funded research. The goal of the legislation was to bring ideas out of the ivory tower and into the marketplace, by offering universities the opportunity to license campus-based inventions to U.S. companies, earning royalties in return. Both the government and the business world saw universities not merely as centers of learning and basic research but as sources of commercially valuable ideas, which is why the Business-Higher Education Forum, a coalition of corporate and academic leaders, and similar groups lobbied to tear down the walls separating universities from the marketplace. In

the years since, Congress has passed numerous other laws to bolster university-industry ties, including generous tax breaks for corporations willing to invest in academic research.

The Bayh-Dole Act was from the beginning controversial. Some in Congress argued that granting private companies the rights to publicly funded research amounted to an enormous giveaway to corporations; others pronounced the act a visionary example of industrial policy that would help America compete in the fast-moving information age. What is undeniable is that Bayh-Dole has revolutionized university-industry relations. From 1980 to 1998 industry funding for academic research expanded at an annual rate of 8.1 percent, reaching \$1.9 billion in 1997—nearly eight times the level of twenty years ago. Before Bayh-Dole, universities produced roughly 250 patents a year (many of which were never commercialized); in fiscal year 1998, however, universities generated more than 4,800 patent applications. University-industry collaborations, Rausser argues, have brought important new products—anti-AIDS treatments, cancer drugs—to market, and have spurred America’s booming biotech and computing industries. “The University of California alone has issued over five hundred patents since Bayh-Dole,” Rausser says.

This is a powerful argument, but a troubling one. In an age when ideas are central to the economy, universities will inevitably play a role in fostering growth. But should we allow commercial forces to determine the university’s educational mission and academic ideals? In higher education today corporations not only sponsor a growing amount of research—they frequently dictate the terms under which it is conducted. Professors, their image as unbiased truth-seekers notwithstanding, often own stock in the companies that fund their work. And universities themselves are exhibiting a markedly more commercial bent. Most now operate technology-licensing offices to manage their patent portfolios, often guarding their intellectual property as aggressively as any business would. Schools with limited budgets are pouring money into commercially oriented fields of research, while downsizing humanities departments and curbing expenditures on teaching. Occasional reports on these developments, including a recent *60 Minutes* segment on corporate-sponsored research, have begun to surface beyond the university. But the larger picture has yet to be filled out. It is this: universities, once wary beneficiaries of corporate largesse, have become eager co-capitalists, embracing market values as never before.

## Secrecy and Science

In a classic paper published in 1942, the sociologist Robert K. Merton likened the culture of science more to the ideals of communism than to capitalism, because intellectual property was commonly shared and discoveries were freely exchanged. “The scientist’s claim to ‘his’ intellectual ‘property,’” Merton wrote, was “limited to that of recognition and esteem,” and scientific knowledge was assumed to be a public good.

Today scientists who perform industry-sponsored research routinely sign agreements requiring them to keep both the methods and the results of their work secret for a certain period of time. From a company’s point of view, confidentiality may be necessary to prevent potential competitors from pilfering ideas. But what constitutes a reasonable period of secrecy? The National Institutes of Health recommends that universities allow corporate sponsors to prohibit publication for no more than one or two months (the amount of time ordinarily necessary to apply for a patent), but lengthier delays are becoming standard. Berkeley’s contract with Novartis, for example, allows the company to postpone publication for up to four months. A survey of 210 life-science companies, conducted in 1994 by researchers at Massachusetts General Hospital, found that 58 percent of those sponsoring academic research require delays of more than six months before publication.

“One of the most basic tenets of science is that we share information in an open way,” says Steven Rosenberg, of the National Cancer Institute, who is among the country’s leading cancer researchers. “As biotech and pharmaceutical companies have become more involved in funding research, there’s been a shift toward confidentiality that is severely inhibiting the interchange of information.” A few years ago Rosenberg confronted this problem firsthand when he tried to obtain information on safe-dosage levels for a reagent he sought to use in a clinical trial involving an experimental cancer treatment. The company asked Rosenberg to sign a confidentiality agreement, and when he refused, they withheld the information. Rosenberg has become so alarmed about secrecy that he now urges all scientists and research institutions to reject confidentiality restrictions on principle. Few have heeded his call. A 1997 survey of 2,167 university scientists, which appeared in the *Journal of the American Medical Association*, revealed that nearly one in five had delayed publication for more than six months to protect proprietary information—and this was the number that admitted to delay. “The

ethics of business and the ethics of science do not mix well,” Rosenberg says. “This is the real dark side of science.”

Nelson Kiang, a professor emeritus at the Massachusetts Institute of Technology and at Harvard, who recently organized an MIT conference on “Secrecy in Science,” worries in particular that students, rather than learning proper scientific protocol, are being taught to accept the inhibiting power of money over science. “One hears of many students at MIT who complain about not being able to publish their theses in a timely fashion,” Kiang says, “but when we tried to involve them in the conference, not a single one would come forward, and they actually asked us specifically not to be named. Of course, it’s not surprising. They fear that if they come forward, they might get into trouble with their supervisors.”

Worse than the problems of enforced secrecy and delay, however, is the possibility that behind closed doors some corporate sponsors are manipulating manuscripts before publication to serve their commercial interests. In the summer of 1996, four researchers working on a study of calcium channel blockers—frequently prescribed for high blood pressure—quit in protest after their sponsor, Sandoz, removed passages from a draft manuscript highlighting the drugs’ potential dangers, which include stroke and heart failure. The researchers aired their concerns in a letter to the *Journal of the American Medical Association*: “We believed that the sponsor ... was attempting to wield undue influence on the nature of the final paper. This effort was so oppressive that we felt it inhibited academic freedom.” Such meddling, though generally difficult to document, may well be common. A study of major research centers in the field of engineering found that 35 percent would allow corporate sponsors to delete information from papers prior to publication.

