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The costs and benefits of 'red tape': Anti-bureaucratic structure and gender inequity in a science research organization

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Abstract

This paper explicates a central conflict that can affect science research organizations, the conflict between the anti-bureaucratic stance believed to advance science and concerns for gender equity rooted in the universalist ethos of science. We present a case study of a science research organization, using employment and publication records, a survey of 308 employees, and qualitative interviews with 60 employees. We show how anti-bureaucratic organizational structures perpetuate gender inequities for both female scientists and non-scientists.

Keywords

bureaucracy, gender, organization, science, structure

In a discussion with John D. Rockefeller Jr., Albert Einstein claimed that the strict regulations Rockefeller had set for his educational foundations stifled genius. '"Red tape," the Professor exclaimed, "encases the spirit like the bands of a mummy!" Rockefeller, on the other hand, pointed out the necessity for carefully guarding the funds of the foundations …. "I," Einstein said, "put my faith in intuition." "I," Rockefeller replied, "put my faith in organization"' (Nathan and Norden, 1960: 157).

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In addition to 'red tape' and 'bands of a mummy', sociologists are familiar with a third metaphor about bureaucratic shortcomings - the 'iron cage' imagery Max Weber employed to describe a root condition of modern life (Weber, 1958 [1904–5]: 181). Weber's pioneering analysis of bureaucracy was grounded in the mega-trend he saw at work in modern societies: rationalization (Schöllgen, 1985; Zingerle, 1981). For Weber, bureaucratic procedures embodied rationalization; they introduced a more predictable and systematic way to accomplish tasks in an organization. However, Weber also was aware of the disadvantages of societal rationalization. In this context, he coined the 'iron cage' metaphor that would become popular among critics of rationalization and bureaucracy. The common complaint behind these metaphors – 'iron cage', 'bands of a mummy', and 'red tape' – is that bureaucracy is inflexible and stifling.

Since Weber's groundbreaking work on bureaucracy, the concept has been the subject of considerable study and critical discussion (for example, Bozeman, 2000; Crozier, 1964; March and Simon, 1993; Merton, 1968[1940]; Wilson, 1989). The term 'red tape' has also received attention and scrutiny. According to a widely used definition, organizational red tape is a specific dysfunction of bureaucracy; it describes the 'rules, regulations, and procedures that remain in force and entail a compliance burden for the organization but have no efficacy for the rules' functional object' (Bozeman, 1993: 283). This definition makes possible a distinction between 'objective' red tape and people's perceptions of red tape, and the latter aspect has become a fertile research field (for example, DeHart-Davis and Pandey, 2005; Pandey and Welch, 2005; Rainey et al., 1995). Perceiving red tape may be independent of whether red tape, by an objective measure, exists.

The perception of red tape is also at the core of a hostile attitude toward bureaucracy, which we call an anti-bureaucratic stance. This stance leads individuals to value creative freedom and flexibility and devalue firm rules and procedures that are seen as creating 'red tape'. In this article, we trace the roots of an anti-bureaucratic stance in research and describe how it shapes an anti-bureaucratic structure within a particular science research organization. We then analyze the disadvantageous effects of that structure on women in the organization.

We maintain that the relatively informal and implicit organizational structures that an anti-bureaucratic stance can produce have a serious downside. Those structures tend to disadvantage newcomers to an occupation – or 'strangers' (Simmel, 1950 [1908]) – who lack an intuitive grasp of the nuances of the occupational culture and often are subject to negative stereotyping.[1] One group of relative newcomers to science research organizations remains a focus of concern: women. Understanding what still holds women back in such organizations – and particularly the role of institutions in fostering or reducing a gender gap – remains an important issue. This paper uses a case study to examine how anti-bureaucratic organizational structures perpetuate gender inequities in a particular research organization. Following a sociological tradition of case studies (Erikson, 1976; Hochschild, 1997; Selznick, 1953; Vaughan, 1996), we focus on the tension within this organization between the anti-bureaucratic stance and the core norm of universalism that had been central to Weber's analysis of bureaucracy and that Merton (1973[1942]) famously associated with science. According to that norm, all scientists, regardless of ascribed statuses such as gender, should be selected

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and rewarded based on merit. Findings that women in science benefit from more formalized and explicit structures that describe duties and expectations, specify criteria of performance evaluation, and disseminate information evenly (Long and Fox, 1995), suggest a tension between these two fundamental organizational principles.

Whereas most research on women in scientific organizations has focused solely on scientists, we broaden our analysis to include both scientist and non-scientist workers. We hypothesize that the anti-bureaucratic organizational structure in this research organization disadvantages all female employees, not just scientists. This organization has many women working in administrative, support, human resources, and other positions that are not immediately linked to its scientific mission. Yet we maintain that the anti-bureaucratic structures implemented to enhance a scientific research culture have implications for all employees. That is, we expect that such an organizational culture shapes the entire structure and influences how principal investigators (PIs) and senior personnel organize their working relationships with all their employees. For instance, when formalized procedures are limited, all employees are particularly reliant on informal networks for information about opportunities and career advancement, which tends to put women at a disadvantage compared with men (McGuire, 2002). We investigate how anti-bureaucratic organizational structures in this organization create gender inequities for scientists and non-scientists alike.

Women in science

A large body of literature examines the gender gap in science in different national contexts (for example, Bosch, 2002; Etzkowitz et al., 2000; Fox, 1995, 2001, 2006; Glover, 2002; Long, 2001; Schiebinger 2002; Sonnert and Holton, 1995; Xie and Shauman, 2003). In the US, women's overall representation in science has grown considerably since the 1970s, but the number of women holding advanced degrees, working in scientific careers, and publishing their work remains well below parity with men. Women composed only 27% of the college-educated workforce in science and engineering occupations in 2007 (National Science Board, 2010). Marked differences exist in the representation of women across science disciplines, and women are also vertically segregated within science fields, with significantly fewer women in higher ranking positions (Committee on Science, Engineering, and Public Policy, 2007; Sonnert and Holton, 1995).

Scholars have identified various factors contributing to gender disparity in the sciences, including gender stereotyping and discrimination (Acker, 1990; Kilduff and Mehra, 1996; Ridgeway, 2001), gender socialization (Etzkowitz et al., 2000; Xie and Shauman, 2003), familial responsibilities (Long 1990, 1992; Xie and Shauman, 2003), and the organizational structure of scientific work (Fox, 2000, 2001; Robinson and McIlwee, 1989; Smith-Doerr, 2004; Sonnert and Holton, 1995). A review of this extensive scholarship is beyond the scope of this article.[2] Here, we discuss the organizational factors that affect women's ability to succeed in scientific research institutions.

