

## 6 Women's (and men's) graduate experience in science

The overall picture is of a prevailing academic culture that provides inadequate direction and mentoring for women, thereby eroding their self-confidence. In the first years of the program, women Ph.D. students experience the entire range of disorientation delineated in the Srole anomie scale: (1) the perception that community leaders are indifferent to one's needs; (2) the perception that little can be accomplished in the society which is seen as unpredictable; (3) the perception that life-goals are receding from reach rather than being realized; (4) a sense of futility; and (5) the conviction that one cannot count on personal associates for social and psychological support.

In addition, the individual is left with the feeling that it is she who is to blame, and this exacts a severe psychic toll including doubts about competency that prevent the successful working through of problems as they arise. It is not surprising that half of the informants revealed having sought personal psychological counseling during this period.

Isolation also creates powerlessness, loneliness, and confusion which, in many cases, leads to dropping out. Reports by informants describe how isolation reduces the opportunity (a) to compare experiences through communication with others in the same situation, (b) to test the reality of their experiences to ascertain that difficulties are not based on personal deficit, (c) to reduce feelings of alienation and rejection in hostile, male-dominated labs, (d) to work through strategies to deal with discrimination by male advisors, (e) to experience peer support when advisory support is non-existent, (f) to gain information and practical advice regarding strategies to succeed within the program, (g) to build a professional network among female

peers for future professional advancement, (h) to feel safe to have questions answered without being judged as stupid or inadequate, (i) to practice the necessary skills for future advancement (presenting papers, discussing science).

#### NEGATIVE CONSEQUENCES OF ACADEMIC CULTURE FOR WOMEN

The academic structure, rather than aiding the passage of qualified and competent women, actively discourages them. The tiny cuts and stigmatizing reproaches experienced in graduate school range from assumptions of devalued admission to simply not having one's comments in a research group meeting taken seriously, only to hear them accepted when repeated a few minutes later, in a more glib and deeper voice, by a male counterpart.

Despite a formal and even at times a strongly stated commitment to non-discriminatory treatment of women, discrimination can be manifested informally. For example, a female graduate student reported different treatment of men's and women's contributions. She said, 'In group meetings I get the sense that if a woman says something, "okay fine" and that's the end of that.' In contrast, the response to males would be enthusiastic. Frequently compliments and praise would be given for the thought. This graduate student even mentioned that a woman might make the same observation and be met with a dismissal while a male student would receive accolades for the thought. The devaluation of women's scientific contributions is widespread (Benjamin, 1991) and takes many forms, including crediting the male partner in scientific collaborations and ignoring the work of women (Scott, 1990).

In some instances women are devalued by not being included in professional events. A female graduate student reported that invisibility was imposed when 'you have a visitor to the lab, the professor introduces the male students, but does not introduce you.' Another reported self-imposed invisibility in reaction to expectations that her contributions would not be valued:

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[In lab meetings] you feel very self conscious saying what you  
think and I think it's because you are a woman. They would just as  
soon you would sit back and be quiet and when they ask you if it  
turned red or green, [you say] 'it turned red,' rather than saying 'it  
turned red and this is what we're going to do next.'

Made to feel uncomfortable, women sometimes hold back from  
contributing their ideas to the scientific give and take of research group  
meetings.

The graduate school experience, as constituted at present, is often  
counterproductive. It results in the loss of many brilliant female minds  
to science and creates damaged identities instead. How is a secure  
scientific identity created? A sense of competence is related to the  
esteem of others for one's contribution and is further enhanced by a  
feeling of acceptance and inclusion by others. This amplifies a sense of  
self and ultimately frees us to take chances. The AIDS researcher who,  
against well-accepted methodological practice, mixed several samples  
together in order to have sufficient material to conduct an experiment,  
exemplifies the scientist as risk taker (Haritos and Glassman, 1990). In  
this instance the risk paid off; had it failed the individual would have  
been subject to ridicule, embarrassment and the censure of colleagues.  
To take such a chance, and to be prepared to accept its negative  
consequences, requires a secure sense of self. Without it, such  
scientific risks are not likely to be taken.

