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Making It in Engineering: The Career Attainment and Mobility of Caucasian, Black, and Asian-American Engineers

By Joyce Tang, Associate Professor of Sociology, Queens College of the City University of New York

Engineers have an important influence in our lives. They build electric cars, Chunnel trains connecting London to the European continent, spacecraft Voyager, Olympic stadiums in Sydney (Australia), our fax machines, cellular telephones, notebook computers, . . .

Books on engineers focus on their work and ideology or on engineering design and development. *Doing Engineering* examines the career attainment and mobility of engineers in the United States (Tang 2000). The purpose of this article is to provide: (1) an overview of this recent publication, (2) a summary of its major findings, and (3) a discussion of its implications for policy making and sociological research in stratification.

1. Overview

The first comprehensive study to systematically compare three groups in engineering, *Doing Engineering* tells how Caucasians, Blacks, and Asians[1] fare in the engineering labor market and what they can look forward to in the future. Historically, relatively high starting salaries, steady demand, and institutionalized career paths—to name just a few—have made engineering careers quite appealing to Caucasian workers. But things have changed. Economic and organizational transformations in recent decades have altered the opportunity structure of engineering. For example, corporate restructuring has shrunk management layers. As a result, a rising number of engineers have adjusted their career goals of becoming a manager. Additionally, demographic shifts in the engineering population, coupled with fluctuations in demands for technical personnel, have made career progress in engineering more complex than it traditionally seems. An increasingly diverse engineering workforce and downsizing in engineering industry might have changed the career process in engineering.

Career progress of different groups[2] is one of the most important social concerns. The United States is one of the largest employers of engineers among industrialized countries. There are approximately 1.7 million engineers in the United States. Blacks and Asians constitute 11% of the U.S. engineering population. The numbers of Black and Asian engineers have grown at a much faster rate than the number of Caucasian engineers. A projected steady increase in engineering jobs, coupled with demographic shifts, suggests that more racial minorities will move into this well-paying profession. Yet, current works on engineers have little to say about what happens once these racial minorities get into engineering jobs: whether they move up the organizational ladder, whether these minority engineers ever manage to achieve their potential, or whether they are on the road to achieve occupational parity with their Caucasian counterparts. *Doing Engineering* fills this gap in the literature.

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FROM THE EDITORS:

Each issue of ***Making Strides*** features a profile on an institution that received an NSF Alliances for Graduate Education and the Professoriate (AGEP) award as well as an interview with a professor who is making a difference in the fields of science, mathematics and engineering (SME) by encouraging and mentoring students. This month we are pleased to feature an article highlighting the AGEP program at Howard University, written by Dr. Cynthia Winston. Dr. Harold Deutschman, Professor of Civil and Environmental Engineering at the New Jersey Institute of Technology, took the time to chat with us this month about his experiences as a professor and mentor.

Dr. Joyce Tang, Associate Professor and Deputy Chair, Department of Sociology at Queens College in New York writes a piece that profiles her recent publication, Doing Engineering: The Career Attainment and Mobility of Caucasian, Black, and Asian American Engineers.

Melissa Castillo-Garsow, News Editor of "The Tattler," Ithaca High School's student-run newspaper, contributes a piece on The David Blackwell and Richard Tapia Distinguished Lecture Series in the Mathematical and Statistical Sciences at Cornell University. She is a junior and works part time at the Ithaca Journal.

September 18-19, 2000, the American Association for the Advancement of Science held a study group meeting in Washington, DC with key researchers, educators and scientists who conduct research on minorities in science, mathematics and engineering at the undergraduate and graduate levels and in the SME professorial career area. The objectives of the meeting were to:

- Review what we know about the research on undergraduate, graduate, and faculty career experiences of underrepresented (URM) minorities in science, mathematics, and engineering.
- Identify gaps in the research base on URM minorities in SME at the undergraduate and graduate levels and in the professorial career area.
- Recommend further research questions on minorities in SME at the undergraduate and graduate levels and in the SME professorial career area.

AAAS staff will produce a report on the study group process before the end of 2000.

LET US KNOW WHAT YOU THINK

Please continue to send us your comments, feedback and inquiries. Afterall, the goal of this newsletter is serve the needs of its readers. If you are interested in submitting a research article, please contact Yolanda George at ygeorge@aaas.org. For further information on our work, visit: http:// ehrweb.aaas.org/mge.

2. Major Findings

Doing Engineering offers new insights into stratification in the engineering profession. The most striking finding is that among engineers Blacks do not fare significantly worse than Asians, and Asians do not fare significantly better than Blacks.

Based on aggregated data provided by government agencies, it looks as though it is easier for Asians than for Blacks to make it in the engineering labor market. For example, Asians have high levels of representation in engineering education and employment (National Science Foundation 1999). Results of analysis on career attainment and mobility among engineers suggest otherwise. Generally, Caucasians performed better than both Blacks and Asians in career achievements and advancement in the 1980s. After their entry into the engineering profession, Asians fared only slightly better than their Black counterparts. The popular perception that Blacks lag significantly behind Asians is not well supported in terms of career advancement among engineers. Once they have entered the engineering labor market, there are more similarities in career patterns between Caucasians and Blacks than between Caucasians and Asians. The results suggest that Blacks and Asians in engineering have divergent career paths.

In addition to documenting the development and growth of American engineering, *Doing Engineering* provides a review and critique of popular explanations for inequality in labor markets. Drawing on research and detailed analyses of employment and career history data, the book addresses the following questions:

2.1 Has the nation's engineering population become a globalized workforce?

Based on the trend and profiles of engineers, the engineering population is experiencing a slow, subtle demographic revolution. However, despite the significant increase of racial minorities and foreign nationals in engineering education and employment, Caucasians and the native-born are still the majority in the engineering workforce. A substantial proportion of Caucasians, Blacks, and Asians are employed in the Big Three: civil, electrical and electronic, and mechanical engineering fields. Separate analyses for the "Big Three" and "Other Engineering Fields" were conducted to examine patterns of racial differences in career achievements and advancement.