The norm of universalism that Merton (1973[1942]) described as one of the pillars of the ethos of science not only covers criteria for assessing truth claims, but also applies to the social attributes of the scientists who put forward such claims. Merton (p. 270) stipulated that a meritocratic social structure rewards a scientist without regard to such

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ascribed statuses as 'race, nationality, religion, class, and personal qualities' ('personal qualities' presumably including gender). In accordance with the Mertonian view, scientists and science organizations tend to pay lip service to the scientific ethos, including the norm of universalism, despite some real-life ambivalence and occasional deviation from it (Mitroff, 1974; Rothman, 1972).[3] A major instance of a divergence between the universalist norm and organizational practice is the gender issue – how male and female employees act and are treated differently in the workplace.

While some scholars argue that all organizations are inherently gendered and must be fundamentally modified to eliminate gender inequalities (Acker, 1990; Britton, 2000; Ridgeway, 2001), others maintain that formalized bureaucracy can reduce the idiosyncrasies in hiring and promotion decisions that often disadvantage women (Baron et al., 2007; Bielby, 2000; Campbell and Rosenfeld, 1985; DeHart-Davis, 2009a, 2009b; Fox, 2001; Long and Fox, 1995; Reskin, 2000). Bureaucratic structures are seen to have a leveling effect that promotes workers on merit, regardless of gender. Baron and his colleagues (2007) found that women's employment in core scientific roles was highest in firms whose leadership articulated and used bureaucratic means to serve the goals of universalism and meritocracy.[4] This body of work suggests that a bureaucratic structure can create a platform of transparency, where organizational requirements are overtly defined so that employees clearly understand how to obtain grants or promotion.[5]

Women tend to be disadvantaged in organizations that rely on more informal structures. For example, informal channels of information transmission, such as social networks and mentoring, often exclude women who may have difficulty entering predominantly male networks or finding senior scientists to act as mentors (McGuire, 2002). Collaborations with mentors from doctoral training is a crucial factor affecting productivity (Long, 1990), yet women may be less able to participate in such projects for a variety of reasons, including increased family responsibilities.

The anti-bureaucratic stance and the social organization of science

Over the last two centuries, an anti-bureaucratic stance has become firmly embedded in the ethos of the scientific researcher. In the early 19th century, university reformer Wilhelm von Humboldt (1956 [1810]) used two characteristics to describe the archetypal spirit of research he wished to foster: 'solitude and freedom'. Universities, of course, need administrative structures that function along bureaucratic lines. But academics and other researchers who considered academe a normative model wholeheartedly subscribed to the 'solitude and freedom' motto. They cherished their autonomy above all and tended to view the administrative structure as a necessary evil, something to be minimized in order to give maximum freedom to the 'spirit'.

Since Humboldt's era, the reality of the organization of scientific research has increasingly shifted from the individual researcher working in solitude to collaborative research and, in the extreme case, to the 'big science' of large and often interdisciplinary teams including dozens of doctoral-level scientists (Hara et al., 2003). As scientists' solitude evaporated, freedom took on a new meaning, and the anti-bureaucratic stance became focused on limiting the formality of the organization of research.

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Today, scientific research is conducted in a variety of organizational settings, including academic institutions, research and development divisions of major companies, government science institutions and laboratories, and non-governmental not-for-profit organizations. The PI model – where research projects are conducted in groups with researchers and support personnel working under a PI – is widespread in both academic and non-academic organizations, especially those seeking support from large funding agencies, such as the National Science Foundation, that adopt the PI model. This model is both hierarchical and informally organized (such as the one in particle physics that Traweek (1988) studied). The PI is ultimately responsible for a research project, acquires funding for it, and holds a high degree of authority over members of the research group, often with little oversight by department heads, human resource officers, or other members of the organization.

The PI model can be considered the routinized ('industrialized') incarnation of the master–apprentice model that Zuckerman (1977) observed for how high-caliber scientists carefully select and groom young scientists as their heirs. This model projects vestiges of the 'solitude and freedom' ideal onto a social reality increasingly dominated by teamwork. Considerable numbers of young scientists pass through the PI's work groups, and the master–apprentice relationship takes on the flavor of the boss–employee relationship. Looking out for junior scientists' career development, or 'mentoring,' becomes optional, and the personal bonds become weaker, but they are not replaced – to the same extent as in other segments of a modernizing (that is, rationalizing) society – by bureaucratic regimentation. The PI still enjoys many freedoms of the master. In that sense, the PI model harkens back to a mode of production characterized by masters and apprentices.

Fox (2000) argues that the dominance of the PI model in academic science departments is closely tied to their dependence on external funding awarded to individual faculty to pay for facilities, laboratory equipment, and staff. As graduate students obtain skills and credentials by working on their PI's projects, graduate training is effectively integrated into funded research programs. PIs clearly benefit from this arrangement. Decentralizing authority to individual PIs enables a greater degree of flexibility, as research groups can innovate and respond rapidly to new opportunities. However, the loose organizational structures entailed in this model, such as a lack of written guidelines, can promote less favorable conditions for female students. Furthermore, a PI's interests as a researcher and as an educator may not coincide. Rather than helping qualified students to graduate and search for postdoctoral opportunities, a PI might take advantage of their advanced training and familiarity with the work by keeping them working on his or her own projects. Because universities benefit from research grants, administrators have little incentive to implement more centralized graduate training or address exploitative workplace practices by successful PIs.

Some critics view the PI model as obsolete in the new reality of increasingly large and interdisciplinary research projects, and propose alternative models of research organization (for example, BECON, 2003; Transportation Research Board, 2002). Others examine trends toward bureaucratization in laboratories and regard them as potential barriers to research flexibility (Bozeman, 1993; Bozeman et al., 1992; Crow and Bozeman, 1989, 1998). Whereas the prime concern for these discussions has been efficiency and scientific productivity, we focus on the effects of organizational structure on gender equity. The PI

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model may be one source of the problems women experience at work, and certain increases in bureaucratic features may help to alleviate them.

The 'Science Research Organization' as a case study

We call the organization that we studied 'Science Research Organization' (SRO). The human subjects protocol under which we carried out this case study included the strict safeguarding of the confidentiality of the participants and the organization, both because of the sensitive nature of the information we collected and the very small number of such organizations in the particular field. A crucial advantage of this protocol for our purposes was that the participants could express their opinions freely and without fear of consequences. The disadvantage was that we can describe the organization and its field only in general terms. We can, however, say that the field in which SRO operates is characterized by a substantial under-representation of women, both overall and in the higher ranked positions (National Science Board, 2010).