Women Ph.D. candidates are frequently mystified and sometimes  
struggle with guilt as to why they feel unable to enjoy the psychological  
freedom to assert themselves and take similar risks to their male  
counterparts. However, to enjoy such freedom requires connective  
tissue in which two powerful needs are met: 'the striving for autonomy  
in which self-organizing, self-enhancing and self-determining needs  
may be freely sought, and the striving for harmony which is the need to  
relate to and feel a part of a larger whole' (Ullman, 1992). These  
universal needs are inextricably interwoven and interdependent on  
one another.

The development of autonomous functioning, highly valued in the scientific work ethic, cannot be accomplished without full membership and inclusion within the social psychological milieu of the scientific workplace. Isolated and without interpersonal connection, a woman's ability to be playfully creative is impeded. Moreover, she is understandably reluctant to ask for the help she needs since it is likely that she will then be labeled as 'dependent'. A gendered 'apartheid system' exists in which many male advisors offer support to male students, but leave women to figure things out for themselves. With no support or connection with an advisor, taking risks in the lab becomes too threatening. People only take risks when they feel safe to do so. In contrast, there is sufficient support and acceptance, by way of informal interactions with male advisors and peers, for male students to enjoy the freedom to be innovative.

Women found it difficult to be taken seriously as professionals outside the department as well. One said: 'If I go to conferences, if I ask a question, the answer gets addressed to a man in the room. It's worse in physics than in other fields.' A female graduate student reported her response to being ignored, 'It's always a thing where being invisible, you don't exist . . . It was in a sense, I didn't exist.' Other times, women are made to feel different by being made too conspicuous. A female graduate student reported that a professor was ' . . . addressing the class, "Gentlemen" . . . and then made a big pause and looked at me and added, "and lady". I was different. Other people noticed it . . .'

Still other times women are patronized. A female graduate student told how 'I was sitting at this table and he kept referring to us as "my girls." In that context I didn't like it. He was thinking of us differently. He didn't say "my boys."' At one department, many graduate women felt that they were treated as 'one of the boys' but this too was an unsatisfactory resolution. Since the demands or possibility of child-bearing were not taken into account in structuring work schedules and evaluation, women were placed at a disadvantage, nevertheless.

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#### LIFE-COURSE EVENTS

Academic transition points sometimes coincide with life-course events that affect how decisions are made. For example, as mentioned earlier, a pregnancy that coincides with such critical transitions as finding an advisor will set a female Ph.D. student at a disadvantage, if decision makers view child-rearing and research as inherently incompatible. A female graduate student said: 'There are no real good role models to follow. The women a generation ahead of us had it so difficult that they are by and large a very aggressive group. [They had to be so aggressive] and that's who got ahead. You have trouble looking at them and saying, "I want to be like that." You don't.' Even as taken-for-granted academic practices continue to work against them, most women in science do not want to be 'men'. Instead, many attempt to legitimize a female model of doing science (*Science*, special issue, 1993).

Male expectations about female commitment to family roles often lead to further discrimination against women in academic science. Many scientists believe it to be legitimate to take family responsibilities into account in evaluating a colleague, irrespective of demonstrated achievement; this is held to be the converse of a commitment to long hours spent at the laboratory site which is positively interpreted, irrespective of how they are spent. A female junior faculty member reported:

I asked [her mentor and colleague] what his reaction would be if I had a child. He said, none. Then he said, 'I take that back. There are others in this department who will say, "Well, she won't be around now." A decision to have a child before tenure will have an impact on your tenure decision.' He was always extremely supportive. It was devastating [that he did not understand]. He's somebody who has good politics, who has been supportive of women. It was shocking to me. That did play a big part in my decision to stop working with him. I have felt completely isolated since then.

The barriers discussed in the previous chapter are exacerbated by the desire of most women, and an increasing number of men, for a personal life beyond the work site and the inability of academic science to accommodate their wishes.

#### MARRIAGE AND FAMILY

Marriage and children negatively affect women's careers in academic science at three key times: having a child during graduate school, marriage at the point of seeking a job, and pregnancy prior to tenure. In addition, we found some disparagement of marriage during the graduate student career. Women, but not men, are sometimes thought to be less than serious about their science if they do not stay single while in graduate school. As a female graduate student recalled:

When I first interviewed to come here, I was single. On my first day of walking into this department I had an engagement ring on my finger. [My advisor's] attitude was 'families and graduate programs don't go together very well.' First he was worried I was going to blow my first year planning my wedding. I got a lot of flack about that and so did other women . . . teasing. 'So and so's not going to get much work done this semester because she'll be planning her wedding.' [sarcastically] The guys don't plan weddings.

