Sociological Forum, Vol. 20, No. 2, June 2005 (© 2005)
DOI: 10.1007/s11206-005-4101-7

Institutionalizing the Network Form: How Life Scientists Legitimate Work in the Biotechnology Industry

Laurel Smith-Doerr[1]

This study combines insights from economic sociology on recent structural changes in the knowledge economy with neoinstitutionalist analyses of cultural change in organizations. Because a network form of organization relies on interorganizational ties, new models of legitimacy emerge alongside of old ones, rather than replacing them, so that seemingly contradictory institutions coexist in the network form. This article explores how life scientists legitimate working in the biotechnology industry—a new option that nevertheless fails to delegitimate the old academic path. The data are based on qualitative observations of a young biotechnology firm. These are supplemented by observations at a university laboratory and interviews with 41 life scientists.

KEY WORDS: institutional change; network form; scientific work; biotechnology industry.

INSTITUTIONAL CHANGE

In the past decade or so, the number of organizational studies focusing on institutional change has swelled to form a virtual new wave of neoinstitutionalism (e.g., Clemens, 1997; Haveman and Rao, 1997; Hoffman, 1997; Lounsbury and Ventresca, 2002; Rao *et al*., 2000; Scott *et al*., 2000). With the incoming tide of social movement research this school has risen above the earlier criticisms that its explanations of similarities in organizational fields were too static. Largely influenced by the literature on political social movements, institutional change has been described as a process that begins with the delegitimation of older institutions to make way for the

[1]Department of Sociology, Boston University, 96 Cummington St., Boston, Massachusetts 02215; e-mail: ldoerr@bu.edu.

emergence of new logics of nascent institutional orders (Clemens, 2002; Scott, 2001). In the developing model, institutional change is usually viewed as revolutionary—the new displaces the old—however gradually the shift may occur. For example, Armstrong's (2002) study of pro-homosexual organizations shows how bureaucratic gay rights associations of the 1960s gave way to the loosely organized identity-politics groups of the 1970s.

Legitimacy, in this and other institutional analyses of organizations, denotes structures and practices that are widely diffused and taken for granted as appropriate ways of doing things (Powell and DiMaggio, 1991).[2] A common focus in new institutionalism concerns how organizational agents—managers and professionals—use the structure of their organizations to signal legitimacy (Meyer and Rowan, 1977). For instance, an MBA who learned about matrix-type organizations in business school might start a company using that form in name, if not in practice, in order to sustain the myth of rational management. A strong criticism of earlier models was that neoinstitutionalists paid little attention to institutional formation and change. For example, Jepperson (1991:159) warned: "Institutional effects should not be narrowly associated with explanations of stability or thought to be irrelevant to change."

Inspired by sociological studies of social movements, neoinstitutionalism has begun to examine radical change in a variety of organizational fields.[3] Davis *et al.* (1994) describe the change from the conglomerate form of the for-profit corporation in favor of the "firm-as-portfolio" model. Hoffman (1997) demonstrates how "green" environmentalism in chemical corporations went from being "heresy" to "dogma" in a relatively short time. Scott *et al.* (2000) explain how healthcare organizations switched from the logic of professional dominance by physicians to a cost-containment, managed-care mentality. Lounsbury (2002) charts the transformation of the institutional logics employed by professional finance associations from regulatory to market logics. Similarly, publishing experienced a shift from an

[2]Neoinstitutionalism builds on symbolic interactionist insights in sociology (i.e., Berger and Luckmann, 1966; Goffman, 1974), as do management scholars following Weick (1995), who discuss the role of "sensemaking" in organizations. Additionally, the use of symbolic interaction in science studies is not new (see Clarke and Gerson, 1990, for a review). Science studies have traditionally focused on the social construction of knowledge rather than the organization of science (Kleinman, 1998).

[3]Another branch of research on institutional dynamics places more emphasis on the emergence of novel organizational structures and professions than on change in existing fields. DiMaggio's (1991) study of the professionalization of art museum administration, and Haveman and Rao's (1997) study of the evolution of the thrift industry are well-known examples. Biotech is a new network organizational form for life scientists to work in, but it arises in an existing professional field, and contends with older, dimmer views of science in "industry." Thus, for this article, the literature on institutional change is more relevant than that on origins.

editorial to a market logic (Thornton and Ocasio, 1999). Howard-Grenville (2002) shows the gradual yet distinct departure in the semiconductor industry from the old logic of responsibility for the effects of one's products to the new logic of voluntary partnership with the EPA to reduce PFC emissions.

On the basis of the growing body of empirical studies, new institutional theorists have outlined some of the general processes of institutional change. Clemens (Clemens, 1997, 2002; Clemens and Cook, 1999) explains the role of politics in institutional transformation. Social movements, in particular, play the role of bringing grievances to light, which aids in the deinstitutionalization needed to clear the way for institutional innovation. Following Giddens (1984), Scott (2001) refers to this process of removing the old institution to make way for the new as "destructuration." Lounsbury *et al*. (2003) empirically demonstrate the direct effects of social movements on the deinstitutionalization of old frames by describing how environmental activists' criticisms revolutionized the solid waste industry's institutions concerning recycling.

While the study of revolutionary social movements has enriched new institutionalism in many ways, the view of institutional change as requiring delegitimation neglects shifts that may evince greater continuity. This article examines the question of how organizational conditions might permit institutional change with a commingling of logics rather than a replacement of old with new. I argue that when the new structure to be institutionalized is a network form of organization, old modes persist rather than being replaced, so that seemingly contradictory institutions coexist. The old commingles with the new as linkages across organizational fields bring together disparate institutional logics. My argument seeks to combine insights from economic sociology on recent structural changes in the knowledge economy with neoinstitutionalist analysis of cultural changes in organizations.

The research context is the biotechnology industry—an important part of the new knowledge economy. As Kleinman and Vallas (2001) explain, the way knowledge workers negotiate the blurred boundaries between academia and industry involves an apparently paradoxical combination of institutions. This article explores the microinstitutional context of career paths to understand the processes by which life scientists legitimate working in the biotechnology industry—a new option that nevertheless fails to delegitimate the old academic path. Legitimation is the process by which a social construct comes to be taken for granted—that is, how it becomes an institution. Although individuals do the legitimating, the logics they employ add up to more than individual self-justification. Institutionalization is a social process, even when actors speak of legitimacy in terms of their individual experience. For example, in Gouldner's (1954) classic study of a

gypsum-processing plant, when individual workers justified smoking on the job, they strengthened the assumption that it was okay to break the rule as long as the inspector was not around. Similarly, scientists in my study explain their individual decisions in a social context of institutionalizing career norms that appear to break the old rules. The data are based on ethnographic observations of a young biotechnology firm I call BioNow. These are supplemented with observations at a university laboratory engaged in similar research problems and interviews with 41 life scientists in a variety of organizational settings.

THE NETWORK FORM OF ORGANIZATION

The question I pose for the emerging model of institutional change is whether structural context produces variation in this cultural process. This article therefore combines an institutionalist perspective on the content of legitimacy logics with economic sociology concerns about patterns of relationships among social actors. I draw particularly from one line of work in economic sociology that has emphasized the differences between hierarchical organizations, steeped in formality and bureaucracy, and more fluid organizations with so many ties to external parties that they resemble a spider's web, or a network, much more than a pyramid (Powell, 1990). Among organizational actors, Podolny and Page (1998:59) describe those who employ a network form of organization as "any collection of actors that pursue repeated, enduring exchange relations with one another."

From 1992 to 1994, during the period that I observed BioNow, the average number of dedicated biotechnology firms was 230 (Powell *et al.*, 1996:133). These biotech firms employed a network form of organization—a governance structure that relies on project-focused interorganizational collaboration. Rather than being governed by spot contracts like markets or by vertical chains of command like hierarchies, the network form engages in durable yet flexible ties with external partners. Organizations that employ the network form abound. Craft-based organizations like construction firms demonstrate how workers use tacit knowledge and a range of skills autonomously at the work site while simultaneously cooperating with other skilled tradespeople on the project (Stinchcombe, 1959). Likewise, in Hollywood, a film brings together a variety of players for a short-term project. Yet skilled participants become embedded in networks of long-term working relationships over a series of movie projects (Faulkner and Anderson, 1987). Project-based organizations that bring together teams across formal organizational boundaries can be found in advertising, high fashion garment manufacture in Northern

Italy, New York book publishing, Japanese business groups, and information technology, as well as in biotechnology (Smith-Doerr and Powell, 2005).