The organization is affiliated with a research university located in the US. Of its nearly 1000 employees, slightly fewer than half are scientists. The research enterprise at SRO depends primarily on external funding, and like in many science organizations with externally funded research, the PI model predominates (Fox, 2000).

Like the science field in which it specializes, SRO has significantly fewer women than men in scientific roles. Records for spring 2004 showed 84 female scientists and 313 male scientists, a ratio of 1:3.7. These scientists include permanent employees, postdoctoral research fellows, visiting fellows, graduate students, and contract researchers.[6] Except at the postdoctoral level, the representation of female scientists at SRO lags somewhat behind national averages of women's representation in the particular discipline.

Non-scientists at SRO show a more equal gender ratio of approximately 1:1.3, with 221 female and 283 male non-scientists. The genders are segregated by employment area, with the majority of male non-scientists working in technical positions, often those requiring specialized degrees. Female non-scientists dominate in administrative, support, and human resources positions, but both men and women are represented in other non-scientific jobs, such as educational outreach, finance, information technology, and grant administration.

The overall structure of SRO most closely resembles a non-governmental not-for-profit research organization, yet it combines some elements of public and private control. It also performs the educational function of training students because of its links to a university. It is funded primarily by external grants from national funding agencies. Obtaining competitive funding is an important part of the scientists' jobs and a measure of their career success.

The PI model is in force at SRO. PIs enjoy great flexibility and autonomy in managing their projects, and their leadership styles are relatively diverse and idiosyncratic. Importantly, the hierarchical yet informal structure of the PI model extends to the organization of non-scientific work. Some non-scientists are assigned to research groups in a support capacity, receiving instruction mainly from PIs. Others work in groups under a non-scientific group leader, yet the organization of these groups is similar to that in the scientific teams. Because authority is highly decentralized among PIs, organization-wide bodies have relatively little involvement in training, evaluating, or promoting personnel.

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Non-scientific units therefore tend to be self-regulating, like the scientific ones. The centrality of the supervising relationship makes employees, both scientists and non-scientists, particularly dependent on their relationship with the PI or group leader.

In this study we employed multiple perspectives and sources of data to enable a holistic and in-depth examination of the patterns and processes in SRO (Ragin and Becker, 1992; Yin, 2003), and of how the organization's structure contributed to gender inequities. As Yin writes, 'case studies, like experiments, are generalizable to theoretical propositions and not to populations or universes' (2003:10). The goals of such studies are to develop, confirm, illuminate, expand, or correct the theoretical notions that guide research (Vaughan, 1992; Walton, 1992). Here, we develop the theoretical proposition that an anti-bureaucratic stance shaped the organization's structure in a way that disadvantaged women, and we apply this proposition to all women throughout the organization.

A single case study of this kind presents substantial limitations for drawing generalizations. Furthermore, the absence of comparison cases prevents us from exploring the extent to which the structures and outcomes we identify are present in other organizations. An advantage, however, is the ability to examine in great detail multiple perspectives within the organization and multiple data sources. We therefore use this approach to suggest, for this site, an explanation that can be pursued in research on other cases.

Data and methods

This research was commissioned by the SRO Gender Equity Committee, which was created in response to concerns by some employees that women did not receive equitable treatment. Neither author was an SRO employee; because the impartiality of the researchers was a primary goal, the SRO deliberately hired independent contractors to conduct the research. The study followed a three-pronged approach: an analysis of employment and publication records; an online survey of SRO employees; and qualitative interviews. Employment records as of May 2005 were analyzed for the largest organizational unit of SRO, which contained about two-thirds of SRO employees. For the scientists, a database of scientific publications in their discipline was used to ascertain their publication and citation records.[7]

The survey was conducted among all SRO employees through a restricted access website during spring 2004. Participants responded to items about various aspects of SRO employment. More than 300 employees participated, resulting in a response rate of 32.4%. Whereas the relatively low response rate certainly allows for potential non-response bias, this problem is mitigated by our being able to triangulate from three different data sources that elucidate one another, one of which is a complete population data set without missing values. We should also note that we have survey responses from one-third of the population of interest, not of a sample. This would let us apply a finite population correction factor, $\sqrt{\frac{N-n}{N-1}}$, that diminishes standard errors and tightens confidence intervals around estimates (this correction factor would be 0.8). However, in our analyses, we made the conservative choice not to capitalize on the finite population correction factor. Of the survey participants, 40.2% were female and 59.8% were male; 50.3% were scientists and 49.7% were non-scientists; 92.2% were White and 7.8% were non-White. Women and scientists were slightly overrepresented

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among the survey participants compared with their percentages at SRO (33.9% and 44.1%, respectively).

Qualitative interviews were conducted with 60 SRO permanent employees and post-doctoral fellows in summer 2004; this involved 15 interviews each with female scientists, female non-scientists, male scientists, and male non-scientists.[8] The interviewees were asked both about gender equity specifically and about other aspects of employment. In this article, names have been omitted and information indicating specific units or other recognizable groups has been removed.

Gendered experiences at SRO

Our analysis of employment records showed that, when controlling for educational level and length of service or degree age, men attained higher average ranks than women (Table 1). In general, the size of the gender gap in rank correlated inversely with the employees' educational level. It was largest among employees with a high school education and generally decreased with higher educational credentials. Because our employment and publication data represent the entire population of interest, rather than a sample, we used significance testing merely as a gauge for the importance of existing differences. The gender gap reached significance among employees with a high school education or Bachelor's degree, but was below significance for employees with higher educational backgrounds. The employees' educational backgrounds approximate the distinction between scientists and non-scientists. While virtually no scientists are below the doctoral level, the doctoral level contains very few non-scientists. Thus, the gender gap in rank is largest among non-scientists and particularly those with the lowest qualifications. Yet at all educational levels, women attained a lower average rank than men.

In terms of the scientists' publication and citation patterns, the averages were consistently lower for women (Table 2). For instance, women scientists had slightly fewer refereed papers, fewer citations, lower productivity and citation rates, and lower average citations per publication. However, none of these differences reached statistical significance.

For the survey, our procedure was to examine the questionnaire responses for differences by gender, job type (scientists vs non-scientists), and for any interaction between these two variables. At the 1 per cent significance level, 24.7 per cent of the 275 items in the survey showed differences between scientists and non-scientists, 12.0 per cent showed differences by gender, and 1.5 per cent showed a science–gender interaction.

