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DEVELOPING GRADUATE STUDENTS OF COLOR FOR THE PROFESSORIATE IN SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM)*

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ABSTRACT

This paper presents part of the results of a completed study entitled *A Longitudinal Study of Minority Ph.D.s from 1980-1990: Progress and Outcomes in Science and Engineering at the University of California during Graduate School and Professional Life.* It focuses particularly on the graduate school experience and degree of preparation for the professoriate of African American doctoral students in the sciences and engineering, and presents the results of a survey of 33 African American STEM Ph.D.s from the University of California earned between 1980-1990. Relationships with thesis advisors and principal investigators are evaluated by the study participants in fifteen specific areas from highly-ranked intellectual development to low-ranked training in grant writing. Deficits in training and socialization are discussed along with the tension between being both an African American and a graduate student. Career choices and outcomes are presented. These findings, in conjunction with current analyses of graduate education in STEM, suggest ways in which graduate training for all could be improved.

> *The educational system as it has developed both in Europe and America [is] an antiquated process which does not hit the mark even in the case of the needs of the white man himself. If the white man wants to hold on to it, let him do so, but the Negro, so far as he is able, should develop and carry out a program of his own.* (Woodson, 1933, in Jones, 2000)

Although written 81 years ago, Carter Woodson's observation about education at white mainstream institutions and its general lack of suitability for the education of all—let alone its incompatibility with the needs of African Americans—is still with us. A current

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judgment by an African American faculty member in science affirms the central thought expressed by Woodson:

> Your ethnicity is from society, it affects virtually all your experiences. It is part of American society, it is part of the consciousness of Americans. It influences the nature of your experience in graduate school, how you are perceived. It is impossible for me to separate this from graduate education. (MacLachlan, 2004)

If more graduate students of color are to be "developed" for faculty positions in science, technology, engineering, and mathematics (STEM), then much more active measures are needed than those currently in place. At the time that Woodson made his comment, Mexican Americans and American Indians were hardly thought of in relation to participation in higher education. Today they join African Americans in the struggle for inclusion in good education at all levels. Members of all three groups are seriously underrepresented at white mainstream institutions (WMI). While the numbers from each group earning Ph.D.s from WMIs has been increasing since the late 1970s, they are still very low and bear no relationship to the percentage of each group in the general population. In STEM fields the numbers are particularly small, going from 254 in 1980 to 800 in 2002. Out of the total population of individuals holding STEM doctorates, depending on the field somewhere between 28% (biology) to around 50% (chemistry) will eventually enter academic employment, so these numbers point to a serious shortage (FASEB, 2002; ACS, 2004). In 2002 the three underrepresented minority (URM) groups earned the most doctorates in these two fields, 185 and 56 respectively (Hoffer, 2003, pp. vi, 121). At this rate, it will take many lifetimes to create a cadre of URM STEM faculty at white institutions generally and particularly at the top research institutions which train STEM Ph.D.s.

At present the number of URM ladder faculty employed by the top 50 National Research Council (NRC) ranked research institutions in chemistry and physics is minuscule, according to the Nelson Survey (2001). It is of course an open question as to how attractive faculty positions are to anyone of any ethnicity at the moment ,since faculty work is being reshaped while entrance qualifications continue to rise (Altbach, 2002). But for faculty of color, there can be additional issues of isolation, often, but not necessarily, coupled with a sense of alienation and marginalization (Thomas, 1993). On the whole, African American faculty tend to vote with their feet: of the approximately 150 Black physicists documented by the American Institute of Physics, two-thirds teach at an historically black college or university (HBCU) (Ivie, 2001, p. 9).