This past May, at a meeting of the American Association of University Professors, in Boston, a group of academics gathered to discuss the growing corporate threat to academic freedom—and the apparent reluctance of universities to defend it. Among those present was David Kern, formerly the director of occupational medicine at Brown University’s Memorial Hospital. In 1996, while serving as a consultant to Microfibres, a Rhode Island company that produces nylon flock, Kern discovered evidence of a serious new lung disease among the company’s employees. Upon learning that he planned to publish his findings, the company threatened to sue, citing a confidentiality agreement that forbade Kern to expose “trade secrets.” The information that Kern had

gathered had come from tests on volunteers, and concerned not proprietary secrets but a serious threat to public health. Yet Brown University, too, tried to dissuade Kern from publishing, warning that the company might file suit. Outraged, Kern published anyway, and in 1997, the Centers for Disease Control officially recognized the new disease, flock worker's lung. Although Microfibres never did file suit, Kern's position at Brown was eliminated. "Universities should protect their faculty from any efforts to encroach on academic freedom," Kern says. "Unfortunately, with so much corporate money flooding into academia, that's not happening." At the AAUP conference several professors shared similar experiences, and these may only hint at the scope of the problem.

Mildred Cho, a senior research scholar at Stanford's Center for Bio-medical Ethics, warns that for every David Kern who steps forward in such cases, an unknown number of researchers voluntarily toe the company line. "When you have so many scientists on boards of companies or doing sponsored research," Cho explains, "you start to wonder, How are these studies being designed? What kinds of research questions are being raised? What kinds aren't being raised?" In a 1996 study published in the *Annals of Internal Medicine*, Cho found that 98 percent of papers based on industry-sponsored research reflected favorably on the drugs being examined, as compared with 79 percent of papers based on research not funded by industry. More recently, an analysis published in the *Journal of the American Medical Association* found that studies of cancer drugs funded by pharmaceutical companies were roughly one eighth as likely to reach unfavorable conclusions as nonprofit-funded studies. Might the public begin to see academics less as stewards of truth than as hired hands?

Or worse than hired hands: interested parties. More and more, professors not only accept industry grants to perform research but also hold stock or have other financial ties to the companies funding them. In a study of 800 scientific papers published in a range of academic journals, Sheldon Krinsky, a professor of public policy at Tufts University and a leading authority on conflicts of interest, found that slightly more than a *third* of the authors had a significant financial interest in their reports. Michael McCarthy, an editor at the British medical journal *The Lancet*, says such links are now so common that he "often can't find anyone who doesn't have a financial interest" in a drug or therapy the journal would like to review. Although Krinsky

doesn't believe that the mere existence of such ties makes an academic study suspect, he advocates full disclosure. Yet in none of the nearly 300 studies in which Krimsky found a conflict of interest were readers informed about it.

The Securities and Exchange Commission has also detected this trend and is now investigating numerous academic researchers suspected of engaging in insider trading. In a case filed recently in Pennsylvania, the SEC charged Dale J. Lange, a Columbia University neurologist, with pocketing \$26,000 in profits after Lange bought stock in a company that was about to release promising new findings concerning a drug to treat Lou Gehrig's disease. Lange expected the stock to soar because he had conducted the confidential clinical trials.

The growing concern about potential conflicts of interest has prompted some universities to forbid professors to perform sponsored research for companies in which they hold equity. The federal government is also taking steps. In 1996, the Public Health Service issued guidelines that require all academic researchers to report it to their schools if they have received payments of more than \$10,000 from a company or if they hold at least five percent of its stock. At most universities, however, such information is kept private, which means that frequently neither journal editors nor academic peers know who has ties to industry and who hasn't.

More than a year before fen-phen, the appetite suppressant, was pulled off the market because it seemed to be implicated in a number of deaths, a group of researchers published a study in *The New England Journal of Medicine* warning that drugs like fen-phen could have potentially fatal side effects. But the same issue contained a commentary from two academic researchers that downplayed the health dangers of fen-phen. Both authors had served as paid consultants to the manufacturers and distributors of similar drugs—connections that were not mentioned. "I was outraged when I saw that," Stuart Rich, a professor at Rush Medical College, told the *Chronicle of Higher Education* when the ties were exposed. "The study was the only scientific study that said these diet pills kill people." Like universities, some journals have begun requiring academic contributors to disclose corporate financial ties. But in a study released last year Sheldon Krimsky and another researcher examined 62,000 articles and found that these ties were disclosed in only 0.5 percent of them.

Corporate underwriting of research is by no means confined to the medical sciences. In his book *The Heat Is On: The High Stakes Battle*

*Over Earth's Threatened Climate* (1997), Ross Gelbspan documents how, over the past several years, fossil-fuel companies have bankrolled numerous academic studies that downplay the threat of global warming—distorting, Gelbspan argues, the public-policy debate. And last June controversy erupted at the University of Florida following the disclosure that Charles Thomas, a criminologist at the school who advised the state on prison policy, had pocketed \$3 million in consulting fees from the private-prison industry, in which he also owned stock. (Thomas's views on private prisons are quoted frequently in *The Wall Street Journal* and *The New York Times*, and he has trumpeted the virtues of “full-scale privatization” in testimony before Congress.) “I’m really kind of astounded that the state university system would tolerate something like this,” said a member of the state ethics commission, which slapped Thomas with a \$20,000 fine.