Earlier in the century, marriage was grounds for a woman's expected retirement from a faculty position. The mutual exclusion of academic and family life has a long history. Until well into the nineteenth century Oxbridge male academics were also expected to choose between academic career and marriage. Nevertheless, there have been few if any residual carryovers from the academic celibate role for men, whereas for women, even when a choice between academic career and family is no longer an official requirement, the presumption that each role requires a woman's total attention survives. It next surfaces when children are contemplated or arrive.

Women graduate students expect that they will be penalized for

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women's careers in academic child during graduate school, and pregnancy prior to tenure. In the event of marriage during the life of men, are sometimes thought of as a disadvantage if they do not stay single. A graduate student recalled:

Here, I was single. On my first semester I had an engagement ring on my finger. I was 'families and graduate students well.' First he was worried I was not going to get my wedding. I got a lot of teasing from the other women . . . teasing. 'So and so's getting married this semester because she'll be able to get a job [ally] The guys don't plan

rounds for a woman's expected career. The mutual exclusion of academic and family until well into the nineteenth century were also expected to choose between career and age. Nevertheless, there have been women in the academic celibate role for a long time. In a choice between academic and family requirement, the presumption of family attention survives. It next to be expected or arrive.

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having children. One informant visualized her advisor's and the department's reaction: 'If I had walked into —'s office and said I was pregnant, they would have been happy for me as a woman, but in their list of priorities as to . . . who to support I would have plummeted to the bottom of the list.' These concerns arise because the existing academic structure is ill equipped to deal with pregnancy. Pregnancy is discouraged and graduate women who have children are encouraged to take leaves of absence that tend to become permanent withdrawals. In one department an informant reported that: 'The only one left is — [of the students who have children]. Two women Ph.D.s who got pregnant were strongly encouraged to take leaves of absence. One did and one did not come back.' In another department a female graduate student reported:

One person took a leave of absence to get married and asked her advisor if she had a child would she be able to work part time and he told her, 'Absolutely not. No way.' What if I should want to do something like that? Is it the end of my career in — ? Was it just the advisor? What am I going to do with my life? People say they're not going to have children until they're 40 and have tenure. I can't think like that. Thinking about [these] details is what scares me. That's when I think I should drop out.

The expectation that women students will succumb to the pressures of child-bearing and child-rearing makes some male and female faculty members wary of taking on women students in the first place especially since funding is tight and every place must be made to count. Another female faculty member stated:

If a student had a baby with her, I wouldn't have her. Students who have babies here get no work done. It's not that I wouldn't take a woman with a child in the first place, but the first sign of trouble, I would just tell them to go away. If my students fail it looks bad for me.

Graduate student women were caught in a bind, wanting to have

children and, while doing so, wanting to show that they could keep up with the pace of graduate work. A female faculty member reported:

I had one student who was having her child in the middle of the semester and was to take and pass her qualifiers at the end of the semester. She wanted to do it. I said, 'Don't do it' . . . because of the emotional state you are in and the physical state after having a baby. We discussed this at length at one of our meetings . . . she ended up not doing it.

One department had taken child-bearing into account to a limited extent:

During evaluations, if a Ph.D. [student] has a child she will be given some leeway for that semester . . . I think that's pretty funny . . . it's such a small amount of time. I think the women should get more leeway, you're physically out of it. It should be longer . . . at least a year. What's the big deal? [In one case, a student] had the baby in November and had until the end of the semester. It was partly her fault as well, she did not want to say she could do less. The faculty gave her a choice of doing a part-time thing or keeping up to pace. She chose to be put to the same standard as everyone else.

A peer had a somewhat different view of the faculty's action and described an unusual instance of solidarity among women graduate students:

She decided not to take a leave [when she had the child] and made the decision at the end of the semester when we are all evaluated. She got a particularly harsh letter, [the faculty] essentially threatened to cut her support. They gave her requirements that would not be achievable for anybody . . . even without a baby. Two people had left the department earlier in the semester. One was a new mother, the other was a man who was very involved with his family. We got the feeling this was being done to



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 husband and a number of us to renegotiate this because it was  
 clearly off base and came out of the blue.