A major problem affecting new Ph.D.s of all ethnicities is that they are rarely trained to be effective college/university faculty (NAS, 1995; AAU, 1998; Golde & Dore, 2001). In and of itself, teaching now involves entirely new activities, such as incorporating web-based learning, internet communication, or student based learning, and in many science fields, particularly, it also involves burgeoning knowledge and a high degree of interdisciplinarity (in nano-science, for instance). In addition, students are highly diverse in terms of background, culture, preparation, and language facility (Flacks, et al. 2004). Campuses are not becoming more diverse, however, in terms of welcoming American URM students, especially not since the demise of Affirmative Action in many states. Raising issues of diversity and preparing graduate students for all aspects of teaching and academic work would give them the tools to make the transition to academic employment successfully. This kind of training would especially help in developing URM graduate students for faculty positions in that transmission of this kind of practical

knowledge would no longer depend on private networks and relationships. By requiring the training for all, it also gets around the issue of socializing first generation students.

If URM graduate students are to be effectively "developed" to become successful faculty in STEM, it is important to understand how they experience graduate training. One reason is to be able to address areas for improvement. Another reason is that an individual's own learning experience shapes how he or she teaches. That at least is the working hypothesis for this paper. Given the paucity of knowledge about how individuals of color experience graduate education in STEM, this paper intends to augment that knowledge. Because of space constraints, it focuses only on African Americans in order to examine their graduate school experience in some detail so as to represent the unique character of their experience. They are among other highly successful students who earned their Ph.D.s in science and engineering fields from several University of California (UC) campuses between 1980 and 1990. They were admitted to some of the NRC's top ranked departments, and despite the difficulties they may have had, succeeded in finishing their doctoral program. They all are bright and good at science, exhibit a strong will to succeed, to master necessary skills to move ahead, and to structure a professional life compatible with personal and community values. If individuals of this caliber had difficulties in getting through their graduate programs, others found these difficulties insurmountable and left the program—one of the "root causes" for the so-called "leaky pipeline," although not well documented (Lovitts, 2001; Nerad, 1996). The issues these students had with their training should therefore be taken all the more seriously as they are the successful survivors.

There are three sections to this analysis. The first section presents part of the findings of the qualitative study described below, which is a kind of group portrait of how graduate education was experienced. Following a very brief overview of the students' background, the discussion moves to their motivations to go to graduate school, their admission to a UC campus and to Berkeley in particular, the quality of their overall experience, the extent to which their experience was shaped by racism, the role of their advisors, and finally, the advantages and deficits of their training. The second section is a brief overview of the different career paths chosen by the African Americans in the study and the general reasons for satisfaction in their current position. The final section examines the structural discontinuities affecting the development of URM graduate students as faculty, and makes a series of recommendations for encouraging broader participation in STEM that builds on the experience of the study participants.

Description of the Study

The data employed in this article come from a four year qualitative project entitled *A Longitudinal Study of Minority Ph.D.s from 1980 to 1990: Progress and Outcomes in Science and Engineering at the University of California during Graduate School and Professional Life*. Included in the study are African Americans, Chicanos, and Native Americans. They are augmented by Asian Americans and Hispanics, and matched with a white group. The match was made by selecting a white graduate student from the same lab or who had studied with the same advisor as a minority student and who received his or her Ph.D. around the same time. Data were collected through telephone interviews generally lasting two hours using a standard questionnaire. Questions were asked covering respondents' entire lives from family background and early schooling through graduate school and professional life. A total of 158 interviews were completed.

The total URM (African American, Chicano, Native American) population for the UC System, 1980-1990, is 206 out of a total of 13,700 STEM Ph.D.s. The breakdown of those interviewed is:

All Campus Study Distribution
(By Gender and Ethnicity)

Ethnicity	Total	Women	Men
African American	34	10	24
Asian American	30	8	22
Chicano	25	6	19
Hispanic	12	9	3
Native American	5	2	3
White	52	27	25
Total	**158**	**62**	**96**

Source: A. J. MacLachlan, *Progress and Outcomes*, 7/2003

Background: Commonalities of Entire Population

A short summary of the findings about the lives and education of all of the 158 scientists and engineers shows significant similarities in several important respects. Despite substantial differences in parents' educational level and occupations, the young scientists were strongly supported by parents and other family members as well as by schoolteachers or counselors. Another commonality is that most in the study knew they were bright from a fairly early age. Often a significant event or "critical incident" produced this awareness, such as winning school prizes, skipping grades, or being put in accelerated programs. Except for the Asian American students, who mostly selected research universities for their undergraduate education, all the rest selected a broad range of colleges for a number of reasons, not necessarily academic. Because many African Americans and Chicanos were first generation college students, they often ended up in college thanks to high school teachers and counselors.