2.2 Is engineering a profession open to all talents?

Engineering is often perceived as an "open" profession in the United States, meaning that the only requirement for entering the field is technical ability. Yet, very few engineers work in either the private or public sectors without some kind of formal education. Equally important, there are no uniform state laws requiring mandatory licensing, certification, or registration for practicing engineering in the United States except in certain industries. However, one can register as a certified Professional Engineer (P.E.) in major fields such as civil (sanitary and structural), electrical, mechanical, and chemical engineering. Engineers with a P.E. license can certify engineering projects that affect public health and safety.

Since there are no formal barriers to entry, it would be interesting to find out if engineering is a career conducive to entrance for all. For example, do Caucasians, Blacks, and Asians enjoy similar chances of being employed in engineering? Because summary statistics hide differences in demographic factors, education, experiences, and other characteristics, without regression analysis it is impossible to draw any general conclusions about the relative employment statuses of these three groups in the engineering labor market. To answer this question, we must examine their probabilities in being unemployed, holding other relevant factors constant. Logistic regression was employed to predict the probability of being unemployed for engineers. The first model (model 1) predicts the likelihood being unemployed as a function of race. The results reflect the direct effects of race on the chances of being employed. The second model (model 2, full model) adds control for other demographic, geographical, human capital, and structural factors. We want to see how variations in these background and structural factors mitigate part of the zero-order racial differences in being unemployed in engineering.

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The finding that Black and Asian engineers have a relatively high likelihood of being unemployed does not sit well with the proposition that engineering is a profession open to those with similar credentials. This result has important implication for the minority engineering population. Engineering has traditionally been a favorite career choice among Asians in the United States. An engineering job provides prestige, high pay, and job security. For educated minorities, employment security may be the most important criterion for career selection, probably because of their perception or experience of labor market discrimination. However, engineering is a field with strong and close ties with the defense industry. Thus, substantial cuts in federal defense budgets mean fewer government orders for military aircrafts and weapons, and less public funds devoted to defense-related research and development than before. The era of downsizing has had a disproportionate impact on the engineering population. Many scholars have noted that structural changes generally have a greater impact on well-educated minorities than on Caucasians. Because of their recent entry into predominantly Caucasian-dominated professions, minority professionals would be most vulnerable during periods of economic recession. The finding that Blacks and Asians are more likely than Caucasians with comparable characteristics to be out of work in engineering corroborates this claim.

2.3 Do engineers have a stronger commitment to their professional community than to their employer?

In general, engineers have real professional identity. Those who perform primarily technical engineering work show a relatively high commitment to their professional community. The opposite is true for those who perform primarily managerial work. Several propositions are relevant to understanding differences in professional commitment among engineers: the ideology of professionalism, the ideology of management, the master of own house thesis, and the diversity thesis (Tang 2000:112-118). For instance, people may adhere to the ideology of professionalism if they cannot achieve their career goals. Downsizing and mergers have resulted in engineering layoffs and a shrinking middle management. To ease the transition to job losses or job changes, some companies adopt cost-cutting strategies such as geographical transfers, demotions, or outsourcing (i.e. rehiring former employees as independent contractors). As a result, many engineers face new challenges to job security and professional autonomy. To meet these challenges, engineers may be compelled to re-assert their professional standing in organizations. Identifying themselves as "engineers" may demonstrate their loyalty to the professional community—engineering—rather than to the organizational community—their current or prospective employers.

I also found racial diversity in professional commitment, especially in the private sector. There is more similarity in professional commitment between Caucasians and Blacks than between Caucasians and Asians. For some reasons, Asian engineers show relatively more attachment to their profession. This is especially the case for Asians who were born outside the United States. This finding is not totally surprising. Some scholars have noted that engineers in Asian cultures are held in much higher regarded than their counterparts in western cultures. Another explanation for Asians' relatively strong commitment to the professional community is that it is a manifestation of their blocked mobility in engineering.

2.4 How likely are members of a particular group to cross over the drawing board to become a manager?

Caucasians, Blacks, and Asians in engineering do not have similar probabilities of crossing over the drawing board. Minority and foreign-born engineers are less likely than their comparable Caucasian and native-born counterparts to be managers. Specifically, Asian engineers are the most likely to do technical work and the least likely to be in technical management or general management.

Additionally, Blacks and Asians in both the "Big Three" and "Other Engineering Fields" are less likely than comparable Caucasians to become a manager.

2.5 Has engineering become a hybrid career for all?

Engineering has *not* become a hybrid career. Caucasians, Blacks, and Asians do not have similar likelihood of track switching and backtracking.[3] For example, Blacks and Asians have relatively low tendencies of leaving technical engineering for management. Specifically, Asians in the "Big Three" are less likely than comparable Caucasians to switch track. Blacks in "Other Engineering Fields" are less likely than comparable Caucasians to leave technical engineering for management.

In general, Asians are less likely than Caucasians with similar backgrounds and characteristics to move from management to technical engineering. Asians in the "Big Three" are less inclined to backtrack relative to comparable Caucasians.

It is important to note that people switch track or backtrack for different reasons. I classify these reasons behind track switching or backtracking into four categories: personal, professional, structural, and cultural.[4] There are a variety of reasons behind the move from technical engineering to management. They range from personal development, to interests in working on nontechnical issues, to seeking tangible and nontangible rewards. However, having personal interests as well as the ability to enter management is necessary but insufficient to smooth track switching. Aspiring engineers also need a desire for professional (or career) development. A pushing force behind track switching also may be obsolescence of technical skills and knowledge. Track switching can occur as a result of external forces. For one, structural changes such as the emerging global economy have changed the way organizations conduct their business and activities. For example, to meet new and changing demands on the world market, professional workers may be temporarily (re-)assigned to managerial posts.

There are people who backtrack later on, too, for different reasons. After a period of trial and error, engineers performing managerial work may select themselves out of the "fast trackers." Some of these engineers-turned-managers may have found

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out after all that they are not "management material." For one, generally there is a relative heavy demand on personal time for managers. And taking care of "people issues" after all is not their "cup of tea." Some have lost their desire for being managers, due to adverse experiences on the managerial track. There are individuals who quit the managerial track due to demotions.

