1988 Report of the Task Force on Minorities in Mathematics

MAA

MATHEMATICAL ASSOCIATION OF AMERICA

The Mathematical Association of America

1988 REPORT OF THE TASK FORCE ON MINORITIES IN MATHEMATICS

The Mathematical Association of America

1988 REPORT OF THE TASK FORCE ON MINORITIES IN MATHEMATICS

NOVEMBER, 1988

TABLE OF CONTENTS

LIST OF ACRONYMS USED IN THIS REPORT

Throughout this report there is mention of a number of organizations in the mathematics and science community. These organizations and their acronyms, as used in the report, are as follows:

AAAS	-	American Association for the Advancement of Science
ACM	-	Association for Computing Machinery
AMATYC	-	American Mathematics Association for Two-Year Colleges
AMS	-	American Mathematical Society
CBMS	-	Conference Board on the Mathematical Sciences
JPBM	-	Joint Policy Board on Mathematics
MAA	-	Mathematical Association of America
MSEB	-	Mathematical Sciences Education Board
NAM	-	National Association of Mathematics
NAST	-	National Association of Science Teachers
NCTM	-	National Council of Teacher of Mathematics
ORSA	-	Operations Research Society of America
SIAM	-	Society for Industrial and Applied Mathematics
TFMM	-	Task Force on Minorities in Mathematics
TIMS	-	The Institute of Management Sciences

ACKNOWLEDGMENTS

The members of the Task Force on Minorities in Mathematics thank the Mathematical Association of America for initiating this endeavor and making their vork possible. The Task Force also acknowledges the prior MAA efforts, especially the Blacks and Mathematics Program, undertaken to assist in ameliorating the under-representation of minorities in mathematics and related fields. It acknowledges, too, the wisdom of the Association in establishing this Task Force at a crucial juncture in the changing demographic development of American society. This is a critical time for devising programs which enhance and improve mathematics education for minorities, and which increases their participation more broadly in the mathematical sciences.

The Task Force also publicly acknowledges its appreciation to The Ford Foundation for its financial assistance which enabled the Task Force and its committees to prepare its final report. None of the findings or recommendations of this report reflect the opinions or attitudes of The Ford Foundation personnel.

PREFACE

"Educators Alarmed by Growing Rate of Dropouts Among Hispanic Youth" (*Nev York Times*, 3/5/87)[1]

"College Outlook Grim for Blacks 25 Years After Barriers Fell" (*Chronicle of Higher Education*, 9/2/87) [2]

"Many Minority Teachers Plan to Quit, Poll Finds" (New York Times, 10/5/88) [3]

"Black Students Cite Finances as Chief Reason for Dropping Out, …" (*Chronicle of Higher Education*, 9/2/88) [4]

"Doctorates Earned by Blacks Decline 26.5 Pct. in Decade" (*Chronicle of Higher Education*, 2/3/88) [5]

"Panel Urges Colleges to Boost Production of Minority Scientists" (*Chronicle of Higher Education*, 6/15/88) [6]

"Blacks, Hispanics Fall Behind Early, MD. Math Study Says" (*The Washington Post*, 7/13/88) [7]

"Negative Peer Pressure Said to Inhibit Black Student Achievement" (*Education Week*, 3/25/87) [8]

'Neglect of Minorities Jeopardizes Future U. S. Prosperity" (*Chronicle of Higher Education*, 5/25/88) [9]

These are just a few of the headlines which have appeared in various newspapers since the MAA Task Force on Minorities in Mathematics began its work in February 1987. They reflect the issues and problems inherent in the mathematics education of minorities. Hardly a day goes by that we do not see or hear of situations which cry out for the improved skills and enhanced knowledge of our minority populations in this country. These skills and knowledge are needed to help improve the quality of life of minorities. They are essential if our country is to remain a leader in scientific, engineering and technical fields. These skills are also critical if our country is to maintain a viable competitive position in an increasingly international economy. The MAA has before it an exceptional leadership opportunity to help remedy this situation, especially as it relates to mathematics education.

Although the subject of this report relates to the field of mathematics alone, it must be stated at the outset that the formation of mathematicians, mathematics teachers at any level, and mathematically-literate people, occurs necessarily in an educational system. It must be noted that an education within that system will not be truly effective, especially for those who are considered

"minority," unless the students acquire a sense of their own worth and of the worth of others. (See Appendix A.) This also implies that the student's educational experience should be approached from the standpoint of general student development. This means that underlying developmental and social issues, as well as the acquisition of particular knowledge, must be addressed. (See Appendix B.)

The task of improving the mathematical education for minorities in the United States is similar to that for all students. It calls for recognizing, nurturing, motivating and developing intellectual talent to its fullest potential. While it is impossible to always recognize mathematical talent and leadership qualities during the early years, it is possible to conduct programs which sensitize and energize students to think about and get involved with mathematics in deeper ways. The MAA must encourage its members to work with minority students with the same enthusiasm and dedication they use with students who are identified as gifted and talented.

The MAA is an organization which focuses its attention on collegiate mathematics, and on what a national professional association can do to improve that sector of the mathematical community. However, it was the charge of this Task Force to consider issues of mathematics education for minorities at "all levels from kindergarten through graduate school." However wise this may have been, it has not been possible within the time constraints of the Task Force and its limited financial resources to consider all of the relevant issues through all grade levels. It is the opinion of the Task Force that this would have taken full-time staff, significant monetary resources, and considerable consultation with teachers, mathematics supervisors, leaders of school systems, directors of intervention programs to benefit minorities, private organizations supporting minority programs, and other associations throughout the country. Funds were not available to support an endeavor of this magnitude.

EXECUTIVE SUMMARY

In February 1987, the Mathematical Association of America established its Task Force on Minorities in Mathematics. This report reflects more than 18 months work by the 42-member Task Force and its four operating committees. Dr. Louise Raphael, Professor of Mathematics at Boward University, has chaired the Task Force.

Its charge was "to make recommendations to the officers and Board of Governors of the Mathematical Association of America on what MAA can do to help improve the mathematics education of Black, Hispanic, and Native American students at all levels from kindergarten through graduate school."

Headlines in several newspapers since the Task Force's establishment point to the many issues of mathematics education for minorities, … "Colleges Outlook Grim for Blacks 25 Years After Barriers Fell" …, "Panel Urges Colleges to Boost Production of Minority Scientists" …, "Neglect of Minorities Jeopardizes Future U. S. Prosperity" …, "Many Minority Teachers Plan to Quit"…. All of these, in their own way, call for the recognition, nurturing, motivation, and development of minority intellectual talent to its fullest potential. They also led the Task Force to conclude that the MAA must encourage its members to work with minority students with the same enthusiasm and dedication they use with students who are identified as gifted and talented in mathematics.

The numerics of the problem is that a teaching force of approximately 192,000 (predominantly white), employed in elementary through graduate schools and with varying degrees of teaching and mathematical qualifications, has the stupendous task of providing first-rate mathematics education to approximately 12.8 million minority students.

The development of one of America's richest and relatively untapped human resources, its minority population, through a program designed to improve the mathematical skills of minorities would benefit not only the minority students and their community in general, but also the mathematical community. Ultimately, this development would affect the future prosperity of U. S. business and industry, as well as the economic future of our country.

As the Task Force proceeded through its deliberations, it decided to examine three principal areas of concern that would have to be addressed for any national program to improve mathematics education for minorities. These were: (1) MAA internal operations; (2) collaborative endeavors; and (3) innovative intervention programs. The more than 40 recommendations in the report are grouped under these three categories.

There are certain priority recommendations vhich the Task Force feels deserve immediate attention by the Association. These refer to:

- the development and wide distribution of a policy statement with respect to mathematics education and minorities, and the declaration that a national program to match the magnitude of the problem is a top priority of the Association.

- the appointment of a standing Committee on Minority Participation in Mathematics.
- the establishment of an Office of Minority Participation in Mathematics along with methods for financing such an office.
- and, the need for collaborative efforts, especially with other mathematical organizations, corporations, and government agencies at local, state, and Federal levels.

The report calls for the reestablishment and revitalization of the previous Blacks and Mathematics program as well as numerous ways to increase the participation of minorities in all facets of the work of the MAA. It calls for new initiatives by the MAA Sections, a National Meeting Assistance Fund, closer ties with the historically black institutions, greater participation by minorities on all MAA committees, and special attention to the first two years of collegiate mathematics.

The report also spells out ideas to increase minority participation as associate editors and referees for MAA journals, wider participation in the Visiting Lecturer and Consultant programs, and the involvement of more minority students in the American Mathematics Competitions. There are ideas about collaborative efforts with other organizations, how to establish new innovative intervention programs, and how to develop standards for such programs. The Joint Policy Board for Mathematics is called on to use its Office of Government and Public Affairs to increase awareness of minority concerns at national and state levels.

This report is not the end of a lengthy, concerted effort to solve the many problems of the mathematical education of minority students. It is one goal achieved at the beginning of a new impetus and renewed commitment by the MAA to enhance opportunities in mathematics and related fields for all students, especially those from the currently underrepresented Black, Hispanic, and Native American minorities.

The MAA is the appropriate organization to take a leadership role in working toward relieving the current crisis in mathematics education for minorities. MAA members must begin to see their participation in the solution of the special problems of mathematics education for minorities as an urgent and legitimate part of their professional responsibility and development.