Once in college, biology and chemistry were the overwhelming choice of major. For African Americans and Chicanos, however, the career track was often medicine. Participation in sponsored research programs, such as the Minority Access to Research Careers Program (MARC) and the NSF Research Experience for Undergraduates (REU), as well as other field experiences increased interest in research careers to such an extent that through the research itself and the acquisition of mentors through participation, the path was set for graduate school and a Ph.D. If there was ever any doubt about the importance of these programs, the experience of this population should put those doubts to rest permanently.

The majority of the scientists and engineers in the study earned their degrees at UC Berkeley. If choice of undergraduate institution had been idiosyncratic for many, graduate school and a particular department were more consciously selected. The URM students largely appear to have been admitted under Affirmative Action, although at least 50% had grade point averages of 3.3 and above. Affirmative Action had the pronounced benefit of not only ensuring the admission of these students, but also

providing most of them with fellowships when other sources of funding were unavailable. As several commented, “Affirmative Action got [them] through the door, but they still had to pass their exams.” Several also had competitive fellowships such as the NSF Graduate Research Fellowship, Ford, and others.

There is a commonalty about how almost all of the first year graduate students of all ethnicities felt in their new environment in terms of how they ranked themselves academically and intellectually, with most placing themselves in the top 10 to 25% of their cohort. Some were quite intimidated by their new surroundings, some felt competent and well prepared, others were anxious about succeeding or felt unprepared. Having a good advisor right from the beginning made the path much easier. Several throughout the disciplines took extra classes in their first year to fill in gaps in their preparation.

African Americans: Getting to Graduate School

This was a generation in transition. Of the 33 Americans of African descent (excluding the one African), 76% of their parents were born in the South and western Border States, as were 18 (55%) of the total study participants. Within this group there is a twenty-year age difference, with the oldest born in 1943 and the youngest in 1963. Consequently, several grew up during the Civil Rights Movement and were the first Black to attend a white high school. Sixty percent of all their parents had a high school diploma or much less.

According to the Carnegie Classification System in place in the 1980s, 13 attended Research I institutions, 2 Doctoral Granting, 12 Comprehensive (M.A.) Institutions, and 6 attended Liberal Arts Colleges. Ten of these institutions are HBCU’s. The most popular undergraduate major was biology with 11, one of which was a double major with chemistry. Chemistry followed with 5 degrees, engineering with 4, plus one in chemical engineering. There were 2 math degrees. One of the math majors and one of the engineering majors graduated with a double major in physics. Two earned degrees in sociology and one in English. After that there are single degrees in biochemistry, agricultural science, food and nutrition, pharmacology, physics, health education, and economics. Grade point averages were distributed from a low of 2.6 to 4.0, with the majority clustering in the 3.3-3.7 range. Three of the four students with less than a 3.0 earned Master’s degrees before entering a UC doctoral program. The one student who was admitted directly from college with under a 3.0 finished his Ph.D. in 6 years at the age of 25. Altogether 13 individuals earned Master’s degrees before entering a UC Ph.D. program. Those with B.A.s in fields like English or sociology entered public health-related M.A. programs on their way to earning a doctorate in public health, often much later than their M.P.H.

The greatest number of African Americans selected biology, with 9 earning Ph.D.s in fields from endocrinology to zoology. Ten are in physical science, including 8 in chemistry. Four are engineers, including 1 chemical engineer. Two are in math, 1 in science and math education. Seven earned doctorates in public health, one in nursing.