Some would argue that such relationships, far from being unseemly, are in keeping with the utilitarian strain that runs through the history of American higher education. Certainly, in comparison with their European counterparts, U.S. universities have always displayed a pragmatic bent. Whereas in Europe universities took pride in pursuing knowledge for its own sake and in remaining aloof from the outside world, in America educators from Thomas Jefferson to John Dewey have argued that universities ought to be engaged in the world, and that knowledge exists to be put to use. When Congress passed the Morrill Act, in 1862 (which gave rise to America's public land-grant universities, including Berkeley), it specifically instructed the states to establish schools that would teach “agriculture and the mechanical arts . . . in order to promote the liberal and practical education of the industrial classes,” rather than the classical curriculum.

Thus it is hardly surprising that, as the historian David Noble documents in his book *America by Design* (1977), the rapid growth of the U.S. industrial economy at the turn of the century coincided with a surge in university-industry collaboration. Engineering and chemical giants underwrote research in exchange for the services of academic scientists; universities established industrial-research centers to furnish corporations with personnel; some schools even went into business themselves, with the University of Minnesota operating its own mine and New York University running a macaroni factory. Such entanglements inspired the radical economist Thorstein Veblen to comment acerbically in 1908 that “business principles” were transforming higher education into “a merchantable commodity, to be produced on a piece-

rate plan, rated, bought, and sold by standard units, measured, counted and reduced to staple equivalence by impersonal, mechanical tests.”

World War II, however, ushered in an era of public support for higher education. The role of university scientists in the Manhattan Project and other wartime initiatives—such as the development of penicillin and streptomycin—convinced public officials that academics were uniquely capable of undertaking crucial research initiatives. As corporations slowed their funding of academic research, public money filled the role: from 1953 to 1968 public support grew by 12 to 14 percent annually. Whereas funding for scientific research from all sources totaled \$31 million in 1940, federal funding alone reached \$3 billion in 1979, much of it dispensed by the National Institutes of Health and other new agencies. This influx of federal dollars reflected a growing appreciation for the basic, undirected research that universities perform. “New products and new processes do not appear full-grown,” Vannevar Bush, President Franklin Roosevelt’s chief science adviser, declared in 1944. “They are founded on new principles and new conceptions, which in turn are painstakingly developed by research in the purest realms of science.”

The Bayh-Dole Act changed this, and not simply by creating incentives for corporations to invest in academic research. What is ultimately most striking about today’s academic-industrial complex is not that large amounts of private capital are flowing into universities. It is that universities themselves are beginning to look and behave like for-profit companies.

## The University as Business

The Office of Technology Licensing (OTL) at Stanford University occupies the third floor of a drab concrete building located just off the main loop that circles the palm-studded Palo Alto campus. This unprepossessing spot is the hub of a commercial enterprise that is the envy of universities across the country. The OTL’s mission is to commercialize discoveries made by professors and to manage Stanford’s growing patent portfolio. In the main lobby, encased in handsome wooden frames along the walls, are displays highlighting the various patents and products the office has recently helped bring to market. One describes a valve that creates high-resolution images on the surface of a silicon chip, another a new case-management system for heart failure that the university is hoping to license to the nation’s hospitals.

“We’re receiving about two hundred and fifty invention disclosures a year, roughly one in four of which is patented,” says Jon Sandelin, a senior associate at the OTL. Sandelin says that Stanford earned \$61 million from its technology-transfer activity last year—a success he credits to creating the right entrepreneurial environment. “You have to understand—initially the department chairmen and school deans weren’t thrilled by having this new activity that was diverting the attention of their faculty away from teaching and research,” he explains. “So how do you offset that? You make them stakeholders—you make them beneficiaries.”

Once professors and their departments learned that they could earn a cut from inventions, Sandelin says, they became more enthusiastic about bringing their ideas to the OTL. To reinforce the message, the OTL conducts aggressive outreach, organizing lunches with department heads; publishing a newsletter, *Brainstorm*, that touts the latest faculty discoveries; and dangling incentives in front of would-be inventors. In 1990, Stanford established a Research Incentive Fund to help professors convert academic concepts into “prototype products.” “Got an idea for the next great whatchmacallit but don’t have the funds to move from hypothesis to thesis?” a recent issue of *Brainstorm* asks. “This fund might just be your answer.”

Traditionally, universities regarded patents as being outside their orbit, generally believing that proprietary claims were fundamentally at odds with their obligation to disseminate knowledge as broadly as possible. Today nearly every research university in the country has a technology-licensing office, and some have gone further. Johns Hopkins Medical School, for example, has established an internal venture-capital fund to bankroll commercially promising lines of research. The University of Chicago, renowned for its classical tradition, has created an affiliated non-profit, the ARCH Development Corporation, whose mission, in part, is to launch start-up companies based on faculty innovations. The dean of Chicago’s medical school, Glenn D. Steele Jr., recently removed many faculty department heads and bluntly told *Business Week* that he plans to begin “insinuating the place . . . with entrepreneurial people”—a clear statement that commercial acumen is becoming an important qualification for new faculty.