BACKGROUND

In February 1987 the MAA established a Task Force on Minorities in Mathematics. The Task Force was given the following charge:

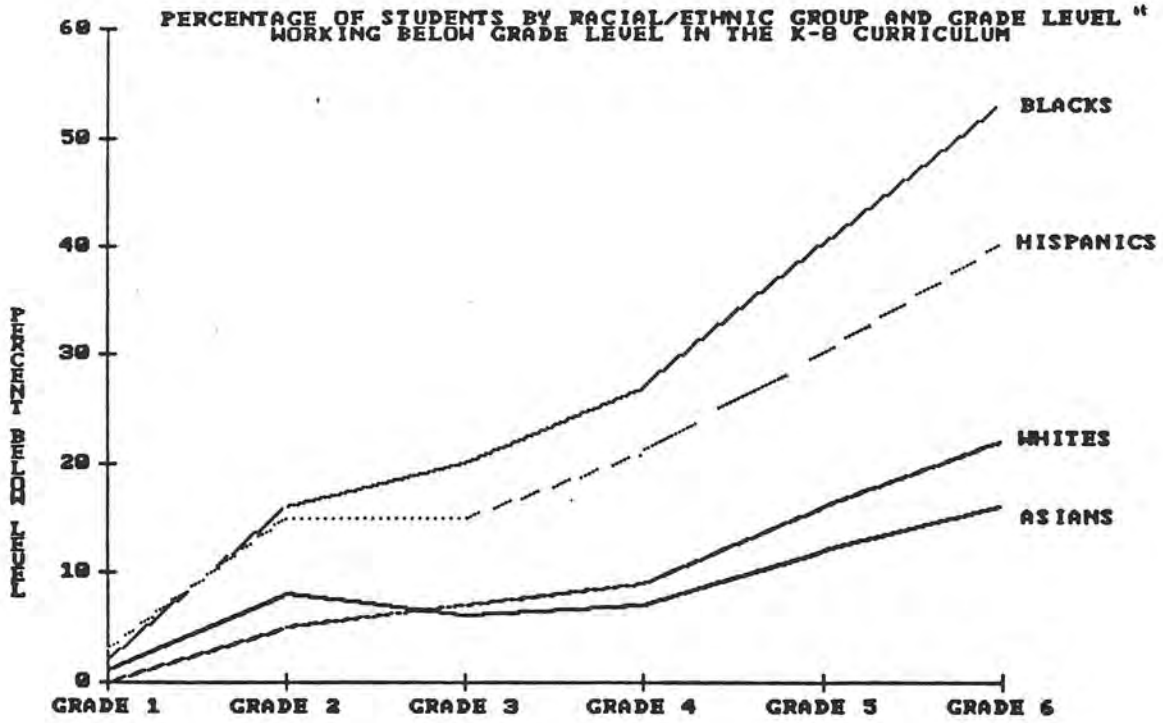
> "To make recommendations to the officers and Board of Governors of the Mathematical Association of America on what MAA can do to help improve the mathematics education of Black, Hispanic, and Native American students at all levels from kindergarten through graduate school. The Task Force's recommendations should be broad in scope and should include plans both for building on the successful work of the MAA's Blacks and Mathematics program (BAM) and for establishing effective collaboration with other national efforts aimed at increasing minority involvement in mathematics and mathematics-related disciplines. The Task Force's recommendations should be action-oriented and should contain detailed plans for implementation."

The 42-member Task Force organized itself with an executive committee and four operations subcommittees: a Committee on Local and Regional Action, a Committee on Collaboration, a Committee on Recognition, and a Committee on Creating Awareness. (See Appendix C for a list of Task Force members and the subcommittees and their charges.)

This report reflects more than 18 months work by the Task Force. (See Appendices D, E, and F.) The Task Force was aware of the immensity of its charge from the beginning. It could have said that this was an impossible task given its limited time frame and restricted financial resources. However, the crisis situation with respect to minorities in mathematics which now exists in this country could not be ignored any longer and demanded immediate attention and recommendations for action by the MAA.

The wisdom of the charge to start with kindergarten is reflected in the Montgomery County Public Schools' recent, in-depth report, *Participation and Performance of Women and Minorities in Mathematics*.[10] This report notes dramatic differences in participation and performance in mathematics by Black and Hispanic students which appear as early as the primary grades. Furthermore, once students fall behind in their progress in the mathematics curriculum, they are likely to remain below their grade level in the following years. (See Chart 1 on next page.) The Task Force has seen other reports that indicate this is a national phenomenon.

CHART 1



Report of Montgomery County Public Schools

SOCIETAL DYNAMICS

Magnitude of Problem

The magnitude of our current situation with respect to the mathematics education of minorities is reflected primarily in figures of student enrollments and the number of mathematics teachers.

ENROLLMENTS - 1986
(in thousands)

	Elementary & Secondary Schools		Institutions of Higher Education			
			Undergraduate		Graduate	
White	28,957	70%	8,552	79%	1,132	79%
Black	6,622	16%	995	9%	72	5%
Hispanic	4,064	10%	569	5%	46	3%
Native Amer.	356	1%	84	1%	5	1%
Asian	1,158	3%	394	4%	43	3%
Non-Residents			204	2%	136	9%
TOTAL	41,157		10,798		1,434	

Center for Educational Statistics, U. S. Department of Education.

We are concerned therefore with approximately 11,041,500. minority students on the elementary and secondary levels; 1,648,000 at the undergraduate level; and 123,000 at the graduate level.

With respect to teachers, The Education Information Branch of the U, S. Department of Education reported that for 1983 (latest figures available) there were the following numbers of mathematics teachers at the elementary and secondary levels:

Mathematics Teachers - 1983

	Public	Private
Elementary	17,500	3,300
Secondary	111,400	14,800
TOTAL	128,900	18,100

It is estimated that there are an additional 45,000 full and part-time mathematics faculty in our colleges and universities.[12]

At the elementary and secondary levels, the percentage of minority teachers from grades kindergarten through twelve decrease from 11% to 4%.[13] On the collegiate level, no more than eight percent of the faculty are from underrepresented minority groups.[14]

This teaching force of 192,000, elementary through graduate school, which is predominantly white, and with its varying degrees of teaching and mathematical qualifications, has the stupendous task of providing first rate mathematics education to approximately 12.8 million minority students.

Changes to Come

We are entering a period of profound and dramatic change. To cite some of the major change ahead, by the year 2000:

- One out of every three persons in the United States will be Black or Hispanic.[15]
- Eighty percent of the new entrants to the labor force will be minorities, women, and new immigrants.[16]
- Forty-two percent of the children in the school-age population (K–12) will be minorities.[17]

According to one major report, "The United States must renew its commitment to the advancement of minority groups or jeopardize the future prosperity of the nation."[18]

Eric Bloch, Director of the National Science Foundation, has stated that "… there is no problem that is more important, because without more participation from these groups [minorities], we cannot possibly meet our needs for trained technical and scientific personnel in the decades ahead."[19]

In mathematics, of 730 doctoral degrees conferred in the mathematical sciences as recently as 1986, 3.8% were awarded to Blacks and Hispanics (none to Native Americans).[20] The statistics for 1987 graduates and projections for future years are similar.

For those mathematicians who are about to retire, there is another demographic statistic that is most interesting. In 1950, 17 workers paid the benefits of each social security retiree. By 1992, only three workers will provide the funds for each retiree and one of the three workers will be a minority.[21]

If U. S. industries are to compete successfully in a world economy in which high technology prevails, they must be able to draw on a well trained pool of mathematicians, scientists and engineers. This need to expand the pool of mathematicians, scientists and engineers for U. S. industries is the national economic justification for a program to improve the mathematical knowledge of minorities.

The failure to develop our human resources as effectively as do other nations is cited in the report of the President's Commission on Industrial Competitiveness as one of the main causes for the decline of U. S. competitiveness.[22] This failure is reflected in the fact that the percentage of U. S. undergraduates majoring in mathematics, science and engineering has been declining since

1972.[23] As a result, U. S. industry's competitiveness continues to be constrained by the limited pool of U. S. mathematicians, scientists and engineers with competence in the current and emerging math-dependent technologies.

A recent issue of *Business Week* carried a special section devoted to human resources in the United States labor pool. It stated that many workers do not possess the necessary communication and mathematical skills to fill some available positions, and possible new positions that will be created in the twenty-first century. The series of articles reported the necessity to utilize all available human resources. These resources clearly include the present generation of minority students in mathematics and science.

The development of one of America's richest and relatively untapped human resources, its minority population, through programs designed to improve the mathematical skills of minorities, would benefit U. S. industry, minority students, and the mathematical community.

Our industries would benefit by an increased participation of minorities in the scientific and engineering work force in high-technology industries. Minorities would benefit through an increased share of the economic benefits flowing from the emerging technologies. The mathematics community would benefit by maintaining the prominence of America's high international standing in mathematics, as well as by providing mathematics educators for the upcoming generation.

Concern Within the Mathematical Community

If mathematicians do not determine the direction of educational change in mathematics for minorities, who will? The Task Force believes that many of the current intervention programs aimed at improving the mathematical education of minorities fail because they do not involve mathematicians. The mathematical community must assume responsibility for the mathematics education of all students, including minorities. And it may be noted, programs which effectively address the educational needs of minorities generally provide insight into better ways to teach all students.

An immediate concern of the MAA is the dwindling pool of potential mathematics majors at the collegiate level, College eligibility and retention rates for minority students are substantially lower than those of majority students. In future years, many entering freshmen will be from minority groups. It is critical to increase the number of these students who perform well in mathematics at the high school level. Pre-college course work in mathematics (illustrated in the table below) points to the need for collaborative efforts among professional societies, universities, school systems, industry, and government agencies to motivate pre-college youth to study mathematics and science.