Although several of these scientists and engineers had dreamed of a career as a scientist from very early on, nineteen of the 33 had become so interested in their field in college, particularly those in research programs and jobs, that it was then they decided to get a Ph.D. Six others had their interests clarified while in an M.A. program. The rest

either always knew that is what they would do or developed an interest in high school. It basically came down to, “I really like chemistry, I like thinking about the scale of large molecules”; “I always liked biology”; “math has always been my first love”; “in my first physics class [as an undergraduate], I wanted to learn more, so I read Feineman’s lectures which made it interesting and I got really interested in electromagnetism.” Most of those who went into public health and nursing did so to address the healthcare needs of the African American community. One woman commented that she wanted the Ph.D. in order “to be a power broker, to be at the table where decisions are made about minority health.”

Twelve of these scientists only applied to UC Berkeley or withdrew their application from other universities when they were accepted. One only applied to UC San Francisco. The other 20 applied to 2 to 5 other graduate programs in institutions like MIT, Harvard, Cornell, Johns Hopkins, Stanford, or Georgia Tech—the list of distinguished names is long. Most were accepted by these programs. An engineer who had been accepted by the last two on the list elected Berkeley although, “UCB offered the least amount of money in fellowships, but had the best professors.” While academic distinction was the primary reason for his choice, it was augmented, as in the choice of Berkeley by many others, because “it was a great place to live.”

Even though many of these African American future scientists were encouraged and supported by teachers and/or counselors in high school and beyond, for some it was a great challenge to get to Berkeley. One man who attended a white Catholic all-boys school graduated as one of two Blacks in the senior class. His advisor at the time, the math teacher, told him he would be lucky to go to community college. Having learned from this advisor that UCB “was the best school in the nation,” he came to California to get in six months after the application deadline. He did indeed have to go to a community college for a while, but did get into UCB eventually. Since his counselor “said I didn’t have it to make it, I didn’t want to prove him right.” For him attending Berkeley was destiny. As part of the “Talented Tenth” his view is, “I work best when given an impossible challenge. I always have done.”

On the other hand, Berkeley and a few other UC campuses actively recruited several of these students. One professor from Berkeley with a talented African American graduate student went to New Orleans and recruited students city-wide. So did other faculty members from other Berkeley departments. Other students were flown out to prospective graduate programs, one by UCLA, UCB, and UT. The student chose Berkeley because, “I was treated a little better at Berkeley, they had done their research about interacting with minority people. . . I’d have a place to sit and have an advisor in place, a mentor to stay with if I wanted, not a one month rotation like UCLA had.” While six students or more were recruited, other African American students profited from the more customary faculty networks in which undergraduate advisors knew faculty at Berkeley, so recommended that their student study at Berkeley and found a place for that student in a UCB colleagues’ lab. In other cases, faculty at Berkeley had been told about a promising student by a colleague, so invited the student to apply.

In summary, getting to graduate school for this group of African Americans followed many paths. For 13, this included a Master’s Degree before the Ph.D. program, while the rest mostly went from college to a Ph.D. program, although one man did military service in between, and another worked for a few years. For those in public health there was usually a long interval between the M.P.H. and the doctorate. The 7 or more who were

recruited were part of an affirmative action program. The scientists and engineers came to graduate school with a passion for their subject, high grade point averages, and a determination to succeed. Their overall profile looks like that of any other graduate student, but unlike many in their entering cohort, these students succeeded in earning their Ph.D.

African American Experience in Graduate School

When these individuals entered their various UC graduate departments, those who entered without a Master's degree tended to be quite young: one was only 19, one was 20, the rest were between 21 and 23, with one who had been in the military all of 26. Those who had Master's degrees were clearly older, the oldest being 38 when she entered her doctoral program. Time to degree varies greatly, with 3 earning their Ph.D.s in 4 years or less (chemical engineering, public health, and physical chemistry), 9 earning theirs in 5 years, 11 in 6 years, 4 in 7 years, with a few outliers who took between 8 and 14 years. There is no clear relationship between educational level of the parents and time to degree as some from the least educated families earned their Ph.D.s quickly, while the few students with highly educated parents earned their degrees no more quickly than anyone else.