3. Implications for Policy Making and Research

The trend of declining interest in engineering education has done more than stimulate inflows of technical talent from abroad, it has also expanded the opportunities for racial minorities in this high-pay, high-status profession. The engineering field presents an interesting case for tracking racial diversity trends in the educated workforce. The results presented in *Doing Engineering* should be useful to policymakers who are concerned with efforts to encourage racial diversity in professional occupations. Although Black and Asian engineers may have overcome many barriers in the educational system, results of this comparative study show that Caucasians, Blacks, and Asians have not achieved a comparable rate of success in the occupational system. The problems and possibilities facing these minority engineers today may affect the career choices of those who contemplate similar careers. For instance, if Blacks are less likely than comparable Caucasians to get a full-time job in engineering, aspiring Black students might be discouraged from pursuing engineering careers. Similarly, if Asian engineers are less likely than comparable Caucasians to be in management, this phenomenon may perpetuate racial segregation in the engineering profession.

A relevant issue is the impact of affirmative action on the career attainments and mobility of various racial groups in engineering. The findings suggest that what current policies and programs (such as affirmative action or diversity) have been doing for Blacks cannot do the same for Asians. Structural forces have played themselves out differently for Black and Asian engineers.

Furthermore, results of this study have presented a paradox. Asians are faring better than Blacks in terms of getting into engineering. After their entry to engineering, however, Asians are not faring much better than Blacks in upward mobility. Policy makers tend to gauge the success of a group by how many of its members have gotten a job in a professional occupation or by how much money they make. When we move beyond these standard measures of achievements, the apparent success of Asians in engineering education, for example, does not continue in professional occupations. Ironically, it is difficult to imagine the achievements Blacks have demonstrated in engineering today as the excluded group they once were. However, it is important to note that since there are so few Blacks in this profession, we can make the argument that those who made it must be exceptional.

Given that the private sector employs the bulk of engineers, much of the career movement among engineers is expected to take place in business and industry. Their prospects for moving horizontally or laterally depend to a large extent on whether economic and structural changes would result in increasing or declining career opportunities. Trends of downsizing, for example, would intensify and expand competition for managerial positions. Some scholars have noted that minority professionals would face greater difficulties in improving their career achievements in tough economic times.

This study is a test of complementary theories with career achievements. I use conventional theories such as human capital models and structural theories to generate a number of hypotheses. Most structural approaches to the study of mobility conclude that minorities would achieve full assimilation in the labor markets when they have accumulated human capital endowments such as education and experience comparable to those of Caucasians. Results of this study do not fit these predictions. The findings challenge social scientists to adopt a more dynamic approach to studying career achievements of professionals (e.g., Tang, Jacobs, and Lai 2000). A multimethod approach would allow us to construct a more dynamic theoretical model. Future studies combining both quantitative and qualitative approaches would provide a more dynamic view of engineering careers. Researchers in future studies of engineering careers should also address the impact of gender on career attainment and mobility. Answers to questions such as "What is the interactive effect of gender and race on upward mobility?" would contribute to theoretical development in the field of stratification and mobility.

What forms of stratification, if any, are evident in the engineering profession today? Results suggest emergence of a tripartite division of labor in the engineering labor market. Caucasians, Blacks, and Asians are located in different positions in respective queues by virtue of different patterns of career mobility. The traditional Black-Caucasian dichotomy that dominates much of the literature can no longer capture the complexity of career mobility in engineering. This characterization of racial differences in professional occupations is drastically oversimplified.

Equally important, this study takes changes in primary work activity from "technical engineering work" to "managerial work" as an indicator of "career advancement." While the dichotomy (technical engineering work vs. managerial work) may indicate first-level promotion, it can conceal more than it reveals for career mobility of different racial groups, depending upon the scope or range of the managerial hierarchy within an organization.

What do the results tell us about the engineering career structure? Engineering is a dynamic professional field. Results of analyses on track switching and backtracking have shown that career mobility among engineers can no longer be adequately represented by entry into management. Career paths in engineering can take different forms and shapes. Moving back and forth between technical engineering and management work is not uncommon among engineers. Career mobility should not be equated with career advancement. We have seen that some ìmanagersî returned to technical engineering. Diversity in work tasks may become an emerging feature of engineering careers. The boundary between professional-technical and managerial ladders may become increasingly blurred. If this is the case, the conventional wisdom that technical engineering as a gateway to management and that occupation of managerial positions as the standard measure of career success is outmoded.

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I argue that "successful" engineers are those who can perform both technical and managerial tasks competently. Structural forces have strengthened the relationship between technical engineering and management. Empirical and theoretical evidence from this and other studies of engineers has suggested that because most of the engineers are salaried professionals, they do not enjoy a lot of professional autonomy and independence. Engineers are still relegated to subordinate positions in corporate settings.

4. Conclusion

Doing Engineering looks at stratification in engineering from the racial dimension. There is a racial hierarchy in the opportunity structure in engineering. The data reveal that career paths of Asians in engineering are different from those of Caucasians and Blacks. In spite of or because of Asians' concentration in the engineering workforce, there is no indication that Asians enjoy a comparative advantage over Blacks in various measures of career attainments and mobility.

As we move into a new millennium, the nation's economic competitiveness, to a large extent, depends on how we deploy scientific and technical workforce. It would be interesting to find out if we can observe similar or different patterns of racial differences across minority groups in science as well as in other professional fields (e.g., Tang and Smith 1996).

Acknowledgments

The author wishes to thank several reviewers for their comments on an earlier version of this article.

Notes

[1]In the article, for brevity, I use the term "Asians" to refer to "Asian Americans." Since the focus is on career achievements of Caucasians, Blacks, and Asians, the analysis was restricted to these three groups (native- and foreign-born, U.S. citizens and permanent residents). For detailed discussions of methodological issues, please refer to the Appendix section of the book (Tang 2000:211-214).