CHART 2

Appendix table 35. Types of mathematics and science courses attempted by 1980 high school sophomores who graduated in 1982 by sex/racial/ethnic group

MATHEMATICS						
Sex/racial/ ethnic group	Algebra I	Geometry	Algebra II	Trigonometry	Analysis	Calculus
Total	67.7%	54.2%	34.3%	22.9%	8.9%	6.9%
Male	66.1%	53.9%	35.2%	25.8%	9.9%	8.2%
Female	69.3%	54.4%	33.5%	20.0%	7.8%	5.7%
White	71.2%	60.4%	38.1%	26.3%	11.1%	8.3%
Black	63.7%	46.3%	29.2%	16.2%	4.9%	3.6%
Asian	65.6%	68.4%	38.7%	42.7%	17.0%	19.4%
Native American	56.8%	33.8%	21.6%	13.7%	1.4%	3.6%
Hispanic	60.4%	39.7%	26.3%	14.9%	4.1%	3.6%

SCIENCE							
Sex/racial/ ethnic group	Physical Science	Biology	Advanced Biology	Chemistry	Chemistry II	Physics	Physics II
Total	67.8%	78.8%	18.0%	35.5%	4.4%	16.9%	1.7%
Male	70.5%	77.0%	16.4%	36.4%	5.2%	22.1%	2.6%
Female	65.1%	80.7%	19.6%	34.5%	3.6%	11.6%	0.9%
White	67.1%	79.2%	19.5%	39.3%	5.1%	19.8%	2.0%
Black	71.1%	79.7%	15.5%	29.8%	2.9%	11.9%	1.0%
Asian	52.2%	78.7%	24.5%	58.1%	9.1%	35.6%	7.1%
Native American	66.9%	70.5%	13.7%	23.7%	2.9%	9.4%	0.0%
Hispanic	69.6%	77.9%	14.5%	25.6%	2.6%	9.3%	0.8%

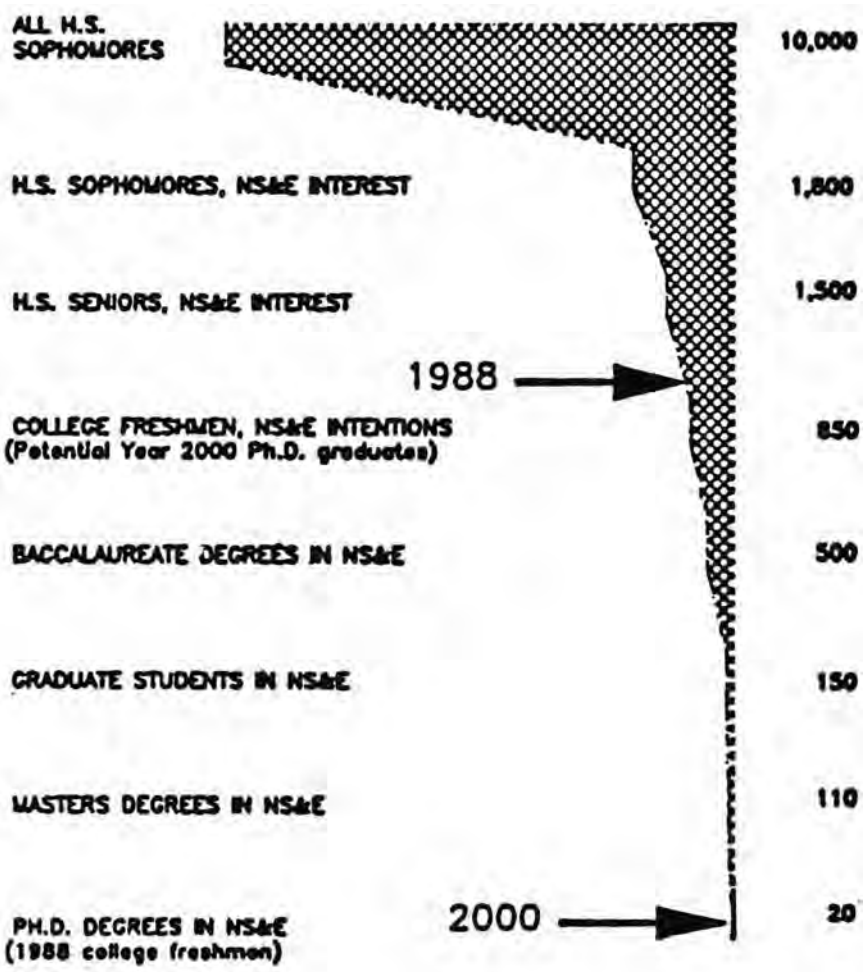
SOURCE: National Center for Education Statistics, HIGH SCHOOl AND BEYOND TABULATION: MATHEMATICS COURSETAKING BY 1980 HIGH SCHOOL SOPHOMORES WHO GRADUATED IN 1982 and HIGH SCHOOL AND BEYOND TABULATION: SCIENCE COURSETAKING BY 1980 HIGH SCHOOL SOPHOMORES WHO GRADUATED IN 1912, (Washington, D.C., April 1984).

National Center for Education Statistics, High School and Beyond

Equally striking is the data that show the choice of natural science course work at the high school level, enrollment in college and selection of majors, and decision to go on to graduate study. See the charts below, especially Chart 4 which shows that minorities fall away from mathematics, sciences, and engineering at a steeper rate than the general population.

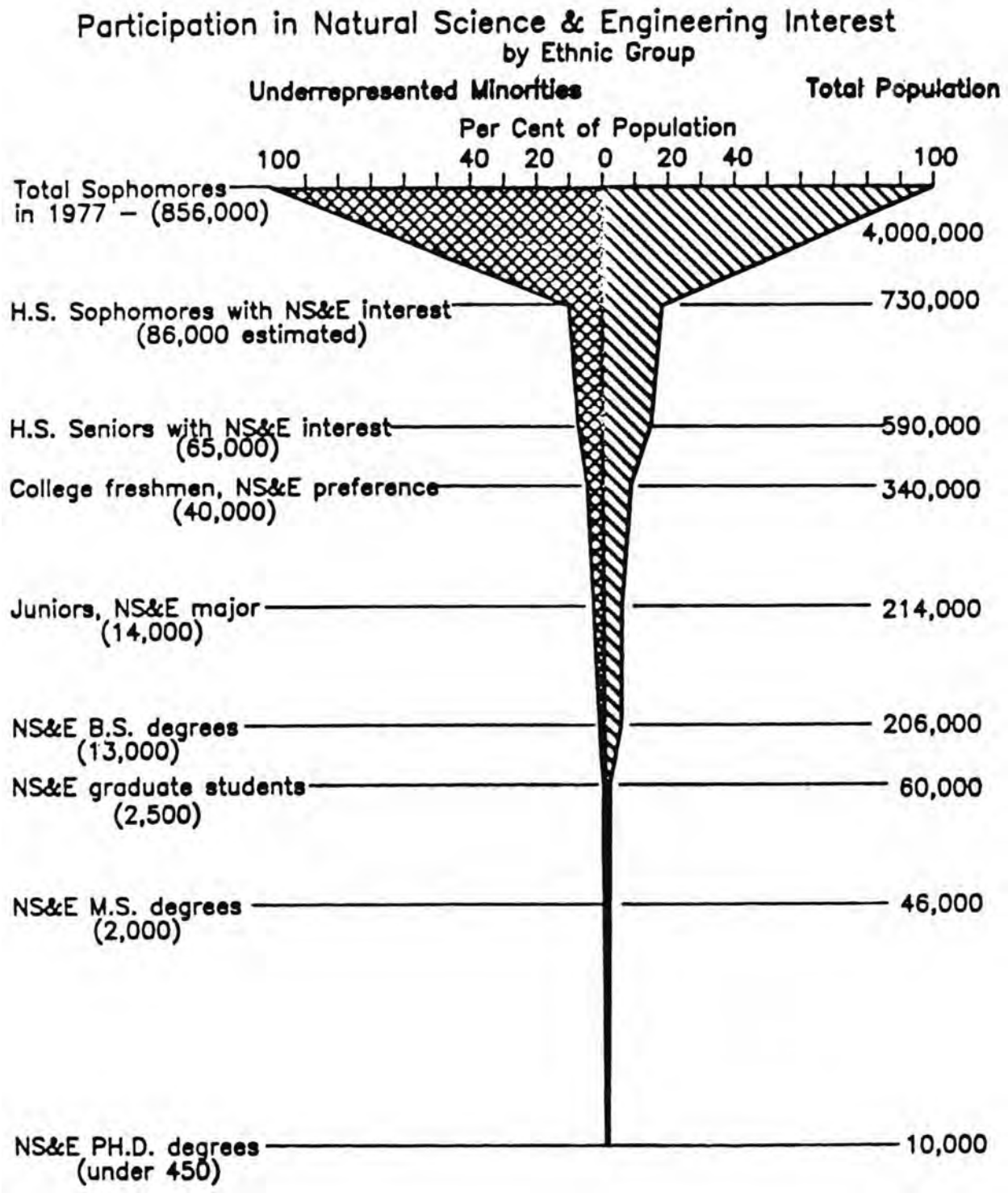
CHART 3

PERSISTtNCE or NATURAL SC1ENCE ANO ENCINEERINC INTEREST
FROM HIGH SCHOOL THROUCH PH.D. DECREE



National Science Foundation, Science Resource Studies Division

CHART 4



National Science Foundation, Science Resource Studies Division

An informal survey conducted by the Task Force of 745 northeastern mathematics departments at undergraduate and graduate institutions reinforces these statistics. The survey asked for an ethnic breakdown of the students in the mathematical sciences, mathematics education, computer science, and engineering. Seventy-five responses indicated a dearth of underrepresented minority students in the first three disciplines. Of the 1,766 underrepresented minority students declaring an engineering major from the responding institutions, 1,068 were Afro-American, 660 Hispanic, and 38 Native American. (See Appendix F.) The Task Force surmises that these larger enrollments reflect successes of intervention programs run by the professional engineering organizations.