Only five students responded negatively to the question, "did you understand the expectations of your graduate program?" Three of the 5 graduated in 6 years, 1 in 8, 1 in 14 (although for personal reasons). At the same time, none of them went into tenure track academic careers, and made remarks about the absence of preparation for careers in response to the question, "what training would you have like to have received, but did not?" Of those who said they did understand graduate school expectations, it is clear that the department and/or particular faculty communicated those expectations and provided feedback when they were not being met. Yet the overall experience of graduate school was very complex, involving for some a major adaptation to an institution like Berkeley when coming from an HBCU and/or a small town in the South. One very successful man commented—in response to the question, "What did you wish you had known when you started the program?" —that "Berkeley was totally different—I went into culture shock." He went from a city that was 60% African American to a small liberal arts college which was 90% Black and then to Berkeley: "Berkeley was a cold environment, totally different."

For all the African American students, there was always a tension between being a graduate student and being an African American graduate student. Nevertheless, most African American students developed good working relationships with their advisors, most found colleagues and friends among their peers, and most were excited about what they were learning and felt that they had been well trained in their field. It is the hope of every graduate program that their students have this kind of experience. At the same time, quite a large number of students articulated deficits in their training which affected their success in subsequent careers. If students are to be fully developed for the professoriate in particular, training needs to be more focused on long-term development after the student leaves graduate school. Training of this kind falls into two different areas: the academic functional area, which includes all forms of professional development; and the social dynamics of science area, which addresses issues of ethnicity and gender directly. Neither form is really addressed in any research graduate program. The need for both is clearly demonstrated by the experiences of these 33 African American students.

In the study, there are several sources for information on areas of training students would have liked to have received but did not. The first is a question asking exactly that, the next what advice participants would give an incoming graduate student, and finally what suggestions they would make for improving training. In the questionnaire these questions are preceded by a question about useful and productive aspects of training received. This question also indicates important aspects not available to all. The second source is a set of questions about the relationship with the advisor which are very specific about whether the advisor provided information on publishing, writing, grant writing, etc. The responses are extensive, so in this article a summary of each area is provided.

The response to the questions about training—involving useful aspects, deficits, what they wished they had known when they started, advice to incoming students, and suggestions for improvement—provides the following picture. When considering these responses, it is useful to keep in mind that these judgments are made at a distance of many years. Perhaps the most fully expressed positive evaluation of their training is:

> I received good quality training and experiences in my discipline, in my evolution and maturity as I went through the grad school program. I learned how to think independently, critically, and to solve problems, all the things necessary to become a good scientist. I interacted with peers, who are now very successful, and established a good network with them which in turn has helped my students.

Yet his biggest disappointment was “the realization that people will still judge you by the color of your skin instead of your intellectual ability or what you can do.” Still, most African American men expressed a similar positive judgment of their training, while only 6 of the 10 women had such a good learning environment. The less satisfied of both men and women would have strongly preferred to receive more guidance in the program and what they call a “structured environment.” The lack of structure in a particular program and/or the lack of direction from one’s advisor promoted floundering, failed experiments, and lost years, and drove students out of the program. Since these are the comments of those who earned their degree, it is not surprising that their general trend is positive, if tempered.

Apart from a lack of mentoring, other deficits in training documented by this set of questions include career training (9), grant writing (9), collaboration (9), lack of training in public speaking, publications, teaching, networking, and more interdisciplinarity. The absence of diversity and the need for diversity training for students and faculty was specifically raised by 8 individuals but concerned many more, as the issue of usually being seen as African American first and being treated differently was touched on by nearly all. The absence of a diversified faculty was specifically raised by only 5 students, but touched on in various ways by several more.