Significant gender differences revealed in the survey are summarized in Table 3. These items used a four-point rating scale ('disagree strongly' (1), 'disagree somewhat' (2), 'agree somewhat' (3), 'agree strongly' (4)) for participants to indicate the extent to which they agreed or disagreed with the item.[9] On the rating scales, a mean of 2.5 indicated that, on average, the group was evenly split between agreement and disagreement, while a mean above 2.5 indicated more agreement on balance, and a mean below 2.5 indicated more disagreement.

Table 3 shows that female respondents, both scientists and non-scientists, were less satisfied with the promotion process than were their male peers. Female scientists were less likely to agree that they understood the criteria for achieving promotion or were supported in the promotion process. Female respondents were slightly (yet significantly)

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Table 1. Gender gap in terminal rank by employees' educational level, controlling for employment duration or degree age

	N	Average male rank	Average female rank	Difference	Statistical significance of difference (p value)
Controlling for employment duration					
High school	110	72.8	58.3	14.6	<.01
BA	181	80.5	67.9	12.6	<.001
MA	85	88.0	84.6	3.5	NS
Doctorate	157	95.0	89.9	5.1	NS
Controlling for degree age					
BA	185	84.6	71.6	13.0	<.001
MA	90	96.5	89.0	7.5	NS
Doctorate	164	95.6	93.2	2.4	NS

To mask the identity of SRO, its ranking system was mapped onto a ranking scale from 1 to 100, with 1 indicating the lowest possible rank and 100 indicating the highest. Because rank did not increase linearly with employment duration or degree age, non-linear growth functions of the following type were fitted for each of the groups of employees that were distinguished according to their educational credentials:

$$Rank = 1 + b_0 (1 - e^{-b_1 x}),$$

where 1 is the lowest rank found for members of the particular group; x is the independent time variable (for example, years at SRO); b_0 determines the upper limit of the function; and b_1 determines the shape of the function. Thus, the terminal rank reported here is the rank plateau reached by longer-serving employees ($1 + b_0$).

Table 2. Publication patterns by gender

	Men	Women	Difference	Statistical significance
Average number of refereed papers over career	82.9	70.5	12.4	NS
Average number of citations over career	2522	2084	438	NS
Average number of citations to individuals' most-cited paper	285	235	50	NS
Average number of citations to individuals' five most-cited papers	770	662	108	NS
Average annual productivity rate over career	5.6	4.9	0.7	NS
Average annual citation rate over career	130	112	17	NS
Average citations per publication	27.5	23.0	4.5	NS
N	189	36		

The men, as a group, have a slightly higher average professional age, which boosts their refereed papers over their career, but this effect is controlled for in the average annual productivity and citation rates.

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Table 3. Selected significant gender differences in employee survey

Item	N	Male non-scientists	Female non-scientists	Male scientists	Female scientists	Effect
Promotion process						
'I am/was satisfied with the promotional process overall.'	234	2.8	2.5	3.1	2.3	G
'I understand/understood the criteria for achieving promotion.'	248	3.1	2.9	2.8	2.4	(G)S
'I feel/felt supported in my advancement to promotion.'	236	3.0	2.9	3.1	2.4	G(GS)
Unwritten rules						
'I encounter unwritten rules concerning how one is expected to interact with colleagues.'	273	1.9	2.3	1.9	2.2	G
Gender equity						
'In regard to work assignments, I have observed that staff are treated without regard to gender ...						
... [in my sub-unit].'	244	3.4	3.1	3.5	3.1	G
... [at SRO].'	199	3.4	3.0	3.2	2.5	G(S)
'In regard to performance evaluation, I have observed that staff are treated without regard to gender...						
... [in my sub-unit].'	197	3.6	3.2	3.5	2.7	G
... [at SRO].'	144	3.3	3.0	3.3	2.5	G(S)
'In regard to career advancement, I have observed that staff are treated without regard to gender ...						
... [in my sub-unit].'	210	3.3	3.0	3.2	2.3	G,S(GS)
… [at SRO].'	172	3.3	2.7	3.0	2.0	G,S
'I often have to forgo personal activities (for example, family activities) because of work responsibilities.'	281	2.4	2.1	2.5	3.0	S,GS
'My [sub-unit] has identified ways to move women into leadership positions.'	128	3.0	2.3	2.5	2.2	G

Means of a four-point rating scale: 'disagree strongly' (1), 'disagree somewhat' (2), 'agree somewhat' (3), 'agree strongly' (4). G indicates a significant main effect of gender at the alpha level of .01 or better in ANOVA models. S denotes a science main effect, and GS a gender*science interaction. Effects with .01 < alpha <.05 are in parentheses. The maximum Ns are: male non-scientists=63, female non-scientists=83, male scientists=114, and female scientists=36.

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more likely than their male counterparts to agree that there were unwritten rules concerning how one is expected to interact with colleagues, although the average scores for all four groups indicated that disagreement with the question prevailed. Female scientists and non-scientists also responded that there was more gender bias in work assignments, performance evaluations, and career advancement. Together, these findings support our hypothesis that the anti-bureaucratic stance has effects beyond the scientists and pervades the whole institutional climate. Female scientists reported more difficulty with balancing personal and professional life than male scientists. However, no significant gender differences showed up in responses about overall career satisfaction, the hiring process, compensation, or satisfaction with SRO programs and resources.

Based on the above results, it would be wrong to characterize SRO as a den of gender inequity. The survey results did not show women to be a severely disgruntled group, although they revealed that women were particularly dissatisfied with the promotion process and with gender biases in assignments and evaluations. The institutional data indicated gender disparities in career outcomes, but these were most pronounced among employees with lower education levels, illustrating the need to take female non-scientists' situations into account. On the whole, female employees seemed to experience a variety of disadvantages, which may have accumulated over the course of their careers, as predicted by the Mertonian concept of the accumulation of small advantages and disadvantages (Zuckerman, 1989). The findings from the institutional analyses and the survey underscored the need for a more in-depth exploration of the employees' experiences and attitudes.

The anti-bureaucratic stance at SRO

Many interviewees said that bureaucracy was a major hindrance. Male scientists in particular discussed this problem at length. They believed there was already far too much bureaucracy, and several immediately identified bureaucracy in response to a general question about what they thought had hindered their career development. One male scientist asserted, '[t]he bureaucracy is huge and stagnant and impenetrable. I spend, maybe, a half a day each week trying to shuffle paper a little faster through the hands of the many people who have to look at it, and it affects my ability to get grants through the system so that money becomes available.' Female scientists and some non-scientists, especially males, also raised the problem of the large amounts of paperwork and 'red tape' they saw at SRO.