There is a strong cultural bias in most of the academic science  
 departments we studied against women combining parenthood with a  
 graduate career; most advisors expect students to delay having  
 children until after the degree, but then, when is the 'right time' if a  
 woman stays on the academic track?

#### THE ACCUMULATION OF DISADVANTAGE

Barriers to women deriving from the structure of the academic system  
 are reinforced by 'cumulative disadvantage' factors that excluded other  
 women from science but also carry over and affect the academic careers  
 of those who persisted. Beyond cumulative disadvantage carried over  
 from previous negative experiences lies the realm of 'marginal  
 disadvantage', irritations, the tiny cuts and stigmatizing reproaches  
 experienced in graduate school. Disadvantage experienced at the  
 margin of presumed success, after admission to a prestigious graduate  
 program, is the unkindest cut of all. The fall to failure from such a lofty  
 height is brought about in many ways.

Cumulative disadvantage extends back to the differential social-  
 ization of men and women. Girls are encouraged to be good students in  
 so far as they expect to be given a task, complete it well, and then  
 receive a reward from an authority figure. The roots of this problem lie  
 in the different experiences of boys and girls. As young girls and  
 women, females are socialized to seek help and be help-givers rather  
 than to be self-reliant or to function autonomously or competitively, as  
 are boys. In graduate school, despite the underground support structure  
 provided for male students, behavior is expected to be independent,  
 strategic, and void of interpersonal support. These expectations are  
 antithetical to traditional female socialization. In addition, the needs  
 of women, based on socialization which encourages supportive  
 interaction with teachers, is frowned upon by many male and some

female academic staff as indicative of inability. As a female graduate student put it: "The men have the attitude of "Why should people need their hands held?""

Many women come into graduate programs in science with low self-confidence. Women in physics, chemistry, and computer science reported that their graduate school experience further eroded their confidence. A female graduate student described the following symptoms: "Women couch their words with all these qualifiers [because they are so insecure] . . . "I'm not sure, but maybe . . ." One female graduate student said: "I have the symptoms of the insecure woman. A comment from a professor can cripple me. I would be self-deprecating. My science is different because of my socialization, not my gender." Another woman reported, "Women tend to measure themselves: "Am I allowed to do this? This I know and this I don't know. This I should be ashamed I don't know." Depletion of confidence is a signal of impending disaster.

An insecure person is like a weakened immune system, vulnerable to destruction from even a mild attack. If things are working out well, then initial lack of self-confidence is not too important: but if problems arise, then negative feelings come forth. For example, one woman had this to say: "It is much worse if a woman fails an exam because her self-confidence is so low. I got an A- on an exam and was upset. The man sitting next to me got a C and he said, "So what?"" Another woman described the invidious comparisons that she began to make if things were not going well: "If I'm not feeling good about myself, I start comparing myself to these brilliant people [highly qualified foreign students]. It doesn't affect American males as much."

Finally, if the barriers remain high, low self-confidence translates into an increased rate of attrition. This loss can be viewed as a result of the cumulating thwarting of the development of a viable professional identity. Even those who do not give up, or are not pushed out, often reduce their professional aspirations.

Young women who remain in science and engineering Ph.D. programs, as well as those who leave, frequently describe expending a

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great deal of emotional energy in order to cope with a harsh social environment. A woman who left a Ph.D. program in chemistry after investing three years of effort said:

There is no impetus that [my family] can give me that I would put myself back in that situation. There was no feedback on how I was doing, no pat on the back for what I had done. No feeling that I could knock on the door to initiate that kind of conversation. And constantly living with sexist joke telling. It was a complete blow to my self-esteem for the first time in my life . . . I was always successful in finding summer employment in chemistry, winning internships, getting science scholarships. Then I came here and I couldn't survive.

Similar feelings were expressed by women who persisted to the degree despite the alienation they experienced. For some women, experiences of denigration, rejection and dismissal are sometimes so elusive that they are not recognized until years later.

When rejection inexplicably follows great success a person is ' . . . left feeling inadequate and a failure, particularly when an individual has, up until this point, held a different view of herself' (White, 1974). Such a cumulatively deprecating experience erodes one's sense of personal worth. The female chemist drop-out further elucidated the effect on her of leaving the Ph.D program:

It was really the first failure. The first major failure. I still view myself as intelligent enough, hard working enough to have earned that paper. I guess part of me views my graduate experience as a big black mark on an otherwise successful life. I very much wanted to earn the Ph.D. This continues to be an open wound because I didn't finish.

