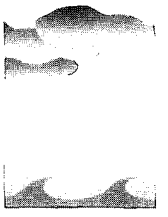
Salaries and Advancement of Women Faculty in Atmospheric Science: Some Reasons for Concern



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The original version of this paper was prepared as a discussion document for the 1994 AMS/UCAR Meeting of Heads and Chairs of Atmospheric Science Departments. Although the paper is addressed specifically to departmental heads and chairs, the AMS Board on Meteorological and Oceanographic Education in Universities felt that the information presented, and the issues and concerns raised, are of interest to the wider meteorological community.

ABSTRACT

Zevin and Seitter's analyses of the 1993 American Meteorological Society membership survey indicated that university/college employees had the largest difference in salary by gender when controlling for experience and age. Further analyses of the membership survey presented here indicate that a large salary discrepancy exists for female full professors in atmospheric science. In addition, the small number of women at the associate professor rank suggests a "leaky pipeline" for female atmospheric science faculty. A comparison of tenure-stream faculty to Ph.D.-level atmospheric scientists outside of academia suggests that female Ph.D.'s have fared better in nonuniversity positions in terms of senior-level salaries and advancement from entry- to midlevel positions. Possible explanations for the salary differential at the full professor level and for the small number of female associate professors in atmospheric science are explored, although no conclusive explanation can be given at this time. Possible actions to remediate the salary differential and poor advancement of faculty are proposed. These remediative actions are directed to heads and chairs of atmospheric science departments who are often in a position to initiate change within their departments and universities.

1. Introduction

The recent analysis by S. Zevin (National Weather Service) and K. Seitter [American Meteorological Society (AMS)] of the 1993 AMS "Survey of Society Membership and Issues in the Workplace" indicated that for atmospheric scientists the largest discrepancy in salary by gender is found for the "university/college" employment category (Zevin and Seitter 1994). This finding was discussed at the 1994 annual meeting of the AMS Board on Meteorological and Oceanographic Education in Universities (BMOEU). The BMOEU felt that the large magnitude of the salary discrepancy identified by Zevin and Seitter warranted discussion at the upcoming AMS/University Corporation for Atmospheric Research (UCAR)-sponsored Meeting of the Heads and Chairs of Atmospheric Science Departments. A subcommittee, composed of two BMOEU members and a member from the UCAR University Relations Committee, was subsequently formed to prepare a discussion document regarding this issue.

In their comparison of salary by gender, Zevin and Seitter controlled for the respondents' years of work experience and ages. However, other factors, such as type of position (i.e., tenure stream vs nontenure stream), full- or part-time employment, terminal degree, and rank influence the salaries of university/col-

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lege employees. As its first step, the subcommittee further analyzed the survey responses to help clarify the nature and degree of the salary discrepancy. Similar analyses were also performed on the responses from Ph.D.-level scientists in nonacademic jobs in order to evaluate the relative "well-being" of women atmospheric scientists in academic compared to nonacademic positions. These analyses are presented in section 2 of this paper.

Generally, the additional analyses indicate that a large salary discrepancy is indeed evident between male and female senior faculty but that no discrepancy exists for senior nonacademic Ph.D.-level atmospheric scientists. Furthermore, the representation of women at the associate professor rank is proportionally smaller than that for other ranks and for midcareer nonacademic atmospheric scientists. In sections 3 and 4 of this paper possible explanations for these two findings are explored. For these sections we have drawn heavily on previous literature concerning women's participation in science. Whenever possible, we have used responses from the AMS survey to evaluate a proposed explanation. Possible remediations are described in section 5.

Why direct this discussion paper to the heads and chairs of atmospheric science departments? As pointed out by Bielby (1991), science is done in organizations. The careers of scientists are influenced by the rules and procedures of these organizations and the means by which these rules and procedures are applied or enforced. For university settings, many of these rules and procedures, particularly those related to personnel matters, are formulated and applied at the departmental level (Bielby 1991; Szafran 1983). Many of the decisions and allocations of resources and rewards within departments involve considerable administrative discretion by chairpersons (Fox 1991). Very simply, heads and chairs are in a position to initiate change and to make a difference, even if that change or difference is modest.

2. Characteristics of Ph.D.-level atmospheric scientists

The AMS survey was distributed with the 1993 membership renewal forms in late 1992 and included questions regarding members' age, marital status, race, citizenship, location, disabilities, number of dependents, education, employment, position level, experience, workload, and income. Approximately 55% of the membership, or 5282 people, returned their questionnaires.

Our first step was to narrow the additional analyses to only Ph.D.-level atmospheric scientists in order to control for the of type of terminal degree. Also, we included only full-time employees in our analysis. The university/college employees category on the survey form encompassed a variety of job types including tenure-track professors, nontenure-track professors, research scientists, programmers, and others. Differences in salary can be expected for these employment types. To control for this, only tenure-stream faculty were considered as being academic employees for this analysis.

The two groups (tenure-stream faculty and Ph.D.-level nonuniversity employees) were then stratified by position level in an attempt to ensure that individuals with similar rank and experience were being compared. The three subgroups were 1) entry level (e.g., assistant professor, instructor, scientist I, intern), 2) midlevel (e.g., associate professor, scientist II, journeyman), and 3) senior level (e.g., full professor, scientist III, meteorologist in charge, science operations officer, lead forecaster). Each of the three subgroups was then sorted by gender. The executive/administrator category from the survey was not included in our analysis due to the small number of individuals, particularly women, in this category.

Differences in the mean characteristics of male and female Ph.D. atmospheric scientists were evaluated using the parametric t test. Whenever an F test indicated that the assumption of equal variance for the two groups being compared was violated, the approximate t statistic was used in place of the usual t statistic. Differences in the mean that are significant at the alpha = 0.10 (alternatively, 90% confidence interval), alpha = 0.05 (95% confidence interval), and alpha = 0.01 (99% confidence interval) levels are noted in the following tables. The alpha level is simply the probability of rejecting the null hypothesis (e.g., no difference between two groups) when it is true. Because of the small number of women respondents, median values also are provided in the tables.

Before discussing our analyses, we would like to remind readers of the difficulties in interpreting survey responses. Although the survey return rate was high, the response rates for particular groups likely vary. Also, not all practicing atmospheric scientists are members of the AMS. The number of women with Ph.D.'s in atmospheric science is small and constituted just 105 out of the 5282 respondents (male and

female) to the survey. Thus, individual responses have a large influence on the statistics for women. Readers should carefully note the sample size, included in all the tables, when interpreting the statistics presented here. Another consideration is that not all respondents interpreted the questions similarly. The questions concerning secondary employer/position and number of years employed in current position, in particular, seemed to have been interpreted differently, given the wide range of responses for these two questions. Finally, the question concerning salary was worded "total annual income from activities in the atmospheric and related oceanic and hydrologic sciences (including consulting, bonuses, summer employment, etc.)." We found incidents of extremely small salaries for individuals who indicated that they were employed full-time. We assume that the majority of their salary must come from activities that do not involve atmospheric science. Approximately an equal percentage of men and women reported what seemed to be unrealistically small salaries for full-time employees; thus, we opted to include these values in our statistics.