Many of the bureaucratic procedures at SRO are externally imposed. While SRO employees are obliged to meet the demands of funding agencies and of the institutions with which SRO is affiliated, the organization tries to keep to a minimum the bureaucracy it can control. A male scientist distinguished between the minor bureaucracy of day-to-day activities and the broader principle of openness and freedom that governed the SRO's administration:

> **Q:** What things about [SRO], in particular, do you think have really helped your career advancement?
>
> ... There's a lot of flexibility .... It's not the kind of organization that hamstrings you from trying new things …. I mean I went from being a scientist to a program manager literally in a blink of

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> an eye, and nobody said 'you have no experience, you can't do that.' Nobody waved a rule book and said, 'Wait a minute, we're going to have a hire a new project manager who actually has some experience here.' No. They threw in me in the deep end of the pool, which was fine by me. I mean it was – it allows that kind of flexibility.

Many defined the mission of the organization as bringing some of the best minds in the discipline together and giving them the freedom to pursue their work. Scientists, particularly men, saw this flexibility as a tremendous asset of the organization.

To ensure maximal flexibility, many policies were not set in stone or consistently enforced. Scientists and non-scientists alike described many of these policies as 'opaque' or 'a black box'. PIs had considerable autonomy to run their laboratories and manage their teams however they saw fit. One female scientist believed that a phrase used by some in the organization symbolized its leadership style: 'in ambiguity lies opportunity'. The emphasis on deal-making, rather than on strictly adhering to formal policies, allows the organization and its high-level employees to act freely in their best interests.

Importantly, this situation at SRO illustrates the point made above that the perception of red tape and the real amount of red tape do not necessarily coincide. Cultural attitudes influence reference levels and color perceptions; even a relatively low amount of bureaucracy is not low enough for someone with an anti-bureaucratic stance. Our findings show both that an anti-bureaucratic stance exists at SRO and that it is implemented, to a considerable degree, within its organizational structure.

SRO's flexibility, however, can disadvantage certain groups of people through its very informality. A female scientist said:

> We … tend to be very loose, right? We tend to want to make exceptions to help people do whatever they want to do. We're a bureaucracy that's trying to [be] as un-bureaucratic as we can, which is mostly a good thing. But it means that the rules aren't really all that clear. And then the problems can't get easily solved ….

> [I] very much … believe that things like gender equity rely on having policies that are open and clear and are being implemented the way people expect them to be. And then it's this loosey-goosey kind of, you know, there aren't any rules because we'd rather make deals because that way we can make more people happy. It leaves the people out who didn't know you were supposed to be making a deal. And that tends to be the women and the minorities and the less aggressive men. And it isn't because it's … gender discrimination, but it leads to it.

The following sections detail some of the ways that informal structures and anti-bureaucratic tendencies disadvantaged both female scientists and non-scientists at SRO.

SRO structure and gender inequity

Like the survey, the interviews also showed that many female respondents were dissatisfied with the promotion process and perceived gender biases in workplace decisions. Yet the interviews went further in revealing the perception that many of the disadvantages women faced at SRO stemmed from its organizational structure, particularly the centrality of the PI or supervisor relationship,[10] coupled with a fairly ad hoc process of

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decision-making and information flow. According to many employees, this structure provided them with few clear avenues for following up on problems that supervisors had no time to pursue, while also making them dependent on their relationships with their supervisors. Because PIs rarely received formal managerial training and typically prioritized their research agendas over the management of employees, informal networks became more central to employees' success than formal evaluation and promotion rules. We maintain that these reported aspects of the organization created a structural basis for gender inequities that many in positions of power were unable to link explicitly to considerations of gender.

The centrality of the supervising relationship

The units of SRO were frequently described as distinct 'fiefdoms' with relatively little interaction. The scientific groups worked fairly independently, and a large amount of the administrative authority for assignments and promotions lies with the groups' leaders. Interviewees in all four categories observed that the rate of career advancement greatly depends on the supervisor. One female scientist said that the supervisor is crucial for passing along information about opportunities for advancement. When asked how satisfied she was with opportunities for leadership positions at SRO, she commented, 'Well, there had been none that I was aware of until this new [supervisor] stepped in. And so, again one needs to know what the opportunities are. … And that depends very much on having somebody who wants to see you participating in that way.'

Interviewees' characterizations of the supervisory relationship varied greatly. Some said they were happy with the amount of feedback, training, and mentoring they received. Others claimed they rarely saw their supervisor and received little to no feedback. One female scientist said that while this mainly related to each supervisor's personality, the structure of supervision – specifically the fact that all formal supervision was centralized in this one relationship – perpetuated the problem:

> I think it's very much a personality issue. [Other supervisors] really do promote their [junior people] and tell them things like, 'this is a meeting you should be going to' or 'here, we have a visitor' .... But what is institutional is that it's all down to one person. … You could imagine some kind of institutional setup where there'd be some other sort of secondary supervisor. ... Because of my personality, [I] sort of tried to develop these [relationships]. … But again, that's because I'm not shy. And so, if someone was shy … if their supervisor wasn't proactive or promoting them, … it's hard for me to imagine how they would get any sort of help in this regard.

How proactive supervisors were in promoting employees was said to lead to concrete disparities in salaries and titles. Although salaries were based on a formal pay scale tied to ranks and time served in rank, many respondents claimed that some supervisors fought harder than others to start their hires at higher levels. Some employees said they moved jobs within SRO based on informal knowledge about which supervisors more actively promoted their employees. A female scientist explained why she did not get a promotion one year – her supervisor simply forgot to submit the paperwork. This was an oversight on his part, but indicates that employees depend on the initiative of their specific supervisor.

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Many interviewees said that the concentration of responsibility at the level of unit or group heads meant that less attention was paid to equity across groups. They further claimed that they had little recourse if they disagreed with a supervisor's decisions or if personal problems arose. Employees had the option of confiding in an Ombudsman, but several people claimed they avoided this path because there was no guarantee of confidentiality. If denied a promotion they believed was deserved, they could appeal the decision, but the likelihood of a successful appeal was unclear, and few respondents said they would pursue this option. A related theme was that the lack of centralized oversight could produce disparities in career advancement linked to the assertiveness of individual employees. A female scientist explained:

> We don't have … any kind of real oversight for … these earlier career years. … I think the kind of thing that might work … would be a more aggressive oversight …. The [Unit Head] … should be thinking about 'Is everybody here where they should be?' And … the [Director of SRO] … should be saying 'Is everyone in your [unit] where they should be?' And it should be part of that supervising responsibility. And I think what happens instead is it's kind of random. [They] all supervise too many people. … So the people who are more aggressive – 'I want a promotion' – the people who are not, don't [get one]. So it comes down to who asks and who doesn't ask.

