THE LIVES AND CAREERS OF MINORITY WOMEN SCIENTISTS[1]

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In 1975 Shirley Malcom, Paula Hall, and Janet Brown organized a meeting on minority women scientists at the AAAS called "The Double Bind: The Situation of Minority Women in Science."[2] The purpose of the meeting was to examine their current concerns and issues and to bring together many such women at different stages of a scientific career. Some thirty women attended of the 300 or so minority women Ph.D. scientists they were able to identify. That was the first national meeting to draw attention to the scarcity of minority women scientists and the double barreled disadvantage of their situation. A significant outcome was a clear summary of the issues of minority women scientists and a clear agenda for what needed to be done. This was twenty-five years ago. All of the issues raised then are still with us today, some are exactly the same, some now have a different emphasis. Change has occurred, not least because the same time period encompasses Affirmative Action, gradually introduced after the Higher Education Amendment of 1972 and a quarter century of programs for minorities or for women.

How great the changes are remain to be assessed. The focus of programs launched in 1972 and later have not much changed the visibility of minority women in science who remain in important respects uniquely invisible. The comment in 1975 was, "minority women were, in fact, falling somewhere in between the funded efforts to improve science opportunities for minorities and efforts to advance women in science." (p. vii) It is not only that the number remains small for those holding a Ph.D. and fully employed in a scientific or technical occupation. Invisibility is reinforced by the way in which national data bases are structured. Minority women tend to disappear among aggregates of all women, or all members of a particular ethnic group. Even disaggregating women alone from many science databases is not so simple, particularly in regard to employment.[3] Beyond this obstacle is the tendency of researchers to engage with issues of one ethnic group only so that there can be unfortunate comparisons among groups, based on a lack of knowledge of the situation of other ethnicities, and by implication suggesting that particular issues experienced by women of one group may be unique to them. The majority of studies do not deal with minority women in science and if they do, rarely pay attention to the structural conditions surrounding scientific Ph.D. training which can give rise to many difficulties for all persons.

Still, there is no doubt that in the last decade or so the number of women receiving Ph.D.s in science and engineering fields have been increasing. In the general rising tide of new female Ph.D.s the numbers of minority women receiving Ph.D.s in science have also grown, so that in 1997, the last year of available data, the number of women of color has increased to 548 out of 3,003 such degrees granted to women who are citizens of the United States. This compares to 203 Ph.D.s granted to women of color in 1988 out of a total of 2,066 granted to American women. (See table 1) In itself this is a wonderful increase, almost a tripling. By contrast, the total number of doctorates granted to everyone who studied science and engineering at an American university grew from 14,622 in 1988 to 19,309 in 1997, an increase of 32%. That means that the number of doctorates in science and engineering granted to American minority women amounted to 1.4% in 1988, compared with 2.8% in 1997. When compared with degrees granted to U.S. citizens only, in 1988 8,687 degrees were granted, in 1997 10,341, increasing the percentage of American minority women Ph.D.s to 2.3% in 1988, to 5.3% in 1997.[4] Which ever way the statistics are represented it comes down to the fact that a woman of color is still very likely to be the only minority women, or still

even

Table 1: U.S. Citizen Women Ph.D.'s in Science and Engineering, 1988-1997

Year	US All women	Black	Asian/ Pac. Isl.	Hisp.	Native Am.	Mex. Am.	Total Min.	White
1988	2,066	33	72	87	6	5	203	1,863
1989	2,316	38	93	108	9	8	256	2,060
1990	2,375	36	85	119	2	15	257	2,118
1991	2,493	48	134	148	9	14	353	2,140
1992	2,549	36	147	126	11	16	336	2,213
1993	2,699	56	174	150	5	14	399	2,300
1994	2,812	77	156	148	9	20	410	2,402
1995	2,908	79	223	132	9	20	463	2,445
1996	2,958	74	240	149	17	21	501	2,458
1997	3,003	94	244	172	8	30	548	2,455
Totals	**26,180**	**571**	**1,568**	**1,339**	**85**	**163**	**3,726**	**22,454**