A network form of organization differs from others in having more permeable boundaries and relying on close connections for all organizational functions, including core activities. Biotech firms collaborate with other firms, universities, and nonprofit research institutes on their key R&D projects. One might say that a core competency for network organizations is to establish and maintain interorganizational relationships. Maintaining a position at the nexus of network ties gives social actors (whether individuals or firms) access to diverse information, which in turn facilitates innovation. For example, Padgett and Ansell (1993) show how the Medici family's creative rise to power in the Florentine Renaissance was due to the family's unique position, which spanned disconnected social networks.

To illustrate a central feature of network organizations—the learning that occurs across permeable organizational boundaries—consider one example from daily life in the biotech firm I studied. Tacit knowledge was shared through cross-organizational projects on a daily basis. One meeting I observed on an R&D project included BioNow researchers and managers as well as Frank,[4] a university researcher, and Paul, a scientist from another biotechnology firm. In a small conference room at BioNow we sat around an oval table, and periodically someone would use the white board on the wall. The BioNow researchers were discussing a laboratory process that they had developed; they were willing to share it with the outside collaborators, but were also aware of the value of this intellectual property. Paul initiated the conversation by suggesting a way around a problematic result, which Luther negated. A little later Frank stood in front of the white board to draw a diagram, to try to explain to Paul why the process was not working at their firm:

Frank: One thing I'd like to add, if you put [substance X] in here (pointing to his drawing with the pen), you can get a direct finding that way.
Luther: You have to wash off [X]; during the wash it associates with [substance Y].
Frank: You need to be real fast.
Luther: It washes very quickly. I don't know why you [Paul's company] can't do it. It doesn't make sense.
Paul: How often do you wash?
Luther: We wash quickly, in a minute.

[4]I gave pseudonyms to all individuals and most organizations to protect the confidentiality of my informants.

Gabriel, the executive, then spoke up and directed his earnest attention to Paul, leaning forward and making direct eye contact with him: "These methods are highly proprietary. It took a long time to find something that would work. [Sits back and breaks eye contact]. But it's obviously not a patentable solution." Gabriel's perspective, honed by experience in a large drug company, clashed somewhat with the spirit of scientific problem solving that developed in the project meeting. Yet even he simply warned Paul against conveying the "proprietary but not patentable" process to other competing networks. In this meeting, Paul learned not only about a new technical method, but also about the norms for sharing information at BioNow. Flexibility comes into play through working on expanding technologies; one can never be certain which paths will lead to successful outcomes (e.g., a profitable drug). In the network form, the organizational capacity for change is highly developed, particularly at the project level. Thus it is possible to pursue new projects rapidly, and it is easy to draw upon new collaborators both inside and outside the organization.

Collaborative ties supply more than just information flows for innovative projects. Status and prestige also come from network ties. The connection between actors A and B (or the lack thereof) provides an important symbol to actor C and others about the relative status of A and B (Podolny, 2001). A key part of the legitimacy or institutionalization of a field is the set of network ties among firms. These ties are interpreted and maintained by individuals. Zuckerman (2000), for example, documents how financial analysts track portfolios in areas of the economy that are institutionalized. Rather than examine the entire market, analysts look to locations where legitimate cognitive maps help them make sense of the interfirm networks and other features of the industry. Especially in the network form of organization, the ties between prominent individuals serve as channels for the flow of information and as indicators of legitimacy for firms and for the field as a whole. Often, when a new field is gathering steam for institutionalization, the movement gains energy by burning the older institutional order. Yet the network form, which maintains close connections between the old and new—as with biotech's connections to academia—puts less emphasis on delegitimating traditional institutions.

In the context of such connections, as in the biotechnology industry, the institutional change process looks different. Rather than deinstitutionalizing the older mode to make way for the new institution, in the network form, institutions—like the social actors who construct them—may be linked. Even seemingly contradictory, taken-for-granted practices may coexist in the network form. In the life sciences, past academic frames are conjoined with emerging institutions concerning work in the biotech industry. Tension exists between the old and new constructions, but the conflicting

elements are mostly ignored. I observed little evidence of cognitive dissonance even among informants using seemingly conflicting frames. In some social situations, however, problems appear as the tacit social agreement shows signs of strain. When this happens, people gloss over the tensions, as we will see.

RESEARCH SETTING AND METHOD

The development of the life sciences has been heralded as one of the most important human achievements of the last half of the twentieth century. In June of 2000, Craig Venter, the CEO of Celera Genomics, made a joint announcement with U.S. Human Genome Project director Frances Collins that all 30,000 or so genes of our human DNA (rather than the estimated 100,000) had been mapped, 3 years ahead of schedule.[5] Along with the rapid scientific and medical changes emerging from the life sciences have come significant organizational and social changes. I examine how highly educated scientific professionals choose and frame work in novel settings—small, science-based firms—that resemble neither older industrial jobs nor traditional academic careers.[6] The biotechnology industry is unique in its close relation to the university, but in other respects it is typical of a so-called new economy industry—authority is more widely decentralized and based on expertise, and firms are less hierarchical. The newness of the biotechnology industry makes it a strategic site for the study of the processes by which work is legitimated.

The scientific labor market has changed in a number of key respects. For one thing, industry is more attractive, but is not the traditional industry of the past. Caplow and McGee's (1961) interviews with academics 40 years ago show the attitude toward scientists who must "settle" for leaving the university. One interviewee described a "failed" academic colleague: "He was blocked for promotion because he didn't publish, [so] he went to a corporation" (Caplow and McGee, 1961:52). For life scientists prior to the early 1980s, a job in industry meant employment in a large pharmaceutical corporation, until the emergence of the biotechnology industry presented another option.

Typical job listings in the journals *Science* and *Nature* and on their websites (www.science.com; www.nature.com) reveal the differences between work for life scientists in the academy, biotech industry, and pharmaceutical corporations. Three ads published in 1997 (just after the observations

[5]In 2004, scientists dropped their estimate of human genes to 20,000.

[6]This article presumes Leicht and Fennell's (1997:222) definition of career: "job transitions of individuals over their work lives."

made for this article) are indicative. A top university requested candidates doing basic science, specifically "investigating cellular and molecular mechanisms of development." A large multinational pharmaceutical company wanted PhDs "committed to practical bench science." And a biotechnology firm requested scientific legitimacy and collaborative skills in candidates who would be "setting up and monitoring projects involving in vivo models with external organizations. Personal qualities should include scientific credibility. . . and teamwork." The ads for universities and biotech firms are successful at attracting the same kinds of candidates. Four of the five young "super PhDs"[7] whom I interviewed in different settings indicated that they had only applied for positions in academia or biotechnology firms. Biotechnology represents for many a place to do "good basic science" outside of academia.

A second change in the life sciences labor market is that university positions have not increased in number, while PhDs have (National Research Council, 1998). The intensified requirements of publishing and postdoctoral experience have rendered university careers more demanding, if not less appealing (Freeman *et al*., 2001). In 1965, half of all biological PhDs who had postdoctoral appointments during in the 1960s spent an average of less than 2 years in the apprentice position, while the median time spent as postdocs in the 1980s doubled to nearly 4 years and seems to be increasing (Regets, 1998). This "postdoc mill" context undoubtedly has helped to make nonacademic employment more attractive to new PhDs, but the push or pull factors for biotech careers are not as predictable as might be expected. Normally, we would expect scientists at less elite universities to make the move more often to industry; instead, elites have moved more frequently into biotech (Robbins-Roth, 2000). Evidence of a pull factor makes more sense when we realize that the entrance of elites to the biotech industry represents a kind of natural excludability. Life scientists at elite universities are closest to the new discoveries and best able to capitalize on them.