The need for individual assertiveness may disproportionately disadvantage women, whom many of our interviewees said were less likely to submit claims for promotion to their (primarily male) supervisors (see Babcock and Laschever, 2003). Others noted a cultural double-standard where assertiveness was valued in men but criticized in women. Just as more formalized bureaucratic arrangements tend to encourage gender equity (Baron et al., 2007; Reskin, 2000), variability in supervisors' pro-active efforts to promote their employees can explain disparities in the advancement of men and women employees, such as those that were evident in the SRO data, especially for employees with lower education.

Managerial training and management skills

On the survey, female scientists and female non-scientists were more likely than males to indicate that they perceived a gender bias in work assignments, performance evaluation, and career advancement. In the interviews, the lack of managerial skill demonstrated by supervisors emerged as a major source of these perceptions.

The business of the SRO, many pointed out, is to conduct research. Therefore, employees are promoted and selected into positions of leadership based on their success in conducting or supporting scientific research. Their ability to be effective leaders and managers was usually not a criterion for becoming supervisors or PIs. Importantly, respondents said that the need to develop such skills was not emphasized by the organization. A male non-scientist explained:

> In this organization, management and supervision is not valued. … The basic imperative itself of really being a good manager, and I mean investing the time in doing that – [is] not in any way, shape or form encouraged. In fact, in some ways, it's sort of discouraged. It's like, 'Oh,

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> yeah, … doing performance reviews is something you've got to do, but it's a pain in the [expletive deleted],' or something.

> … I'll give you a for instance. … There are mandatory training courses that all supervisors and managers are supposed to attend. All. Okay? For example, EO [Equal Opportunity] training. Training in preventing sexual harassment … as well as how to conduct performance reviews, performance appraisal reviews, and so forth. … I've attended every one of them. In every case, there are almost no scientists there. Almost none. And [in] every case, you'll see most of the people from the business, the services side of the organization. … So, there's this real dichotomy and the message is clear, because we're a science research organization, and so there is a pecking order.

Numerous organizations face the structural problem that employees, as they rise in the ranks, must take on heavier managerial loads, but the anti-bureaucratic stance at SRO exacerbates this problem. Many scientists look down upon management activities as the bane of their existence, and they tend to get away with this attitude. Participants said that scientists generally believed that there would be few if any repercussions for not attending managerial training sessions.

Rather, there was a perception that the organization believed management skills would simply develop naturally, something that intelligent scientists could easily pick up by themselves. In reality, this was often not the case. In the words of a male non-scientist:

> What happens is … you're a scientist. You do a great job. You've come up with this fantastic discovery. So you get more money, and that means you hire some people to help you with that. So now you're a manager, right? And eventually, you might become the [head] for the [unit] that you're in. Nothing in your training has … trained you for that. You know, courses in [an advanced science topic] don't teach you anything about management, right? ... And there is this real sense that a PhD in [a science] is hard, and everything else is easy by comparison. I'm sure a PhD in [a science] is hard. That said, however, being a good manager is also very hard.

Those experiencing problems with their supervisors claimed that scientists often made particularly bad managers – either due to a lack of social skills or because their focus on their science was so all-encompassing.

The qualitative interviews were rife with examples of management problems, notably a lack of communication with employees and insufficient feedback on their work. Female employees, particularly non-scientists, complained of the harsh and disrespectful treatment they sometimes encountered when they failed to meet unarticulated expectations. They often attributed this to managers' lack of 'people skills'. For instance, one female non-scientist who works in an administrative support capacity explains how supervisors often would not take the time to explain to their staff what they needed, yet expected the job to be done anyway:

> It's not that [my bosses] don't care or they're uncaring people, but they're very involved in their science, and … they just want me to be able to do the job without even telling me what I need to do. They want me to be a mind reader. … And then they get frustrated when [I can't do that.]

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> … You know, they're really overbooked and busy, and the science is the most important thing. And so I'm just really not that important in the scale of things. But it's sort of a self-fulfilling prophecy; if they want me to do the best job that I could do, they should take the time to make sure that we have a good relationship. But they don't.

Like many other female non-scientists, this respondent believed that the lack of communication between managers and their employees was the biggest administrative problem at SRO.

The functions of non-scientists working in administrative or support positions are not immediately tied to the scientific mission of the organization, and many of the women in those positions had worked in other office environments, including other departments at the university. Yet in comparing the management skills of supervisors at SRO with what they had encountered at their other workplaces, they viewed the lack of set policies and clear expectations at SRO as a particular problem. One female non-scientist claimed:

> [SRO] is a little strange in the sense that nothing – I mean, maybe things were written down exactly how they should be, but right now, everything is very fluid. So, one person can say something's done one way ... and one person will say it's done another way. Or one person will one day [say] this is how you should do it, and the next day say it's different. So, that is actually very frustrating .... We need to have a set of rules and guidelines on how to handle things ... I came from an institution that had – everything was very clear and very set, and when somebody told you to do it some way, that's the way it was to be done .... And then to come here where everything is not so clear and some people are really passive-aggressive .... They just don't want to tell you how to do things, and they just leave it. ... And, I think, that's not the right way to run things. I've always found that in research things are not quite as, like – in the business world, that would not happen. If it did, the company would not be doing well.

One way that female non-scientists experienced the brunt of the undervaluing of managerial skills was in their supervisors' unwillingness to train them. We were told that there was little emphasis on training within the organization. Some of these women described themselves as disposable in an organization that would sooner replace them than spend time training them. Because they typically held the lowest status positions within the organization and often had the least specialized skills, the organization's inattention to training affected them the most. These experiences may help explain why the rank data (Table 1) showed the largest gender gaps at the lowest employment ranks.

In sum, female respondents (both scientists and non-scientists) especially emphasized problems resulting from a lack of managerial skills. More women than men expressed concern about insufficient feedback or guidance. These women said they were substantially disadvantaged, because supervisors play such a prominent role in determining the employees' career progress.

Unclear criteria for promotion

The survey revealed that women were more likely than men to be dissatisfied with the promotion process, and that female scientists, in particular, claimed that they did not understand the promotion criteria or felt their advancement lacked support. The interviews illustrated that age and experience also influence women's perceptions of the promotion

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process. Compared with their male counterparts, female non-scientists and junior scientists (that is, entry level scientists and postdoctoral fellows) were less sure of the basis for promotion. A junior female scientist explained, 'I'm sure there are written rules but I don't know where they're written …. It's not really clear what the criteria for advancement are …. If I wanted to get promoted to the next [rank] I have no idea what I would have to do.' Male and female non-scientists who had done well in their annual reviews were less troubled by the review process, but they described the criteria by which they were judged in quite vague terms: 'you have to do a good job' or 'it depends on your performance'.