Surprisingly, two decades after Bayh-Dole was passed, no independent assessments of its economic impact have been made. But the Association of University Technology Managers, a consortium of over 300 universi-

ties and research institutions that engage in technology transfer, does publish an annual statistical survey of its members. In 1998 alone, the AUTM reports, 364 start-up companies were formed on the basis of a license to an academic invention, bringing the total since 1980 to 2,578. The group estimates that overall, university technology-transfer activities generated \$34 billion that year, supporting 280,000 American jobs.

“There’s clearly a kind of ferment going on at U.S. universities,” says Lita Nelsen, the director of technology licensing at MIT. “When I went to MIT as an undergraduate, in 1964, the Kendall Square area was a bunch of vacant lots with a greasy old diner, and that was it. Now if you look out my window, it’s brick high-rise buildings filled with little start-up companies—everything from Lotus down the street, to Neuro-metrics across the alley, to Biogen and Sapien. The old mills with broken windows have been refurbished into high-tech incubators.” The clustering of computer-engineering and biotech firms around academic-research centers in Silicon Valley; Austin, Texas; Route 128 in Massachusetts; and the Research Triangle, in North Carolina, derives in large measure from the synergy between universities and industry that Bayh-Dole has fostered.

No sector of the economy better illustrates the potential benefits of this synergy than biotechnology, a multibillion-dollar industry that grew out of university research labs. Garry Nolan, an assistant professor of molecular pharmacology at Stanford, epitomizes the new generation of professor-entrepreneurs. A few years ago Nolan founded Rigel, a biotech firm based in San Francisco that has pioneered a promising new method for identifying the proteins involved in asthma, allergies, immune disorders, and other health problems. “We’ve already attracted a hundred and fifty million dollars in investment from various drug companies interested in our work,” Nolan says. “There’s almost no greater and more immediate feedback than when you find a commercial entity interested in what you’re doing.”

Walter Powell, a sociologist at the University of Arizona who has tracked the growth of the biotech industry worldwide, believes that the close links between universities and industry are a principal reason why U.S. firms now dominate the biotech market—a lesson America’s competitors are taking to heart. “You’re seeing other countries moving in the same direction,” Powell says, pointing out that the University of Munich has been involved in spinning off at least five private companies in Germany in the last two years alone. Lita Nelsen says her office

at MIT has been overrun with visitors from other countries, including Japan, which recently passed its own version of the Bayh-Dole Act.

The surprising twist, however, is that although university licensing offices are churning out patents, most of these offices are themselves barely breaking even. “Everybody was waiting for a hundred million dollars a year out of their technology-transfer offices,” Nelsen says. “The reality is that hardly any schools earn anywhere near that.” Although some academic achievements—such as the discovery of recombinant DNA and the development of the hepatitis B vaccine (developed jointly at the University of California and the University of Washington)—have generated millions, most have not, and Nelsen says it is impossible to predict which will be lucrative.

Far from restraining universities, however, the difficulty of turning a profit seems to have made them more aggressive. A growing number of schools, for example, are buying equity stakes in the very companies that stand to profit from their faculties’ research—a practice that both raises the potential for conflict of interest and is financially risky. In the 1980s and early 1990s, Boston University poured \$85 million (nearly a fifth of its endowment) into Seragen, a biotech firm specializing in cancer research, which several BU professors had founded. Convinced that the company would generate windfall profits, BU President John Silber also personally invested heavily in Seragen and persuaded numerous professors and trustees to do likewise. But from 1991 to 1997 Seragen lost almost \$150 million. The university, which at one point owned 91 percent of the company’s stock, was accused of egregiously mismanaging the school’s endowment to prop up the company and to protect the trustees’ investments.

Might such a cautionary tale dissuade other universities from going down the same road? To the contrary: the University of California recently established a policy allowing it to acquire equity stakes in startups and now owns shares in thirty companies committed to developing UC technologies. Stanford took a similar step in 1994.

Meanwhile, universities are devising increasingly creative—and controversial—ways to raise their royalty earnings. Michigan State University, for example, recently took the unusual step of applying for a new, slightly altered patent on a widely prescribed cancer drug, cisplatin, that was patented by the university in 1979. Filing twice on the same invention is prohibited, but MSU’s original patent, which along with its analog, carboplatin, generated \$160 million in royalties, was about to ex-

pire. Thus the slight alteration. The move may have been good for MSU's bottom line, but did it serve the public interest? In October 1999, a U.S. District Court in New Jersey invalidated the second patent for "obviousness-type double patenting," clearing the way for four drug companies to market cheaper, generic versions of the drug.

Stanford has advanced beyond mere patenting. The university recently invested more than \$1 million to develop its own brand-name product, Sondius-XG, a sound-synthesis technology that it will market in conjunction with Yamaha. Why? Because unlike patents, which expire after twenty years, brands generate revenue forever. Mary Watanabe, who works with Jon Sandelin at the Office of Technology Licensing, let slip during an interview that the university is also considering launching a "Stanford company." She declined to divulge details.

If these activities appear to be out of keeping with the university's nonprofit educational mission, that's because they are. In a provocative 1996 article in the *University of Pennsylvania Law Review*, Peter Blumberg, then a law student, argued that technology-transfer activity at universities is so far removed from the university's public mission that it "could be treated as unrelated business income for tax purposes." Universities, Blumberg writes, "enjoy their tax exemption because of a belief that they are producing research that no other market actor would produce absent a public subsidy; basic research, publishable research, research that educates students and ... is usable by the whole society."