The psychological toll of such an insidious experience has consequences for how one adapts to the situation or if one even chooses to remain a scientist.

Ironically, most women Ph.D. candidates view graduate school as

just as stressful for their male peers as for themselves. They are perplexed as to why they lack the apparent self-confidence and assertiveness of their colleagues. Anxiety often escalates into self-blame, exacerbated by feelings of inadequacy. Women report feeling increasingly anxious, and careful, desiring more direction in their research, and quick to blame themselves for perceived failure. In contrast, they observe their male peers as more assertive, action-oriented and risk-taking. These behaviors are cited as evidence of 'independence' and 'autonomy', and that lack of these characteristics is frequently mentioned by an older generation of male scientists as the rationale for women's 'inherent' difficulties in academic science.

The findings discussed above have been corroborated elsewhere, for example in site visits to assess the climate for women in physics departments (Dresselhaus *et al.*, 1997) and in a study of three other science disciplines carried out in 1994 by the Association of Women In Science. There have also been a few attempts to supplement qualitative evidence by querying and comparing broad representative cross-sections of students of both genders. One such recent survey (Curtin *et al.*, 1997) which aimed at all female graduate students and a comparable number of randomly selected male students in physics in a given year, provided confirmation, albeit modest, of the picture that emerged from qualitative studies. Among students who were U.S. citizens, women students were somewhat less likely to describe the faculty as easy to discuss ideas with (38% as against 52% for men), or fellow students as respectful of the respondent's opinions (72% compared to 87% for men). U.S. women were also slightly more likely than men (15% to 8%) to indicate a currently unfulfilled wish to belong to a study group.

However, most other aspects of departmental life evoked only muted differences between male and female students. These included respondents' relationships with other students in their research group, their sense about whether other students in general treated them as colleagues, and the degree to which they are encouraged by faculty members. Indeed, most graduate students gave positive evaluations of

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their department environment, with a few notable exceptions such as whether the department encouraged student self-confidence, or whether department faculty as a whole treated students as colleagues, and such reservations issued more or less equally from male and female students alike.

One clue to understanding these apparently equivalent findings for each gender is buried in the comments provided by the respondents at the end of the questionnaire. Women who had given negative evaluations of their graduate experiences quite often elaborated specifically on a departmental climate that they felt was hostile to women, whereas male 'complainants' discussed issues such as the poor job market they faced once they graduated or the overall quality of their coursework and the coverage of their program's curriculum. Thus, although men and women seemingly evaluate the overall graduate environment similarly, women note distinctly different bad experiences. The human price for the Ph.D. is higher for women than for men, and the rewards are often lower.

A good graduate school experience can allow the effects of previous disadvantages to be left behind. Too often, old bad experiences interact with a new set, further lowering self-confidence. This concatenation of disadvantage, as it is disentangled, explains the cumulative thwarting of female scientific talent. In conjunction with lack of a viable professional identity that should have been nurtured in graduate school, it produces reduced aspirations. A male faculty member said of his female students, 'Their job aspirations are so low, their self-confidence is so low, they tend not to apply for what they see as a very tough place.' The effects of traditional female socialization are exacerbated by the assumption that women should fit in to a 'male' academic culture, instead of that culture being reformulated to accommodate both sexes.

#### INFORMAL TRANSITIONS: THE ROLE OF CONFERENCES

A key hopeful finding is the identification of participation in conferences as a significant informal transition point. In addition to

'vertical' transitions through the stages of a Ph.D. program, there are also 'lateral' transitions in which the student moves out of the research group and department and into the broader scientific community. If Ph.D. students participate in conferences, it widens their social circles and allows them to envision their future in the scientific community. Several respondents brought up the topic of conferences without being asked and discussed how their participation had enhanced their graduate career. One advisor's suggestion to a student that she take part in a conference was taken by her as a signal of his high regard. Here we see exemplified the role of the advisor in assisting their graduate students and moving them forward. A female graduate student pointed out that 'not just everyone can attend . . .' and that the invitation gave her a feeling that she was 'doing the right thing'; that she was ' . . . on the right track.'