Collectively, the advice these African Americans would give to new graduate students is focused on academic success. Incoming students should have clear goals about what they want to achieve in the Ph.D. program in terms of learning, self-development and independence, and getting the information they need. Students should ask questions of everyone who might have the answer, be clear and assertive about their intellectual and professional development needs, make mistakes and learn from them. In laboratory sciences, students should make sure that they are in the right lab for their research interests and not hesitate to form alliances with other labs. They should realize that

science and the academy are very political, but not let it deflect them. Students should get to know many people, build their own networks, keep looking for a faculty mentor with whom they can relate freely. They should find a dissertation topic quickly and get started. If they are writing papers, they should write with an eye to publication. A lot of these suggestions arise from hindsight, from activities the proponents did not engage in themselves, only to suffer consequences during the Ph.D. program and sometimes afterward.

Depending on the employment area individuals entered, whether business, government, or college and university teaching, different specific deficits in training were articulated. Perhaps a better measure of positive activities as well as deficits in training can be derived from how these students ranked their thesis advisor on 15 specific topics. The ranking system goes from 1 to 5 with 1 being excellent, 2 good, 3 nothing particular, 4 poor, 5 bad.

Overall Advisor Relationship: In terms of the overall relationship students had with their advisor, 27 out of the 33 gave a rank of 1 or 2. Typical comments from these students are: “good interaction, mentor and still a friend,” “very encouraging,” “the best,” “he made all the difference,” “very positive, caring.” But a student assigning a 2 still said, “I wasn’t mentored that great.” Another, “fairly decent advisor, but he was not respectful.” The 6 remaining students who gave ranks of 2.5 to 4 comment that advisors were not around, laissez-faire, “cold, hands-off.” For those students who did not get much guidance, independence and self-reliance was cultivated, and assistance was sought from others better able to provide it.

The 15 specific areas advisors were rated on often received a rank at odds with the high overall ranking. Some areas, such as organizing opportunities to teach or support monies, were out of the advisors’ hands in several cases. Using the mean as the comparison instrument the extent of deviation is clearly seen:

Overall relationship: 1.8
Guided intellectual development: 2.06
Provided effective training in the discipline: 2.06
Imparted knowledge of the academic profession: 1.98
Organized teaching opportunities: 2.14
Developed research skills: 2.27
Provided opportunities to present: 2.53
Provided information on grant writing: 3.3
Encouraged preparing articles for publication: 2.68
Imparted knowledge of ethics of science: 2.15
Introduced student to other faculty in field: 2.29
Provided information on lab management: 2.64
Provided moral support: 2.21
Quality of advisor’s evaluation of student: 1.78
Ability of advisor to secure financial support: 1.51
Ability of advisor to understand non-academic constraints of student: 2.05

The means make clear that overall training to become an effective academic is inconsistent. Perhaps too much is asked of individual advisors as academic work becomes more complex and demanding of faculty time. But the result is that far too many of these students left a UC campus not understanding what is involved in the life

of an academic. Not necessarily getting good or even any career advice, some of these students made poor decisions about what kind of work to seek, or took a bad postdoctoral position.

African American Employment

Out of the 33 interviewees, 20 currently hold academic positions and several more now in other sectors once worked in the academy. Six work at either government laboratories or other government facilities. Eight are in the private sector: two are lawyers, one of whom has his own patent agency; one is a medical doctor, two others business owners, two work as staff scientists, and one is a software engineer. For most who currently teach and for several who do not, teaching is usually a means to give back to their community. Where they teach is a result of more complex circumstances, however. The birth family and partners, the possibility of doing research, and developing minority programs at mainstream institutions are among the factors playing a part in decision making. Eight actually teach at HBCU's or predominantly Black institutions (Spellman, North Carolina A&T, Xavier, Howard, Morgan State, Morehouse, UNC Charlotte, and Tuskegee), although four others either aspired to or teach part-time besides their other full-time positions. The women are associate professors, as are most of the men; two men are full professors. Several also teach at Research I Universities (SUNY Stonybrook, UC Berkeley, Rice, Georgia Institute of Technology, and the University of Washington), with a few in various other Carnegie categories such as City College of New York, West Point, California State University (CSU) San Diego, and the University of Massachusetts at Amherst. One woman from UC San Francisco is now full professor and President of an all white nursing college.