Ph.D. scientists made up approximately 29% (1527 people) of the survey respondents. Most of the Ph.D.-level scientists responding to the survey indicated that their major field was either atmospheric science/meteorology or climatology. The percentages in these two categories were similar for male and female respondents (57% and 55%, respectively). Of the Ph.D. scientists employed full-time, approximately 58% were employed in nonuniversity positions, primarily in the federal government and government sponsored laboratories [including National Center for Atmospheric Research (NCAR)/UCAR]; 27% were tenure-stream faculty; and the remaining 15% were nontenure-track university employees (including instructors, postdocs, programmers, and others). The percentages, again, were similar for both men and women. Women represented 7% of the Ph.D. respondents, compared to 9% of all respondents. Female representation was similar for both tenure-track faculty and nonuniversity employees, although female representation varied substantially with position level (Table 1). As expected, given the historically low number of women in atmospheric science, female representation was highest at the entry level (12% for faculty and 14% for nonuniversity Ph.D. employees), small at the senior level (7% and 4% for faculty and nonuniversity employees, respectively), and practically nonexistent at the executive/administrator level. A surprising finding, however, was the small proportion of women (5%) at the associate professor level, particularly in comparison to the proportion of women midlevel nonuniversity employees (10%).

When the characteristics of male and female Ph.D. scientists were compared for 1) all Ph.D.'s, 2) tenure-track faculty, and 3) nonuniversity employees, women in all three groupings were significantly younger than men, had received their Ph.D. degrees more recently, had been employed in atmospheric science for a shorter period of time, and had spent less time in their current positions (Table 2). Also, they were less likely to have dependents, and their average annual salary was less. The majority of women atmospheric scientists were married, although proportionately, a larger segment

TABLE 1. Number of Ph.D. respondents employed full-time by category.

	Men		Women	
	Number	Percent	Number	Percent
All Ph.D.'s	1422	93	105	7
Tenure-track faculty	383	93	28	7
Nonuniversity employees	828	93	58	7
Assistant professors	60	88	8	12
Entry-level nonuniversity	85	86	14	14
Associate professors	102	95	5	5
Midlevel nonuniversity	184	90	21	10
Full professors[a]	179	93	14	7[b]
Senior-level nonuniversity[a]	398	96	17	4
University administrators	38	97	1	3
Nonuniversity administrators	132	97	4	3

[a] Does not include administrators.

[b] Percentage for women is inflated, as administrators, who usually also are full professors and are almost exclusively male, were not included in the full professor category.

TABLE 2. Mean (median) values of the characteristics of all Ph.D.'s, tenure-track faculty, and nonuniversity Ph.D.-level employees and number of respondents.

	All Ph.D.'s		Tenure-track		Nonuniversity	
	Men	Women	Men	Women	Men	Women
No. of respondents	1422	105	383	28	829	58
Age	46.1 (46.0)	41.0[a] (39.0)	47.1 (47.0)	43.7[c] (40.0)	46.4 (46.0)	41.8[a] (40.0)
Year awarded Ph.D.	1977 (1977)	1982[a] (1984)	1975 (1975)	1980[b] (1981)	1977 (1977)	1981[a] (1984)
Years employed	18.3 (18.0)	12.7[a] (11.0)	19.2 (20.0)	14.6[b] (11.0)	18.8 (19.0)	13.6[a] (12.0)
Years current position	8.8 (6.0)	5.5[a] (3.0)	11.6 (9.0)	8.5[c] (7.0)	8.0 (5.0)	4.8[a] (3.0)
Years current employer	11.4 (9.0)	7.6[a] (5.0)	13.5 (12.0)	9.5[b] (7.5)	11.1 (9.0)	8.1[b] (6.0)
Hours worked/week	47.7 (48.0)	47.3 (45.0)	51.0 (50.0)	50.7 (47.5)	46.5 (45.0)	45.5 (45.0)
Classroom hours/week	– –	– –	6.6 (6.0)	6.2 (5.0)	– –	– –
Income[d]	$65,073 ($65,000)	$54,048[a] ($55,000)	$65,108 ($65,000)	$55,000[b] ($55,000)	$68,317 ($65,000)	$58,929[a] ($55,000)
Number of dependents[e]	1.1 (1.0)	0.6[a] (0.0)	1.2 (1.0)	0.5[a] (0.0)	1.1 (1.1)	0.7[b] (0.0)
Percent married	84	66	87	64	84	67
Percent with dependents	58	38	60	30	58	40

[a] Male–female differences significant at alpha = 0.01.
[b] Male–female differences significant at alpha = 0.05.
[c] Male–female differences significant at alpha = 0.10.
[d] Respondents selected the category within which their total annual income fell. Category values were converted to dollar amounts using the midpoint of each category (i.e., $5000, $15,000, $25,000, etc.) except for the ≥ $100,000 category where a value of $125,000 was used.
[e] The number of dependents was defined as the number of dependents under the age of 30.

of the women respondents were single than were the male respondents. Men and women faculty in tenure-stream positions had comparable teaching loads.

Stratification by position level reveals a more complex picture. There were no significant differences in the characteristics of male and female nonuniversity employees at the entry level (Table 3). On the other hand, weakly significant (alpha = 0.10) differences were observed for two parameters among assistant professors. Women assistant professors had fewer dependents and had been employed for a shorter period than male faculty at this rank.

As was the case for entry-level employees, no significant differences in the surveyed parameters existed for midlevel nonuniversity employees (Table 4). Female midlevel faculty (i.e., associate professors) appear to be younger than their male counterparts and to have been employed for a shorter period. The means

of the other parameters, including salary and the number of dependents, did not differ significantly. However, all statistics presented in Table 4 for associate professors should be interpreted cautiously, if at all, as only five women at this rank responded to the survey. The large difference in the mean and median salaries of women associate professors illustrates the impact of individual responses on average values when sample size is small.

The most dramatic gender difference was evident at the senior level for academic employees. Female full professors differ from their male colleagues in terms of income, where the shortfall for women was substantial ($18,000, significant at alpha = 0.01), and in the smaller number of young dependents (Table 5). Also, female full professors were somewhat less likely to be married compared to male respondents at this rank. A difference in income by gender was not evident for senior-level nonuniversity employees, in spite of the younger age and shorter employment history of senior-level women. Senior-level women in nonuniversity jobs, like women full professors, had fewer dependents than senior-level men and were less likely to be married.