Source: *Science and Engineering Doctorate Awards 1997*, NSF 1999

Table 2: U.S. Citizen Women Ph.D.'s in Science and Engineering, 1997
By Field and Ethnicity

	Black	Asian/ Pac. Isl.	Hisp.	Nat. Am.	Mex. Am.	Total Min.	White
Engineering:	*22*	*45*	*35*	*2*	*7*	*111*	*310*
Chemical	6	3	3	1	1	14	48
Civil	0	3	1	1	1	6	38
Electrical	3	16	9	0	3	31	46
Mechanical	1	8	6	0	0	15	32
Other Eng.	12	15	16	0	2	45	146
Physical Science:	*9*	*45*	*18*	*0*	*2*	*74*	*388*
Astronomy	1	0	2	0	0	3	21
Chemistry	7	31	14	0	2	54	290
Physics	1	14	2	0	0	17	72
Other	0	0	0	0	0	0	5
Earth, Atmospheric, and Ocean Sciences	2	5	7	1	1	16	120
Mathematics	2	6	9	0	1	18	120
Computer Science	1	12	4	1	0	18	62
Biological Sciences	54	126	93	4	19	296	1,338
Agricultural Sciences	4	5	6	0	0	15	117
Totals	**94**	**244**	**172**	**8**	**30**	**548**	**2,455**

Source: *Science and Engineering Doctorate Awards 1997,* NSF 1999

the only minority in a great many departments in the United States, particularly in engineering, physics and mathematics. (See table 2) While she may well not be the first women of color in a particular department, she is still likely to experience much of the isolation and special scrutiny accorded the very first women of color. It would be an exceptional department in physical science and engineering that would have a female faculty member of color.[5] The life sciences are doing much better than these areas in the numbers of minority women Ph.D.s granted and the slow emergence of minority women on the faculty. It remains an open question, however, if even there the "critical mass" postulated by Henry Etzkowitz has been attained for minorities, let alone minority women.[6]

Where does this leave us? It leaves us in a situation in which women from many cultural backgrounds have to negotiate American academic and scientific cultures in some respects still very much on their own, have to find their own solutions to the cultural and intellectual challenges they face in graduate school and the workplace beyond. They may still be the first in their family to attend college, let alone graduate school, they may come from cultures which view the world very differently from the world of Newton. They are also women in a research environment shaped by white men who generally continue to hold and exercise almost all power and control in science

Notwithstanding the difficulties impeding minority women's participation in science, women do succeed, do attain successful careers. How they made it through, what they make of their experiences and how they evaluate their careers forms the center piece of this paper. Many questions remain about the lives of women scientists of color. Do they receive the encouragement and material support necessary to excel in science? Is their organizational ascent typical for those with their training and experience? What choices do they make and how do they evaluate their professional lives. Above all what is the quality of their lives? Finally, how might their experiences differ from those speaking in 1975?

This work presents the first provisional results of a larger research project on how and why all under represented minorities (and a matched group of all other ethnicities) in the University of California System who received Ph.D.s between 1980 and 1990 in science and engineering succeeded in doing so, and whether the careers of these graduates correspond to their training and aspiration. It is based on interviews conducted with minority women scientists from Berkeley over the last year, augmented by an earlier study of mine at UCB on the graduate experience of women and minorities based on 337 interviews. The purpose here is to give dimension to the experience of minority women, to present the multiplicity of answers which individual women find for themselves. In formulating this topic I am particularly indebted to two researchers whose thoughts and work greatly influenced the shape of my study. The first is Daryl Smith who has written vigorously on the need to re-shape both the discourse and the logic behind diversity in the academy by focusing on success rather than barriers.[7] The second is Patricia Gandara whose interviews of 50 Chicano Ford fellows from low income backgrounds analyzed in *Over the Ivy Walls*, *The Educational Mobility of Low-Income Chicanos* serve as an inspiration for shaping my own questionnaire, although there was only one woman scientist among her study population.[8]

Very much like the women of 1975, the ten women recently interviewed in great depth are all confident in their intellectual abilities, excited about doing science, undeterred by racism and sexism, and knew they were smart and capable from an early age. Seven are African American, 3 are Hispanic.