Biotechnology is one of the two main pillars of the knowledge economy (the other being information technology). "Knowledge economy" is a term that acknowledges the university origins and continuing close connections between new economy industries and academia. The life sciences are rife with academic-industry relationships at both the organizational and individual levels. In such a cutting-edge setting, why would scientists need to legitimate their work?

[7] "Super PhD" is a term used by the scientists to indicate an individual's experience in prestigious postdoctoral fellowship position(s); effectively, to distinguish her or him from the more newly minted PhDs.

One of the first things Rob told me about himself when I met him at the biotech startup firm was that he had been offered positions at universities as well, but had decided instead to work at BioNow. An MIT PhD, Rob wanted me to know that going into biotech was a choice, not a desperate move. Rob was not the only one who seemed to need to justify his choice of working in a commercial laboratory. My ethnographic observations at BioNow and in a university laboratory for comparison revealed that scientists gave considerable attention to making sense of their career paths into the fledgling biotech industry.

Even some elite life scientists are not convinced of the benefits of increased interaction between commercial and academic science. Owen-Smith and Powell (2001) describe how the personal connections of famous academics to industry influence how congenially they view the blurred boundaries between university and biotech science. Although some biotech founders view the industry positively, part of the enduring academic legacy in the biological sciences is the idea that any PhDs worth their salt obtain university positions, and other options are clearly second best. To illustrate, the following excerpt from my field notes from a time when I was hanging out in the university lab one day and shows how Peter, a postdoc, felt about his upcoming job interview at a traditional drug company:

> Peter came in looking for something on his bench. I said, "Hi," and asked how his talk went. He said, "It went well. I'm giving it next week in a job interview." He didn't say where the interview was. I asked if he was nervous. He shrugged and said with a nonchalant tone and facial expression, "I guess maybe a little bit—it's at a large pharmaceutical company in [a big city]," as if saying it was at a large pharmaceutical company was less cause for nervousness than its location. I asked at which company, and he told me. I responded positively with recognition and said, "That is a really well known international corporation." He grunted an agreement without making eye contact again, and quickly exited the lab with his notebook under his arm, seeming to me to lack pride in the job interview.

Later, I found out that Peter did not actually go to the interview at the large drug company. He said that he had to cancel because he was suddenly ill, and never rescheduled the job talk. I asked him how the lab director felt about his interview at the pharmaceutical corporation. Peter replied, "He's not really against industry like *some* professors [referring to another professor who had made disparaging remarks about industry in lab meetings], but I know he thinks I can do better." "Better" meant an academic position. When I asked the lab director about Peter and the job market, he mentioned the interview Peter had landed at the large drug company, but concluded, "He'll have other opportunities." He implied that Peter did not have to "settle" for a job in pharma.

When biotech firm scientists discuss their choice of work, they must deal with this traditional idea that academic jobs are the default legitimate option. Rather than deinstitutionalizing academic models, however, scientists combine them with new (and sometimes contradictory) sources of legitimacy in biotech firms. Deinstitutionalization does come into play somewhat in the legitimation process when scientists separate biotech firms from large pharmaceutical corporations. The main focus of their narratives, however, is comparison of the biotech industry to academia. The legitimacy narratives surrounding biotech work emerged from ethnographic observations made primarily in BioNow. Field studies can reveal new questions or dimensions that the researcher may not have set out to investigate. Yet field research is sparse in sociological studies of work (Barley and Kunda, 2001), industrial science (Kleinman and Vallas, 2001), and institutions (Lounsbury and Glynn, 2001). Institutional change is more often studied with archival than interpersonal data. This study contributes a needed look at the process of legitimating work in a new kind of employment setting.

I conducted the fieldwork for this article between 1992 and 1996. I recorded notes during observations of meetings and laboratory life and then elaborated these brief notes on the computer after leaving the field. I supplemented these data with observations at a university laboratory engaged in similar scientific projects, and with 41 semistructured interviews in a variety of life science settings. Thus, the main setting was a biotechnology firm, but I also interviewed scientists involved with biotechnology but primarily employed in university and government institute positions. Interviews were tape-recorded. The conversations with PhDs who were affiliated with biotechnology but worked outside the industry speak to the emerging interorganizational character of life science collaboration and careers. Access was less of a problem than I expected. Scientists were quite willing to talk about their careers and seemed to appreciate the opportunity to reflect on what the emergence of the biotechnology industry means for life scientists.

BioNow was one of hundreds of young biotechnology firms in the United States founded during the 1990s, whose research focuses on human diseases. In many ways, BioNow was a typical young biotechnology firm. From the beginnings of the industry, university labs have provided the spawning grounds for new biotech companies (Kenney, 1986). BioNow was no exception: scientists from laboratories at a state university research center founded the firm. Like the majority of similar biotechnology companies less than 5-years old, BioNow was partially funded by venture capital companies and held patents as its main assets. The ratio of scientists to other employees is typically quite high in a biotech firm, and this was the case with BioNow. I observed the firm for 1 day per week for 6 months, and returned after that for occasional interviews and meetings.

BioNow's physical plant consisted of two buildings across the street from each other. There were three departments at BioNow, divided by scientific disciplines: biology, chemistry, and biochemistry. Each department had its own laboratory space. The older building housed the biology and most of the chemistry department. The newer building had the smallest number of scientists, accommodating the tiny biochemistry department and a few chemists. In this flat organization, there were only three official levels of researchers: department heads, other PhDs, and laboratory technicians. Department heads had private offices, other PhDs usually shared an office, and technicians in a department shared common cubicle space. All of the administrators and secretaries had offices in the new building. The vice president of research organized the scientists into project teams based on certain disease targets (e.g., prostate cancer). The project teams crossed department lines, so that scientists worked more closely with others trained in different disciplines than with scientists in their own department.

In the biotechnology industry the most successful firms forge ties with multiple organizations. Research and development ties, in particular, are often based on informal linkages between scientists in different organizations. As biotech scientists have interacted with others connected to their firms from a variety of organizations—universities, pharmaceutical corporations, nonprofit research institutes, government agencies—a new career path across sectors and organizations has developed.

Of the scientists I interviewed, Miles and Luther were particularly attentive to the larger structural changes in careers for life scientists. Miles noted the career movement both between and within different forms of organization:

Q: What do life scientists' careers look like now?
Miles: Scientists aren't staying in the same place; they are moving around.
Q: Do you think they move between organizations of the same type—like from university to university—or between different settings?
Miles: They are both moving within and between different settings. And even within the same organization, they are not doing the same things. At biotech firms some scientists are in sales and marketing, some are at the bench.

Luther described his willingness to leave the pharmaceutical corporation and take a biotechnology position partly in terms of the greater interorganizational movement between academia and biotech firms. When asked what led him to taking the BioNow position, he observed, "It had been established in biotechnology that people could go back and forth between the university and the industry—as long as they published enough while

they were in a company." And when asked whether he wanted to go back to academia someday, Luther replied, "I think I will." This career movement back and forth between biotech and university is related to how scientists speak about work in biotech, giving it meaning especially in relation to academia.

Common Narratives Used to Legitimate Work in the Biotechnology Industry

Neo-institutionalists have borrowed micro-level assumptions and nomenclature from the symbolic interaction literature. I follow other institutional scholars in using the terms *narratives, logics,* and *frames* interchangeably to refer to the common stories used in a field to make sense of organizational life and shape the rules of interaction. This study, however, focuses on logics that are perhaps more pronounced because they have to do with visible change, tension, and new routines. In the analysis of my field notes, three basic frames consistently organized scientists' comments about biotechnology careers. The legitimacy of biotech as a distinct career option for life scientists appears to be constructed principally on frames that I refer to as the *resources, social networks,* and *asset of newness* narratives. Scientists' narratives demonstrate how biotech work became institutionalized—in other words, a legitimate, taken-for-granted feature of their social landscape. The frames that emerged were geared primarily to a scientific audience (to students and colleagues) although generally the scientists seemed pleased to share their thoughts with me, an outsider.

Scientists spend their days in a variety of tasks, but all share the basic functions of laboratory work, communication with colleagues (written and oral), and administrative duties in their organization. The amount of time spent on tasks varies by rank: senior scientists spend more time in communicating results, technicians in lab work and administrators in organizational management. There may be some parallel between the three common narratives that emerged and the common tasks of scientists—resources for lab work, communication networks, and reflections on administering a biotech firm in a new field. However, as the data show, these connections between frames and duties are loose and overlapping rather than tightly drawn.