In summary, these additional analyses, controlling for terminal degree, type of position, and rank, support Zevin and Seitter's initial finding that a substantial salary differential exists between senior male and female faculty in atmospheric science. The salary differential for full professors must, of course, be treated cautiously given the small number of women academicians. However, similar salary discrepancies have been identified for women scientists in general (Ahren and Scott 1981; Benditt 1992; Holden 1991, 1993), providing support for our finding. Furthermore, the salary differential in the atmospheric sciences appears to be larger than that for other disciplines. For example, a recent analysis of the 1992 American Institute of Physics member survey revealed that for mean salaries at the full professor level the male–female salary differential was $7000 (Curtin and Chu 1993) compared to the $18,000 differential identified here for atmospheric science. A surprising result was that, within rank, salaries are comparable for male and female nonuniversity Ph.D.-level atmospheric scientists. Large discrepancies have been found in the nonacademic employment sectors for other disciplines such as chemistry (Amato 1992) and physics (Curtin and Chu 1993). This inconsistency between disciplines may result in part from a smaller private or industrial employment sector in atmospheric science compared to other disciplines. The federal government or government-sponsored laboratories, where most nonuniversity Ph.D.-level atmospheric scientists responding to the survey were employed, may have more formalized merit salary evaluation procedures than private industry and universities.

TABLE 3. Mean (median) values of characteristics of assistant professors and entry-level nonuniversity employees and number of respondents.

	Assistant professor		Entry-level nonuniversity	
	Men	Women	Men	Women
Number of respondents	60	8	85	14
Age	35.3 (34.0)	33.4 (32.0)	35.0 (34.0)	34.6 (34.5)
Year awarded Ph.D.	1987 (1988)	1988 (1990)	1988 (1990)	1989 (1990)
Years employed	7.5 (7.0)	5.9 (6.0)	6.3 (5.0)	6.4 (5.0)
Years current position	3.3 (3.0)	1.9[a] (1.5)	3.0 (2.0)	2.3 (2.0)
Years current employer	3.3 (3.0)	1.9[a] (1.5)	3.2 (2.0)	2.5 (2.0)
Hours worked/week	52.6 (50.0)	48.3 (45.0)	45.1 (43.5)	46.9 (48.0)
Classroom hours/week	6.3 (6.0)	6.6 (7.0)	– –	– –
Income	$43,333 ($45,000)	$41,250 ($40,000)	$42,229 ($45,000)	$40,384 ($35,000)
Number of dependents	1.1 (1.0)	0.2[a] (0.0)	1.0 (1.0)	0.6 (0.0)
Percent married	72	62	75	71
Percent with dependents	57	12	59	43

[a] Male–female differences significant at alpha = 0.10.

The analyses of the AMS survey presented here also suggest the possibility of a "leaky pipeline" for women faculty. The small number of women associate professors coupled with the shorter period of employment for female compared to male assistant and associate professors suggests that women faculty are not progressing as smoothly as male faculty from one level to the next, and that relatively more women than men may be dropping out at each level. The evidence for a leaky pipeline is not as compelling as that for the salary discrepancy but is in accordance with findings for women scientists in other disciplines (Alper 1993; Barber 1995; Barinaga 1992; Brush 1991; Etzkowitz et al. 1994; Gibbons 1992b; Sposito 1992) and warrants further examination.

3. Possible explanations for the salary difference by gender

Let us consider some possible explanations for the discrepancy in salary between male and female full professors in atmospheric science. As mentioned previously, we have drawn heavily on previous literature for possible explanations. Whenever possible, information from the AMS survey or other sources is used to evaluate the appropriateness for atmospheric science of a proposed explanation. Once again, note that the survey question asked only for total annual income from atmospheric and related science and, therefore, did not differentiate among annual salary, academic year salary, and other sources of income.

TABLE 4. Mean (median) values of characteristics of associate professors and midlevel nonuniversity employees and number of respondents.

	Associate professor		Entry-level nonuniversity	
	Men	Women	Men	Women
Number of respondents	102	5	184	21
Age	43.4 (43.0)	38.8[a] (39.0)	42.1 (41.0)	43.0 (42.0)
Year awarded Ph.D.	1979 (1980)	1983 (1983)	1981 (1982)	1981 (1982)
Years employed	15.7 (14.0)	7.6[a] (8.0)	13.9 (13.0)	13.0 (12.0)
Years current position	8.1 (7.0)	5.6 (6.0)	8.0 (6.0)	6.1 (5.0)
Years current employer	10.2 (8.5)	5.6 (6.0)	8.9 (7.0)	7.6 (6.0)
Hours worked/week	49.6 (50.0)	54.0 (60.0)	44.6 (40.0)	43.7 (40.0)
Classroom hours/week	7.2 (6.0)	8.2 (5.0)	– –	– –
Income	$52,500 ($55,000)	$67,000 ($45,000)	$53,791 ($55,000)	$51,190 ($45,000)
Number of dependents	1.4 (2.0)	1.2 (1.0)	1.1 (1.0)	0.9 (0.0)
Percent married	85	60	79	67
Percent with dependents	68	80	58	48

[a] Male–female differences significant at alpha = 0.01.

a. Entry salary

Lower salaries for senior women professors may reflect their entry into academia at a time of gender discrimination, that is, women were hired at lower salaries compared to their male counterparts for similar positions. A related explanation is that women atmospheric scientists initially entered academia at a lower rank than male counterparts, such as in a nontenure-stream position. Thus, they may have a history of lower salaries prior to their promotion to senior positions. Considerable evidence from academia in general supports the latter explanation. Several authors have noted that women academicians historically started out in lower, often nontenure-stream, positions than men and took longer to get tenured and promoted (Zuckerman 1991).

b. Differences in jobs performed

Differences in the jobs performed by male and female faculty may be voluntary, especially when higher-paying positions tend to involve larger workloads, or may be dictated by fewer offers of higher-paying options.

1) Administrative positions. Men are more likely to hold administrative positions such as department chair or dean (Brush 1991). In fact, only one woman faculty respondent to the

AMS survey indicated she held an administrative position. As administrative positions usually are annual rather than academic-year appointments, higher salaries would be expected for administrators even if their monthly base salaries are similar to those of faculty without administrative appointments. The relatively greater number of men than women in administrative positions does not explain the salary discrepancy identified by Zevin and Seitter. We have shown that a very large salary differential exists between male and female full professors without administrative positions (Table 5). However, this analysis did not control for faculty whose current salaries may reflect increases from previously held administrative positions.