Those employees who rose in the organization acquired more experience with the promotion process, not least because they became involved in the 'other side' of the evaluation and promotion procedures. Nonetheless, many women who had been promoted continued to discuss 'unwritten rules' and believed that there was a lot of room for interpretation. Many noted that the criteria for promotion were vague and idiosyncratically applied, and that evaluations could be affected by subtle disadvantages women faced in the institutional culture.

In particular, these women reported that loosely applied criteria allowed for a double standard in promotion decisions. Several female scientists said that being aggressive or outspoken could be interpreted negatively, although it would not be for men. Because clear guidelines were not stated, they believed that the tendency to view an assertive woman as 'not being a team player' could be used as an excuse for passing her over for promotions.

The interviews revealed that female respondents believed more strongly than did men that there were 'unwritten rules' in how the organization operated. This dovetailed with their suspicion, reported in the survey, that workplace decisions were not free from gender biases. One consequence of permitting greater flexibility in promotion criteria is that it allows subtle cultural assumptions and even prejudice to affect women's opportunities.

Information diffusion, the distribution of resources, and informal mentoring

Several interviewees expressed concern and frustration with the lack of clarity regarding SRO policies in general. They said that policies were often not clearly formulated, making it difficult to find out how things operated. As a male scientist observed,

> … many times you go into [units] … they say, 'Well, that's not [SRO] policy.' Okay, I can live with that. Where's it written? It's not written down. Well, ladies and gentlemen, if it ain't [written] down and distributed, it ain't policy; it's your wishful thinking. And that's been an issue. And we've had numerous conflicts over hiring people. 'Well, we can't hire that person at that [rank].' 'Why not?' 'It's not [SRO] policy.' 'Well, what is the –' 'Well, we don't want to have disparities between postdocs' salaries.' 'Where is that written down?' 'Well, it's not written down. It's a guideline.' 'Where is it written down as a guideline?' 'It's not written down as a guideline; it's just the way we do it.' Well, ladies and gentlemen, just because you want to do [it] that way doesn't mean it's the right way to do it.

A female scientist related the following example. She was told that her postdoctoral fellow had to be located at a different building because there was no room in hers. She then discovered that her male colleagues were subsequently able to get office space for their

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postdocs in the purportedly full building. She finally sought to determine what the policy was only to discover, 'There's no policy! ... They're just randomly doing what [they want]. And I don't think it was blatantly gender discrimination against me. I think it was just I didn't scream loud enough.' Because women can face sanctions when they do 'scream loud enough', the need to resort to such tactics can hurt women disproportionately.[11]

The organization was frequently described, particularly by higher-level scientists, as 'secretive' about its resources and procedures. Interviewees claimed that important information tended to circulate informally by word of mouth, reaching only select people. With such an absence of transparency, some respondents expressed suspicion that opportunities or resources were allocated according to whim or personal connections rather than systematically. Some scientists – even at high levels – acknowledged that 'secret' resources were distributed, such as cash awards, retention bonuses, and internal funding. Those who were knowledgeable about them noted that there is a formal application process for internal research and development funds that is open to everyone. However, information about this resource and the award process evidently had not reached many scientists at SRO. This became a gender issue, as many female scientists claimed that these resources were unlikely to go to women. One of them said:

> We have some internal funds that are competed for internally. And … you could argue it's more for [a specific scientific area] and, therefore, men do that more. But … there are also aspects of it where people don't know to compete … I think there are a lot of cases where women didn't [know] to ask for a retention bonus. Women didn't know that there were cash awards. Women didn't know to ask. So it isn't even just that they were blatantly not given something, but that the information has not always been distributed equally.

According to these responses, the reliance on informal channels results in unsystematic access to information, with women – or perhaps all 'strangers' – likely to be excluded.

In such an institutional structure, personal networks are extremely important, particularly for scientists. Establishing relationships with powerful individuals was seen as central to promotion at SRO. The way those 'in the know' tended to hear about internal resources and opportunities was through informal conversations with powerful contacts. Significantly, most of the female scientists said they would benefit from more mentoring, while most of the male scientists and the non-scientists either said they did not need mentors or that they received sufficient mentoring. Female scientists found it harder to find mentors because there were fewer women in high-level positions who could serve in that capacity. Most of them preferred to have another woman as mentor, and some senior men considered it unbecoming or uncomfortable to mentor younger women. This illustrates how existing gender hierarchies tend to perpetuate themselves, even in the absence of deliberate and strenuous efforts to maintain an 'old boys' network'.

Even non-scientists said that informal networks were crucial, and male non-scientists often described relying on their personal connections to powerful individuals. As one of them noted, such ties were important for career advancement.

> **Q:** Are there any things that you feel have particularly helped your career advancement at [SRO]?

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> … There have been a couple of individuals, … senior level scientists who are people I can go to and say, 'What the [expletive], what's going on here!' Right? And have them sort of say, 'Well here's the deal.' You know, I just want to understand the situation, so that I can know how to handle it.

His connections to scientists in key positions allowed him to understand important planning and procedural issues that the SRO leaders were discussing. Several male non-scientists said that personal connections to the director or to senior scientists enabled them to take their positions at SRO, while no female non-scientists mentioned this. Studies of other types of organizations also have shown that women are less likely than men to receive such help from informal networks (McGuire, 2002). Because SRO's non-bureaucratic structures make its employees dependent on their informal networks, women employees are likely to fare worse, regardless of their positions within the organization.

Discussion and conclusions

At its core, SRO is certainly an organization of the bureaucratic type that, according to Weber, pervades our modern society. However, contemporary organizations differ in the extent to which they adhere to the bureaucratic model. At SRO, we found that an anti-bureaucratic stance manifests itself structurally in several interconnected ways: a high degree of flexibility in applying and enforcing regulations; a low emphasis on disseminating information through official channels; and a relatively strong reliance on informal rules and tacit knowledge.[12] At the same time, the existing degree of bureaucracy is vociferously condemned by SRO employees, especially those in elevated science positions. One root of this anti-bureaucratic stance and structure lies in a centuries-old academic belief in 'solitude and freedom'; another one lies in the PI model with its external mechanism for funding research, which dominates in research-oriented universities and research institutions such as SRO (Fox, 2000).