Resources

The abundance of resources in firms would seem an obvious factor to consider in explaining how biotechnology became an acceptable career route. Both the greater competition for obtaining academic support and

the increasing amount of resources for biotechnology are themes that scientists discuss as part of the attraction of biotech. Scientists are generally concerned with the changes in funding for academic science in the post-Cold War era. Hackett (1990:272) quotes a scientist who expresses the sentiment of many others in saying that "easy money" is no longer available in academia, as perhaps it once was. Although the NIH budget was well funded throughout the 1990s, the life scientists I talked to felt a sense of restriction surrounding academic positions. Sal, a PhD scientist at BioNow, focused on the competition for tenure track positions when I asked him what the job market was like: "Well, of my cohort from graduate school no one I knew got an academic position. It used to be 20 or 30 people would compete for one spot, but now it is extremely competitive and hundreds of people apply for one position." There does seem to be a push factor at work, with PhDs overflowing from the ivory tower. But how do scientists describe a pull factor, the legitimate desire to enter the biotech industry? A simple resource motivation story based on financial rewards or research budgets would actually favor large, established pharmaceutical corporations with billion-dollar drug markets over small, high-risk, startup biotech firms. Yet biotechnology firms differ from pharmaceutical corporations in providing young scientists the opportunity to lead their own projects and publish the results. Biotech scientists carefully point out that there is more to the resource story than dollars. Specifically, scientists assert that biotechnology allows greater access to resources needed for research and publication, while academia is less able to provide these resources generously.

The older academic idea is that financial compensation is not the most important incentive for true scientists. Todd, full professor and head of a laboratory in a research university, describes the ideal typical motivation for academic scientists: "Basically, scientists want to be famous; they want to be known for discovering something fundamental. If you're out to make money, you're in the wrong business!" In an informal interview, Rob explained the motivation of scientists (old frame) as well as the attractive resources for research in biotech firms (new frame). Rob was a "super PhD" employed at BioNow. As a postdoc, he had had experience collaborating with an elite biotech firm (one of the best-connected organizational "players" in this highly networked field). When I asked Rob whether he thought people's consideration of careers in biotech had anything to do with the possibility of making more money, he responded, "I don't think so. It's more that biotechnology has a greater visibility, and people believe it will be intellectually stimulating. Scientists (at least good ones)—whether in industry or the university—are more interested in being able to do their own work than in fat paychecks. Or else they would be venture capitalists [laughs]." Rob's remarks demonstrate the influence of the academic perspective on

framing biotech careers. But the resource frame legitimating biotech also includes new material.

Biotech work, according to the frame, is valuable beyond monetary compensation (like academic science work) yet offers resources for research that university positions do not provide. Rob argues that the time constraints on academic scientists decrease their ability to do research:

> A PI [principal investigator] carries the weight of the world on their shoulders. They are responsible for making smart decisions about the direction of research—will this line of work pay off, getting students jobs, etc. It's a tremendous load of responsibility. In industry you do not have to scrounge up money. It is a team effort. Scientists can rely on administration to get funding, administrators can rely on scientists to produce. The lines are more distinct, more specialized in industry. I had academic opportunities, but I wanted to focus on research rather than writing grants and recruiting students.

Ironically, he argues that more science can be done outside of academia, where "pure research" has traditionally been one of the few purported goals, along with training students. The blending of specialties in a team (without the binding rules of bureaucratic specialization) allows for better science, according to the narrative.

Richard, a BioNow technician, had another perspective on academic resource scarcity in working at the bench:

> At the university everything is funded by grants, so you have to worry where money is coming from, since everyone is paid off the grant. Funding is such a problem that even getting equipment is a problem—if you want an enzyme you can't just order one when you need it, you have to go borrow one. It slows down the process. The person I worked for [in an academic setting] did good research, but it wasn't in a hot topic area, so it was harder to get money. Science has fads, so you have to tie your research to what's fashionable, like AIDS research is now.

Richard's point is that academic scientists are constrained by available resources, perhaps as industry scientists are constrained by concern with the bottom line.

This bottom-line concern in for-profit enterprises is a tension that arises in the resource frame. In order to be doing "good science" in biotech firms, scientists must consider its implications for the firm in order to communicate about their work with financiers. So, the resource story is not about money; or is it? Sal, like many of his co-workers, describes science in biotech firms like BioNow as profit-driven: "Science is focused here—you listen to the speech Damon [the CEO] has prepared for the venture capitalists and realize that there is supposed to be a product somewhere down the road." Indeed, Damon, the thirtyish CEO (whose experience was as a venture capitalist rather than as a scientist before heading BioNow) focuses

on the importance of cash infusion to a healthy firm and what makes the money flow:

> Investors buy stories. And they look at the credibility of the people telling them. Like any sale—there is always a story. You have to make them believe that a company will be more than it is today and that it won't crash on the way there. They look for new technology and solid management. Some don't give a rat's ass about management; they fund a technology and will put in their own management. Others don't give a rat's ass about technology; they fund good management and will license a technology. But at some point you need both.

Note that Damon, from his financial background, frames market outcomes as the basis of the successful biotech firm. Sal's comment above shows that BioNow scientists incorporate the CEO's viewpoint into their sensemaking, but may still fail to realize that lovely science is only part of the race and that new medical therapies are the finish line, rather than beautiful molecules.

As part of the pattern I observed, however, this tension about the funding process goes unacknowledged for the most part. For example, later in the same conversation with Rob quoted above, in which he said that "scientists can rely on administration to get funding," he discussed the role of finance in a fledgling startup: "As a scientist in a firm like BioNow, you have to be able to talk to financiers and to show them that your work will have a payoff, at *some* point down the line." In other words, biotech scientists claimed that they did not have to spend time persuading people in order to get their money the way that academics writing grants do, but at the same time they talked about having to persuade the venture capitalists to give them money. Such contradictory comments about monetary resources—that is, *not* having to worry about them and having to worry about them—were common. All of the people with whom I spoke were articulate and self-reflective. By pointing out that they did not see contradictory elements of their collective stories, I do not mean to imply that they are ignorant, but that social constructions are often difficult for anyone to see. They could talk about biotech scientists (like academics) as being above money-grubbing, and at the same time discuss how the whole industry is driven by capital. Two ideas emerge to form a resource frame that is logically disjointed, but narratively seamless.

Perhaps because of the materialistic discourse in popular culture, scientists found it easy to tell resource stories about the emergence of biotech careers. One way to classify the different resource tales used to frame biotechnology legitimacy is to say that scientists seem concerned with the availability of resources used for a variety of ends. Rather than centering all of their attention on monetary resources for personal consumption, biotech scientists, like academics, talk of resources for their science. The discussion

of resources is complex; scientists are both concerned about the extreme intensity of competition for academic resources, and gratified by the research resources—including the value placed on publication in the biotechnology field as compared to other industry settings. This is not to say that self-interest is not an important part of the story, but that the resource frame is complex rather than a simple economic compensation narrative.

Networks

Another factor in framing legitimate careers is the role of social networks. Network connections predict the attainment of good jobs (Granovetter, 1995). Granovetter notes that because most of the best professional jobs are not advertised, information gathered through personal network ties proves invaluable in procuring positions. Information gained through friends and acquaintances is trusted more than job ads by candidates and more than resumes by employers.

To refer to a cultural legitimacy narrative as a "networks" frame may seem to be confounding culture and structure. But in talking about their networks as a way of legitimating their work, scientists view network ties as symbolic rather than structural. So networks are not only conveyers of information, but also serve as frames for discussing job choice. In science, the most significant relationship for a young scientist contemplating a career path is with his or her mentor/lab director. Nearly every scientist I spoke with about choosing a career path mentioned the person in whose lab they were trained as influential in the decision. This taken-for-granted academic model provides the basis for descriptions of entering the biotech industry only on the advice of respected, well-established scientists. Luther's account of the major reason why he took the BioNow position fits Granovetter's weak-tie hypothesis well: "I went into the company because of [a] scientist I knew. I didn't work with him, but I trusted him. He's a good scientist." Rob also found his way into the biotechnology industry, and to BioNow in particular, through network connections that helped to frame biotechnology firms as locations of legitimate science:

> I did my post-doc at MIT. I worked with someone who had a connection at "EliteBio" so I worked there too. BioNow was promising. I had my "intellectual eye" on it. I talked to people in biotechnology—people I knew at EliteBio—and talked to people here about the game plan to see if it fit in the biotechnology community. People told me it had a sound research basis.