In their zeal to maximize revenue, many schools are not only raising questions about their nonprofit status—they are getting into some embarrassing skirmishes with their own students and professors over the rights to potentially lucrative ideas. In the most extraordinary case to date Peter Taborsky, a student at the University of South Florida, wound up on the chain gang of a maximum-security state prison after colliding with his university over the rights to a discovery he made as an undergraduate. Taborsky had been working as a research assistant on a project sponsored by the Florida Progress Corporation, a local holding company. At the end of the sponsored research period, Taborsky claims, he received permission from Robert Carnahan, a dean in the College of Engineering, to begin work on his own experiments, following a different approach, which he hoped to use as the basis for a master's thesis. But as soon as Taborsky made his research breakthrough, which had obvious commercial utility as a way to remove ammonia from wastewater, Florida Progress and USF both laid claim to his discovery. The univer-

sity filed criminal charges against Taborsky and spent more than ten times the amount of the original research grant on outside legal counsel alone. In 1990, a jury found Taborsky guilty of stealing university property, and the State of Florida required him to begin serving his sentence on a chain gang in 1996. But the case became an embarrassing media spectacle, and Governor Lawton Chiles soon intervened to offer Taborsky clemency, which Taborsky, on principle, refused.

Why would a state university go to such lengths? To protect future investments, of course. As Seth Shulman argues in *Owning the Future*, a new book about intellectual property in the information age, the Taborsky case “underscores what can happen when universities, beholden to industry for an increasing share of research dollars, let financial concerns overshadow the notion of research as a shared intellectual pursuit.”

Today it is common for universities to pay exorbitant legal fees to defend their intellectual property. According to the Association of University Technology Managers annual report, dozens of major universities—Brandeis, West Virginia, Tufts, and Miami among them—actually spent more on legal fees in fiscal year 1997 than they earned from all licensing and patenting activity that year. A growing number of disputes pit universities against their own faculty members. In 1996, a jury awarded \$2.3 million to two professors, Jerome Singer and Lawrence Crooks, who filed suit against the University of California for shortchanging them on royalties resulting from their pathbreaking research on magnetic resonance imaging, a widely utilized medical test known as the MRI. An appeals court found that the university improperly sheltered revenue by dramatically discounting the patents it licensed to manufacturers in exchange for more than \$20 million in research funding.

Is this where the Bayh-Dole Act was supposed to lead? Two summers ago a working group at the National Institutes of Health issued a report to the NIH director, Harold Varmus, warning that changes in the way universities guard their intellectual property are endangering the free exchange of basic research tools—such as gene sequences and reagents—that are crucial to all research. The NIH found that the terms universities impose on their research tools, through their technology-licensing offices, “present just about every type of clause that universities cite as problematic in the [contracts] ... they receive from industry.” These include requirements that universities be allowed to review manuscripts prior to publication and provisions extending their own-

ership claims to any future discoveries deriving from use of their research materials. Universities, the NIH charges, “have no duty to return value to shareholders, and their principal obligation under the Bayh-Dole Act is to promote utilization, not to maximize financial returns. It hardly seems consistent with the purposes of the Bayh-Dole Act to impose proprietary restrictions on research tools that would be widely utilized if freely disseminated. Technology transfer need not be a revenue source to be successful.” Ironically, the proliferation of ownership claims threatens not only to stifle the free exchange of ideas but also to impede economic growth. James Boyle, an expert on intellectual-property law at American University, warns that if current trends continue, “creators will be prevented from creating,” as the public domain is “converted into a fallow landscape of walled private plots.”

### Controlling the Research Agenda

Immediately after the April faculty meeting at Berkeley several members of Students for Responsible Research gathered in an outdoor courtyard at La Burrita, a pub just off campus, to air their concerns about the Novartis deal—and to let off steam. “This place has some of the cheapest pitchers around,” said Jesse Reynolds, one of the group’s leaders, as glasses were poured and beers were passed around a long picnic table.

Unlike the student radicals of the sixties, these students never intended to lock horns with the university establishment. Reynolds, who studies California water resources, says he’s relatively new to student politics—and to politics altogether. “I’m generally one of those people who gripe a lot and do nothing,” he explained. “But when the best state agricultural college in the country makes this kind of leap, the world is bound to follow. I really fear that.”

David Quist, a second-year graduate student in environmental science, laughed as he told a story illustrating the culture that now permeates the university. The previous October, Quist said, at a town-hall meeting where the Novartis deal was first made public, Dean Gordon Rausser invited concerned students to examine the contract for themselves. “So the next day I came to his office,” Quist recalled. “I was given some materials and sat down to take notes. But as soon as an administrator saw me, she said, ‘Oh, no, you can’t do that.’” Quist’s notes were confiscated and held at the dean’s office for several months.

Wilhelm Gruissem, a professor in the Department of Plant and Microbial Biology who helped to negotiate the Novartis deal, insists that the negotiations were as open as possible without divulging the company's proprietary secrets. But even students within the department felt shut out. In December of 1998, twenty-three graduate students sent a letter to the faculty complaining that their views had never been solicited and that they had been "forced to rely on rumors and supposition throughout the negotiation process."

What most concerns the Students for Responsible Research is that as university-industry ties grow more intimate, less commercially oriented areas of science will languish. "Let's say you're a graduate student interested in sustainable agriculture or biological control or some other area that is not commercial," Reynolds explained. "My guess is you're not going to come to Berkeley, or you'll at least think twice about it."