2) Secondary positions. The survey requested the total annual income for atmospheric science rather than the salary of primary position. A male–female difference in that portion of the income due to additional sources such as consulting would show up as an income differential even if primary position salaries are identical. To evaluate the importance of this explanation, all full professors (without administrative positions) who indicated a secondary employer or secondary position were removed and the average salary was recalculated. A large, statistically significant salary differential ($73,473 for males vs $58,076 for females) still exists.

c. Mobility

One way to increase salary is to change jobs, especially if more than one institution can be enticed into a bidding game. Past studies have suggested that marriage, with its consequent family responsibilities along with the constraints of reconciling two careers, limits the mobility of married women (Cole 1979; Marwell et al. 1979). The responses to the AMS survey both support and discredit the influence of mobility to explain the salary differential. In support, over 60% of the female faculty respondents are married and thus may be required to consider two careers in any change in employment. On the other hand, the salaries of married women faculty do not differ significantly from those of single women who should be fairly mobile (Table 6).

d. Nontenure-stream positions

Overrepresentation of women in nontenure-track positions has been cited as a possible reason for the generally lower salaries of academic women in science (Benditt 1992; Cole and Fiorentine 1991; Yenstch and Sindermann 1992; Zuckerman 1991).

TABLE 5. Mean (median) values of characteristics of full professors and senior-level nonuniversity employees and number of respondents (does not include administrative or executive-level personnel).

	Full professor		Senior-level nonuniversity	
	Men	Women	Men	Women
Number of respondents	179	14	398	17
Age	52.2 (51.0)	51.7 (54.0)	48.7 (48.0)	44.6[b] (44.5)
Year awarded Ph.D.	1970 (1971)	1972 (1973)	1975 (1974)	1977 (1978)
Years employed	24.2 (23.0)	22.5 (23.0)	21.1 (20.0)	17.6[c] (15.0)
Years current position	16.8 (18.0)	14.5 (15.0)	9.0 (7.0)	5.3[a] (3.0)
Years current employer	18.4 (19.0)	17.3 (17.5)	12.5 (12.0)	11.5 (10.0)
Hour worked/week	50.2 (50.0)	50.8 (45.0)	45.6 (45.0)	46.8 (42.0)
Classroom hours/week	6.5 (6.0)	5.5 (5.0)	– –	– –
Income	$75,176 ($75,000)	$57,142[a] ($55,000)	$72,335 ($75,000)	$72,058 ($65,000)
Number of dependents	1.1 (1.0)	0.5[b] (0.0)	1.1 (1.0)	0.8[c] (0.0)
Percent married	92	69	84	69
Percent with dependents	59	23	84	44

[a] Male–female differences significant at alpha = 0.01.
[b] Male–female differences significant at alpha = 0.05.
[c] Male–female differences significant at alpha = 0.10.

TABLE 6. Mean and median salary ($) and number of respondents by marital status.

		Men		Women	
		Single	Married	Single	Married
All Ph.D.'s	mean	55 416	66 869[a]	49 167	56 594[b]
	median	55 000	65 000	45 000	55 000
	number	216	1161	36	69
Tenure-track faculty	mean	51 383	67 105[a]	50 000	57 778
	median	55 000	65 000	50 000	55 000
	number	47	323	10	18
Nonuniversity employees	mean	58 740	70 194[a]	52 222	62 105
	median	55 000	65 000	50 000	65 000
	number	131	668	18	38
Assistant professors	mean	43 824	43 140	45 000	39 000
	median	45 000	45 000	45 000	35 000
	number	17	43	3	5
Entry-level nonuniversity	mean	39 286	43 226	42 500	39 444
	median	35 000	45 000	40 000	35 000
	number	21	62	4	9
Associate professors	mean	48 333	53 235	45 000	81 666
	median	45 000	55 000	45 000	75 000
	number	15	87	2	3
Midlevel nonuniversity	mean	50 897	54 580	43 571	55 000[b]
	median	55 000	55 000	45 000	60 000
	number	39	143	7	14
Full professors	mean	58 333	76 455[a]	55 000	58 333
	median	55 000	75 000	55 000	55 000
	number	12	158	5	9
Senior-level nonuniversity	mean	67 741	73 193[b]	63 000	75 833
	median	65 000	75 000	55 000	70 000
	number	62	332	5	12

[a] Single–married differences significant at alpha = 0.01.
[b] Single–married differences significant at alpha = 0.10.

Women are thought to more often accept lower-paying, less secure, nontenure-track positions compared to men due to family and mobility constraints. Our analysis, limited to only tenure-stream faculty, indicates that a substantial salary differential exists even when nontenure-stream faculty are not considered. In fact, this issue appears to be a relatively unimportant consideration in atmospheric science. Only 5% of the Ph.D.-level women responding to the survey and 4% of the Ph.D.-level men marked "nontenure-track professor" as their primary position.

e. Type of institution

Women faculty in the United States historically have been segregated by institution, with more women faculty in two- and four-year colleges than in research universities (Bielby 1991; Turner 1989). This segregation appears to be disappearing, as the greatest increases since the 1970s in the proportion of women faculty have occurred in major research institutions (Zuckerman 1991). The salary differential by gender for atmospheric science may reflect an earlier tendency for women faculty to be hired at smaller, teaching-oriented schools, which typically pay less than larger, research-oriented programs (Hamermesh 1993). A quick review of both the 1992 and 1994 *Curricula in the Atmospheric, Oceanic, Hydrologic, and Related Sciences* suggests that this is not a likely explanation. For both years, only 3 women faculty were in departments with fewer than 10 members. The average size of the faculty for departments having women faculty is 17. It appears that the larger departments are more successful in recruiting women faculty, perhaps because they have more on-campus political power to obtain an extra position or because they have sufficient internal flexibility to accommodate dual career couples. (Only departments listed as "Atmospheric Science" or "Meteorology" were included in this count. Women were identified from recognizably feminine names in the list of faculty for each department, thus the number of women may be underestimated due to the difficulty in interpreting foreign names. Women whose positions were identified in the curricula guide as visiting professor, research professor, or emeritus were not included.)

f. Publication rate

If performance is the basis for reward in academia, then the lower salaries for women full professors in atmospheric science, specifically, and in science in general, may simply reflect lower productivity by women compared to men on activities evaluated for merit. Authoring or coauthoring scientific papers is a

highly regarded, if not the primary, activity for merit salary evaluation, particularly at research universities. Many studies have found that women scientists do not publish as many articles annually as men, and that with increasing age and rank, the difference in publication rate increases. (See Cole and Zuckerman 1984, 1987 and Zuckerman 1991 for reviews of these studies.) The reasons for the difference in publication rate are not understood, although one sociologist has argued that gender inequalities in science cannot be understood until productivity differences are understood (Fox 1991). We do not have information on the publication rates of male and female atmospheric scientists, but given the findings from other scientific disciplines, further investigation of this issue is clearly warranted. Explanations that have been suggested for gender-specific differences in publication rate include the following:

1) *Children.* Women simply may not have the time to publish as frequently during their child-raising years, or they may consciously decide after tenure to "throttle back" on their careers to accommodate a family (Barinaga 1992). Any impact of child raising on a woman's productivity and subsequent salary raise, even for a brief period, can multiply with time given that most faculty raises are calculated as percentages of current salary. However, Cole and Zuckerman (1987) have found that the rate of publication of women scientists is unrelated to the number of children they have. The AMS survey results are in line with the findings of Cole and Zuckerman. Women faculty with children earn salaries comparable, if not larger, to those of women without children (Table 7). Note also that the average number of hours worked per week for women with children is similar to the hours worked for both male faculty and female faculty without children (Table 8). Women with children are reducing the amount of their discretionary time rather than their work time. In sum, the impact of child rearing, while possibly creating stress and time pressures for women faculty, does not appear to account for the salary differential for full professors.
2) *Review process.* Women may fare more poorly in the manuscript review process due to greater isolation or a smaller circle of colleagues with whom they circulate manuscripts before submission, consequently reducing the probability of acceptance. We do not have any information to evaluate this explanation specifically for atmospheric science, although earlier studies for science in general have found little association between gender and acceptance and rejection of manuscripts by journal reviewers and editors (Cole and Singer 1991). Also, Yentsch and Sindermann (1992) note that female journal editors and associate editors report little manifestation of exclusionary practices by editors.
3) *Differences in research style.* Fox (1991) argues that access to collaborators is critical for scientists because solo authors have smaller publication

TABLE 7. Mean and median salary ($) and number of respondents for women Ph.D.'s with/without young dependents.

		No dependents	Dependents
All women Ph.D.'s	mean	53 125	55 488
	median	50 000	55 000
	number	64	41
Tenure-track faculty	mean	51 000	65 000
	median	50 000	55 000
	number	8	20
Nonuniversity employees	mean	60 625	56 666
	median	55 000	55 000
	number	32	24
Assistant professors	mean	39 286	—[a]
	median	35 000	—[a]
	number	7	1
Entry-level nonuniversity	mean	37 857	43 333
	median	35 000	45 000
	number	7	6
Associate professors	mean	—[a]	72 750
	median	—[a]	60 000
	number	1	4
Midlevel nonuniversity	mean	52 273	50 000
	median	55 000	45 000
	number	11	10
Full professors[b]	mean	56 818	58 333
	median	55 000	55 000
	number	11	3
Senior-level nonuniversity[b]	mean	69 444	75 000
	median	65 000	65 000
	number	9	8

[a] Salary not given as only one respondent fell into this category.
[b] Administrators or executive-level personnel not included.

rates, isolated research can be difficult to fund and sustain, and collaborative work seems to fare better in the publication process and is more likely to be cited. Several previous studies have suggested that women tend to collaborate less than male scientists and therefore have more single-authored papers and fewer total publications (Ward and Grant 1992). Other authors suggest that women are as likely as men to publish jointly authored papers (Cole and Zuckerman 1984), but that men have a significantly larger number of different collaborators (Fox 1991). Any differences in the collaboration rate of women faculty in atmospheric science would likely be reflected in their publication rate and salary.

4) *Access to graduate students.* If a faculty member has few or no graduate students, less research is accomplished. Any differences in the ability of women faculty to attract and retain graduate students will impact their productivity and consequently their salary. Two factors may contribute to a smaller number of graduate students for female faculty. First, male graduate students, who make up the majority of atmospheric science graduate students, may be reluctant to work with or feel uncomfortable working with female faculty (Yentsch and Sindermann 1992). Second, greater isolation of women faculty may reduce the probability of a women faculty member being recommended as a possible advisor to a student contemplating attending graduate school.
5) *Access to informal support and communication.* Women may not be receiving the encouragement, support, and mentoring they need in order to publish at the same rate as male faculty. As evidence of this, Cole and Zuckerman (1987) have shown that women scientists married to another scientist, but not necessarily in the same discipline, publish on average 40% more than women married to men in other occupations. It is likely that these women are receiving valuable encouragement and mentoring from their spouses.
6) *"Burnout."* Yentsch and Sindermann (1992) claim that women scientists are susceptible to burnout at a younger age than male colleagues, possibly as the result of balancing both professional responsibilities and family early in their careers. As a result, mid- and late-career productivity of women faculty may suffer.

TABLE 8. Average number of hours worked per week by women with/without young dependents. (Number of respondents in parentheses.)

	No dependents		Dependents	
All Ph.D.'s	47.7	(61)	46.7	(41)
Tenure-track faculty	50.5	(18)	51.2	(8)
Nonuniversity employees	47.1	(31)	43.5[a]	(24)
Assistant professors	48.3	(6)	—[b]	(1)
Entry-level nonuniversity	47.2	(8)	46.3	(6)
Associate professors	—[b]	(1)	52.5	(4)
Midlevel nonuniversity	43.3	(9)	44.1	(10)
Full professors	50.9	(10)	50.7	(3)
Senior-level nonuniversity	50.6	(9)	40.5[a]	(8)

[a] Difference significant at alpha = 0.05.
[b] Not given as only one respondent fell into this category.

g. Obtaining extramural support

Success at obtaining grants not only contributes to a faculty member's annual merit rating but also is a means for providing summer salary. Additionally, when faculty members are not successful at obtaining grants, their research programs proceed at a slower rate, consequently affecting their publication rate, as they do not have the funds to support graduate research assistants and other personnel. Some types of research may not be possible without extramural funds to purchase equipment or support field experiments. To obtain a crude picture of how successful women atmospheric scientists have been in obtaining grants, departmental listings of research grants in the *1992 Curriculum in the Atmospheric, Oceanic and Hydrologic, and Related Sciences* were examined. All departments, except oceanography and marine science programs, were included in this analysis. Oceanography/marine science departments were excluded because, although they comprise close to 50% of the listings in the curriculum guide, only 10% of the Ph.D. respondents to the AMS survey were oceanographers. Eighteen women indicated that they had grants in effect at the time their departments' contributions to the curriculum guide were prepared. These women had an average of 2.9 grants each, for a total of 52 grants held by women. Not all departments listed grant amounts. Of those departments that did, women principal investigators had been awarded $5,053,366 in grants; the average grant

amount per women awardee was $153,132. The numbers suggest that the total number and amount of grants held by women is respectable. However, these figures are highly skewed by two extremely successful women faculty who were responsible for 67% of the listed amount of grant funds obtained by women (over $3,000,000). When their grant activity is removed from consideration, women atmospheric scientists appear to have competed rather poorly for extramural funding.