The Task Force also learned that in geographic areas where there are significant demographic changes, many colleges and universities are facing enrollment crises, especially in mathematics-based fields. An increasing number of institutions of higher education are finding that they no longer have the enrollment base for upper-level courses in mathematics and mathematics-related disciplines. Thus, they must now address the underrepresentation of minorities in their institutions, not only for ethical and legal reasons, but also for reasons related to institutional survival.

At the doctoral level, the situation with respect to minorities in the mathematical sciences is particularly distressing. Dr. John Polking, former Director of the Division of Mathematical Sciences, National Science Foundation, stated that 730 doctoral degrees were conferred in mathematics in 1986. Only 19 (2.6%) who were awarded these doctorates were Black or Hispanic, and not one was an American Indian. Of the 19, eight were U. S. citizens and took academic jobs in the U. S. Of those eight, only three are currently pursuing research careers in U. S. institutions. Two of these are black women, one is a male Hispanic.

Mathematical Sciences Degrees Earned by Minorities
(B=bachelor, M=master, D=doctorate)

	1979			1983			1985		
	B	M	D	B	M	D	B	M	D
White	10,229	2,352	505	10,031	1,845	395	12,163	1,873	350
Black	652	71	11	629	68	3	770	53	7
Hispanic	288	36	10	253	48	7	266	49	12
Native Amer.	41	8	0	27	6	0	59	7	0
TOTAL	11,534	2,571	572	11,470	2,103	439	14,143	2,146	402

Science Resource Studies, National Science Foundation

These demographic pressures eventually will be felt in the membership figures of professional organizations like the MAA. A CBMS study written by Professor Barry Simon of the California Institute of Technology, 1986, concludes that in 15–20 years there will be too few replacements for retiring mathematical faculty members at colleges and universities. As there is a dwindling pool of mathematicians, there could well be a dwindling membership of the MAA. The future of the MAA depends on how it responds to these realities.

CHART 5

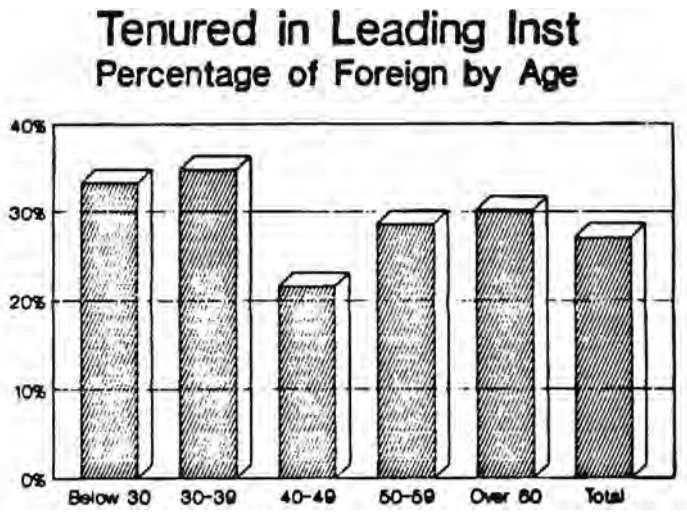
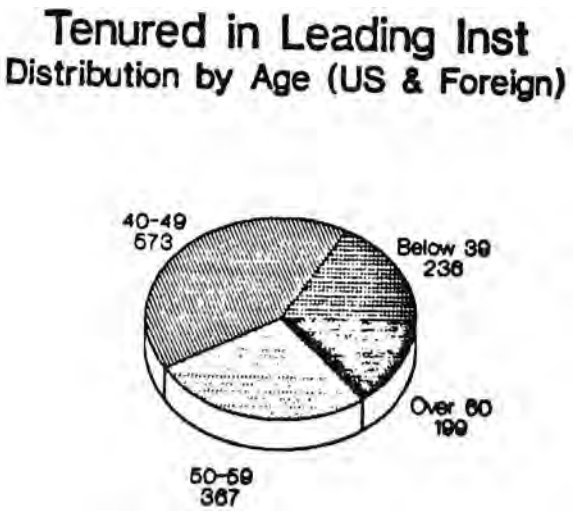


CHART 6



Conference Board of Mathematical Sciences, Report of the Committee on American Graduate Mathematics Enrollments

ASSUMPTIONS

The Task Force report outlines a program for increasing the participation in mathematics activities and improving the mathematics education of minorities. Its recommendations are based on economic and academic rationales. They also are based on the following assumptions:

A. The MAA has the determination and requisite talent to undertake a leadership role in establishing an educationally integrated program whose mission will be to improve the mathematics education of minorities.

B. A subsidiary goal of this program necessarily will be to successfully address the under-representation of the minority population in the fields of mathematics, science, and engineering.

C. Any significant improvement in the mathematics education of minorities will require a long-term effort equal in magnitude to the current problem.

D. The program to improve the mathematics education of minorities will require human and financial collaborative efforts with professional societies, business and industry charitable foundations, and all levels of government, local, state and Federal.

E. This program will be an educationally integrated program incorporating primary, secondary, and postsecondary levels.

F. The MAA Sections will participate actively in this program.

G. There are strong societal and economic justifications for a national program whose specific focus is the improvement of the mathematics education of minorities, and better representation in the mathematical community.

REPORT STRUCTURE

The report reflects the composite work of the Task Force and its several committees. It highlights the most important issues raised in both public and private sessions.

In preparing its recommendations, the Task Force decided to examine three principal areas of concern that would have to be addressed for any national program to improve the mathematical knowledge of minorities.

A. MAA Internal Operations

What might the MAA do within its own organizational structure to increase the participation of minorities and assist in raising the consciousness of tbe MAA membership about the magnitude of the problem facing this country with respect to mathematics education for minorities? More specifically:

1. How can the existing MAA functions, activities, and programs be strengthened in ways that will generate greater minority participation, both from students and faculty?
2. How might the M.AA broaden the scope of existing programs to make them more useful to members interested in the problem of under-representation of minorities in mathematics?
3. What can be done to make the MAA membership aware of the professional status of minorities in mathematics?

B. Collaborative Endeavors

How might the MAA develop effective ideas that could be translated into new programs and services in collaboration with other organizations? Specifically the Task Force asked:

4. What is the appropriate role for the MAA in educational collaborative endeavors for minorities?
5. How can the MAA make best use of its relationships with other professional associations, agencies of government and organizations in the private sector to foster collaborative projects to increase minority participation in mathematics?

C. Innovative Intervention Programs

Finally, the Task Force wanted to identify some successful intervention programs in operation at various institutions. This would enable the MAA to recommend how these programs might be expanded and replicated. It would also enable the MAA to serve as a catalyst for the development

of new, innovative intervention programs. Questions raised were:

6. What kinds of intervention programs can the MAA undertake in the future to assert and secure a leadership role in the advancement of minorities in mathematics?
7. How can the MAA serve as a resource to those interested in learning about successful intervention programs for minority students?
8. How can the MAA cooperate with government agencies and private sector organizations to initiate intervention programs which ultimately will provide a mathematically competent workforce?

These eight questions are repeated in the body of the report as lead-ins to specific recommendations.

RECOMMENDATIONS

General Perspectives

There are 5 priority and 42 specific recommendations in this report. Some of these are short-range and others are long-range. Some will need no immediate financing, just the will and determination to take appropriate action. Others are going to need specific financing in order to carry out their intent and purposes. The Task Force hopes that the MAA Development Officer will be greatly involved in the search for appropriate funding sources.

Some of the recommendations refer to actions which the MAA can take alone. Others need the collaboration of other organizations. There are a number of recommendations which depend upon fostering an effective MAA relationship with business and industry.

Priority Recommendations

The priority and broad-based recommendations of the Task Force on Minorities in Mathematics are:

I. Policy

The MAA should take leadership for the preparation, publication, and wide distribution of a major policy statement which outlines the current situation with respect to mathematics education and minorities from kindergarten through graduate school, and declares that a national program aimed at improving mathematics education for minorities and increasing the number of minorities in mathematics is a top priority of the Association working with the entire mathematical community.

Implementation. The Committee on Minority Participation in Mathematics (see next recommendation) should prepare this policy statement for approval by the MAA Board of Governors.

Much of this policy statement can be taken from this report and other references mentioned throughout the report. This policy statement should be published in *FOCUS* and the *AMS Notices*. Section governors, secretaries and newsletter editors should develop strategies to disseminate the statement at Section levels.

The policy statement also should be disseminated widely throughout the mathematical community to sister professional associations and societies and to mathematicians at all levels of our educational system. The statement should be widely distributed with an accompanying press release among the scientific media.

II. Standing Committee on Minority Participation in Mathematics

A standing Committee on Minority Participation in Mathematics should be established by the MAA. Such a committee will: (1) demonstrate that the MAA leadership believes this topic is ur-

gent and needs special and continued attention; (2) draft the major policy statement mentioned in I. above, and (3) begin implementation of the recommendations contained in this report.

Implementation. The MAA Committee on Committees should consult with the current Task Force on Minorities in Mathematics about possible members to serve on this Committee and to determine the charge for the Committee. Membership on the committee should include minority and majority mathematicians, mathematics educators, student development specialists, and/or others with special expertise in minority education. This Committee should be established as soon as possible.

III. Office of Minority Participation in Mathematics

The MAA should be the first mathematics organization to integrate into its organizational structure an Office of Minority Participation in Mathematics. The Office needs a director and staff, and a three-year plan of programs and activities.