There are similarities with the women of 1975 with respect to family background and early school experiences. In this study, one woman's parents had no more than six years of school, several had high school or less, three mothers had B.A.s, one set of parents had Master's degrees. Four were born in the South, five came from California, one from the Mid-West. One woman attended a segregated school through sixth grade, nine went to public high schools, one to a Catholic school. Five of the public schools had science programs, the rest did not. Those which had such programs defy stereotyping: The most extensive were in a small towns in Alabama and Georgia. Some of the big city locations offered nothing or only AP courses. But brightness and an interest in science was apparent in some of these women even before high school. One skipped third grade, one was taken from her regular classes in elementary school and put into a variety of advanced programs. All report that one or more teachers were tremendously helpful to their academic development. One particularly mentioned her 6th grade teacher, Mr. Owens. "He made mistakes on the board with his math. I was so frustrated by him, so he talked to me after class about making it up to me. He had me (a shy person) agree to correct him. It drew me out as a person. He would tell me I would go far. He was African American [she was not], the first person to tell me I'd go far."

Still, despite support from teachers, parents, siblings and an aunt during these years, a few women reported on all too commonplace discriminatory behaviors intended to direct minorities away from an education and a professional life. In one case, the woman had applied to a UC campus, but a school counselor thought she wasn't ready and switched her to a junior college. After inconsequential attendance and a full time job she was encouraged by her chemistry tutor to go to her first choice. She did. In California, though, with this kind of tracking to community colleges, minority students tend to be tracked right out of the higher education system with less than 6% ever attending a UC campus, and a small percentage ever receiving AA degrees.[9]

Undergraduate college experiences varied quite a bit. Four women went to Historically Black Colleges & Universities (HBCUs). Apart from their good reputations, they were local and their family did not want them to go far away. For the same reason, one woman attended the University of Chicago, rather than her first choice, Mount Holyoke, as her father would not let her go there. All the rest went to first class institutions: USC, Loyola Marymount, UCLA, Bryn Mawr, UCSC. If they had not already been fully committed to a life in science, college experiences were critical. Three participated in the MARC Program, one in a summer science program at Howard, another in an MBRS Program. Two department chairs, one a "dynamic African American woman," and a few professors all contributed to a love of research and a commitment to a lifetime doing it. Here too, experiences in majority institutions were not all positive and for one the stress of being the only minority in advanced math classes caused her to go back to regular classes.

The emphasis of this study is on graduate school experience and professional life, so far more questions were asked about these. All were enrolled in a Ph.D. program at UC Berkeley, all were accorded affirmative action status in one way or another, although their qualifications suggest that they would have been admitted anyway. What is most significant is what they did in these various graduate programs. Partially reflecting the distribution of women Ph.D.s in general, 7 were in the life science fields, one in mathematics, 2 in public health. Six received their Ph.D.s at age 30 or younger, the youngest was 25, the oldest 38. All but two earned their degrees within normative time set by their departments. All but one had an undergraduate major in the same field as their Ph.D., the one who did not had social science training appropriate for her field in public health.

Their profile in graduate school compared to the overall profile of all the 143 science Ph.D.s earned between 1980-1989 who were interviewed in an earlier study, including men and women and

all ethnicities, is virtually identical.[10] Viewed at a distance in this way it seems that the graduate careers of the Berkeley minority women were distributed along a normal continuum of behaviors resulting in the successful completion of the degree. Whereas this paper is only discussing the ten most recent interviews in detail, the 143 include 30 minority Ph.D.s in physical science, of whom 8 were women, 2 Hispanic, 6 Asian. Life Sciences had 41 minority Ph.D.s, 21 of whom were women. Engineering had 23 minority men, 2 Asian women. One sees here successful behaviors for the completion of a Ph.D. distributed among all those who completed. Critics of Affirmative Action should consider these data.