Rob attributes knowing how the company fit into the scientific community to his networks, giving "talking to people" a discursive importance beyond mere information about a job opening.

It is perhaps not surprising that in an industry rife with interorganizational collaboration (Baum *et al*., 2000; Powell *et al*., 1996), chronicles of biotech firm foundings are headlined by personal networks. Frank, one of the founders of BioNow, identifies himself primarily as an academic. He describes the importance of network connections to starting up the firm:

> [The basis of starting up the firm] was a concept first, an idea I brought up myself. I got "Ethan McMaster" to help me set up a lab to test it. We proved that the process works and had to disclose it to the university because of rules about patents. The university's consultant on patents said they weren't interested. So we did some more tests and came back, but the university still wasn't interested so the patent was allowed to go back to me, the inventor. I, and fellow researchers, put up a small amount of money. Ethan McMaster's ties with venture capitalists and financiers were used. The financier put us through vigorous tests with well-known scientists to see if it would be profitable.

The description Miles gives of the beginnings of the biotechnology industry, and his personal relationships with scientists like the founder of one of the first biotech firms, clarifies some of the grounds for his early entry into the fledgling industry:

> I was there when "NewTech" was first conceived. "Alan Stewart"—the guy who started NewTech—his first venture... only lasted for two years. I was in the living room when he was looking for ideas for another new venture. NewTech did well. It had more money than EliteBio, but didn't focus—it had too many irons in the fire. "Life Co" began in 1979. There were 30 employees when I joined.

Clearly networks play a critical role in spreading news about opportunities, and access to these opportunities furthers the propensity to frame biotechnology jobs as legitimate. The industry originally gained legitimacy by association with credible scientists who played key roles in the origins of the field (Zucker *et al*., 1998). Now, a frame that the "stars" of life science legitimated the industry is used to explain why other scientists take biotech jobs. The reverse also seems to be true—that scientists are given credibility through their association with prominent biotech firms. For example, Frank, a BioNow founder, was tenured after his experience in the biotech industry; some of his colleagues argue that his biotech patent was the main reason for his promotion to associate professor.

The result of the academic "follow in my mentor's footsteps" model preceding the "biotech is legit, just ask the eminent Dr. X" heuristic seems to present a discrepancy in narrative content. PhD students in Todd's program encountered conflicting stories about desirable career paths. Matt is a full professor who was collaborating with Todd on a research project that I observed unfolding. Mart's response to my question about what advice he gives to graduate students about biotech work reflected the traditional academic frame: "I would not advise good students to go into industry. Industry

only does a little science at the beginning [of a project]. I think I look down on industry because it does not do basic science. It's too product oriented, and does not explore interesting things that aren't marketable. [In firms] they only publish to support their product." Todd's view was tempered by his positive relationships to scientists working in biotech:

> I now know some good people working in industry, in biotech firms. Since my graduate school career, there has been more interdisciplinary collaboration, inside and outside the academy. The progress in knowledge in DNA and molecular biology has been applied to many systems. It breaks down barriers between chemists and cellular biologists, and [between] university and industry, that used to exist. It's because of the advent of new technology.

Graduate students and postdocs on the project did not see these two professors' different perspectives on biotech as conflicting, but the students clearly favored the new network frame. One postdoc confided to me that

> Todd knows more of what he's talking about than Matt. He knows more people all over the world in universities, and in biotech, too. Todd would probably be okay with his student going into industry, if it's a good company, but Matt is much more old-fashioned. As long as you're doing good science and publishing, Todd will be happy.

Note that Todd's more extensive professional networks were acknowledged as key to seeing biotech as a legitimate career path. Building off of the traditional idea that one's mentor is one's career model, the students know that networks are important to choosing the right career path. But their framing also includes the element of legitimating a route that does not lead (at least not directly) into academia. The conflicting elements of the network frame, however, are glossed over by saying "as long as it's good science."

The Asset of Newness

A lack of legitimacy is part of the liability of newness, and contributes to the main problem of young firms—organizational failure. According to Stinchcombe (1965:148), "The process of inventing new roles, the determination of their mutual relations and of structuring the field of rewards and sanctions so as to get maximum performance, have high costs in time, worry, conflict, and temporary inefficiency." Yet instead of describing the hassles of new roles in biotech, scientists viewed the newness as an asset. The innovation, creativity, and connections with other cutting-edge labs that result from inventing new roles were viewed as sources of legitimacy, if more complex than other narrative frames.

Among the legitimacy narratives, scientists discussed resources and networks in rather concrete terms. Life scientists also had more symbolic means of expressing the legitimacy of biotech work. Here discussions of

"quality," "endorsement," and "interaction" arise that seem somewhat more difficult to explain than funding or connections, but are nevertheless given importance. In conversations, comparison and contrast patterns emerged in how scientists constructed a rhetoric of biotechnology as a good venue for life science research. On the one hand, biotech research was compared to the standard frame—the well-established legitimacy of academic science. On the other hand, biotechnology was framed as a new, exciting place to do cutting-edge work. The difference between the construct "academia is always the first choice," and "biotech work has new advantages over academia" is clear. Tension becomes apparent when scientists in biotech firms are deciding on the criteria for and outcomes of their work—should they publish right away or wait until after further developments are patented?

Miles seemed a bit defensive about the old frame that academia is the place to do "real" science:

> Scientists in academia are not the only people that care about their research; you can care about your research in industry, too. But there is this attitude [in academia] that if you're not doing curiosity-driven research that you're being co-opted, and the work is low quality. That is totally false! The work being done in industry is at least equivalent to the quality of research in academia.

Some of Miles's fellow scientists must agree that biotech research is at the same level of quality as that in academia. As Frank explains, BioNow has successfully competed with universities for funds from peer-reviewed federal grant programs:

Q: How has the recent NCI grant BioNow received [$3.1 million] influenced the firm?
Frank: It is really just a small amount—a drop in the bucket, [pauses] Okay, maybe several drops in the bucket. But more importantly, the grant from NCI showed that they accept the method; it was an endorsement.
Q: So it's mainly important for scientific prestige?
Frank: Yes. Another type of agreement we have more for endorsement is with NIH and [another biotechnology firm].

Note that Frank is arguing strongly that the grant money is more important as a symbol of scientific legitimacy, or "endorsement" in his words, than as a financial resource. Frank's response also reveals that collaboration with other biotechnology firms, not just with universities, can be an important indicator of scientific credibility.

In contrast to these connections and comparisons to academic legitimacy, biotech scientists also frame their industry as new and exciting,

separate from any other way of organizing science. One recurring theme in expressing the excitement of biotechnology was collaboration. The scientists constructed a frame that says biotech work leads to greater collaboration in research—more so than in universities.

Sara, the first female PhD to be hired at BioNow, describes the excitement of collaboration in a new firm in a new field, in contrast to academia:

> Here everything is new, everyone is excited, and we're working together on a common goal. You don't see the type of political fights that go on in the university. I think they are unnecessary. There is more competition in the university. I was working in a lab at [a university] and one day two PI's were having a fight in the hallway—shouting at each other about supplies. They weren't really fighting about pipettes and light bulbs, but were just rivals in every way.