Implementation. The Committee on Minority Participation in Mathematics should assume as one of its first responsibilities the design and programming of this Office. Among the Office's responsibilities should be the provision of assistance to the Association, its Sections, members, and member institutions.

The Office is envisioned as an entity which can:

- inform MAA members about ongoing, successful programs that encourage minority students to pursue mathematics in undergraduate and graduate programs, and careers in mathematics.
- assist members and their institutions in the design and implementation of new projects or replications of existing programs designed to increase minority participation in mathematics.
- provide a national technical assistance program of workshops, consultants, and other intervention strategies to assist institutions with the solution of issues and problems which they face with respect to mathematics education for minorities.

At the end of three years, the new MAA Office of Minority Participation will have:

1) Facilitated the increased participation of minorities in all facets of MAA's activities, programs, and functions.
2) Facilitated the replication of successful intervention programs which increase the participation of minorities in mathematics at all educational levels.
3) Established working and cooperative ventures with both public and private organizations.

IV. Financing

The Committee on Minority Participation in Mathematics should seek external funding for the creation of the Office of Minority Participation in Mathematics.

This recognizes the current financial constraints of the MAA and the fact that corporations are directing equipment, financial and human resources to well-conceived projects aimed at enhancing minority participation and performance in mathematics at all educational levels. Local community and general welfare foundations are also supporting such projects.

Implementation. The new Committee on Minority Participation in Mathematics should work closely with the MAA Development Officer to research funding sources and prepare appropriate proposals for submission to those appropriate public and private agencies.

V. Collaborative Endeavors

The MAA should take leadership and initiate collaborative endeavors with other appropriate organizations aimed at improving the mathematics education of minorities.

Implementation. Staff from the Office of Minority Participation in Mathematics should consult with officials of organizations which are concerned with any and all levels of the mathematical sciences and mathematics education, engineering, and the natural sciences. These should also include corporations and government agencies at local, state, and Federal levels.

One purpose of these consultations would be to establish a knowledge base about existing organizational projects that concern themselves with the mathematics education of minorities. A second purpose would be· to initiate cooperative ventures where there are mutual interests.

MAA PROGRAMS

QUESTION 1: HO'W CAN EXISTING MAA FUNCTIONS, ACTIVITIES AND PROGRAMS BE STRENGTHENED IN WAYS THAT WILL GENERATE GREATER MINORITY PARTICIPATION, BOTH FROM STUDENTS AND FACULTY?

Although the charge to the Task Force was to recommend ways to improve mathematics education of minorities, the first set of recommendations involves strategies to increase the participation of minority mathematicians in the MAA at both the national and sectional levels. Task Force members felt that the MAA could not begin to address student-related issues until minorities themselves are brought more fully into the mainstream of MAA activities and committee work.

David Ballew, chair of the Committee on Sections, in his 1988 Summer Report to the MAA Board of Governors, stated that an area of increasing concern to the Sections is the lack of participation of minorities in their activities. Of the 29 Sections surveyed, responses to the level of minority participation ranged from "none" to "fair". The Task Force sees this as a strong indication that the MAA Sections need to be involved in the beginning stages of initiating any changes.

To determine action in this area the Task Force's Committee on Local and Regional Action, chaired by Manuel Berriozabal of the University of Texas-San Antonio, conducted two surveys. The first, "The current state of awareness of or participation in regional minority intervention programs and initiatives by MAA sections", was mailed to the 29 sections. There were 10 responses noting knowledge of 5 intervention programs. This indicates that MAA sections are generally unaware of intervention programs in mathematics for minorities. (See Appendix F.)

The second survey, "Minority participation in MAA activities at the local and regional levels", was mailed to 29 Sections and 54 historically black colleges and universities (HBCU). Twelve Sections and six HBCU's responded. The conclusion is that MAA Sections have not had much involvement by minorities as committee chairs, officers, members, or presenters. (See Appendix F.)

Recommendation 1

National and sectional program committees should include MAA members from minority groups and institutions with large minority populations.

Implementation. The appropriate MAA officer should send letters to Section governors and program committee chairpersons identifying the historically black colleges/universities and colleges with large minority enrollments in their Sections and asking that they invite Association members from those institutions to serve on the committee.

Recommendation 2

National and sectional program committees should highlight the contributions of minority mathematicians by inviting them to take active roles in meetings. Minority mathematicians should be invited to give addresses, to participate on panels and to present contributed papers.

Implementation. The new Committee on Minority Participation in Mathematics will compile a list of names of minority members available for these purposes. Regional lists of minority mathematicians will be compiled from the TFMM, NAM, and other sources. Already compiled by Professor Raymond Johnson of the University of Maryland, College Park, is a partial list of known black mathematicians and their research publications. (See Appendix G.)

Recommendation 3

The MAA should undertake and support endeavors that bring recent Ph.D.'s from minority groups into active participation with the mathematical community as quickly as possible.

Implementation. Through the auspices of NAM, the MAA should invite recent Black Ph.D.'s in mathematics or mathematics education to give short talks about their dissertations or other research areas in which they are working. (For a complete description of this activity, see Appendix H, conceived by Professor Donald Hill of Florida A&M University.)

The Task Force applauds the MAA Membership Committee's recommendation which has resulted in a free, one-year membership to each student awarded a Ph.D. in mathematics or mathematics education.

Recommendation 4

All MAA search committees for executive level positions should have at least one minority member.

Implementation. In order for the executive level of the MAA to represent a cross section of its membership, especially minority members, it is necessary to consider minority applicants for executive positions. To improve the chances of having members of minority groups apply for these positions, it is important that search committees include members of minority groups.

COMPM will provide a list of names of candidates available to serve on MAA search committees.

Recommendation 5

The MAA should establish a National Meeting Assistance Fund to support minority students' attendance at national meetings. Outside funding should be sought for this fund.

Sections should seek funding from local and regional corporations and foundations to assist with travel to Section meetings.

Implementation. One model for implementation is contained in Appendix H.

Recommendation 6

The Committee on Sections should make a concerted effort to encourage Sections to negotiate with historically black colleges/universities and in colleges with large minority enrollments to host Section meetings.

Implementation. The new director of the Office of Minority Participation in Mathematics should send letters to Section governors and program committee chairpersons identifying the historically black colleges/universities and colleges with large minority enrollments in their Sections. They should be asked to contact Association members at those institutions to discuss the possibility of hosting a meeting.

Recommendation 7

Sessions should be held at national meetings to disseminate information about: 1) successful intervention programs aimed at improving mathematics education for minorities which are faculty based; 2) consultant services to assist in implementation, evaluation and follow-up activities for new intervention programs; and 3) funding possibilities for these programs.

Sections that have significant minority membership and student populations should be encouraged to feature similar sessions.

Implementation. The new Committee on Minority Participation in Mathematics will compile a list of names of individuals available for these purposes. (For successful intervention programs, see Appendix I.)

QUESTION 2: HOY CAN THE MAA BROADEN THE SCOPE OF EXISTING PROGRAMS TO MAKE THEM MORE USEFUL TO MEMBERS INTERESTED IN THE PROBLEM OF UNDER-REPRESENTATION AMONG MINORITIES IN MATHEMATICS?

These programs include the Blacks and Mathematics (BAM) program, MAA Committees, such as the Committee on the Undergraduate Programs in Mathematics (CUPM) and the Committee on Teaching Undergraduate Mathematics (CTUM), mini-courses, awards and other forms of recognition, and the American Mathematics Competitions.

Existing Structure of BAM

The Task Force acknowledges the MAA for steps it has taken to ameliorate the under-representation of minorities in mathematics. The greatest single effort was in 1977 when the MAA created the Blacks and Mathematics (BAM) program aimed at high school students. BAM was created to increase awareness in Black students of the need for mathematics courses in preparing for scientific, engineering, or other mathematics-oriented careers. BAM speakers function as role models for black students and work with counselors, teachers, and parents to direct more black students into mathematics-based careers.

During the 1985–86 academic year, there were 10 BAM regions active in the United States. A total of 84 schools were visited by BAM speakers; 5,990 students heard 91 different presentations.

In addition, 194 teachers, counselors, and administrators attended these sessions and interacted with program personnel. Other activities included field trips to work places, mathematics contests, and Math Day programs.

BAM has been supported by both private and public funding agencies. From 1982 to 1986, its support came primarily from the Minority Institutions Science Improvement Program (MISIP) of the U. S. Department of Education. This funding expired in September 1987.

A special MAA review committee evaluated the work of BAM and made its recommendations in a report to the Board of Governors. They concluded that BAM is an excellent vehicle for encouraging minority young people to get involved with mathematics. The Task Force endorses the positive evaluation and recommendations of the BAM Evaluation Committee.

Recommendation 8

The MAA should retain BAM as an ongoing program and make every attempt to strengthen it.

Implementation

1. Seek external funding for existing and expanded BAM program activities within an overall three-year program scheme.
2. Include a summer program and/or weekend classes in cooperation with a local college or university to complement the speakers program.
3. Initiate a parents' orientation and awareness component to seek their assistance in encouraging students to take the proper mathematics courses.
4. Design an evaluation component at the onset of the program's new activities to insure that outcomes can be measured. A mechanism for follow-up and an impact study should be conducted.
5. Hold BAM Days in all regions.
6. Give BAM and its activities visibility through the Association's publications and meetings to increase awareness about it in the mathematical and educational community.
7. Establish a BAM advisory committee.
8. Provide a substantial support system for each director including salary and administrative assistance.
9. Award financial and other incentives to speakers.
10. Keep BAM apprised of academic intervention programs for blacks and encourage a mechanism for linkage with these programs.
11. Bring representatives of organizations such as NAM, NCTM, local school officials, etc., together with MAA to discuss the expansion of BAM.