Donald Dahlsten, the associate dean of the College of Natural Resources, shares this concern. "Molecular biology and genetic engineering have clearly risen as the preferred approach to solving our problems, and that's where the resources are going," Dahlsten says. "New buildings have gone up, and these departments are expanding, while the organismic areas of science—which emphasize a more ecological approach—are being downsized." Dahlsten once chaired Berkeley's world-renowned Division of Biological Control. Today that division, along with the Department of Plant Pathology and more than half of all faculty positions in entomology, are gone—in part, many professors believe, because there are no profits in such work. "You can't patent the natural organisms and ecological understanding used in biological control," Andy Gutierrez, a Berkeley entomologist, explains. "However, if you look at public benefit, that division provided billions of dollars annually to the state of California and the world." In one project Gutierrez worked on, he helped to halt the spread of a pest that threatened to destroy the cassava crop, a food staple for 200 million people in West Africa.

Gordon Rausser counters that far from draining resources from other areas, the Novartis deal will benefit the college as a whole, because a quarter of the money will be spent outside the Department of Plant and Microbial Biology. "I'm sitting here with three science buildings that were built in the 1920s, thirties, and forties," Rausser says. "I can't get those buildings modernized for first-rate research without resources."

Chris Scott, who until recently oversaw industry collaborations at Stanford's medical school, describes another reason that working with

the private sector is essential. Scott points out that for the past several years industry researchers have consistently been ranked among the most frequently cited scientific authors, making academic isolation intellectually deleterious. But Scott, too, recognizes the danger of allowing market criteria to dictate the paths of scientific inquiry. “Show me an industry-sponsored research project on schistosomiasis—a liver parasite that afflicts people in the Third World—or malaria or river blindness or dengue fever,” Scott says. All these diseases primarily afflict people in developing nations who can’t afford to pay high prices for medicine, he says, so all have been dropped from the pharmaceutical industry’s docket. Mildred Cho, of Stanford’s Center for Biomedical Ethics, agrees, pointing to vaccine research as another neglected area. “Public-health services simply can’t afford to pay high prices,” Cho says. “If research is market-driven, it raises potential problems not only for the research agenda but for public health.”

As the research agendas of universities and corporations merge, there is one other danger: namely, that universities will cease to serve as places where independent critical thought is nurtured. Anne Kapuscinski, a visiting professor from the University of Minnesota who studies genetically engineered organisms, and other scholars we met with at Berkeley fear that raising questions about the safety of genetically altered crops—a principal research focus of Novartis—may prove difficult if more and more agricultural colleges turn to corporations to finance their research. Concerns about genetic engineering are mounting, Kapuscinski notes. A study published last May in *Nature* found that the toxins dispersed from the pollen of Bt (*Bacillus thuringiensis*) corn, a Novartis product, can kill nonpest insects, including the monarch butterfly—a problem with potentially enormous ecological implications. Such dangers prompted the Food and Drug Administration to convene a series of public hearings last November on genetically altered crops, whose use has provoked huge demonstrations in Europe and elsewhere. Ignacio Chapela, of the College of Natural Resources’ executive committee, believes that the most important thing Novartis stands to gain from the alliance is legitimacy. “The sheer value of having the logo of the University of California next to the logo of Novartis is immensely valuable to the company right now,” he says.

Maybe so—but the plan may end up backfiring. At last year’s graduation ceremony, in a graphic display of dissent, a student speaker placed the blue-and-orange Novartis logo directly above Berkeley’s,

while a hundred students in the audience mockingly donned graduation caps emblazoned with the Novartis logo—hardly the public exposure the company sought.

### Downsizing the Humanities

The students at Berkeley were not the only ones protesting the growing corporate influence on university research last spring. In March of 1998, students at dozens of schools, including the University of Wisconsin, Harvard, and Cornell, held a series of teach-ins on the subject. At George Mason University, a state school in Fairfax County, Virginia, another graduation protest erupted as hundreds of students attached bright pink buttons bearing the slogan “Stop Dis-Engaging Our Future” to their caps and gowns. The buttons, which were distributed by Students for Quality Education, were a pointed reference to a recent George Mason mission statement, “Engaging the Future,” which calls for increasing investment in information technology and tightening relations between the university and northern Virginia’s booming technology industry.

In 1998, James S. Gilmore, the governor of Virginia, promised to increase state funds for GMU by as much as \$25 million a year provided that the university better serve the region’s high-tech businesses. GMU’s president, Alan G. Merten, a computer scientist and a former dean of the business school at Cornell, hardly needed urging. “We must accept that we have a new mandate, and a new reason for being in existence,” he announced at the World Congress on Information Technology, a gathering of industry executives hosted by GMU in the summer of 1998. “The mandate is to be *networked*.” By year’s end Merten had added degree programs in information technology and computer science, poured money into the 125-acre Prince William campus, whose focus is biosciences, bioinformatics, biotechnology, and computer and information technology, and suggested that all students would be trained to pass a “technology literacy” test. Amid this whirlwind of change, however, other areas fared less well. Degree programs in classics, German, Russian, and several other humanities departments were eliminated.

In defending the changes, Merten speaks as a realist—and, it’s impossible not to notice, as someone versed in the language of the business world. “There was a time when universities weren’t held accountable for much—people just threw money at them,” he says. Today “people with

money are more likely to give you money if you have restructured and repositioned yourself, got rid of stuff that you don't need to have. They take a very dim view of giving you money to run an inefficient organization." The process of making GMU more efficient was, he concedes, "a little bloody at times," but there was a logic to it. "We have a commitment to produce people who are employable in today's technology work force," he says. Students at GMU are "good consumers" who want degrees in areas where there are robust job opportunities, and the university has an obligation to cater to that demand.