[2]Hispanics and American Indians are heavily underrepresented in engineering. However, the Hispanic population in the United States is a very heterogeneous group. It is not feasible to include Hispanics for comparison in this study. Additionally, the very small number of American Indians in engineering profession does not allow us to draw any meaningful conclusions from racial group comparisons. For these reasons, *Doing Engineering* did not examine the statuses of Hispanics and American Indians in engineering.

[3]Track switching refers to: (i) movement from technical engineering work to (a) R&D managerial work or (b) general managerial work; (ii) movement from R&D managerial work to general managerial work; or (iii) movement from general managerial work to R&D managerial work. Backtracking refers to: (i) movement from R&D managerial work to technical engineering work, or (ii) movement from general managerial work to technical engineering work.

[4]The data set provided by the NSF for analysis does not provide information on all of these factors. For detailed discussions of these factors, please refer to Chapter 7 of the book (Tang 2000:166-170).

REFERENCES

National Science Foundation. 1999. *Women, Minorities, and Persons with Disabilities in Science and Engineering: 1998.* Arlington, VA: National Science Foundation. (NSF 99–338).

Tang, Joyce. 2000. *Doing Engineering: The Career Attainment and Mobility of Caucasian, Black, and Asian-American Engineers.* Lanham, MD: Rowman and Littlefield Publishers, Inc.

Tang, Joyce, Jerry A. Jacobs, and Z. Lai. 2000. "The Career Mobility of U.S. Engineers: Stability and Change During the 1970s and 1980s." Pp. 169–193 in Helena Z. Lopata and Kevin Henson (eds.), *Current Research on Occupations and Professions, vol. 11.* Greenwich, CT: JAI Press.

Tang, Joyce and Earl Smith. Eds. 1996. *Women and Minorities in American Professions.* Albany: State University of New York Press.

About the Author

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PRESIDENTIAL AWARDS

On September 7, 2000, ten individuals and ten institutions received the 2000 Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring. The award is administered and funded through the National Science Foundation (NSF). Up to 10 individuals and 10 institutions annually may qualify for the national award, which includes a $10,000-grant and a commemorative presidential certificate.

Winners are listed below:

INDIVIDUALS:
Daniel L. Akins, City College of New York, New York, NY
James F. P. Cotter, University of Minnesota, Morris, MN
Vallie W. Guthrie, North Carolina A&T State University, Greensboro, NC
Glenn D. Kuehn, New Mexico State University, Las Cruces, NM
Juan Lopez-Garriga, University of Puerto Rico, Mayaguez, Mayaguez, PR
Abdulalim Abdullah Shabazz, Lincoln University, Lincoln University, PA
Carlos G. Spaht, II, Louisiana State University, Shreveport, Shreveport, LA
Michael F. Summers, University of Maryland, Baltimore County, Baltimore, MD
Luis P. Villarreal, University of California, Irvine, Irvine, CA
Maria Elena Zavala, California State University, Northridge, Northridge, CA

INSTITUTIONS:
American Society for Microbiology, Washington, D.C., Board of Education and Training—Clifford W. Houston
Committee on Institutional Cooperation (Big Ten), Champaign, Ill., Summer Research Opportunities Program, —Jean E. Girves
Humboldt State University, Arcata, Calif., Indian Natural Resources, Sciences and Engineering Program—Russell V. Boham
North Carolina State University, Raleigh, College of Engineering Programs for Minorities and Women—Sarah A. Rajala
University of Alabama at Birmingham, Office of Minority and Special Programs—Louis Dale
California Mathematics, Engineering, Science Achievement (MESA)—Michael Aldaco
University of Michigan, Ann Arbor, Women in Science and Engineering (WISE)—Cinda-Sue G. Davis
University of New Mexico, Albuquerque, Minority Engineering, Mathematics and Science (MEMS)—Maurice Thompson
Washington Mathematics, Engineering, Science Achievement (MESA)—Patricia M. MacGowan
Western Interstate Commission for Higher Education, Compact for Faculty Diversity—Ken Pepion

The David Blackwell and Richard Tapia Distinguished Lecture Series in the Mathematical and Statistical Sciences

By Melissa Castillo-Garsow

On May 7 and 8 of this year the David Blackwell and Richard Tapia Distinguished Lecture Series in the Mathematical and Statistical Sciences was established at Cornell University in Ithaca, NY. A conference, attended by both Blackwell, a professor emeritus of mathematics at U.C. Berkeley, and Tapia, the Noah Harding Professor of Computational and Applied Mathematics at Rice University, highlighted their contributions as well as those of a new generation of underrepresented minority mathematicians and statisticians. This lecture series was established to honor the accomplishments of both Blackwell and Tapia, two of the nation's most eminent mathematicians and foremost leaders in the scientific and research enterprises. This lecture series will provide a forum for highlighting the research of African-American, Latino, and Native American mathematicians and statisticians while promoting the increased participation of underrepresented minorities in mathematics and statistics. Carlos Castillo-Chavez, an organizer of the series, stated that, "First of all, we, the minority communities at Cornell University, would like to honor the mathematical and personal achievements of David Blackwell and Richard Tapia. We feel that it is critically important that current and future generations of African Americans, Latinos, and Native Americans, as well as current and future generations of non-minorities, learn and remember the achievements of these two extraordinarily talented and productive mathematicians. The establishment of this lecture series also recognizes their continuous efforts in creating, supporting, and maintaining opportunities for minority scientists, statisticians and mathematicians across the nation."

David Blackwell and Richard Tapia

David Blackwell completed his graduate studies at the University of Illinois at Urbana-Champaign in 1941. He was a member of the faculties of Southern University, Clark College, and Howard University, where he was chairman of the mathematics department before joining U.C. Berkeley in 1954. He has contributed to several areas of mathematics: set theory, measure theory, probability theory, statistics, game theory, and dynamic programming. He is a co-developer of the Rao-Blackwell theorem, which is important in estimation theory and tests of hypotheses. Blackwell is a former Vice-President of the American Mathematical Society and a former President of the Institute of Mathematical Statistics. He was elected to the National Academy of Sciences in 1965 and also is a member of the American Academy of Arts and Sciences. He is the recipient of numerous honors and awards, including the R.A. Fisher Award and the TIMS/ORSA John Neumann Theory Prize, and is an author of the classic book Theory of Games and Statistical Decisions.