There are certainly advantages to an anti-bureaucratic stance, particularly in a research organization in which novel approaches and individual initiative are essential. Rigid adherence to formal policies creates its own set of problems: no organization wants a cumbersome and inefficient degree of bureaucracy. However, informal institutional structures usually disadvantage minorities and groups that traditionally have less access to powerful individuals.

Many of the organizational structures that disadvantaged female scientists also affected female non-scientists at SRO. In particular, female non-scientists described themselves as hampered by the lack of clear criteria for promotion and the lack of emphasis on managerial skills and training among their supervisors. Like female scientists, they also faced barriers from the concentration of decision-making authority in the hands of individual supervisors and the lack of oversight and transparency in the promotion process. When problems with supervisors did emerge, women typically saw few avenues to address their concerns other than leaving the organization. Male scientists and non-scientists were less likely to mention such problems or to say that these structures affected their ability to advance within the organization.

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We do not believe that anti-bureaucratic structures are limited only to science research organizations. To the extent that other types of organizations implement anti-bureaucratic structures, we expect that they, too, will create similar inequities for women and 'strangers'. Again, we should note the limitations of our single case study. Whereas the strength of our methodology lies in the depth and detail to which we were able to examine the gender issues at SRO, we cannot draw firm conclusions about the generality of our results. It is possible, for instance, that organizations structured like SRO, but with more women in supervisory roles, would experience fewer of the problems stemming from inadequate information diffusion, resource distribution, and informal mentoring, even if other structural problems persisted. Only comparative studies – for example, comparing science research organizations with academic science departments, non-science departments, and organizations in other sectors – will be able to determine the extent to which our findings apply beyond this particular research organization.

If we view the gender biases at SRO as part of the dilemma of the iron cage of bureaucracy – of predictability and orderly process versus flexibility and freedom (Merton 1968[1940]) – we realize that such biases might not be easily or entirely resolved.[13] However, we maintain that specific organizational changes that promote gender equity and greater access to scientific opportunities for talented 'strangers' are also consistent with, and even conducive to, the ultimate goal of advancing science.

Scientific research presents a paradox to the sociological observer. At the epistemological level, science at first appears to be a major driving force of societal rationalization and of the concomitant disenchantment that occurs when myths, half-truths, and prejudices are exposed by cold scientific fact. At the level of social organization, by contrast, scientific research appears to be a decidedly pre-modern citadel that tenaciously resists advances of modernity in the form of bureaucracy. On closer inspection, a more complex picture emerges, as one realizes that the epistemological sphere is not thoroughly rational, and the social sphere is not thoroughly traditional, and that these two spheres are interconnected.

The creative aspect of science, alluded to by Einstein's quote and emphasized by SRO scientists, is quite different from what is perceived as certified knowledge that stands at the end of scientific research. The epistemological features of creativity, of putting a premium on novel and unconventional approaches, impact the social organization of scientific research, where they support the anti-bureaucratic stance and limit bureaucracy. However, the norm of universalism within scientific epistemology is also linked to the sphere of social organization, where it justifies – at least at the level of legitimatory discourse – certain aspects of bureaucracy on the basis of evidence that specific bureaucratic procedures can safeguard the equitable treatment of newcomers to science, and that their absence leaves these newcomers open to subtle or more substantial disadvantages.

If the ultimate intent of the anti-bureaucratic stance is to foster scientific progress, then this larger goal is also served by the expansion of opportunities that certain elements of bureaucratization promote. The deregulated structure is meant to facilitate scientific innovation and creativity by talented individuals. Yet by effectively marginalizing female scientists, it does not fully take advantage of the talent and originality they could bring to their field. To truly advance science, the research organization needs to look beyond the immediate interests of those already succeeding and toward the larger goals of

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welcoming new talent wherever it may lie. The challenge for the organization is, while protecting the flexibility and freedom of the scientific process, to identify and implement those specific bureaucratic structures that promote gender equity.

Notes

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1. In some contexts, 'strangers' may benefit from positive stereotypes – for example, token male employees in traditionally female-dominated occupations (Williams, 1995).
2. See Committee on Science, Engineering, and Public Policy (2007), Sonnert (1999), Sonnert and Holton (1995), and Xie & Shauman (2003) for reviews.
3. For a critical review, see Knorr Cetina (1991).
4. However, firms maintaining bureaucratic structures without this logic are unlikely to reduce gender inequities (Long, 1990).
5. For some outcome measures, bureaucratic structures may have an opposite effect. Whittington and Smith-Doerr (2008) find that women are more likely to enter into patenting in more collaborative network-based biotechnology firms than in more formal, hierarchically based organizations. However, such organizations do not offer women advantages for the number of patents, arguably a better indicator of career success.
6. The focus of this study is on SRO's permanent employees and research fellows.
7. Graduate students, visiting fellows, and contractors were excluded from the administrative and publication data and the qualitative interviews.
8. Lists of these groups included some ineligible employees. Of those contacted who were eligible, the participation rate was 54 per cent of female scientists, 54 per cent of male scientists, 58 per cent of female non-scientists, and 47 per cent of male non-scientists. After quotas were reached, the remaining people listed were not screened for eligibility, so the response rate for all eligible individuals is unknown.
9. We converted this ordinal scale to an interval scale by associating the numbers 1 through 4 with the responses, as this allowed us to use a single number (the mean) to characterize the findings. Another option is to analyze the proportion who agreed with the statement. We compared these approaches by regressing the continuous ('means') variable on the dichotomous ('proportion') variable for a sample of questions. Both approaches were highly correlated in a linear manner (R^2=.9902).
10. We use the term 'supervisor' for consistency across scientific and non-scientific divisions.
11. We considered whether perceptions of fairness could relate not only to gender but also to job satisfaction. In the survey, low job satisfaction did predict perception of gender inequities, but a gender effect remained after controlling for this effect. The qualitative data showed similar perceptions of unfairness among women who had succeeded in the company as well as those who were unsatisfied with their advancement. On perceptions of workplace equity in general, see Park and Rainey (2007) and Rainey (1997).
12. On tacit knowledge, see Polanyi (1966) and Duguid (2005).

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13. In his explicit treatment of bureaucracy, Merton (1968[1940]) was somewhat more critical than Weber, who himself was rather ambivalent about it, and emphasized the dysfunctional aspects of bureaucracy. On the other hand, Merton's normative idea of universalism within the ethos of science is aligned with Weber's conception of bureaucracy. It might indicate a deep societal conundrum that the reported empirical results suggest that shortcomings in universalism need to be remedied by the functions of (in Merton's view otherwise dysfunctional) bureaucracy.

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