But should meeting the demand come at the expense of providing a well-rounded education? In response to GMU's cuts in the humanities 1,700 students signed a petition of protest. In addition, 180 professors in the College of Arts and Sciences sent a letter to President Merten arguing that although training students for the job market was a legitimate goal, "precisely in the face of such an emphasis on jobs and technology, it is more necessary than ever to educate students beyond technological proficiency." Kevin Avruch, a GMU anthropologist who signed the letter, explains, "A university should teach people to read and write and think critically. And my guess is that, ironically, that's what corporations really want as well. If they need to teach them Lotus, they can do that after they graduate."

Perhaps—but what happened at GMU is clearly part of a national trend. In 1995 the Board of Regents in Ohio assessed how the state's education dollars should be spent. The verdict? Eliminate funding for eight doctoral programs in history. James Engell, a professor at Harvard who has chaired that school's steering committees on degree programs in both history and literature, and Anthony Dangerfield, a former Dartmouth English professor, recently concluded a two-year national study of the state of the humanities. From 1970 to 1994, they found, the number of bachelor's degrees conferred in English, foreign languages, philosophy, and religion all declined, while there was a five- to ten-fold increase in degrees in computer and information sciences. The elite top quarter of Ph.D. programs in English have twenty-nine fewer students per program than they had in 1975. Meanwhile, humanities professors on average earn substantially less than their counterparts in other fields, and the gap has widened over the past twenty years.

"Test what you will—majors, salaries, graduate programs ... the results come back the same," Engell and Dangerfield write in a lengthy recent article in the Harvard alumni magazine. "Since the late 1960s

the humanities have been neglected, downgraded, and forced to re-trench, all as other areas of higher education have grown in numbers, wealth, and influence.” The authors trace this to what they call the new “Market-Model University,” in which subjects that make money, study money, or attract money are given priority.

Even small liberal-arts colleges are responding to market demand. At the Claremont Colleges, in southern California, a cluster of schools that includes Pomona and Harvey Mudd, a new graduate institute has been launched that features “a curriculum focused on the needs of the industrial sector,” a faculty without tenure, and an educational mandate to train students for “professional careers in emerging fields at the intersection of life sciences and engineering.”

Surprisingly, such developments have received little attention. Since the early 1980s American culture has obsessively debated the content of the Western canon—whether Shakespeare or Toni Morrison, European history or African history, should be taught to undergraduates. In the decades to come a more pressing question may be whether undergraduates are taught any meaningful literature or history at all. Kevin Avruch says that the recent restructuring at GMU brought home that lesson. “It actually united professors on the left and the right,” he says. “This faculty is often characterized as overly liberal, but we discovered that in at least one sense most of us are tremendously conservative: we share a nineteenth-century view that our job is to educate well-rounded citizens.”

### TheHigherLearning.com

While humanities professors at some schools are battling to save their departments from being eliminated, others are discovering, much to their surprise, that university administrators have taken a sudden interest in their course material because of its potential for being marketed online. Seemingly overnight the computer revolution has transformed “courseware” into a valuable piece of “content” that can be packaged and sold on the Internet, and online-education companies are racing to collaborate with academic institutions to exploit this burgeoning market.

Berkeley recently signed a deal with America Online, the University of Colorado has teamed up with Real Education, and the Western Governors’ Association has founded a “virtual university” linking more

than thirty schools in twenty-two states. Michael Milken, the convicted junk-bond trader, is investing heavily in an Internet education company known as UNext.com, which recently signed deals with Columbia University and the University of Chicago.

In a time of budget shortfalls and dwindling public support for education, university administrators and politicians see online education as a way to expand on the cheap. “Just building campuses is a very expensive proposition,” says E. Jeffrey Livingston, the associate commissioner for the Utah System of Higher Education. “Governors see [the virtual university] as a way to not spend as much money in the future, to meet growth.” “Distance learning” is also seen as a promising new teaching tool and as a way to reach nontraditional education markets, such as part-timers and foreign students.

A growing number of professors, however, fear that electronic education is destined to transform teaching into little more than a commodity. Before a university can sell courseware online, it must first control the rights, and that means, in essence, usurping copyright from the creators of the courses—the faculty. “This is going to be one of the most important battlegrounds of the future,” predicts Edward Condren, a professor of medieval literature at the University of California at Los Angeles. In June of 1994, UCLA’s extension program—the largest continuing-higher-education program in the country—signed a deal granting exclusive control (including copyright) over the production and distribution of its electronic courses to OnlineLearning.net (then called The Home Education Network). Despite UCLA’s much-vaunted faculty-governance structure, Condren says, there was no prior faculty consultation, and the academic senate had to wait until February of 1998 before it was permitted to see any version of the contract. “This is a public institution,” Condren says angrily, “and a contract was entered into without any public announcement that bids were being sought.”