Recommendation 9

The MAA should assist other minority groups in establishing similar programs.

Implementation. BAM and the new MAA standing Committee on Minority Participation in Mathematics can give information and assist other groups in organizing such ·programs.

MAA Committees

It is through the Association's elaborate committee structure that much of its policy is made and business is conducted. Yet, the current situation is that there are few members of minority groups who are actively involved in the operation of the Association (on the Board of Governors or standing MAA Committees) and the general level of participation among minority mathematicians in the Association is low. At the time this report was written, the Task Force identified only two members of minority groups serving on MAA committees that are not addressing minority issues. Moreover, there is only one minority on the 48-member MAA Board of Governors. It is critical that in addition to increasing minority participation on all MAA committees, each committee should be encouraged to explore ways in which it can address the problems of minorities in mathematics.

Recommendation 10

To promote the full inclusion of minorities in the Associations activities, there should be minority representation on major MAA committees, for example, CUPM, CTUM, the new Committee on Awards, and journal editorial committees.

Implementation. Ask the Committee on Committees to oversee the implementation of this recommendation. Until the new Committee on Minority Participation in Mathematics is established, the Task Force, with the cooperation of NAM and other organizations, is prepared to assist the Committee on Committees and other committees in identifying appropriate candidates.

Recommendation 11

Nominating Committees, at both the sectional and national level, should seek minority candidates for offices in the Association.

Implementation. Until the new Committee on Minority Participation in Mathematics is in place, the Task Force will provide assistance, where needed, by identifying appropriate candidates.

Recommendation 12

CUPM, CTUM and the American Mathematical Association of Two-year Colleges (AMATYC) should join efforts to develop curriculum and teaching strategies for the first two years of college mathematics to enhance development of minority students with mathematical potential.

Implementation. For example, concerning teaching strategies, MAA and AMATYC could adapt the successful Professional Development Program (PDP) method (University of California, Berkeley) for the first two years of college mathematics for underachieving students. (See Appendix I.)

MAA should encourage and endorse programs for minorities whose essential components include involvement of mathematicians, high student expectations for success in mathematics, and a strong support system for the consistent effort that leads to achievement in mathematics.

QUESTION 3: WHAT CAN BE DONE TO MAKE THE MAA MEMBERSHIP AWARE OF THE PROFESSIONAL STATUS OF MINORITIES IN MATHEMATICS?

Publications and Periodicals

Along with section and national meetings, the Association's periodicals and publications are the principal means for the exchange of ideas. Although the programs of recent meetings have, to a certain extent, reflected the membership's growing interest in issues of the profession, including minority issues, these concerns have not yet found a place in the publications and periodicals. The journals, for example, publish articles about the discipline of mathematics, not the profession of mathematics.

The new AMS-MAA-SIAM Newsletter on Undergraduate Education will have a column on the status of the profession. However, this is not enough to address the problems of minorities in mathematics education. For this reason, it is important that the scope of the MAA's four periodicals (The American Mathematical Monthly, Mathematics Magazine, The College Mathematics Journal, and FOCUS) be expanded to include articles on issues of the profession, including the problems of minorities in mathematics.

Recommendation 13

The MAA should create an appropriate outlet in its periodicals for articles about the profession of mathematics, including the nature, origin, and solution of problems faced by minorities.

Implementation. The new Committee on Minority Participation in Mathematics should notify editors of MAA periodicals of this concern and ask them to consult with their editorial boards regarding how, in their particular journal, issues concerning the profession can be addressed.

Recommendation 14

Editors of MAA journals should be encouraged to give due consideration to minority mathematicians when selecting associate editors and referees, and when soliciting articles and book reviews.

Implementation. The new Committee on Minority Participation in Mathematics, NAM, and other organizations will assist the editors by compiling a list of names of minority mathematicians and their areas of specialization, (See Appendix G.)

Lecturer and Consultant Programs

Tbese two programs not only provide an opportunity for MAA members to exchange ideas, but also offer professional recognition to the participants. There are talented minority mathematicians who are good expositors and would be excellent speakers. Inclusion of these mathematicians in these programs would give greater visibility to minority mathematicians.

Recommendation 15

The Visiting Lecturers Committee should make a conscious effort to recruit minority speakers.

Implementation. The new Committee on Minority Participation in Mathematics will identify minority mathematicians available to perform this service.

Recommendation 16

Both minority and majority mathematicians who are knowledgeable about successful intervention programs should be included in the MAA's Consultant Program.

Implementation. During the course of its work and at the special panel discussion at the 1988 Annual Meeting, members of the Task Force discovered that there is tremendous interest among mathematics departments throughout the country in successful intervention programs that are faculty-based and grounded in sound mathematics. The Task Force has compiled a list of mathematicians familiar with such programs for the Consultant Program and has submitted a preliminary list to Richard Millman, the Chair of the Committee on Consultants.

Awards and Other Forms of Recognition

Recognition by the MAA Board of Governors of minority mathematicians and their achievements, as well as of programs designed to increase minority participation in mathematics, will enhance efforts to increase the number of minority mathematicians for the future. Since a Committee on Awards has been formed with Deborah Haimo as Chairperson, COMPM will cooperate with the committee in this area.

Recommendation 17

The MAA should award recognition to individuals for outstanding efforts in improving the mathematics education of minorities and increasing minority participation in mathematics.

Implementation. The new Committee on Minority Participation in Mathematics should develop a mechanism for implementing this recommendation which will be submitted to the Association for approval and institutionalization.

Mathematics Competitions

One viable way of involving more minority students in mathematics is through participation in the American Mathematics Competitions.

Recommendation 18

Faculty members, competition directors, and the MA.A Committee on the American Mathematics Competitions should be encouraged to develop strategies for significantly increasing the participation by minority students in the competitions.

Implementation. The new COMPM, NAM, and other organizations will lend assistance and offer suggestions regarding how to accomplish this goal.

Mini-courses

Recommendation 19

Mini-courses on successful intervention programs should be a regular feature at national and sectional meetings.

Implementation. Mathematicians, who run successful intervention programs, such as Manuel Berriozabal of the University of Texas-San Antonio, Joaquin Bustoz of Arizona State University, Paul Sally of the University of Chicago, and Uri Treisman of the University of California-Berkeley, could give such mini-courses. MAA President-elect, Lida Barrett, has been instrumental in organizing a mini-course on Treisman's intervention program at the Joint Summer Mathematics Meetings in Colorado. (See Appendix I.)

Recommendation 20

MAA should create a structure for mathematicians who are interested in inservice teacher training. This structure should help hem design, implement, and seek funding for workshops for pre-college teachers who work in areas with large minority student populations.

Implementation. MAA should run mini-courses or workshops at national and sectional meetings for mathematicians who wish to run inservice workshops for pre-college teachers of minority students. Mathematicians such as Uri Treisman, Harvey Keynes, Phil Wagreich, Ronnie Wells, Marvin Marcus, Harris Schultz, could organize such workshops.

EDUCATIONAL COLLABORATIVES

Education in the United States is influenced by numerous factors. The literature points at variables such as background, knowledge, mastery, influence of role models, individual motivation, school structure, and curriculum as important components of sound educational programs. No one institution or professional organization can be expected to have the resources or expertise to address all of these factors. If the mathematics community is truly interested in and committed to improving the mathematics education of minority students from kindergarten through graduate school, a collaborative approach must be used that utilizes the experience and expertise of all professional groups.

Historically, efforts to address the needs of minorities vithin the mathematical community have been fragmented and uncoordinated. Collaboration with other mathematics and science organizations is needed to increase the effectiveness of efforts in this area. Moreover, the MAA can serve effectively as a catalyst for action with other organizations.

Individuals working within teacher organizations, such as NCTM, and on various projects, have successfully developed human resources and expertise in primary and secondary mathematics education. Professional associations, such as the MAA, can provide the knowledge and role models in mathematics to complement the expertise and experiences of other institutions. Linkages vith other organizations, such as NCTM, AMATYC, NAM, AAAS, NAST, and engineering organizations must be strengthened to foster innovative teaching of mathematics.

One example of a successful collaboration is the American Mathematics Project. This is a joint effort among the MAA, NCTM, and the University of California, Berkeley. Its overall purpose is to increase the number of mathematics teacher collaborative projects in the U. S. It recently sponsored a workshop for approximately 20 state teams consisting of a teacher of mathematics (K–12), a college or university mathematician, an industrial mathematician, and preferably a representative from the state school system. The purpose of the Workshop was to provide these teams with knowledge about how to form a collaborative project. Each team is expected to develop a collaborative project in its geographical area to stimulate excellence and creativity in pre-college mathematics teaching.

An existing mechanism for collaboration is the AMS-MAA-AAAS Committee on Opportunities in Mathematics for Underrepresented Minorities. This group was created in January 1987 to expand the participant base of the AMS Committee on Opportunities in Mathematics for Disadvantaged Groups. The charge to the committee was to: a) inform the broader community of opportunities for the study of mathematics and careers in mathematics that are available to minorities; and b) suggest strategies for increasing minority participation in mathematical studies and careers, The committee reports to the broader mathematical community on an annual basis through an open business meeting and a program session at the Joint AMS-MAA winter meeting.

The Task Force endorses the MAA's participation in this committee, but emphasizes the need for the Association to maintain autonomy to act independently and/or collaborate with other organizations or institutions as the necessity arises.