Previous studies of the funding history of women scientists suggest that a poor extramural funding record for women scientists is more likely the result of a lower grant application rate than a higher rejection rate for women compared to men (Cole and Singer 1991; Fox 1991; Zuckerman 1987). The smaller application rate may be the result of less time to prepare grant proposals because of family responsibilities, fewer opportunities to be involved as a coprincipal investigator in large group projects, and fewer opportunities for mentoring in the preparation of proposals.

h. Teaching evaluations

Another important factor in merit raises for faculty is teaching evaluations. Although some researchers have noted that the typical rating of female instructors does not differ significantly from that of male instructors (Seldin 1993), others have shown that female professors frequently receive lower ratings from their male students and higher ratings from their female students (Basow 1994; Bennett 1982). Males majoring in business, mathematical, and technical fields tend to rate female faculty most negatively (Basow and Silberg 1987; Koblitz 1992). Consequently, women who teach in traditionally male fields, such as atmospheric science, and whose classes are composed of a disproportionately large number of male students may receive weaker teaching evaluations.

i. Committee responsibilities

Women may have more committee assignments stemming from the desire to have a woman on every committee (Yentsch and Sinderman 1992). This takes time away from research and teaching activities. Also, women may perform more academic advising, since women students, as well as some men, are thought to be more likely to bring their problems to women faculty (Fehrs and Czujko 1992).

j. Discrimination

Outright discrimination in setting salaries and giving raises is, of course, a possible explanation for the salary discrepancy at the full professor level. Bielby (1991) reports that stereotypes and prejudices are more subtle and less visible today, although they continue to influence the behavior of both men and women scientists. More subtle types of discrimination could include women not getting their share of departmental or university resources.

k. Cultural constraints or socialization

Numerous studies have addressed the impact of cultural factors and socialization on women's participation in science. For example, according to Cole and Fiorentine (1991), men place greater emphasis than women on occupational success and high income. Consequently, they are more likely to engage in behaviors contributing directly to higher income and success, such as publication, obtaining extramural funding, and seeking employment offers from other universities. Alternatively, male scientists may simply be more adept at "marketing" their achievements to university administrators and to their colleagues. On the other hand, Epstein (1991) suggests that women hold stereotypical views about themselves, particularly in regard to their scientific and mathematical abilities, that reduce their self-confidence and influence their performance and productivity. Zuckerman (1991) speculates that women's motivation and career commitment may be reduced by their experiences with gender discrimination, particularly such experiences early in their career. Differences in traits such as confidence and comfort in an environment in which they are a minority, according to Cole and Singer (1991), may produce gender differences in aspirations, motivation, and tolerance to negative events. Finally, several authors have suggested that the status of women scientists, particularly in regard to productivity, is the result of accumulated disadvantage, rather than the effect of a single or small number of factors or experiences (Clark and Corcoran 1986; Cole and Singer 1991; Yentsch and Sindermann 1992).

l. "The other side of the coin"

Instead of approaching this issue of academic salary differential in terms of identifying possible factors negatively impacting the salary of women faculty, one could also look at the problem in terms of why married men do so well. An interesting finding (Table 7) is that the average salary of single male full professors in atmospheric science is comparable to that of single and married women full professors and

significantly less (at the alpha = 0.01 level) than that of married male full professors. Note that the salary differential between single and married men in nonuniversity senior-level positions is only weakly significant (alpha = 0.10). If salary is an indication of faculty productivity, then single men, single women, and married women all have comparable productivity rates, whereas married men are considerably more productive. On the other hand, if these salary differences reflect discrimination, or some combination of discrimination and differences in productivity, then single male faculty are also being discriminated against. These results raise a number of questions. Are the demands of an academic career so great that support from a spouse is needed? Have senior men performed well because two people are devoted to one career? Can one person working alone, either unmarried or married with a professional spouse, stay at the top of his/her field in an academic position? Are the benefits gained by married women from having a spouse partially negated by the demands of children or the lack of mobility? Is a married man supporting a family considered more deserving of higher raises than a single person or a married women with a professional husband? Or do married male faculty feel more comfortable with other married men? Do they frequently interact with each other, providing opportunities for collaboration and mentoring? Are the less numerous women and single male faculty for the most part excluded from these collaborative and mentoring opportunities?

4. Possible explanations for the small number of women associate professors

The participation of women in atmospheric science is small. However, the analysis of the survey results indicated a surprisingly small proportion of women at the associate professor level, particularly when compared to the number of midlevel women nonacademic scientists. Possible reasons for the paucity of women associate professors are explored below.

a. Fewer women promoted from assistant to associate professor

In science in general, proportionally fewer women are tenured compared to male faculty (Cole 1979, 1981; Rausch et al. 1989; Sposito 1992). No data are available to evaluate this explanation for atmospheric science, but given the previous findings for other disciplines it should not be discounted. The lower rate at which women faculty receive tenure has been attributed to a number of factors, many of which were discussed above, including the impact of family responsibilities, lower productivity, and/or poor mentoring.

b. Fewer women available

If few women entered the tenure-track ranks during the past 6–20 years, associate professor numbers would be small even if females were promoted at the same rate as males. A quick perusal of the *1987 Curricula in the Atmospheric, Oceanic, Hydrologic, and Related Sciences* supports this contention, since the number of female assistant professors 7 years ago is roughly comparable to the number of female associate professors who responded to the current survey. Women earning their Ph.D.'s 6–20 years ago simply may have considered nonacademic employment preferable to faculty positions.

c. Differences in time in rank

Gender difference in the amount of time at the present rank could account for the proportionately smaller number of women associate professors. However, the survey data do not support this explanation. If women atmospheric science faculty were promoted more rapidly than male faculty to full professors, we would expect the average ages of both associate and full professors to be younger for women than for men. The results indicate that the average age is less for female associate professors, although the sample size is very small, and the average age of full professors is comparable for males and females (Tables 4 and 5). The standard deviation for age is large for male associate professors, suggesting that the associate professor rank contains a large number of men, but not women, who have held the same rank for a long time. The responses also do not support the contention that women atmospheric scientists are promoted more slowly than men, even though a longer pretenure period has been previously noted for women scientists in general (Cole 1981; Yentsch and Sindermann 1992; Zuckerman 1991).

d. Women left academe for alternative employment opportunities

It may also be the case that women are more likely to move to a different (nonuniversity) position before they are eligible for tenure or even after tenure (Rausch et al. 1989; Richard and Krieshok 1989).

Women may find it difficult in the academic environment to meet both their personal and professional goals. The heavier work loads (Table 8) and perhaps a more hostile work environment in academic departments (Cook 1989) may impact women more than men.

e. AMS membership

Female associate professors in atmospheric science may be less likely than males to be AMS members. For example, a greater proportion of female associate professors in fields that are traditionally not involved in the AMS (e.g., atmospheric chemistry) could be enough to bring departmental male/female ratios into parity. However, such a pattern would not negate the apparent shortage of female associate professors in meteorological fields (who typically are AMS members). Also, fewer women compared to men may have taken the time to respond to the survey.