Table 3: Ethnic Distribution of Women Ph.D.'s, 1980-89 at UC Berkeley

	ENGINEERING				LIFE SCIENCES				PHYSICAL SCIENCES			
	Total	%	Female	%	Total	%	Female	%	Total	%	Female	%
Asian	144	9.9	14	1.0	54	4.7	20	1.8	69	5.1	19	1.4
Black	5	0.3	0	0.0	23	2.0	10	0.9	11	0.8	0	0.0
Chicano	1	0.1	0	0.0	9	0.8	2	0.2	6	0.4	0	0.0
Hispanic	10	0.7	0	0.0	19	1.7	11	1.0	12	0.9	3	0.2
Nat. Amer.	1	0.1	0	0.0	2	0.2	2	0.2	5	0.4	1	0.1
Other	42	2.9	2	0.1	29	2.5	7	0.6	51	3.7	4	0.3
Foreign	651	44.9	27	1.9	121	10.6	28	2.5	256	18.8	37	2.7
White	596	41.1	66	4.6	882	77.4	336	29.5	953	69.9	136	10.0
Totals	**1450**	**100.0**	**109**	**7.5**	**1139**	**100.0**	**416**	**36.5**	**1363**	**100.0**	**200**	**14.7**

Source: *UC Berkeley Graduate Division Database*

Graduate school, though, has much deeper consequences than the acquisition of a degree as the quality of the experience shapes future professional opportunity and ideas about the purpose of scientific training. A major difference making a doctoral program possible for the women of this study, and a major improvement in the quality of their lives compared to the women of 1975 is that funding was available to all. A combination of research assistantships, mandatory paid teaching assistantships and various forms of minority opportunity fellowships, along with NSF, NIH and other competitive sources saw all of these women through to the completion of their degrees. The one exception was the woman who took 10 years to complete, and even then she only borrowed $10,000. Another difference is the fairly extensive role various forms of formal and informal minority support mechanisms played in supporting these women in their programs. Between 1980 and 1990 the number of minority graduate students on the Berkeley campus grew significantly, although much more in the social sciences and education, but even if not in the same department, this growth made specific ethnic networking available. As the decade developed programs such as the Graduate Minority Program summer orientation increased, as did opportunities for socializing

through the Professional Development Program. One woman commented that her first social activity was a dance held for minority graduate students. “It made a difference, let me know I was not alone.”

Advisors also played a central role in supporting these women through their programs, although one had the misfortune to choose an assistant professor who was an utter dud, another a distinguished scientist whose policy as that of a great many advisors, was to let the student figure things out for herself, although even he is credited with building her self-confidence. The other eight remarked along the lines of one: “He was a major reason I have succeeded. A key factor in my getting through and after.” Another remarked “He was supportive and made sure I didn’t lose confidence, a great motivator. I was intimidated as the only African American.” Different stages of the doctoral program were difficult, not always course work, but the dreaded preliminary examination given to almost all doctoral science students which tends to “weed out” many at the end of the first year. Orals were also viewed as sources of difficulty, but finding a research problem usually was not. In all of these specific concerns, advisors or other faculty were helpful and supportive. Adding to the sources of encouragement were several Moms, other family members, friends, one of the members of this study, student colleagues, one undergraduate advisor.

If this was all that could be said about the graduate experience of these women, one could conclude that things have improved greatly. Certainly there is improvement, all of the money and effort which has gone into minority and women’s programs in science have had some results. But it always has to be kept in mind that these are women who succeeded in their program. Whatever environmental factors influenced their success, so did character, persistence, deep commitment to science, and tremendous personal discipline. It was not easy for all and racism and sexism took a toll on some. But, if the focus is adjusted to examine life in the department, on interactions with other faculty and students, then a different picture emerges. Generally departments were indifferently rated on issues of the clarity of the program, the opportunity to develop intellectually, structure of the curriculum and professional development activities. Asked about diversity in the department, all but two gave bad to terrible scores (4 & 5 in a 1-5 rating system, 1 the highest). The absence of minority faculty and women was commented on, one with the quip that diversity amounted to Anglo man vs Jewish man. Department experience was shaped by peers as well so that the strongest comment was, this “was my worst experience of racism ever, from students more than faculty ... Racist office mates at UCB wanted to keep an eye on me.” All the rest saw the situation somewhat differently, but in ways that are similar to the women of 1975. Generally those who commented on racism would remark that there was usually nothing overt, although a few reported specific instances of racist behavior directed toward them. Slightly more characteristic was routinely hearing comments about getting somewhere because of ethnicity, that people approached her differently, faculty and students; or at a conference hearing “a lot about why they didn’t want minorities,–not prepared, will have to spend a lot of time with them.” There were also comments about whether the student had help when a paper was excellent, or received the highest exam score. Faculty would not talk to one woman of this study as a colleague on scientific questions, even though they had related research interests–he only asked where a good Mexican restaurant was. Four responded that they had not experienced racism in graduate school, although they spoke about the existence of racism, just that they had not experienced it, or that they were insensitive to it. This manner of interpreting experience parallels another study of women in medicine (including some women of color) who have adopted the survival strategy of not recognizing sexist behaviors, in order not to be put off course by them.[11] If there were racist or sexist behaviors in the research groups of any of the women