In addition to being a renowned Chaucer scholar, Condren is an authority on intellectual-property law. For the past twenty-five years he has served as an expert witness in a number of high-profile court cases, and he testified for the winning side in *Falwell v. Flynt*. “In my opinion,” he says, “the UCLA extension program in its electronic offerings is operating illegally. It does not have the copyright assignment from the faculty who own the rights to the courses.” Indeed, professors have historically been considered the intellectual “authors,” and thus the

copyright holders, of their work, says David Noble, a historian at York University, in Toronto, where faculty members recently waged a successful battle to protect their copyrights from challenge. The Bayh-Dole Act allows universities to patent the intellectual discoveries of their faculty members and to share in the royalties, but controlling copyright is radically different, Condren says, because “it would undermine the legal protection that enables faculty to freely express their views without fear of censorship or appropriation of their ideas.”

Professors also fear that universities will use distance learning not to enhance education but to eliminate teaching positions. It's a legitimate concern. The New School University, in New York City, now pays independent contractors and adjunct professors a flat fee of between \$2,000–\$5,000 to design and teach an online course. Educause, a consortium of over 1,600 academic institutions and more than a hundred and fifty corporations, in 1994 launched a National Learning Infrastructure Initiative that produced a detailed study of what professors do, breaking down which discrete teaching functions can be automated or outsourced for “productivity enhancement.” William Massy and Robert Zemsky, education scholars based at Stanford and the University of Pennsylvania respectively, argue in a recent Educause paper that universities need information technology to control their budgets. “With labor accounting for seventy percent or more of current operating cost,” they assert, “there is simply no other way.”

The future the professors fear has already arrived. David Noble, citing figures from the U.S. National Center for Educational Statistics, notes that even before the computer revolution, while spending on instruction declined by 9.5 percent at public universities from 1976 to 1994, expenditures on research increased by 21 percent. The American Association of University Professors, examining changes in the academic work force, notes that from 1975 to 1995 the share of full-time faculty positions declined while the use of part-time faculty more than doubled. “In the end students were paying more for their classes and getting less,” Noble argues in a recent paper, “Digital Diploma Mills,” that links the growth in online learning to the increasingly commercial focus of universities. At least some students seem to agree. In May of 1996, at the University of Utah, Jeff Casper and Heather Fortuna were elected president and vice-president of the student body after running under the slogan “Get Real” and campaigning against the virtual university. “I took a class in one of my majors where the bulk of the in-

struction was done through computer,” Fortuna explained, “and it was the most tedious thing that I ever had to deal with. I learned very little in comparison with the experiences I’ve had inside the classroom.”

“It has been the fate of American higher education to develop in a pre-eminently businesslike culture,” the historian Richard Hofstadter wrote in 1952. Through the years, Hofstadter acknowledged, America’s universities had fostered the nation’s technological and economic development. But too often, he lamented, higher education in America was judged on purely pragmatic grounds. “Education is justified apologetically as a useful instrument in attaining other ends: it is good for business or professional careers,” he wrote. “Rarely, however, does anyone presume to say that it is good for man.”

Some would argue that Hofstadter’s vision of higher education is an unaffordable luxury. In today’s information age ideas have become prized commodities. Still, even on the utilitarian grounds that traditionalists like Hofstadter would scorn, preserving the distinction between higher education and business is vitally important.

For if commercial criteria are allowed to prevail, schools not only risk shrinking their educational mission—they risk ceasing to be centers of technological innovation as well. Paul Berg, a Nobel Prize-winning biochemist we met with at Stanford, tells a story that dramatically illustrates why. Berg, seventy-three, is a seminal figure in the biotech revolution, having laid the groundwork for splicing DNA to make hybrid molecules. (Stanley Cohen and Herbert Boyer built on Berg’s work to create the first recombinant DNA clone.) His discovery propelled the billion-dollar industry that is now hailed as a model of university-industry relations. But Berg points to an underlying irony. “The biotech revolution itself would not have happened had the whole thing been left up to industry,” he says. “Venture-capital people steered clear of anything that didn’t have obvious commercial value or short-term impact. They didn’t fund the basic research that made biotechnology possible.” Berg recalls that shortly after his own pathbreaking discovery he gave a seminar at the Merck pharmaceutical company, where he met a young scientist who had been pursuing the same idea. When this scientist encountered some obstacles after six or seven months, Merck prevented him from continuing to work on the project. “Even though Merck was widely championed for its support of research, they wouldn’t let him go beyond a certain point,” Berg says, “and that is just one of the limitations of corporate research.”

The freedom of universities from market constraints is precisely what allowed them in the past to nurture the kind of open-ended basic research that led to some of the most important (and least expected) discoveries in history. Today, as the line between basic and applied science dissolves, as professors are encouraged to think more and more like entrepreneurs, a question arises: Will the Paul Bergs of the future have the freedom to explore ideas that have no obvious and immediate commercial value? Only, it seems, if universities cling to their traditional ideals and maintain a degree of independence from the marketplace. This will not be easy in an age of dwindling public support for higher education. But the nation's top-flight universities can lead the way by collectively establishing new guidelines designed to preserve academic freedom in all their interactions with industry. These could include forbidding professors from having direct financial ties to the companies sponsoring their research; banning universities themselves from investing in these companies; prohibiting publication delays of more than thirty to sixty days and any other editorial constraints; and minimizing proprietary restrictions on basic research tools. In addition, universities could do more to make the case for preserving public support for higher education while refusing to tailor either the research agenda or the curriculum to the needs of industry. "The best reason for supporting the college and the university," Hofstadter wrote, "lies not in the services they can perform, vital though such services may be, but in the values they represent. The ultimate criterion of the place of higher learning in America will be the extent to which it is esteemed not as a necessary instrument of external ends, but as an end in itself."