5. Remediative actions

The survey responses pinpoint a number of similarities and differences between Ph.D.-level men and women holding positions in atmospheric science. These give some guidance for assessing which factors may be related to the low salaries of women full professors and the low numbers of women associate professors. However, there is not enough information to enable a clear identification of the one or more primary reasons for the discrepancies. We suggest remedies related to the possible causes outlined above, without knowing for certain which of these are most likely to address the underlying causes. The problems of underrepresentation of women at the associate professor level and the relatively low salaries of women full professors are likely interrelated. Consequently, we have not divided the remediative actions suggested below by problem. Rather, the remedies fall broadly into three categories: those related to increasing the productivity of women faculty; those related to improving retention of women faculty; and those related to enhancing the academic work environment and informal social interactions. Many of the recommendations below echo recommendations suggested by previous authors (for examples see Brush 1991; Etzkowitz et al. 1994; Smith 1978; Sposito 1992; Yentsch and Sindermann 1992).

For several reasons, we recommend that policies or procedures adopted by departments to address the problems identified in this discussion paper be developed in such a way so that they benefit, or have the potential to benefit, all faculty, not just women. First, women are not the only underrepresented group in atmospheric science departments. Zevin and Seitter's report indicated that minority representation is extremely small. Second, getting tenure, climbing the academic ladder, and balancing career and family are also challenging for male faculty, particularly those who have spouses with professional careers or are single parents. Finally, actions or policies that target specific groups often "backfire" if a group is perceived as receiving special treatment. Thus, most of the actions recommended below, while addressed specifically toward women, can and should be extended to include all faculty.

a. Review past salary histories

Women faculty who are now full professors were hired a number of years ago before equal employment had full effect. We recommend that chairs of atmospheric science departments ascertain whether the present female full professors were hired at a lower salary than their male counterparts and, if so, make appropriate adjustments to remove the discrepancy.

b. Seek employment for spouses

Universities who actively seek employment for a prospective or present faculty member's spouse are more successful at recruiting and retaining faculty members. This is particularly true for women faculty because they frequently are married to other scientists, often in the same discipline (Cole and Zuckerman 1987; Marwell et al. 1979; Selvin 1992; Gibbons 1992c).

c. Work to make the academic environment more supportive of faculty with families

An environment where faculty can more easily meet their family responsibilities will help to retain women faculty and, possibly, help to increase productivity. Actions to improve the work environment can range from small changes easily instigated at the departmental level to changes that require university-level action. A number of possibilities for making the academic environment more favorable for faculty with families are given below.

1) Avoid scheduling meetings, retreats, seminars, etc. on evenings and weekends. Faculty with children find it difficult to attend activities scheduled at these times.

2) Experiment with flexible work schedules, particularly teaching schedules. Family emergencies, such as sick children, perhaps provide the most difficulty for faculty members who are parents. It is often impossible for faculty to stay home to care for a sick child when they are expected to meet their classroom responsibilities. Flexible scheduling may help parents cope with these emergencies. For example, a faculty member whose spouse works during the day may prefer to teach primarily evening courses. That way both parents are able to help out in an emergency situation with a smaller impact on either's work commitments. Coteaching courses or arranging in advance for "backup" instructors can also provide some flexibility in dealing with family emergencies.
3) Provide for at least one semester of paid maternity or family care leave, and allow for longer, unpaid leaves, if requested by a faculty member.
4) Campaign for on-site child care facilities. On-site child care facilities have been shown to be an important factor in the recruitment and retention of women faculty (Rausch et al. 1989; Pennisi 1990). Unfortunately, universities have not been as aggressive as the private sector in establishing on-site child care facilities. Chairs can encourage the establishment of quality child care facilities on campus that can handle both well and sick children.
5) Extend the tenure clock. Women are usually in their prime child-bearing years at the beginning of the assistant professor level, a time of intense workloads and high expectations for faculty. The option to delay starting a family until after gaining tenure is becoming even less feasible than previously. With the greater competition for academic jobs, postdoctoral positions are becoming more common and, in some cases, are a prerequisite before entering a tenure-stream position. Several universities have attempted to accommodate family obligations by adding additional time to the tenure clock for each child born or adopted during the tenure probationary period. We believe this practice should be more widely established and applied to both male and female faculty. This practice also could be extended to faculty members who must care for a family member who is seriously ill or contend with some other personal crisis.

d. Improve and create opportunities for mentoring

"Mentoring is a crucial part of the maturation of any young scientist into a senior researcher. Through a mentor a young scientist makes all-important contacts with meeting organizers, journal editors, and other researchers that lead to career advancement. The mentor can also help a young scientist develop his or her own scientific 'style', choosing from among the wealth of possible problems whose solution will lead to the greatest intellectual reward and career advancement. And finally the mentor offers a precious commodity in a harshly competitive scientific world—encouragement" (Gibbons 1992a).

Women faculty are more likely to lack mentors than male faculty members, and those who do have mentors find them later in life (Gibbons 1992a; Rausch et al. 1989; Yentsch and Sindermann 1992). Mentoring of women can help with difficulties they sometimes encounter due to differences in socialization (Clark and Corcoran 1986). Women with mentors have been observed to be more productive (Fox 1991; Hill et al. 1989; Yentsch and Sindermann 1992). Department chairs can include mentoring activities as part of the merit evaluation of senior faculty, become more involved with mentoring junior faculty themselves, introduce junior faculty to scientists at other universities who have similar research interests, and encourage junior faculty to seek mentors. Chairs also can help women faculty meet more senior women within their university. However, women should not be exclusively mentored by other women, as women mentors themselves may be isolated and lacking information. A number of excellent references, describing both the benefits and difficulties of mentoring, are available (e.g., Brown 1993; Garner 1994; Hall and Sandler 1983; Lewis 1992; Maack and Passet 1994; Sandler 1993; Sands et al. 1991; Wunsch 1994).

e. Encourage collaboration

Science, including atmospheric science, continues to move toward more and broader collaborative efforts. Consequently, faculty must establish collaborative networks early in their career. This can be difficult for women faculty if they are isolated. Chairs should encourage intradepartmental collaborations that include women faculty. Women faculty participating in such collaborations must be viewed as equal participants and receive appropriate credit for their contribution.

f. Monitor committee membership

The need for female representation on committees coupled with the scarcity of female faculty can lead to an abundance of committee assignments for female

faculty. Chairs should ensure that women faculty members are not pressured to serve on departmental and university committees or given other assignments that detract from their scientific productivity. This does not mean excluding women faculty from committees, as meaningful committee work often is the beginning of administrative experience (Smith 1978).