QUESTION 4: WHAT IS THE APPROPRIATE ROLE FOR THE MAA TO PLAY IN EDUCATIONAL COLLABORATIVE ENDEAVORS FOR MINORITIES?

Recommendation 21

The MAA should expand its collaborative efforts in minority affairs and take a stronger leadership role in fostering and promoting collaborations within the mathematical community.

Implementation. The new Committee and the Director of the Office on Minority Participation in Mathematics should be the driving force in the MAA in this arena. It will: 1) develop ongoing relationships with other organizations to develop, expand and disseminate information about joint projects and 2) prepare an annotated list of existing projects by MAA members with proven track records of increasing minority participation in mathematics.

Recommendation 22

MAA should take the lead in assisting NCTM, NAM, AMS, SIAM, and the Society of Mathematics State Supervisors in identifying and placing retired mathematicians who want to volunteer their services to predominantly minority pre-college schools,

Implementation. MAA and NCTM sections, NAM, AMS, and SIAM should compile a list of mathematicians who are willing to volunteer.

The new Director of the Office of Minority Participation in Mathematics should contact the Society of Mathematics State Supervisors, volunteer programs (such as one sponsored by the Federal City Council in Washington, DC) and Ted Drury, now in Baltimore, who developed a program to coordinate the placing of volunteer mathematicians, scientists, and engineers. (See Appendix I.) The director, along with the MAA, should formulate the organizational structure of this office.

Recommendation 23

MAA should initiate discussions and dialogue with the Ford Foundation Urban Mathematics Collaboratives, NAM, NCTM, AMATYC, and state mathematics supervisors to promote and further their common interests in mathematics education, especially as it pertains to minority students.

Implementation. The new Director of the Office of Minority Participation in Mathematics should contact Mark Driscoll of the Educational Development Center to organize brainstorming sessions with the Ford Foundation Urban Mathematics Collaboratives, NAM, NCTM, AMATYC, and state mathematics supervisors to help each urban mathematics collaborative:

- To form links with colleges, universities, and MAA Sections,
- To have access to professional mathematicians, mathematics educators and the resources of their professional societies,

- To have the cooperation of mathematicians in writing grants.

Recommendation 24

MAA and NCTM should cooperate with state supervisors for mathematics to design mathematics education programs for kindergarten through junior high school in which college faculty can participate.

Implementation. Universities and colleges should be encouraged to give released time to mathematicians to teach classes in public schools and also to work with current teachers to strengthen their mathematical knowledge. The new Office of Minority Participation in Mathematics should compile a list of these activities and successful programs.

Recommendation 25

MAA, AMATYC, and NCTM should construct a program whereby four-year institutions can attract minority students from two-year colleges to the four-year colleges' mathematics teacher education programs.

Implementation. The two- and four-year institutions could develop cooperative recruitment programs for minority students at two-year colleges. These programs should encourage and provide incentives for minority students to enroll in mathematics teacher education programs. A formal agreement on which general education courses the four-year colleges can accept would be necessary.

Recommendation 26

MAA Sections, NCTM Sections, NAM, and other organizations should work with local minority organizations and churches to bring mathematics to minority youth and their parents.

Implementation. Through community and church organizations, volunteer mathematicians can work with teachers and parents to use Family Math (Lawrence Hall of Science, University of California, Berkeley). This program has been proven to help parents to work with and encourage their youngsters to think mathematically. (A successful model of this program, in Spanish, has been run by a well-known number theorist, William Velez of the University of Arizona.

QUESTION 5: HOW CAN THE MAA MAKE BEST USE OF ITS RELATIONSHIPS WITH OTHER PROFESSIONAL ASSOCIATIONS AND INDIVIDUALS AND ORGANIZATIONS IN THE GOVERNMENT AND PRIVATE SECTOR TO FOSTER COLLABORATIVE PROJECTS TO INCREASE MINORITY PARTICIPATION IN MATHEMATICS?

Recommendation 27

The MAA should collaborate with other professional organizations to develop standards for intervention programs and a procedure for disseminating information about creative and successful programs to interested individuals.

Implementation. The new Committee and Office on Minority Participation will be the backbone of the development of a process for endorsing projects. It will: 1) draft a set of standards for evaluating projects and their outcomes, 2) develop a procedure for disseminating information about projects, and 3) convene a meeting of representatives from appropriate organizations to review the draft standards and procedure for dissemination, provide input, reach consensus, and jointly publish a handbook about the endorsement process for project directors.

Recommendation 28

The MAA and the Mathematical Sciences Education Board (MSEB) should collaborate in developing projects on minorities and mathematics.

Implementation. MSEB has just received a new grant to mount a national campaign of regional meetings to encourage mathematicians to replicate successful intervention programs for minorities. In addition, MSEB is surveying industry about the kinds of mathematics needed in the workplace. (See Appendix J for the Task Force's version.) Upon notification of the acceptance of this recommendation, two members of COMPM will meet with the Executive Director of MSEB, Marcia Sward, to obtain details about the Board's plans in this area and explore possible collaborative activities.

Recommendation 29

The MAA should initiate discussions with JPBM, through its Office of Government and Public Affairs (OGPA), as to how it can address minority concerns.

Implementation. OGPA should lobby for national recognition of accomplishments by minority mathematicians through the establishment of new programs such as Mathematics Awareness Week for Minorities and increased funding for projects to increase minority participation in mathematics.

In addition, JPBM's media consultant, Kathleen Holmay, should submit articles concerning minorities in mathematics to mainstream publications, as well as minority newspapers and journals. For example, Uri Treisman's and Jaime Escalante's successes are recent newsworthy items that are appropriate to be included in all the major mathematical newsletters.

Recommendation 30

At national meetings of departments of mathematics chairmen organized by JPBM, MAA should present effective and replicative programs for mainstreaming minority students into mathematics-based majors.

Implementation. MAA can feature successful intervention programs such as those at Spelman and Xavier Colleges (historically black institutions) and those developed and implemented by mathematicians, e.g., Paul Sally, University of Chicago, Uri Treisman of University of California, Berkeley, Manuel Berriozabal, University of Texas, San Antonio, and Joaquin Bustoz of Arizona State University. Examples of intervention programs are in Appendix I. MAA can then follow up by offering consulting services to those departments who are starting or revising programs for minority students.

Recommendation 31

The MAA should form a consortium of universities, government laboratories and professional organizations to develop a program for the support of minority graduate students.

Implementation. MAA will collaborate with SIAM, ORSA, TIMS, the Society of Actuaries and NCTM to form a collaborative university-professional-industrial group to investigate how universities might provide tuition, grants, and fees, and how industry and professional organizations might provide summer jobs and financial aid, stipends, and salaries for minority students to pursue advanced degrees in mathematics.

The MAA should also take the leadership to design a clearinghouse for fellowships and internships/jobs offered by industries, professional societies, and government agencies for minority undergraduate and graduate students. For example, an inter-professional publication listing fellowships and summer/academic year internships to be used by academic counselors in helping minority students to enhance their mathematical careers should be distributed nationally.

INTERVENTION PROGRAMS

QUESTION 6: VHAT KINDS OF INTERVENTION PROGRAMS CAN THE MAA UNDERTAKE IN THE FUTURE TO ASSERT AND SECURE A LEADERSHIP ROLE IN THE ADVANCEMENT OF MINORITIES IN MATHEMATICS?

At its Panel Discussion in Atlanta (see Appendix E), it became apparent to the Task Force that all programs which could be run by the MAA must be integrated into its existing structure. With this structure in mind, the following recommendations were created to help increase the pool of minority students involved in mathematics on the collegiate level.

Recommendation 32

Special articulation programs in mathematics should be developed between colleges and high schools to aid minority students interested in majoring in mathematics-related disciplines.

Implementation. For example, an existing articulation program (Ohio State University) which assists high school students to identify future mathematical needs could be adapted for participating colleges and universities to counsel minority students. Another example is New Jersey Institute of Technology which has a successful urban pre-college program including elementary students and inservice workshops for teachers. This program is multi-leveled. (See Appendix I.) Warren Page has recently suggested a model for cooperation between community colleges and high schools with high minority student populations using computers.

Recommendation 33

The MAA should inform its Sections that it is willing to facilitate the creation of a network of undergraduate research programs designed by MAA members with the purpose of preparing a cadre of minority students for graduate programs in mathematics.

Implementation. Summer institutes (similar to the National Science Foundation's program) should be established at universities to give minority students opportunities to work on mathematics projects with research mathematicians. Also, minority students will continue to receive mentoring from university faculty during tbe academic year.

Recommendation 34

MAA, AMS, and SIAM should work jointly with graduate departments of mathematics at institutions with minority enrollments of 50 percent or more to develop research centers of excellence.

Implementation. Teams of researchers can work with mathematicians at minority institutions to develop and implement proposals for the National Science Foundation programs such as the Minority Research Centers of Excellence (MRCE) and the Research Improvement in Minority

Institutions. Of the six NSF MRCE awards (up to $5 million each up to five years) none were in mathematics.

In addition to the traditionally black institutions, urban universities in such states as New York, California, Texas, and universities in the southwest with large Hispanic enrollments would be eligible for such grants.

QUESTION 7: HOW CAN THE MAA SERVE AS A RESOURCE FOR THOSE INTERESTED IN LEARNING ABOUT SUCCESSFUL INTERVENTION PROGRAMS FOR MINORITY STUDENTS?

Recommendation 35

The MAA should establish a clearinghouse of information about intervention programs for minorities and coordinate the dissemination of information about successful intervention projects or projects that are transportable to institutions with large minority populations.