Conferences thus play an unexpected role in the socialization of female scientists, providing information and social support that might not otherwise have been available. Since women experience problems at various points in the Ph.D. career, a transition point that provides a positive experience takes on a greater import for women than men. Participation in conferences builds confidence and gives women a chance to network on a new level. A female graduate student explained that ' . . . being sent to conferences happens in accordance to your relationship with your advisor, specifically it depends on how you please your advisor.' Conferences give additional support to those students who have proven themselves capable of doing excellent work; those who are invited or permitted to attend are pushed into an environment that allows them to make connections they would otherwise not find.

Perhaps the most important event, at sub-specialty workshops and conferences, is being introduced to key senior scientists and fellow graduate students from other departments. While larger meetings are widely publicized, smaller meetings and workshops are often by invitation only. In any event, it is typically the student's advisor who can insure that the student gains the maximum benefit from

the stages of a Ph.D. program, there are when the student moves out of the research into the broader scientific community. If conferences, it widens their social circles and their future in the scientific community. At the topic of conferences without being their participation had enhanced their suggestion to a student that she take by her as a signal of his high regard. Here is the advisor in assisting their graduate ward. A female graduate student pointed out 'attend . . .' and that the invitation gave her the right thing; that she was ' . . . on

an unexpected role in the socialization of formation and social support that might be available. Since women experience problems in their career, a transition point that provides a greater import for women than men. This builds confidence and gives women a level. A female graduate student explained that conferences happens in accordance to your advisor, specifically it depends on how you can give additional support to those who themselves capable of doing excellent work; those permitted to attend are pushed into an environment to make connections they would

at an event, at sub-specialty workshops and are invited to key senior scientists and fellow departments. While larger meetings are smaller meetings and workshops are often by invitation, it is typically the student's advisor who does not gain the maximum benefit from

participation. Legitimation from the advisor, through a few words added to a personal introduction about the quality and potential of a student's research, means that they will be taken seriously from the outset by peers. It is through these introductions that the advisor's social capital is placed like a mantle around the student, guaranteeing that whatever she does or says will be taken seriously.

Invitations to speak at or simply attend conferences are especially important to women in furthering their graduate careers. At least three positive effects can be identified: (1) an increase in the female student's confidence from a favourable reaction to a research presentation; (2) introduction into scientific networks, paving the way for future conference invitations, job possibilities and research collaborations; and (3) reinforcement of the advisor-advisee relationship, as both parties recognize its place in a broader social network. The more recognition they received in the scientific world beyond the department, the greater the acceptance female Ph.D. students felt in their home department.

#### FINISHING THE PROGRAM

Issues of isolation, lack of direction and contacts, and conflict around one's life chances continue to dominate toward the end of the program. A sixth-year student admitted that even though she had only six months left before finishing, she frequently considered seeking counseling. She reported feeling overwhelmed with anxiety about the future and obtaining a job even though she had spent five years in industry before entering the program: 'I was feeling left out. I didn't know where I belonged. The longer I have continued in this work [the more I have felt], "Where am I?" If you're not feeling good, your self-confidence is going down . . . and on top of that you have no money and going in debt, I think that's another consideration [to make you feel like quitting.]'

The only reports of women who elected to drop out toward the end of their graduate school career concerned those who apparently had earlier despaired of remaining in their science owing to difficulties

within the department. After having negotiated continuous conflicts with either advisor or committee, the candidates finally decided to remove themselves completely from a rejecting and distasteful situation by withdrawing regardless of the consequences for their degree.

Not feeling 'cared about' is thematic throughout these interviews. There is frustration that there is no group or individual geared to meet the needs of upper classwomen. For the most part, these women have banded together but find themselves alienated from the mainstream, with little access to learning 'the rules' and gaining access to 'the club.' Advanced female students found that male peers belittled their accomplishments. Male student's attitudes typically reflect what filters down from the male faculty, a complacent, dismissive denial of women's scientific ability.

Many advanced female students were not struggling with issues regarding their dissertations or finishing their degrees. The women who had reached this point had been able to locate an advisor-advocate; those who dropped out had not. Their paramount concerns were for the future, after graduation, 'how their lives were going to go.' They wished to find someone to ask about negotiating a balance between employment and family. Lastly, it was at this juncture, when they were close to the completion of the Ph.D., that many realized that they were devoid of professional contacts and networks as they sought post-doctoral fellowships and employment, and this struck home. Those with children were now concerned about career choices and finding jobs that would allow for time with their children.