Richard Tapia, born in Los Angeles to parents who emigrated from Mexico as teenagers, received his Ph.D. from the University of California at Los Angeles. In 1994, he was the first native-born Hispanic to be inducted into the National Academy of Engineering. He has contributed to mathematical optimization theory and iterative methods for nonlinear problems. His current research is in the area of algorithms for constrained optimization problems and interior-point methods for linear and nonlinear programming. Under Tapia, the computational and applied mathematics department at Rice has become a national leader in promoting women and underrepresented minority Ph.D. recipients in the mathematical sciences. His recent honors include: Lifetime Mentor Award, American Association for the Advancement of Science 1998; an appointment to the National Science Board by President Clinton, 1996; recipient of the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring; and selection as Hispanic Engineer of the Year by Hispanic Engineer Magazine 1996.

This new lecture series was estab-

lished at the initiative of Cornell administrators and faculty, Don Randel, provost; Robert L. Harris Jr., vice provost for diversity and faculty development and professor of Africana studies; Carlos Castillo-Chavez, director of the Mathematical and Theoretical Biology Institute and professor of biomathematics; and with the encouragement of President Hunter R. Rawlings III. Every two years, a distinguished African American or Latino mathematician will be chosen to deliver the lecture series and will receive a plaque honoring him or her as the David Blackwell and Richard Tapia Distinguished Lecture Series Speaker from the office of the President as well as an honorarium of $1,000 dollars. The lecture series is supported by Cornell's Center for Applied Mathematics and the Departments of Mathematics, Statistics, Biometrics, and Theoretical and Applied Mechanics. It also has the support of several deans. The members of the organizing committee were Joe Buhler, U.C. Berkeley; Abdul-Aziz Yakubu, Howard University; and Cornell's Harris and Castillo-Chavez.

The inauguration of the series began with a reception on May 7, followed by a lecture from Dr. Persi Diaconis of Stanford University entitled "Probability, Statistics and the Zeros of the Zeta function." May 8 provided an opportunity for up-and-coming African and Latino scientists to show their research in twenty-minute presentations on topics ranging from Quantum chaos in vibrating billiard systems to dynamics of two-strains of influenza.

There were an estimated one hundred attendees, with representatives from many universities including Cornell, Brown, Spelman, Maryland, MIT, Rice, Howard, Stanford, and Claremont along with representatives from the American Mathematics Association, the National Science Foundation (NSF), Texas Instruments, the Sloan Foundation, and Bell Labs.

A luncheon, also on May 8, was hosted by the eight Cornell-Sloan Graduate Student Fellows with invited speakers Dr. Denise Stephenson-Hawk, provost of Spelman College, and Dr. Albert Bridgewater, the senior science advisor of the NSF. Bridgewater, who spoke on increasing minority participation in scientific and technical careers, stated that, "the individual successes of Blackwell and Tapia changes the nature of the debate on under-representation of minorities in scientific and technical fields. Their careers starkly challenge others to do as well as they have done."

Richard Tapia gave a lecture after the luncheon on his research entitled, "If it is fast, must it always be Newton's Method?"

The inauguration of the David Blackwell and Richard Tapia Distinguished Lecture Series in the Mathematical and Statistical Sciences ended with a banquet at the Statler Hotel. Dr. Margaret Wright, the Department Head of the Scientific Computing Research at Bell Labs, honored Richard Tapia while Dr. James Donaldson, dean of the College of Arts and Sciences at Howard University, honored David Blackwell. Donaldson called Blackwell an "authentic legend" and noted how "Blackwell soared to magnificent heights in his profession during an era where repressive forces had thwarted the aspirations of persons of equal talent; he, through word and, especially, deed, has advanced opportunities in mathematics and science for all people, especially for those from disadvantaged groups." Castillo-Chavez commented that Tapia was a role model for him in graduate school while he was working toward his Ph.D. Even earlier, as an undergraduate, Tapia "served as an inspiration . . . and helped me to imagine myself as a mathematician because I knew there was at least one other person like me."

AAUW Educational Foundation International Fellowships

Women graduate students from countries outside the United States are invited to apply for a $16,860 fellowship from the American Association of University Women (AAUW) Education Foundation for study or research in the United States.

International Fellowships are available to women who are not American citizens or permanent residents. The awards support full-time graduate or postgraduate study in all disciplines for one year. For applications contact:

AAUW Educational Foundation
c/o Customer Service Center Dept. 141
2201 Dodge Street
Iowa City, IA 52243-4030
Telephone: 319-337-1716, x141
E-mail: www.aawu.org; http://www.aawu.org
The application deadline is December 15, 2000.

Ford Foundation Fellowships for Minorities

Approximately 60 predoctoral, 40 dissertation and 30 postdoctoral fellowships sponsored by the Ford Foundation and administered by the National Research Council are open to U.S. citizens or National who are Native American Indian, Mexican American/Chicano/ Alaskan Native/Native Pacific Islander, Black/African American or Puerto Rican who are planning a career in teaching and research at the college or university level.

Predoctoral —$15,500 to the fellow; institutional allowance of $8,500 for three years. **Application deadline of November 10, 2000.**

Dissertation —$24,000 for one year. **Application deadline of December 1, 2000.**

An Interview with
Dr.Harold Deutschman

By Virginia Van Horne, Senior Research Associate

Each issue of ***Making Strides*** *features a short interview with an underrepresented SME professor who has been instrumental in mentoring and encouraging students through the pipeline, as well as demonstrating leadership and outstanding accomplishments in the world of SME.*

This issue I had the opportunity to chat with Dr. Harold D. Deutschman, Professor of Civil and Environmental Engineering and Director of three pre-College programs at the New Jersey Institute of Technology (NJIT). Author of a number of refereed publications, Dr. Deutschman has received awards from the Consulting Engineers Council of New Jersey; the Presidential Award for Mentoring in Science, Mathematics and Engineering; the Allan Cullimore Distinguished Service Award; the American Society for Engineering Education Vincent Benedix Minorities in Education Award and the New Jersey Education Association Distinguished Service Award. As Director of Pre-College programs, he oversees the following programs: the High School Urban Engineering; the American Society of Civil Engineers Summer Institute for High School Minority Students; and US. Department of Transportation grant for High School Students Summer Institute. Dr. Deutschman is actively involved on the NJIT campus, serving as an Institute Member of the Pre-College Industrial Center, Secretary of the Faculty, Member of the Promotion & Tenure Committee, Member of Group Heads and Secretary of the Student Appeals Committee.