g. Evaluate merit salary criteria

Chairs should seek to avoid the "numbers game" in faculty evaluations, which counts publications regardless of the number or order of the authors. Single-authored works should receive appropriate acknowledgement, particularly at the beginning of a faculty member's career when collaborations may not yet have been established. Chairs should make clear to all faculty the criteria for merit evaluation and take pains to ensure that merit evaluation committees reflect the composition of the faculty.

h. Meet annually with faculty

Chairs should review with each faculty member, including full professors, their annual performance evaluation. This meeting should not only address the question of whether a faculty member's salary is commensurate with their contribution to the department and discipline, but chairs should also a) discuss with faculty whose annual evaluations are below average the reasons for this evaluation, b) determine that faculty member's perspective on their lower than average evaluation, and c) help formulate with individual faculty strategies to achieve the expectations of the department and university. Chairs should also conduct detailed exit interviews of faculty who leave. Chairs should be aware of the problems departing faculty may have encountered and consider the remediations they suggest. Chairs also should seek information on the positive experiences of the exiting faculty.

i. Discourage discrimination

Overt discrimination and sexual harassment still occasionally occur (Selvin 1992); chairs should take such complaints seriously. They should make it clear to all faculty members that such behavior will not be tolerated. Women are often reluctant to bring these situations to the chair, but such situations can make the university environment hostile and less desirable. Furthermore, chairs should be aware of, concerned with, and discourage the more subtle differential professional and social treatment that women faculty may encounter, including sexual innuendo, condescension, sex-role stereotyping, lack of support, tokenism, exclusion, attributing women's and other minority's accomplishments to affirmative action rather than to competence, and negative attitudes toward family commitments (Chapman 1978; Flam 1991; McDonald 1991; Smith 1978; Yentsch and Sindermann 1992).

j. Improve interaction with female role models

Successful women scientists can be excellent role models for male and female faculty and graduate students, and as Smith (1978) points out, "it is the obligation of a university to educate all its students, and by not providing diverse and appropriate role models it short changes its female or minority students." Chairs should attempt to increase the interaction of faculty and students in their department with women atmospheric scientists. Consider inviting prominent women scientists to present a colloquium, or even spend their sabbatical leave, in the department. Several societies including the American Physics Society have visiting lectureships for groups of people who are underrepresented in science. The Society pays for the recipients of these awards to visit another university to give one or more lectures and meet with other scientists. Encourage the AMS to establish a similar program of visiting lectureships for women and minorities. Also, universities should actively recruit women to host through the National Science Foundation Visiting Professorships for Women program.

k. Gather more information

As with any survey, this one raised as many questions as it answered. Many, if not all, of the proposed explanations for the low salary of women full professors and the small number of women associate professors could not be properly evaluated due to lack of specific information for atmospheric scientists. We recommend that heads and chairs, with the help of the AMS and UCAR, gather more detailed information concerning some of the possible factors influencing women's advancement and salary. Because of the small number of female atmospheric scientists, questions should be formulated with an eye toward maintaining anonymity. In particular, further information, specific to atmospheric science, on the relative manuscript submission and acceptance rates for male and women faculty, grant submissions and awards, number and gender of graduate students, opportunities to apply for administrative positions, number and type of committee assignments, and informal professional interactions would help in understanding and design-

ing remediations for the salary and advancement differences of women faculty.

l. Monitor faculty salary and advancement

Some of the findings presented here shed a positive light on women's participation as atmospheric science faculty. Specifically, salaries for male and female assistant and associate professors now appear to be equitable and the larger proportion of women at the assistant professor level gives hope that in the future women's representation in atmospheric science departments will increase. It can be argued that the low salaries for women full professors and the small number of associate professors identified here reflect past policies and practices and that the current climate for women in atmospheric science is less "chilly." This contention can be evaluated only by careful future monitoring of faculty salary and advancement. The analyses presented here, along with those of Zevin and Seitter, provide a baseline for evaluating future salary and advancement statistics. We encourage the AMS and UCAR, with the support of heads and chairs, to continue to distribute membership surveys as detailed as the 1993 survey.

6. Conclusions

The analyses of the 1993 AMS membership survey reported here point out two important gender-related issues for atmospheric science faculty. The first is a dramatic salary discrepancy for female full professors. Both the mean and median annual salary for women full professors fall below that of male full professors by more than $18,000. The second issue is an apparent leaky pipeline. In other words, the proportionately fewer women compared to men at the associate professor level suggests that women faculty do not appear to progress smoothly from one level to the next. Furthermore, a comparison of tenure-stream faculty to Ph.D.-level atmospheric scientists outside of academia suggests that women Ph.D.'s have fared better in nonuniversity positions in terms of a) salaries comparable to men at similar rank and b) advancement from entry to midlevel positions. The shorter work week (on average, 5 hours) of both men and women nonacademic Ph.D scientists compared to those with academic appointments may provide greater opportunity to balance career and family. However, in both the academic and nonuniversity arenas, few women have been able to advance into executive or administrative positions. Finally, the low-average salaries for single male faculty compared to married male faculty hint that there are inequities in academia beyond those associated with gender.

It is tempting to attribute the differences presented here for men and women atmospheric science faculty to small sample size. True, women make up an extremely small proportion of atmospheric science Ph.D.'s, and, consequently, individual responses had a large impact on the statistics presented here. However, the statistics for women atmospheric science faculty are in line with similar findings for science in general. This accordance suggests that the gender issues discussed here are real, even when accounting for the very small sample size, and warrant further consideration and remediation. Also, one cannot simply look at the current equitable salaries for male and female assistant professors and the increased proportion of female assistant professors and assume that gender parity has been, or soon will be, achieved. First, we have not been able to establish whether the salary differential for full professors is a manifestation of possible lower starting salaries for women who currently are full professors or if the differential arose during women's professorial careers. Future monitoring is required to determine whether the parity in salary we now see at the assistant professor level continues as these faculty advance to higher ranks. Also, the experience for other disciplines suggests that women are not advancing in academia at the rate one would expect given the number of women earning their Ph.D. degrees. As Brush (1991) states, "Much effort has been devoted to recruiting women, but . . . much less has been done to prevent them from dropping out of educational programs and professional careers at later stages."

Salary and advancement differences for women are unlikely to be the result of overt discrimination, but rather arise from an accumulation of subtle disadvantages including family obligations, socialization, and lack of role models and mentors. The complex and interrelated nature of these factors makes remediation difficult, although we have proposed a number of measures that we believe can improve the academic work environment for faculty with families, increase faculty productivity, and enhance professional interaction. We reiterate that these remediative actions can be, and should be, applied to all faculty, as getting tenure, climbing the academic ladder, and balancing career and family are challenging for both male and female faculty.

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