#### POST-DOCTORAL FELLOWS

A recent study of female post-doctoral fellows concluded that, with the possible exception of biology, men in positions of power (doctoral and post-doctoral advisors, tenured professors) often harmed women's scientific careers, intentionally and unintentionally (Sonnert and Holton, 1996). Invidious differences arose from male professors not taking women seriously as scientists; although present in their labs



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they might not do something as simple as passing on information about a relevant conference or as crucial as using their connections to further a promising woman's career as they would for a man. One woman even reported not being introduced by her sponsor to a laboratory visitor, a seemingly surprising but all too typical instance of discrimination also reported in other studies of research groups.

Gender constraints from the larger society further reinforced the male culture of science which tended to make women 'invisible.' A significant number of women reported that they selected a fellowship site not on professional grounds, but in order to follow a husband whose career had priority. Each of these disadvantages might individually appear to be a small matter, an oversight or a matter of personal choice. Yet, over time, advantages and disadvantages accumulate; more often for men into a 'Matthew effect', the halo of success that attracts additional rewards and renown (Merton, 1968), but for women into a 'Cinderella effect' where the reverse conditions hold.

Several Ph.D. students in our sample had graduated and moved on to their post-doctoral placements. Some who had good relations with their advisor at the graduate level reported poor experiences at the post-doctoral level. A post-doc at an Ivy League university said that she received no supervision at the start of the fellowship. Although her situation has since improved, her transition was an isolating experience. She was left alone in her work; nobody noticed her presence. Writing her first paper by herself was a difficult task in these circumstances. She believes that supervision would have helped. In retrospect, she decided that she had received considerable moral support during graduate school, especially in comparison to her post-doctoral experience. She hadn't realized at the time how good it was.

Another student working on her post-doc in New Mexico reported that the work was similar to thesis work she had completed, the only difference being that she is now more highly paid. A student pursuing her post-doc at a cancer research facility in Philadelphia described the environment as being a good hybrid, in between academia and industry, and a good transition, especially if one was interested in a

career in industry. Both of these fellows had taken the initiative in obtaining their positions, either through networking at conferences or simply writing a letter to the chair of a department. But these are not typical cases. Instead of a rich experience of ever-increasing integration into a scientific community, as women move to higher levels, many report isolating experiences.

#### OVERCOMING THE EFFECTS OF ISOLATION

Few women who attain advanced degrees acquire the density of connections that typically accrue to men as they move into the academic system. Increasing the flow of women through the pipeline by removing blockages to entry and exit from Ph.D courses of study is a necessary but insufficient policy. To attain the maximum value from investment in human capital, it is necessary to recognize that the quality of women's Ph.D. experience is as important as the numbers of degrees granted to women.

The crucial relationship for Ph.D. students is with their advisor; the second most important is with fellow students. Female graduate students report problems with both male and female advisors. Feelings of incompetence, self-blame, isolation and confusion arise from poor relationships with advisors. Without the support of an authority figure, women consistently reported feeling lost and incompetent. Early in their graduate school experience, they were often unable to gain their advisor's attention and support. Later in the degree program some reported compensating support from peers that helped them persist to the degree. Under conditions of relative isolation, attainment of a Ph.D. degree could be merely a formal achievement, lacking the penumbra of informal connections that arise from being introduced into a scientific community by a mentor.

Student participation in conferences was identified as a critical informal transition point. Conferences, in addition to providing a forum for the dissemination of scientific knowledge, are also a venue for distribution of 'social capital', the connections and access to information and resources that help build a research career. However,

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#### ISOLATION

Students acquire the density of men as they move into the women through the pipeline in Ph.D courses of study is a function of the maximum value from necessary to recognize that the important as the numbers of

Students is with their advisor, the students. Female graduate and female advisors. Feelings of confusion arise from poor support of an authority being lost and incompetent. They were often unable to. Later in the degree program from peers that helped them overcome feelings of relative isolation, they rely on a formal achievement, transitions that arise from being a mentor.

Isolation was identified as a critical factor in addition to providing a network of knowledge, are also a venue for connections and access to a research career. However,

full participation rests on much more than simply receiving funds to attend. Although access to resources is important, it is the advisor's introduction of the student to colleagues that is crucial in forming relationships that will be important to future scientific success. Women report mixed experiences in being introduced into the broader scientific community in their field by their advisor.