of this study, none commented on it, several explicitly describing these groups as supportive and non-racist.

Professional development issues in a department are also seen very negatively. A major issue is not only socialization to the culture of science, but also to that of the academy. None of these women felt they had been adequately prepared for professional life. The most important lack was understanding the critical significance of postdoctoral training for building a successful academic life. This was also a complaint of the women of 1975. The consequences of not having this made clear led to a couple of women making very poor career decisions after the Ph.D. But training in all structural aspects of a scientific life was neglected so that grant writing, publication strategies and preparation, lab management, teaching, negotiating skills, career options and information was too often lacking. Although this lack was painful to these women specifically, this lack of information bedevils a large number of graduate students at Berkeley in virtually all departments involving all ethnicities and both sexes. To be sure, the expectation is that advisors should transmit this information, and given the good relationships most women had with their advisors, up to the limited level of the advisor's perception of training in these matters, several received some professional training. The problem is that few advisors are really that aware of how much needs to be explicitly taught to graduate students, and indeed, some still firmly adhere to the "boot camp" model of graduate training in which students are expected to find out everything pretty much on their own.

All of the women of this study have current positions in which their scientific training is put to good use, although in a few cases at something of a remove. Two teach at a HBCU, one at the University of Minnesota, one at CSU Hayward, three are senior scientists; one at Stanford, one at the Center for Disease Control, one for an international pharmaceutical company; two are in scientific management, one is a librarian at a technical high school. Their career paths and current positions reflect the universe of conflicting demands and loyalties arising from their commitment to science, to their families, to their ethnic group, to a particular part of the country. Their choices have been made more difficult by not always being aware of their options, or understanding what constitutes a progressive career in science, one that builds on each phase of employment. The two who teach in the South chose these colleges because they were near their homes and families. The librarian had sought her Ph.D. in order to teach at a HBCU also, but was bound to the Bay Area. That was also the reason for the choice of CSU Hayward for another. Some of the other positions now held by the women in this study were partially the result of being at the right place at the right time, since positions in research management, for instance, were not known to them in graduate school.

Satisfaction levels vary since most professional positions have positive and negative aspects, but in these cases, even the most satisfied (one of the senior scientists), indicate the pervasiveness of ineffable racism, and the likely contribution of its functioning to impede her career. As one of the scientists remarked, "there are cultural barriers in terms of expectations of how you conduct yourself in an academic environment, class and gender barriers, one's background continues to be a barrier." An academic remarked that her progress would be greater if there was a more productive working environment, if gender based, racist assumptions were not there. But half of the women of this study in majority organizations do not share this point of view, although with qualifications about being paid less than others, about racist incidents. Here the emphasis is as articulated by one, "I am not inclined to think about racism at work. I deal with it and have gone to human resources, dealt with it appropriately." The "Double Bind" articulated by the women of 1975 also comes clearly to expression.