Dr. Harold Deutschman

What led you to civil engineering?

My father grew up during the Depression. As the eldest in his family, he was expected to forgo high school in order to bring additional income to the family. My mom, meanwhile, emigrated to the U.S. from Poland at age 13. She had to learn English and look for work. I grew up poor in the Bronx. My mom was a housewife and later worked as a sales clerk; my father was a salesman, and was quite good in mathematics. He encouraged me to take math courses and to work hard.

I grew up in the Sputnik era when Russia seemed Russia seemed to be light-years ahead of the U.S. in terms of science and technology. As a child and a teenager, I always did well in mathematics. Based upon my aptitude for math, my guidance counselor, as well as other various teachers, encouraged me to pursue studies in engineering. Fortunately, at that time, there was no charge to attend the city college university system in New York. At the very most, the fees were $6 a semester. Clearly, there was no question in my mind, nor in the mind of my parents, as to where I would be attending college. I entered the City College of New York (CUNY) in 1956, and graduated with a degree in civil engineering in January of 1961. I chose civil engineering because it dealt more with the public than the other engineering disciplines. I wanted to work with public agencies and to be in a field where I could see things being built and know that I had played an active role in it.

And?

After I graduated, I worked for about a year at the U.S. Army Corps of Engineering. Truthfully, I found my job to be a little constraining and boring. I had an opportunity to return to college. One of my CUNY professors told me there was a teaching assistantship at the University of Missouri, Columbia. I had never been away from New York and I thought this would be a very nice change.

I received my Master's degree in Civil Engineering from the University of Missouri, Columbia in August of 1962. Being in a new environment, especially one outside of New York, was a very positive and enjoyable experience for me. Somehow, it was freer and easier; it opened my eyes. It was while I was in Missouri that I realized I wanted to pursue a career in academia as a professor.

Where next?

From there, I obtained a fellowship from Northwestern University.

How did you obtain this fellowship?

One of my professors from the University of Missouri had referred meópaving the way for me. My fellowship began in September of 1962. Financially, it was a very good situation. I was able to work on my Ph.D. in Civil Engineering and I met students from all over the country.

After finishing all of my coursework I learned about a start-up regional transportation-planning agency in New York City called the Tri-State Regional Transportation Planning Agency. This agency was charged with planning the transportation needs for New York, New Jersey and Connecticut. At that time, the field of transportation planning was receiving tremendous publicity. It was the first transportation agency in the NY metropolitan area. I saw it as a tremendous opportunity to return to my home state.

Tell us more about working for the Tri-State Regional Transportation Planning Agency.

I was able to work for this agency and pursue a project that would lead to my dissertation. My project focused

on how people move—what factors push them to move, where they move to, and how transportation was a factor in deciding upon that residential location. Throughout my tenure at this job, I remained in constant contact with my advisor at Northwestern. I worked for this agency for five years and returned to Northwestern in 1969 to defend my dissertation.

After about 7–8 years, there was some feeling that the agency was too large (200 employees) and that it should be reduced in size by splitting it into agencies that could function within each of the states, thereby allowing each state agency to be more responsive to local needs.

I also went through incredible personal life changes during this time period. I got married and we had two kids.

What happened after you defended your dissertation?

I'm beginning my 33rd year at NJIT. One of my closest friends from CUNY had been teaching at NJIT, an urban college in Newark, NJ, for about two years. He really enjoyed it and we thought it would be great to teach together. I applied and began teaching in September 1968. The student body was growing. The college was changing dramatically and undergoing a transition from a suburban environment to an urban environment. It had made a commitment to the community to seek out minority students. Having grown up poor, yet, having been given opportunities, I knew, firsthand, that one could excel when given the chance to do so. I saw an opportunity for the school and for myself to really get involved in bringing in minority students—African Americans and Latinos. And, I wanted to take a leadership position in this area.

Describe the program you initiated.

Our pilot program began in the summer of 1969, bringing in juniors and seniors from local high schools. We wanted to see how the students would respond to being on a college campus. Would they be able to take the necessary coursework to enter into a technical program in engineering? With the help of a few volunteer faculty and limited resources, this turned into a successful program.

How did you identify the students for the pilot program?

We contacted the local high schools and asked them to select the students. We ended up with 30 students. Due to the success of that pilot program, I submitted a proposal to NSF. We were funded! Local high school students began feeding into our special summer programs. By having NSF funding, I was able to meet with other Principal Investigators and exchange ideas.

And, now?

I work with both undergraduate and graduate students. Throughout the years, I have also stayed in touch with other precollege programs at NJIT. What started as one NSF-funded program has developed into 13 programs, with 1,000 students with a host of faculty and administrators. We have a major center for precollege programs, funded by industry as well as government.

While the students come from a variety of socioeconomic backgrounds, they are brought together with the common goal to study, participate, and do something with their lives. Each summer we ask the students to write a short essay about their own personal hero. Although I've been involved with students for 30 years, their essays still profoundly affect me. Many of the students had picked their mothers as their heros; this propels me. I can't describe to you how special and wonderful it is to meet the students' mothers at the end of the program.

I teach during the academic year, more undergraduates than graduates. I generally have one or two students who have participated in the precollege program in one of my classes. I also advise students and recruit students.

Tell us about your department.

The department graduates close to 45-50 students in civil engineering a year. There is tremendous interaction with our students; we get to know each student really well. By senior year, many of our students have job offers. We also offer intern and co-op programs. About 50% of the university is focused engineering. Over the past few years, we've had a tremendous movement toward computer science and IT .