Conducting regular 'body counts' of Ph.D. production, by sub-discipline and department, is an important first step toward evaluating graduate education in the sciences. 'Quality of academic life' indicators should also be constructed. A female graduate student referred to transition points as 'threats', suggesting that intimidation is still the norm. The continuing perception of transitions as dangerous appeared to contradict indications that her Ph.D. program was moving away from a 'weeding-out' approach.

Even though changes have been made, the previous system, or at least its image, is still intact. Critical transitions for women in science are not yet 'rites of passage' into a welcoming community; instead, they are often fraught with peril for female scientific careers. As women ascend the educational ladder, they increasingly find support at the early stages, only to later encounter the exercise of arbitrary authority or simple inattention to women's needs.

#### WOMEN'S (AND MEN'S) GRADUATE EXPERIENCE: A SUMMARY

Getting a Ph.D. involves far more than passing qualifying examinations and producing high quality research for a dissertation. Success in graduate school is highly dependent upon being included in the informal social relations of academic departments. Even though men and women are in the same graduate programs their experience can be strikingly different. Most men quickly become included in the informal aspects of departmental life while women are often left out. No matter how brilliant and academically successful an individual has been in the past, isolation can take a toll.

The academically superior women in our study, who had typically

been at the top of their school and undergraduate classes, were shocked upon entering graduate school to find themselves marginalized and isolated. They were often excluded from study groups and left to grapple with course work and examinations on their own. Many either found themselves deterred from attaining the Ph.D. or received the formal diploma without becoming part of the social networks that are an important prerequisite for future scientific accomplishment.

All of the female students interviewed for this study had had highly successful undergraduate careers. Most reported strong mentoring relationships with a special advisor, professor, or lab director (usually male) who recognized their scientific potential and encouraged them to apply to graduate school. As one respondent put it, 'I think all of us were very successful [before coming], otherwise we would not be here today. I was very successful, cruising through my undergraduate classes.' She continued, 'The one thing that really made me decide to go to grad school was the experience of doing one-on-one research with a professor at my undergraduate institution. He gave me a lot of encouragement which gave me a lot of confidence, all of which has been drained since the first month here.' Although a disproportionate number of women are deterred from graduate training by discouraging experiences in college, the smaller number that do go on have typically had a superior experience that all too often is not repeated at the next level.

Ideally, an educational institution should provide for ongoing development, with each succeeding stage providing new opportunities to further consolidate and advance past achievements. U.S. elementary and secondary education has a mixed reputation. Universities, however, are viewed as the crowning glory and saving grace of an otherwise flawed educational system. Because of this aura of exceptionalism, graduate school is usually examined as a unique closed system: socially, legally, and dynamically different even from other elite institutions. Nevertheless, graduate school is a social-psychological milieu like any other place of work. It can therefore become either a source for self-realization or a place where

graduate classes, were shocked themselves marginalized and in study groups and left to fend on their own. Many either got the Ph.D. or received the social networks that are a significant accomplishment.

For this study had had highly reported strong mentoring professor, or lab director (usually essential and encouraged them to do it, 'I think all of us otherwise we would not be here through my undergraduate advisor really made me decide to go to one-on-one research with a advisor. He gave me a lot of confidence, all of which has been lost. Although a disproportionate amount of training by discouraging research that do go on have typically been lost and is not repeated at the next

should provide for ongoing providing new opportunities for past achievements. U.S. has a mixed reputation. The crowning glory and saving system. Because of this aura is usually examined as a unique and socially different even from graduate school is a socialization of work. It can therefore be a place where

interpersonal interactions are blocked (Berger, 1967). In this chapter our focus has been on the experiences of women in graduate programs in the sciences and engineering and the effects of both formal and informal structures on their training. The different graduate educational experiences of females and males make it almost seem as if there are two Ph.D. programs in the same department: one track for men, the other for women.

The female 'track' has long been less well populated. In recent years an increasing number of women have pursued higher degrees in the sciences, bringing the tension between women's lives and the taken for granted 'male' structure of the Ph.D. program to light. In an earlier era when women in science were very few in number, unconscious negative effects of a training system that did not take women's interests into account were all but invisible.

The fact of a growing population of women at the higher levels of scientific education does not tell the whole story of what is within those advancing numbers. In the next chapter we address the anomaly of dispersion and isolation within this numerical increase: the paradox of 'critical mass' for women in science.