Notwithstanding this ambiguous articulation about racism, sexism and classism, nine of the ten

women view their careers having developed successfully, the one who does not is dissatisfied about being unable to pursue serious research in her field. But she too feels that she is successful in her definition of success which she shares with many of the other women which emphasizes service. The shortest remark on the meaning of success is "the ability to make a positive contribution in the lives of other individuals." More extensively, "Working with students to learn and to do their best, even learning to work hard and fail. Spreading a commitment to learn which leads to developing a culture. Being of service." One clearly views success strictly as a scientist: it being "the ability to develop your own program and direct a research group. To be self-sufficient in those regards." Another combines both science and family: "Having more than 50 publications at the end of career, having an impact of [own] research on public policy. Also, in terms of what my kids do. If my children are not successful, I have to ask what is it all for? Having a positive influence and the skills to do as much as I have done." Another considers wanting to come to work every day and other people wanting her to come as success. There is a clear thread of pleasure and enjoyment of work in most responses.

This has been a rather brief look as aspects of ten minority women's lives and careers as scientists. Although a small sample so far, it permits a view of their struggles, triumphs and the overall ambiguity of their lives as professional women of color, and how they deal with it. Their lives have benefitted by the increased numbers of minority students in higher education, by organizations supportive of these students, by much greater efforts by universities, national professional associations and state and federal governments. Still their success comes at a price. One cried almost every day in her first year of graduate school, but at least had friends of her own group to check up on her every day. Another woman developed an ulcer during graduate school. Yet another was never understood by her family who wondered what good was a doctor who couldn't fix back pain? Coming to terms with the multiple demands of family, husband and children as well as ties to particular regions and groups produced compromises, but also some sense of satisfaction of having found an acceptable compromise. Is the quality of their life better than those of the women of 1975 who had to struggle with so much? It is very hard to say. The struggle is still there, racism and sexism still is at work, even if less obvious than in the past. But the experience of these ten show clearly that with support, such barriers can be dealt with, if not yet fully overcome.

REFERENCES

[1] I would like to thank the President's Initiative for Industry-University Cooperative Research Grant Program for the financial support which made this research possible.

[2] Shirley Malcom, Paula Hall and Janet Brown, *The Double Bind: The Price of Being a Minority Woman in Science.* Washington, D.C. AAAS, 1976

[3] Beatriz Chu Clewell, Angela B. Ginorio, "Examining Women's Progress in the Sciences from the Perspective of Diversity." Cinda-Sue Davis, Angela B. Ginorio, et al, *The Equity Equation, Fostering the Advancement of Women in the Sciences, Mathematics, and Engineering.* San Francisco: Jossey-Bass, 1996

[4] National Science Foundation, *Science and Engineering Doctorate Awards 1997,* Arlington, VA: NSF, 1999

[5] Theodore Cross, "The Black Faculty Count at the Nations's Most Prestigious Universities," *The Journal of Blacks*

in Higher Education, 19 Spring 1998

[6] Henry Etzkowitz, Carol Kemelgor, Michael Neuschatz, Brian Uzzi and Joseph Alonzo, "Gender Implosion: The Paradox of *Critical Mass* for Women in Science." Henry Etzkowitz, et. al., *Athena Unbound*. Cambridge: Cambridge University Press, forthcoming.

[7] Daryl G. Smith, The Challenge of Diversity: Implications for Institutional Research, in M..T. Nettles, *The Effect of Assessment on Minority Student Participation.* San Francisco: Jossey-Bass, 1990

[8] Patricia Gandara, *Over the Ivy Walls, The Educational Mobility of Low-Income Chicanos.* Albany: SUNY Press, 1995

[9] California Postsecondary Education Commission, *Meeting Agenda for December 12-13,1999.* Student Profile 4-10, Proportional Distribution of C.C. Transfers to the University of California by Ethnicity, Fall 1989-1998

[10] Anne J. MacLachlan, "Graduate Education: The Experience of Women and Minority Ph.D.s at U.C. Berkeley, 1980-1989." unpublished manuscript

[11] Anne J. MacLachlan, "The Effect of Gender Discrimination and Sexual Harassment on the Careers of Women Ophthalmologists." Report for Women in Ophthalmology, 1997

Paper presented at the National Association of Women in Education (NAWE) Conference, New Orleans January, 2000