For most of these faculty, to get to where they are today has been a process of finding a reasonable fit between themselves and their institutions. This has usually required changing jobs. Nine went directly into teaching positions, although not necessarily the one they have today. Three had only one postdoc before getting an academic position, while the rest had up to 3 postdocs before getting an academic position. Satisfaction levels vary; academic work is, after all, very complicated, but the ability to conduct research, to teach, to improve the voice of URM students on campus, to mentor students, and to collaborate with colleagues, as well as to have time for one's family are all major components in generating satisfaction. Because all of these faculty members have been in the workforce for up to 24 years, most of them have their struggles behind them. Nonetheless, at the time of their interview a couple of years ago, the sharpness of their distress at going out into the academic world naively, without always having the appropriate training, is still apparent for those who experienced difficulties. Their suggestions to remedy this situation are extensive.

Proposed Development Program:

Before turning to specific recommendations made by this group of African American scientists, a few observations are necessary about the general situation in scientific training in the United States today. While there are likely to be committed individuals in every science and engineering department that trains Ph.D.s who are genuinely interested in developing faculty of color, there are several serious discontinuities in federal and local policy which hinder them. The funding of graduate training is largely in the hands of federal agencies, plus a few private organizations like Ford. The National Science Foundation (NSF), the National Institutes of Health (NIH), and the Howard

Hughes Medical Institute (HHMI) fund the greatest number of fellowships and graduate researchships—especially in biology, where the largest number of URM students are found. The specific programs such as AGEP and IGERT funded by NSF which target students of color allow department/divisions to apply for this funding, and if they get it, to feel that they are supporting developing students of color; but a compartmentalized, externally mandated set of programs.

Another structural barrier to reform is the nature of Ph.D. training itself. Most programs in STEM are set up to have a certain percentage of students fail classes and/or the preliminary exam so that the student population is "weeded out." Excellence—a highly subjective quality—is supposed to be the basis of evaluation. Rarely do departments see themselves as doing anything other than training researchers. While there has been very substantial criticism of this system of training by distinguished organizations such as the National Academies (NAS, 1995), the American Association of Universities (AAU, 1996), and many, many others, the fundamental system is not changing. Even well-meaning faculty are part of a structural inertia because the current graduate system keeps them well supplied with bright research assistants and teaching assistants for enormous introductory courses, while federal funding pays these R.A.s whether they earn their Ph.D. or not. For all that the National Science Board and other entities formulate policy papers, there is absolutely no sense of urgency about increasing the number of underrepresented graduate students or faculty. Nor do these papers and reports address racism and its consequences. While several of these reports, especially on the workforce, emphasize that the nation is not benefiting from the talent of URM groups, there is great argument about whether there really is an impending shortage of American scientists and engineers. Since fields like biology have been "oversupplied" with Ph.D.s—making the academic job market fiercely competitive and leading to lowering the academic salary structure in biology—faculty see no particular advantage to changing graduate education.

The real nexus of change and improvement in the training of Ph.D.s lies in personal relationships. This is abundantly clear from the responses of the 33 African Americans, 27 of whom found good advisors, who may have been fairly useless in providing information on things like grant writing or scholarly communication, but who encouraged and supported their students and provided the necessary level of intellectual direction. Yet in the majority of these African Americans' experience, their skin color was an issue for many in the department and a few experienced serious racist incidents. Those 10 who came from HBCU's or others from southern colleges experienced a very specific form of culture shock in addition to that of going from their undergraduate college into some of the most competitive graduate programs in the country. How difficult it was for African American students from this sort of background to adjust to and flourish in their new California environment was likely incomprehensible for most of their professors–some of whom were not helpful in this process.