Were you surprised to have won the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring?

Actually, this was the second time I was nominated. I received the award in December, 1999.

Is it safe to assume that you really enjoy these summer programs?

The summer is very special to me as I have more time to I interact with the students. Every day from 9:30 to 4:00 (including lunch) for five weeks I get to know them. The students who participate in my program have just completed their freshman year of high school. They apply to the program and are interviewed. My standard "spiel" is to tell them how important it is to be on time and be responsible. If a student comes late, they are required to write an essay and give a speech. Can I just tell you that these students are always waiting for me to be late for any reason!

How do students learn about these precollege programs?

We contact every high school in the greater Newark area, word-of-mouth is the primary venue. Students are required to complete an application, maintain a B or better grade point average, and submit letters of recommendation from a math teacher, a science teacher and a counselor. We interview the students in small groups and try to assess how they would fit in and if they would function well. The cost of the program is $75. However, in many instances this fee can be waived.

Once students come out of this program, they can enter the engineering bridge program (doing college-level physics and design). Hence, we could have the same student returning to NJIT for three summers, participating in a different program each time.

Thank you, Dr. Deutschman.

For additional information please visit: www.njit.edu/PreCollege/.

A Profile of an AGEP Institution: Howard University

By Cynthia E. Winston, Ph.D., Program Coordinator Director

Howard University's commitment to producing Black Ph.D.'s in the field of science is not new. As early as 1955, the first Ph.D. program at the university was created in Chemistry (Thompson, 1955). The visionary for the development of a Ph.D. program in the sciences at Howard University was President Mordecai Wyatt Johnson (1926-1960), Howard University's first Black president. Although he had initially hoped to build a Ph.D. program in zoology around the internationally renowned biologist, Dr. Ernest E. Just, it was determined that Chemistry was a more promising field at the time. In the field of Chemistry, President Johnson had been able to recruit Dr. Percey L. Julian, an organic chemist who had earned his Ph.D. at the University of Vienna. President Johnson also went to Congress to get the money to improve Howard University's facilities and decided to use this money to build a Chemistry building (Personal Communication, Winston, 2000). The specifications for this building, one of the finest chemical research and instructional facilities in Washington D.C., were provided by Dr. Julian. This landmark, at the time the largest science facility accessible without discrimination to Black scientists, was inaugurated with a speech delivered by President Franklin D. Roosevelt.

Although Dr. Julian was the head of the department in the early 1930's and developed the plans for chemistry building, Dr. J. Leon Shereshefsky, a distinguished physical chemist who worked on the Manhattan Project (which produced the first atomic bomb), was Head of the Chemistry Department at the time the Ph.D. program in Chemistry was approved.

Again in a recycling of history, Howard University's current President, H. Patrick Swygert, is committed to continuing that legacy of leadership in the sciences and is examining ways in which Howard University can upgrade its science facilities and enhance the institution's research infrastructure.

Howard University, the largest on-campus producer of Black Ph.D's in the entire nation, is a leader in graduate science education. However, as much progress as this represents, it is not time for celebration. In science, mathematics, and engineering (SME) Howard University produces an average of 10 African American Ph.D.'s per year across 15 science, mathematics, and engineering departments. In light of the national need for additional scientists and the underrepresentation of racial minorities, this is a small number. Thus, while Howard is a leader it must—and can—do better.

Improvement is critical, particularly at a time when advances in science and technology are having a profound effect on the country's current economic growth and prosperity. Moreover, they are quickly changing the way in which people live, work, and learn. Given the increasingly important role of science and technology in society, coupled with the "digital divide" that impedes access to information, the motivation and preparation of African American students and students from other undrerepresented minority groups to master and excel in these fields is of paramount importance to their economic future and that of their the nation.

With the generous support from the National Science Foundation (NSF) and the commitment from the highest level of the administration, the Howard University Alliances for Graduate Education and the Professoriate (AGEP) program is striving to increase by at least 50%—from 10 to 15—the number of African American and other undrerepresented minority Ph.D.'s Howard University produces in science, mathematics, and engineering. The university believes that this goal can be reached through a strong programmatic focus on student development, training, research, mentoring, and other academic & non-academic support. In the last 24 months, a tremendous amount has been learned about the challenges, rewards, and promises of such a program.

Lessons Learned, Priorities, and Future Directions

Retention and Mentoring Program

In Howard University's original grant proposal to NSF, there was a brief description of a retention and mentoring program that would be a significant part of the AGEP initiative. The university would commit, from its own resources, a position for a Director of Retention and Mentoring in the Graduate School. This person would focus solely on providing retention and mentoring academic support for graduate students and faculty.

In the first year of the AGEP program, a retention and mentoring program was developed based upon the existing literature, experiences of faculty and others, and what is known about best practices in general. In addition, SME doctoral students taught us a tremendous amount about what they needed from a retention and mentoring program, especially in the first year of graduate study.

We learned that they needed the following support systems, all of which we have built into our Retention and Mentoring Program:

1. Assistance with facilitating a match between the graduate student and a research mentor.

2. A person and place where students could go when they experienced problems, frustrations, disappointments, and victories with their research mentors and in their classes. It made a difference to them that this person resided in the Graduate School which students consider a neutral place (not in the department or research laboratory). This creates a safe space.

3. Formal periodic progress meetings and skill building & professional development workshops.

In general, the Retention and Mentoring Program offers a comprehensive program of services to science, mathematics, and engineering (SME) doctoral students including monitoring, academic support, and career development (Ellison & Winston, 2000). This program, however, is designed not only to support students' educational and career goals, but also to help make graduate school an intellectually exciting, enriching, and rewarding experience.

The guiding philosophy of this program is to provide all students the opportunity for academic success and not for failure. It creates and supports student learning and talent development. Thus, the program is built upon a foundation, which "overdetermines" the success of students by offering them rewarding educational opportunities through mentoring and academic support. This should also enhance their retention and academic success. An individualized academic and research program of study takes into account students' academic strengths and weaknesses, existing competencies, and career interests. Students should, therefore, be empowered to obtain the greatest possible benefit from their graduate education by acquiring the necessary skills and knowledge base to effectively compete within their respective fields, complete their departmental program of study, perform exceptionally well, and earn a Ph.D. in science, mathematics, or engineering.