Luther also compares the academic organization of science unfavorably to its organization in the biotech industry, where the collaboration is ironically more "collegial": "In academia you're isolated from the people working down the hall. Here we're directed to the same goal. There's a greater will to get things done. Things happen faster." Rob turns to a metaphor to explain the difference between academic and biotech research. He comments on the ease of collaborating at BioNow:

> It's not that way in academia. You have to worry about who gets their names on papers. As science has progressed, the need for collaborators has risen, but it's harder in academia. Let me make an analogy of bead stringers and polishers. In academia you have to worry about how much time you polish as compared to how much time stringers spend, for who gets their name on the paper; and worry about who gets to write what in their grant, since they can't submit the same grants. But at the same time you have to have collaborators send a letter saying that they can do what you need them to do in your grant proposal. In industry they can hire expert bead polishers and stringers to work at the same firm. Here they can hire collections of preassembled teams. I know cellular biology at the molecular level but nothing about chemistry. But I can just go down the hall and speak to Alexander [the department head of chemistry]. In academia there are problems with who gets credit, personal acclaim, and grants that prevent spontaneous collaboration like we have here.

Rob is arguing that working in a biotech firm has teamwork advantages, which results in doing better science; something he never experienced in the university.

This same narrative that I heard comes across in biochemist Cynthia Robbins-Roth's (1998) "how to" volume for scientists entitled *Alternative Careers in Science: Leaving the Ivory Tower.* Robbins-Roth's own chapter is called "A Scientist Gone Bad," a tongue-in-cheek reference to the expectation that real scientists are assumed to be academics. When she took a job at Genentech—a pioneering biotech firm—in 1980, her description of her decision paralleled that of many of the scientists I spoke with—academia and pharmaceutical corporations were not as exciting

(Robbins-Roth, 1998:3):

> [A] cademia was not for me—I couldn't stand the thought of teaching one more medical student lab course. I started interviewing at pharmaceutical companies, but I was discouraged by their apparent propensity for hiring only middle-aged white guys as scientists. . . . [Genentech] changed the ground rules for doing science in a corporate setting . . . and we didn't have to write grants or teach medical students! I was working with some of the best scientists in a broad range of disciplines—protein chemistry, immunology, tumor biology, molecular biology, X-ray crystallography, amino acid sequencing, cell assay development, and so on. I was in heaven.

In my conversations with life scientists I never heard biotech firms described as "heavenly," but certainly Robbins-Roth's description of the benefits of easy interdisciplinary collaboration for doing cutting-edge science has a familiar ring.

The comparative framing of biotechnology involves connecting to the legitimacy of the academy, yet it also includes outlining differences from other settings, including the university. This conflict of ideas was not explicitly talked about (at least not in my presence), but I observed some of the consequences of the tension between competing frames. In one research meeting, the underlying question, "Are we like academia or not?" seemed clear. In this meeting, Luther wanted to publish, a common enough practice in biotechnology. Gabriel, an administrative PhD fresh from a large pharmaceutical corporation, defended the rationale for having different publishing rules in biotech firms and in academia. Their exchange at the meeting follows:

Luther: The other issue is when to go public with this.
Gabriel: Not for a long time.
Luther: Well, we should publish something.
Gabriel: We don't have anything to gain at BioNow right now by publishing. I don't think we should.
Luther: Don't you think it would impress investors?
Gabriel: But I don't think we're at that point. We already tell investors we're successful, but don't say with what. They have accepted this; they're satisfied. It will not give us any more success to publish. If you reveal too much, you give it to the competition. Like you look in *"Bio World"* [a trade publication], and NIH advertises their findings—why would anyone license them? Anyone can figure it out. You don't want to give away your lead structure—you give away everything. That's the basis of the whole industry. [He pauses while Luther folds his arms across his chest, takes in his breath sharply and raises his eyebrows in a skeptical facial expression. Then Gabriel seems to address Luther's nonverbal negativity, looking at him as he continues to talk]. It'll probably

> be publishable sooner than the stuff with [another new biotechnology firm with which BioNow is collaborating]. They're either dead or not, so they're not anxious to publish squat. It'll mean a lot more to [BioNow's collaborator on the project being discussed in this meeting] and us in a year or so.

An interesting aside is that Gabriel is not talking about limiting the secrecy of their research to BioNow's organizational boundaries, but that the information is limited to networks of collaboration dependent on each different project. The issue around publishing was apparently resolved but surfaced again later in the meeting:

> Gabriel: The exciting thing is [describes a result]. We're not sure, but it's a hypothesis. We weren't even sure it could get close.
> Luther: If we show [a result], we should publish.
> Gabriel: Write it up, and we'll see.
> Luther: [chuckling, says in stage whisper] Then I'll see how I could sneak it out of here [to publish]! [In response there is general group laughter; Gabriel smiles and shakes his head indulgently].

The tension between organized perspectives or frames was clear in the laughter in the room. But the humorous moment also allowed Luther and Gabriel a way to bring the group together again around that sense of collaboration the scientists talk about at BioNow. Even when conflict between conceptions of work is obvious, as between Luther and Gabriel in the meeting, the differences are glossed over—with humor in this case. In my observation, the scientists at BioNow seemed intent on maintaining the collegial spirit, assuming that bitter disagreement would mar the ethos of working toward a common goal. Early on, I thought perhaps this framing was more evident because BioNow was a startup firm, but a similar orientation appears in older, larger biotech firms. In light of the collective rewards in biotech—higher stock value, new equipment, day care centers—it is perhaps less surprising that the team ethos shows up more than in academia where the main incentive—tenure and promotion—is individualized. The asset of newness in biotech is a collaborative mentality, as exemplified by collegial, equitable interactions between scientists (Smith-Doerr, 2004).

DISCUSSION

This article has shown how contradictory institutions, although they may not be seen as such by scientists, become part of the interwoven texture of the network form of organization in the biotechnology industry. This study contributes to the organizational literature by outlining variation in the institutional change process when the structural context is the network

form. In the growing literature on institutional change in organizations, deinstitutionalization precedes the legitimation of a new form (Clemens, 2002; Scott, 2001). But in a network organization, I argue, multiple, coexisting institutional logics constitute more than a stage that will soon resolve itself in a paradigm change or a kind of Marxian shift from thesis to antithesis. Instead, multiple paradoxical perspectives work together as a legitimate institutional logic in the network form, because individuals maintain a variety of links to seemingly contradictory information. In biotech firms, successful scientists cultivate relationships across organizational boundaries with academics and PhDs in other firms.

Usually, institutional analysis is couched at the field level. The shifting nature of research in the life sciences is complex; my focus here is on just one aspect—the legitimation of biotech careers. The individual, microlevel process of legitimation, I have argued, has repercussions for the institutional level at which biotech firms legitimate the network form of organization. How, exactly, are these two levels linked? In one sense, we might make the fundamental observation that individuals' occupational identity is naturally linked to the employing institutions in which they expect to work (Becker and Carper, 1956).

In the network form of organization, in which connections are maintained with other kinds of organizations, the typical delegitimation of old institutions during periods of change is unnecessary. For example, the extensive ties between the biotech industry and universities (a major reason why so many campuses founded technology transfer offices in the 1980s—90s) meant that biotech's legitimacy did not depend on the delegitimation of academic science. The allure of network organizations like biotech firms is partly based on the novelty created through a diverse combination of ties. This article has explored how the combinatorial aspects of the network form are not limited to structures but also include the interpretation of work in these organizations. In the narratives scientists use to legitimate their work in biotech firms, different institutional logics commingle, mirroring how firms bring together diverse ties.

The individual narratives of scientists working in biotech are connected to the institutional logics of the network form of biotech firms through the tensions inherent in the three legitimacy narratives. The discussion of resources brought out the tension between the intrinsic rewards of the work and the for-profit basis of the firms. Interestingly, scientists believe that biotech firms allow greater freedom to do science than the academy. Yet the scientists commingle the resource narratives rather than delegitimating academia. Ongoing ties with labs in universities and with other biotech firms, as well as close connections to venture capitalists and pharmaceutical corporations provide the mechanism for intermingled narratives. Other studies have also argued that biotech firms' key ties to universities and

venture capitalists mean that contradictory emphases on publication and meeting financial goals may arise (Kleinman and Vallas, 2001). A network tie is not a one-way street, however. Partners also appear to develop narratives from talking to biotech scientists about the entanglement of values placed on scientific reputation and financial returns, as seen among the university scientists who appreciate opportunities in the industry.