It is not surprising, therefore, that a recommendation made by nearly every one of the 33 Ph.D.s is for diversity training for faculty. This is always tricky, as it needs to be supported by the central administration of any university; deans and department chairs need to support it wholeheartedly. Yet this sort of training has occurred on many campuses for women, so there is a precedent. Accompanying this is the recommendation that faculty of color be hired. The issue is not increasing the number, since it is usually nil, but to hire at least one and go from there. Daryl Smith and colleagues (1996) have documented how difficult this is to do since, despite the rhetoric,

little real effort is made to find qualified candidates of color. The usual argument that there are none seems to insult not only potential applicants, but also faculty colleagues at other Research I Institutions. Surprisingly, few in the study suggested diversity training for students, although a few of the most egregious racist incidents were perpetuated by student peers. In my mind, this is an essential part of the whole. Graduate programs in STEM bring together people from all over the world as well as from all over the United States. Prejudice and stereotypical thinking plague everyone. Such training might improve the atmosphere in any department, but also contribute to the long-term extirpation of thoughtless racist responses and slowly build a cadre of faculty much more sensitive to racist behaviors. Again the department chair and other officers need to support this unequivocally.

Further institutional responses would incorporate training in the areas the respondents considered missing from their own graduate education. This could take the form of a mandatory seminar series or actual courses. The need for such training has been recognized nationally in several initiatives, among them *Preparing Future Faculty Programs in Science* (Pruitt-Logan, Jentoff & Gaff, 2001; see Wulff, 2004 for full list). Unfortunately, little of this work gets read by scientists, but at least greater emphasis on training in teaching is being made by graduate divisions. Still, it would be useful to begin with a detailed orientation to a department for all students that clearly lays out the expectations and requirements. Those students in the study who felt they understood departmental expectations had benefited from a combination of written material, orientations, and faculty advising. Such an orientation might lessen the number of students who fail the preliminary exam on the first sitting. Further classes in teaching, in careers and how to prepare for them, along with grant-writing, scholarly communication, etc. would round out a student's education and also take some of the burden off of individual advisors.

The last institutional response has to do with recruiting. Several of the study participants were recruited to their department by faculty and sometimes accompanied by a graduate student of color. Many faculty at the time were very active about going to the South, to minority conferences and other venues to speak to prospective students, often recruiting them for their own labs and programs. This is an element less emphasized today, at least at UC Berkeley where professional "diversity" recruiters do most of this work. Faculty must be involved for it to be effective, however. It appears to be yet another part of the over-specialization of functions in the contemporary university which discourages faculty from necessarily being engaged, as the institution has already "dealt" with the issue.

The study participants had a lot of advice for new graduate students, all of which could improve the quality of students' life. Transmitting that advice is another issue. One of the ideas was to match up incoming students with an older student who had already passed several milestones in the department. Another idea is to link incoming students, especially students of color, with alumni for mentoring, straightforward advice about racism, information about careers, and general encouragement and support. Other possibilities include putting all of the suggestions into a pamphlet to be given to incoming students, or sponsoring a graduate student association in a department where students at all levels could meet and either invite speakers or have discussions about various graduate student and career development issues. If there is an interest, there are many things a department could do to assist their graduate students.

The key element is departmental and institutional interest. There need to be more graduate students of color who successfully finish their doctorates, complete a useful postdoc, and go on to an academic position. “Developing” faculty of color requires continuous effort and attention on the part of the graduate faculty. Here is the major disjunction in the entire project. Even though big science organizations write reports about the national need to incorporate URM groups into the scientific workforce, faculty in STEM departments, even if they have read these reports, simply do not see recruiting and training students of color as a high priority. The implication of the reports is that STEM graduate students of color are a precious natural resource that should be husbanded and increased in number. The means for “developing” such students into effective successful faculty are available. What is still needed is the will to do so, in order to put to rest Carter Woodson’s judgment about the inadequacy of the educational system not only for African Americans but also for .all graduate students.

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