Partnering

We have learned also that partnering is the key to successful recruitment and retention of students. Historically Black Colleges and Universities (HBCU's) have a long tradition of collaborating in various ways to ensure the success of their students. Thus, from the inception of the AGEP program and prior to NSF requiring the formation of alliances, Howard University's AGEP program sought out partners from the leading HBCU's and Hispanic Serving Institutions in the production of baccalaureate degree recipients in science fields. These partnerships have taught us a lot about the following:

1. How to interest and motivate more students to pursue a Ph.D. in an SME field.

2. There is a strong desire of many faculty and administrators at Howard's AGEP Partner Institutions to learn more about what can be done to strengthen, refine, and change the science and mathematics curriculum and course offerings at the undergraduate level in order to make students even more competitive at the graduate level.

3. The substantial talent pool of science and mathematics majors at Howard's AGEP Partner Institutions with 3.5 GPA's and above who have no plans after college graduation.

4. The need to inform talented and promising students about the rewards and myths related to pursuing a Ph.D. in SME fields.

Thus far, we have attracted over 40 students from our 14 AGEP Partner Institutions to come to Howard University for participation in the AGEP Summer Research Program. We currently have nine students from our AGEP Partner Institutions who receive AGEP graduate fellowships for doctoral study and who also participated in our research program during the summer before their senior year.

Engineering: Strategic Focus 2000/2001

One area in which the Howard AGEP program needs improvement is recruitment in the field of engineering. Currently, only one graduate student is supported by an AGEP fellowship is in engineering. This student was in the 1999 AGEP Summer Research Program. Thus, for the 2000/2001 academic year, one major strategic focus of the AGEP Program is the recruitment of engineering students.

Towards this end, the AGEP program is the beneficiary of the services of a recent environmental engineering Ph.D. recipient, Dr. Nora Savage, from the University of Wisconsin. Dr. Savage, a post doctoral fellow in the Graduate School, is taking the lead in developing an engineering strategic plan with the consultation of engineering faculty at Howard University, faculty at other leading engineering schools, and the Graduate School's Office of Enrollment Management. Although this strategic plan is in the early stages of development, it centers on identifying the following:

1. The factors that impede or deter students from pursuing engineering graduate degrees (e.g. the lure of high paying industry jobs after earning a baccaularate degree).

2. The strategies that have been employed at institutions that have been successful in producing a relatively high number of underrepresented minorities who seek graduate degrees in engineering.

3. The role of faculty in recruiting engineering students.

A Set of Complex Issues

Overall we have learned that there are complex issues related to the recruitment and retention of underrepresented minority students. As we look ahead to the next three years of

the program, we hope to build upon the foundation we have developed, to respond to many of the lessons learned in the first two years, and to infuse a sustained change in our institutional culture in SME departments. Among the complex issues in recruitment and retention are the following:

1. Parents' and families' aspirations have a profound influence on the educational and career decisions of underrepresented minority students, many of whom are first generation college graduates. For example, parents, grandparents and others must be convinced that the Ph.D. is just as good of an option for their child as the M.D.

2. The same social ills—poverty, incarceration, the shrinking pool of African American men pursuing higher education—that affect the African American community in general touch these students lives. Decisions to pursue a Ph.D. requires the careful weighing of not only academic achievement and promise, but present life and family circumstances, financial needs, pressures from the family, and future considerations.

3. It is a different world. For all students, regardless of ethnicity, graduate school is a daunting place. It is simply not, as one of my colleagues from NSF frequently reminds students, "a warm and fuzzy experience." It is characterized by many unarticulated requirements, dependency on primarily one person (research mentor) whose decisions to provide or not provide certain skills, training, and experiences largely determines one's graduate school success and that of the early professional career. There are probably more unknowns than knowns in confronting the graduate school experience.

Conclusion

In almost two years we have learned a tremendous amount, particularly that there is a lot more work that needs to be done to change the culture of our institution and that of others to recruit and retain underrepresented minority students in SME fields. However, it is particularly significant that NSF and many others in the country are dedicating their financial and human resources to increase the number of underrepresented minorities in SME fields. The AGEP program allows Howard University to continue its tradition of producing underrepresented minority scientists. The university's mission, as well as the very prosperity of the future of the nation depends on it.

For further information, please visit: *www.founders.howard.edu/gsas/mge/*

References

Ellison, C. & Winston, C. (2000). The Howard University Retention and Mentoring Program: Placing Students at Promise. Washington, DC: Howard University.

Thompson, C. (1955). Annual Report of Howard University Graduate School. Washington, DC: Howard University.

Winston, M. (2000). Personal Communication.

Making Strides is a quarterly (January, April, July, and October) research newsletter published by the American Association for the Advancement of Science, Directorate for Education and Human Resources Programs. Its purpose is to share information about minority graduate education in the fields of science, mathematics, and engineering. It is available in print and electronic format. Inquiries, information related to AGEP, and all correspondence should be sent to the editor.

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Fellowship Annoucement

Virginia Tech ABD Fellows Program for Minority Doctoral Students Academic Year 2001/02

The ABD Fellows Program is a program to recruit and mentor new faculty members. The purposes of this program are:

To provide young professionals with an opportunity to be mentored by experienced faculty, to make progress on the dissertation, or to advance research past the dissertation.

ABD fellows will teach a course during the term of the fellowship, usually in the second semester. Fellows will deliver a minimum of one seminar on their research. The stipend is $25,000. **Applications are due the first week of January 2001.** Applications received after that date will be considered only if openings become available. Applicants will be notified by the first week of March 2001. For more information contact: Dr. M. J. Reifsnider, Virginia Tech Graduate School, 213 Sandy Hall (0325), Blacksburg, VA 24061. E-mail: fellows@vt.edu. Telephone: 540/231-9549, Fax: 540/231-3714.