The network narrative means relying on collaborative partners for information. This arrangement may lead to conflicting advice from the variety of ties held by successful biotech firms (Powell *et al.*, 1996). Sometimes tension arose between the views of academic mentors vested in the older logic that industry jobs are second-rate and the more positive views of well-known scientist-entrepreneurs with broader prestige networks in the life sciences. Discussion of employment in the biotech industry did not delegitimate the older academic route, but instead added another path to scientific status. Ties between firms and star academic scientists involved with the inception of the industry have led to opportunities for career moves back and forth between elite universities and top biotech firms, particularly among prominent scientists. Such connections in a network form facilitate the use of sometimes conflicting institutional logics.

Finally, the mobility of scientists between universities and biotech firms also means that the narrative about assets of biotech newness (i.e., newer collective rewards like research team recognition and bonuses) conflicts with the older logic of individual rewards to star scientists (Zucker *et al.*, 2002). Scientists' discussion of the assets of newness of the biotech industry introduced conflicts between maintaining secrecy about scientific breakthroughs in order to receive credit for them and the benefits of sharing information in collaboration to speed the implementation of innovative ideas. Conflicting frames existed alongside each other because the ongoing ties and experiences of scientists in pharmaceutical corporations and universities, where secrecy is taken for granted, coexisted with the strengthening of links to other biotech companies, where long-term collaboration provides an atmosphere of trust and excitement about sharing new information.

The three narratives about the legitimacy of biotech work revealed basic tensions in institutional logics that may also be present in other organizations characterized by the network form. Ambivalence is inherent in the network form. This article has shown how structural uncertainty at the interorganizational level is interpreted in daily career terms by the people who inhabit a network form of organization.[8]

[8]Of course, the effects of an uncertain organizational environment have long been a concern of contingency theory. In that school, however, uncertainty was often unmeasured or deterministically applied (e.g., if the environment is uncertain, then organic structure is necessary). In this article, where a network perspective is combined with neoinstitutional insights, I make the more modest claim that in a network form, the dynamic connections between

Is the legitimation effort found here simply rationalization because academic jobs are in short supply, while plenty of industry jobs exist? Certainly, there are now fewer academic posts relative to the number of applicants across the sciences (Fox and Stephan, 2001). Where once nearly half of all PhDs in biology had a tenure-track position 10 years after graduation, in 1995 only 34% of mid-career PhDs were in the academic tenure system (Regets, 1997). If scientists rationalize jobs as desirable based on availability, however, work in global pharmaceutical corporations would be the focus of the legitimation process rather than careers in biotech firms. Roche employs more than 66,000 people, and Millennium, a prominent firm in the biotechnology industry, employs just under 2000.

I should mention, *caveat lector,* that my selection of scientists in or connected to biotechnology firms means I am looking at a particular, nonrandom sample of life scientists. The importance of interorganizational networks in biotechnology means that those involved in the industry are likely to have more extensive network connections, and thus a different perspective from others. One might expect, for example, that scientists more peripheral to core life science networks would be less likely to view biotech work as a legitimate option, perhaps not seeing it as separate from other "industry jobs." Particularly, the narratives pertaining to pharmaceutical corporations should be regarded with care, as I made no observations of scientists currently employed in the pharmaceutical industry. The people with whom I spoke who had previously worked in Pharmaceuticals and left may have had more negative views of its legitimacy than those who currently work there.

Although this is a qualitative study focused on one organization, other authors have similarly described scientists' narratives legitimating biotech work (Rabinow, 1996; Rayman, 2001; Werth, 1994; Dubinskas, 1988). A biotech scientist quoted by Paula Rayman (2001:128) elaborates on the difference between scientific work in biotech and pharmaceuticals: "The pharmaceutical companies aren't out to cure the roots. They are just out to make you feel better. Biotech is out to cure diseases. We're finding out how disease progresses and finding ways to prevent it from happening." Even more specific to this article's findings, Paul Rabinow's (1996) interviews with Cetus employees demonstrate that scientists widely use the network frame to legitimate working in a biotech firm. Rabinow's scientists also refer to their reliance on ties with credible scientists to describe how they made the decision to take employment in one of the first biotech firms: "The people I respected said I should take the job at Cetus" (43); "I had known one of the founders" (56); "I met some of the people . . . and I was impressed with the scientific credentials" (73).

diverse organizations facilitate the use of seemingly contradictory institutional logics. How the institutional ambivalence will play out depends on the local and historical context.

The title of this article claims that it observes how the network form is institutionalized. These processes should operate similarly for laterally organized firms in industries governed by interorganizational ties. Only further study, of course, can determine whether these are general themes that apply in other settings. Although this study is limited to the biotechnology industry, I would expect similar findings in other knowledge-expanding and craftwork industries that employ a network form of organization. The mechanism by which these flatter organizations thrive on contradictory institutional logics is their recourse to multiple, disparate sources of information. A firm that relies on ties to diverse other organizations receives information flows that are often conflicting. For example, David Stark (2001) charts how architects of emergent network organizations in Eastern Europe after the collapse of the USSR bring together the divergent logics (and ties) of capitalism and state-owned enterprise. When contradiction is incorporated into the everyday life of the firm, the process of glossing over tensions in organizational identity mirrors the way individuals gloss over tensions in occupational identity, as I observed at BioNow. The contribution of this article, then, is insight into how a particular organizational configuration shapes the process of institutional change.

ACKNOWLEDGMENTS

I am grateful to Woody Powell, Cal Morrill, and Lis Clemens for valuable, detailed comments on previous drafts of this article. Ed Hackett served as a helpful discussant on an earlier version that was presented at the 1997 annual meetings of the Society for the Social Study of Science in Tucson, AZ. I thank editor Robert Max Jackson and four anonymous reviewers at *Sociological Forum* for insightful comments and suggestions. While this manuscript was in the publication process, portions appeared in chapter 3 of Smith-Doerr, Women's Work: Gender Equality vs. Hierarchy in the Life Sciences. I thank Lynne Rienner Publishers (Boulder, CO) for permission to use this material.

REFERENCES

Armstrong, Elizabeth A.
2002 Forging Gay Identities: Organizing Sexuality in San Francisco, 1950–1994. Chicago: University of Chicago Press.

Barley, Stephen R., and Gideon Kunda
2001 "Bringing work back in." Organization Science 12:76–95.

Baum, Joel A. C., Tony Calabrese, and Brian S. Silverman
2000 "Don't go it alone: Alliance network composition and startups' performance in Canadian biotechnology." Strategic Management Journal 21:267–294.

Becker, Howard S., and James Carper
1956 "The elements of identification with an occupation." American Sociological Review 21:341–348.
Berger, Peter L., and Thomas Luckmann
1966 The Social Construction of Reality: A Treatise in the Sociology of Knowledge. New York: Doubleday.
Caplow, Theodore, and Reece J. McGee
1961 The Academic Marketplace. New York: Wiley.
Clarke, Adele, and Elihu Gerson
1990 "Symbolic interactionism in social studies of science." In H. Becker and M. McCall (eds.), Symbolic Interaction and Cultural Studies: 179–214. Chicago: University of Chicago Press.
Clemens, Elisabeth S.
1997 The People's Lobby: Organizational Innovation and the Rise of Interest Group Politics in the United States, 1890–1925. Chicago: University of Chicago Press.
2002 "Invention, innovation, proliferation: Explaining organizational genesis and change." Research in the Sociology of Organizations 19:397–411.
Clemens, Elisabeth S., and James M. Cook
1999 "Politics and institutionalism: Explaining durability and change." Annual Review of Sociology 25:441–466.
Davis, Gerald F., Kristina A. Diekmann, and Catherine H. Tinsley
1994 "The decline and fall of the conglomerate firm in the 1980s: The deinstitutionalization of an organizational form." American Sociological Review 59:547–570.
DiMaggio, Paul J.
1991 "Constructing an organizational field as a professional project: U.S. art museums, 1920–1940." In Walter W. Powell, and Paul J. DiMaggio (eds.) Powell, and DiMaggio, The New Institutionalism in Organizational Analysis: 267–292. Chicago: University of Chicago Press.
Dubinskas, Frank A.
1988 "Janus organizations: Scientists and managers in genetic engineering firms." In F. A. Dubinskas (ed.), Making Time: Ethnographies of High-Technology Organizations: 170–232. Philadelphia, PA: Temple University Press.
Faulkner, Robert R., and Andy B. Anderson
1987 "Short-term projects and emergent careers: Evidence from Hollywood." American Journal of Sociology 92:879–909.
Fox, Mary Frank, and Paula E. Stephan
2001 "Careers of young scientists: Preferences, prospects and realities by gender and field." Social Studies of Science 31:109–122.
Freeman, Richard, Eric Weinstein, Elizabeth Marincola, Janet Rosenbaum, and Frank Solomon
2001 "Competition and careers in biosciences." Science 5550:2293–2294.
Giddens, Anthony
1984 The Constitution of Society. Berkeley, CA: University of California Press.
Goffman, Erving
1974 Frame Analysis: An Essay on the Organization of Experience. Cambridge, MA: Harvard University Press.
Gouldner, Alvin
1954 Patterns of Industrial Bureaucracy. New York: Free Press.
Granovetter, Mark
1995 Getting a Job: A Study of Contacts and Careers, 2nd edn. Chicago: University of Chicago Press.
Hackett, Edward J.
1990 "Science as a vocation in the 1990s: The changing organizational culture of academic science." Journal of Higher Education 61:241–279.
Haveman, Heather A., and Hayagreeva Rao
1997 "Structuring a theory of moral sentiments: Institutional and organizational coevolution in the early thrift industry." American Journal of Sociology 102:1606–1651.
Hoffman, Andrew J.
1997 From Heresy to Dogma: An Institutional History of Corporate Environmentalism. San Francisco: New Lexington Press.
Howard-Grenville, Jennifer A.
2002 "Institutional evolution: The case of the semiconductor industry voluntary PFC emissions reduction agreements." In A. J. Hoffman, and M. J. Ventresca (eds.), Organizations, Policy, and the Natural Environment: Institutional and

Strategic Perspectives: 291–308. Stanford, CA: Stanford University Press.

Jepperson, Ronald L.
1991 "Institutions, institutional effects, and institutionalism." In Walter W. Powell, and Paul J. DiMaggio (eds.), The New Institutionalism in Organizational Analysis: 143–163. Chicago: University of Chicago Press.

Kenney, Martin
1986 Biotechnology: The University-Industrial Complex. New Haven, CT: Yale University Press.

Kleinman, Daniel Lee
1998 "Untangling context: Understanding a university laboratory in the commercial world." Science, Technology, and Human Values 23:285–314.

Kleinman, Daniel L., and Steven P. Vallas
2001 "Science, capitalism, and the rise of the 'knowledge worker': The changing structure of knowledge production in the United States." Theory and Society 30:451–492.

Leicht, Kevin T., and Mary L. Fennell
1997 "The changing organizational context of professional work." Annual Review of Sociology 23:215–231.

Lounsbury, Michael
2002 "Institutional transformation and status mobility: The professionalization of the field of finance." Academy of Management Journal 45:255–266.

Lounsbury, Michael, and Mary Ann Glynn
2001 "Cultural entrepreneurship: Stories, legitimacy, and the acquisition of resources." Strategic Management Journal 22:545–564.

Lounsbury, Michael, and Marc J. Ventresca (eds.)
2002 Social Structure and Organizations Revisited: Research in the Sociology of Organizations, Vol. 19. Oxford, UK: JAI.

Lounsbury, Michael, Marc Ventresca, and Paul M. Hirsch
2003 "Social movements, field frames and industry emergence: A cultural-political perspective on U.S. recycling." Socio-Economic Review 1:71–104.

Meyer, John W., and Brian Rowan
1977 "Institutionalized organizations: Formal structure as myth and ceremony." American Journal of Sociology 83:340–363.

National Research Council
1998 Trends in the Early Careers of Life Scientists. Washington, DC: National Academy Press.

Owen-Smith, Jason, and Walter W. Powell
2001 "Careers and contradictions: Faculty responses to the transformation of knowledge and its uses in the life sciences." Research in the Sociology of Work 10:109–140.

Padgett, John F., and Christopher K. Ansell
1993 "Robust action and the rise of the Medici, 1400–1434." American Journal of Sociology 98:1259–1319.

Podolny, Joel M.
2001 "Networks as the pipes and prisms of the market." American Journal of Sociology 107:33–60.

Podolny, Joel M., and Karen L. Page
1998 "Network forms of organization." Annual Review of Sociology 24:57–76.

Powell, Walter W.
1990 "Neither market nor hierarchy: Network forms of organization." Research in Organizational Behavior 12:295–336.

Powell, Walter W., and Paul J. DiMaggio (eds.)
1991 The New Institutionalism in Organizational Analysis. Chicago: University of Chicago Press.

Powell, Walter W., Kenneth W. Koput, and Laurel Smith-Doerr
1996 "Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology." Administrative Science Quarterly 41:116–145.

Rabinow, Paul
1996 Making PCR: A Story of Biotechnology. Chicago: University of Chicago Press.

Rao, Hayagreeva, Calvin Morrill, and Mayer N. Zald
2000 "Power plays: Social movements, collective action, and new organizational forms." Research in Organizational Behavior 22:237–281.

Rayman, Paula M.
2001 Beyond the Bottom Line: The Search for Dignity at Work. New York: Palgrave.

Regets, Mark C.
1997 "What's happening in the labor market for recent science and engineering PhD recipients?" Issue Brief 97–321. Arlington, VA: U.S. National Science Foundation.
1998 "Has the use of postdocs changed?" Issue Brief 99–310. Arlington, VA: U.S. National Science Foundation.

Robbins-Roth, Cynthia
1998 "A scientist gone bad: Or how I went from the bench to the board room." In C. Robbins-Roth (ed.), Alternative Careers in Science: Leaving the Ivory Tower: 1–10. San Diego: Academic Press.
2000 From Alchemy to IPO: The Business of Biotechnology. Cambridge, MA: Perseus.

Scott, W. Richard
2001 Institutions and Organizations, 2nd edn. Thousand Oaks, CA: Sage.

Scott, W. Richard, Martin Ruef, Peter J. Mendel, and Carol A. Caronna
2000 Institutional Change and Healthcare Organizations: From Professional Dominance to Managed Care. Chicago: University of Chicago Press.

Smith-Doerr, Laurel
2004 "Flexibility and fairness: Effects of the network form of organization on gender equity in life science careers." Sociological Perspectives 47:25–54.

Smith-Doerr, Laurel, and Walter W. Powell
2005 "Networks in economic life." In Neil J. Smelser and Richard Swedberg (eds.), The Handbook of Economic Sociology, 2nd edn. Princeton, NJ: Princeton University Press and Russell Sage Foundation.

Stark, David
2001 "Ambiguous assets for uncertain environments: Heterarchy in postsocialist firms." In P. DiMaggio (ed.), The Twenty-First-Century Firm: Changing Economic Organization in International Perspective: 69–104. Princeton, NJ: Princeton University Press.

Stinchcombe, Arthur L.
1959 "Bureaucratic and craft administration of production: A comparative study." Administrative Science Quarterly 4:168–187.
1965 "Social structure and organizations." In J. G. March (ed.), Handbook of Organizations: 142–93. New York: RandMcNally.

Thornton, Patricia H., and William Ocasio
1999 "Institutional logics and the historical contingency of power in organizations: Executive succession in the higher education publishing industry, 1958–1990." American Journal of Sociology 105:801–843.

Weick, Karl E.
1995 Sensemaking in Organizations. Thousand Oaks, CA: Sage.

Werth, Barry
1994 The Billion-Dollar Molecule: One Company's Quest for the Perfect Drug. New York: Simon and Schuster.

Zucker, Lynne G., Michael R. Darby, and Marilynn B. Brewer
1998 "Intellectual capital and the birth of U.S. biotechnology enterprises." American Economic Review 88:290–306.

Zucker, Lynne G., Michael R. Darby, and Maximo Torero
2002 "Labor mobility from academe to commerce." Journal of Labor Economics 20:629–660.

Zuckerman, Ezra W.
2000 "Focusing the corporate product: Securities analysts and dediversification." Administrative Science Quarterly 45:591–620.