Implementation. One of the first functions of the new Director of the Office and Committee on Minority Participation in Mathematics will be to seek external funding for the publication of an MAA catalog describing successful intervention programs for minority students. This publication should list contact persons for information on how to replicate these projects. A few examples of intervention programs are in Appendix I.

Moreover, this publication should include standards for identifying "successful" programs. (See the last pages of Manuel Berriozabal program in Appendix I for one model of program accountability.) The new Director of the Office of Minority Participation in Mathematics and Committee of Minority Participation in Mathematics will notify appropriate contributors, gather information, and edit a final document suitable for publication.

Recommendation 36

The MAA should publicize its willingness to receive, review, endorse, and assist in the preparation and administration of proposals for projects by minority mathematicians or for minority students.

Implementation. The Committee on Minority Participation in Mathematics will serve as the vehicle for publicizing the Association's willingness to function in a supportive role in the development and implementation of grants. Members of the committee and of the Task Force with experience in grants writing will assist individuals who wish to develop proposals for federal, state, local, and private funding agencies.

Recommendation 37

A nationwide network of minority mathematicians and computer scientists should be organized to serve as mentors for minority students.

Implementation. MAA will propose to CBMS that a collaborative effort be developed among the mathematics and computer science professional organizations to create a network of minority professionals to counsel students who have declared a mathematics-based major or passed calculus on the steps they must take to ensure success in mathematical careers.

QUESTION 8: HOW CAN THE MAA WORK WITH INDIVIDUALS IN THE GOVERNMENT AND THE PRIVATE SECTOR TO IMPROVE THE MATHEMATICS SKILLS OF U. S. CITIZENS AND HELP PROVIDE SKILLED WORKERS FOR THE MARKETPLACE?

In 1987, corporations and industries in New York City offered 250 entry-level jobs to students graduating from high school in high risk areas of Brooklyn. Only 100 students qualified for these positions.

Recommendation 38

The MAA should work with the offices of the chiefs of staff of the armed forces and personnel office representatives from industry to develop a consortium aimed at initiating new programs to bring the mathematical skills of servicemen and industrial workers to a level necessary to fill available and future jobs.

Implementation. The appropriate MAA officer will send a letter to the chiefs of staffs of the armed services and vice presidents for personnel in a selected group of the Fortune 500 companies informing them of its concern about the generally poor level of mathematical skills in the population and offering to assist them in developing programs to improve the mathematical skills of enlisted personnel and workers in the industrial labor pool.

Recommendation 39

The MAA should help initiate a national program in the mathematical sciences similar to the Minority Access to Research Careers (MARC) Program of the National Institute of General Medical Sciences. MARC, which receives its funding from the NIB, is a research training program in the biomedical and related sciences for students and faculty members at minority institutions that has been successful in increasing the number of minority scientists engaged in biomedical research.

Implementation. The new Director of the Office on Minority Participation in Mathematics will work with representatives from appropriate agencies to seek funding for a comparable program to increase the number of minority students striving to become mathematicians engaged in research in the mathematical sciences.

Recommendation 40

The MAA should enter into discussions with NCTM, AMATYC, and ACM to determine what, if any, mathematics education research might be undertaken at the elementary, secondary, and collegiate levels to enhance our knowledge of how mathematics education for minorities might be improved.

Implementation. The new Director of the Office on Minority Participation in Mathematics will undertake to research the kinds of pedagogical experiments in mathematics education which have been undertaken during the last three years. This bibliography of research will be transmitted to the MAA Executive Director who can then initiate contact with NCTM, AMATYC and ACM.

Recommendation 41

MAA, in cooperation with SIAM and ORSA, should begin discussion as soon as possible about how professional associations might assist colleges and universities to provide U. S. business and industry with a skilled workforce.

Implementation. For example, they could discuss what initiatives professional associations might take in continuing education programs to upgrade mathematical skills of current employees. Also, in conjunction with MSEB (see Recommendation 28), MAA should establish a consortium of business establishments in the manufacturing/ service sectors and government laboratories to identify the mathematical skills needed to develop a workforce able to use the current and emerging technology. The role of the consortium would be to provide the inter-company cooperation and funding needed to implement the recommendations contained in their study. Appendix J contains such a proposal study from the Task Force.

Recommendation 42

The MAA should develop a "link-strategy model" for an integrated primary, secondary and post-secondary program to improve the mathematical skills of minorities.

Implementation. A model for implementation for the link-strategy is described in Appendix K. A key element for the success of the primary and secondary link is the training of minority secondary students by mathematicians to use newly developed, interactive software, mathematics programs as tutorials to develop the interest of primary level students in mathematics.

This last recommendation should be one of the priority endeavors of the new Office of Minority Participation in Mathematics.

SUMMARY

The Task Force does not view this report as the culmination of its activities. the many problems of the mathematics education of minorities which it was charged to investigate. Rather, this report is one goal achieved at the beginning of a new impetus and renewed commitment by the MAA to enhance opportunities in mathematics and related fields for all students, especially those from the currently underrepresented Blacks, Hispanics and Native Americans.

It is the opinion of the Task Force, therefore, that the MAA should continue to openly demonstrate its commitment to issues faced by minority students pursuing mathematics and by minority mathematicians. Without the Association's visible moral support and expeditious implementation of the Task Force's recommendations, the status of minorities in mathematics will not be improved. The MAA leadership has had the foresight to establish the Task Force and give impetus to a renewed sense of commitment to minorities. The Task Force hopes that the MAA will now move to the next step of implementation and establish an Office of Minority Participation in Mathematics to develop a national program to improve the mathematics education of minorities and increase their participation in all facets of the work of the mathematical community.

Improvement of mathematics education for all students should be a priority issue at the national level. The MAA is the appropriate organization to take a leadership role in working toward relieving the current crisis in mathematics education, By taking active and responsible leadership in the area of minority education, the Association will give credibility to the problem from an academic and non-political perspective. Its members will begin to see their participation in the solution of the special problems of mathematics education for minorities as an urgent and legitimate part of their professional responsibility and development.

NOTES

l. "Educators Alarmed by Growing Rate of Dropouts Among Hispanic Youth", *New York Times*, March 5, 1987, p. 22L.

2. "College Outlook Grim for Blacks 25 Years After Barriers Fell", *Chronicle of Higher Education*, September 2, 1987, pp. A88–91.

3. "Many Minority Teachers Plan to Quit, Poll Finds", *New York Times*, October 5, 1988.

4 "Black Students Cite Finances as Chief Reason for Dropping Out, Oberlin Study Finds", *Chronicle of Higher Education*, September 2, 1988, pp. A34-35.

5. "Doctorates Earned by Blacks Decline 26.5 Pct. in Decade", *Chronicle of Higher Education*, Vol. 34, No. 21, February 3, 1988, pp. Al & A32.

6. "Panel Urges Colleges to Boost Production of Hinori ty Scientists", *Chronicle of Higher Education*, Vol. 34, No. 40 1 June 15, 1988, pp. Al & A32.

7. "Blacks, Hispanics Fall Behind Early, MD. Math Study Says", *The Washington Post*, July 13, 1988, pp. Al & A13.

8. "Negative Peer Pressure Said to Inhibit Black Student Achievement", *Education Week*, March 25, 1987, pp. 1 & 14.

9. "Neglect of Minorities Jeopardizes Future U. S. Prosperity", *Chronicle of Higher Education*, May 25, 1988, pp. Al & A20.

10. "Participation and Performance of Women and Minorities in Mathematics", Department of Educational Accountability, Montgomery County Public Schools, Rockville, Maryland, July 1988.

11. Ibid., p. E-11.

12. D. J. Albers, R. D. Anderson, and D. o. Loftsgaarden, Undergraduate Mathematical Sciences in Universities, Four-year Colleges. and Two-year Colleges: 1985-1986, 1987, pp. 41 & 133.

13. Iris Veiss, Report of 1985-1986 National Survey of Science and Mathematics Education, Research Triangle Institute, North Carolina, November 1987.

14. Albers, Anderson, and Loftsgaarden, op. cit. pp. 58 & 139.

15. Harold L. Hodgkinson, *All One System: Demographics of Education, Kindergarten through Graduate School*, The Institute for Educational Leadership, Inc., June 1985, p. 3.

16. Erich Bloch, "Human Resources for Competitiveness: The Role of Minorities", Address to Congressional Black Caucus and the Howard University Institute on Science, Space, and Technology Symposium: Minorities in Science & Technology, Yashington, DC, September 16, 1988, p. 3.

17. Hodgkinson, *loc. cit.*
18. "Panel Urges Colleges. to Boost Production of Minority Scientists", *loc. cit.*
19. Bloch, *loc. cit.*
20. Connors, Edward A. "Report on the 1987 Survey of New Doctorates", *Notices of the American Mathematical Society*, November 1987, Vol. 34, No. 7, p.1083.
21. Hodgkinson, *loc. cit.*
22. President's Commission on Industrial Competitiveness, *Global Competition: The New Reality*, Government Printing Office, Yashington, DC, 1985, Vol. 2.
23. National Academy of Engineering, *The Technological Dimensions of Inernational Competitivness*, Yashington, DC, 1988, p. 61.

BIBLIOGRAPHY

Albers, D. J.; Anderson, R. D.; Loftsgaarden, D. O. *Undergraduate Mathematical Sciences in Universities, Four-year Colleges, and Two-year Colleges: 1985–1986*. Washington, D, C.: Mathematical Association of America, 1987.

Applebome, Peter. Educators Alarmed by Growing Rate of Dropouts Among Hispanic Youth". *New York Times.* Nev York, New York, March, 1987.

Berryman, Sue E. *Who Will Do Science? Minority and Female Attainment of Science and Mathematics Degrees: Trends and Causes*. New York, New York: The Rockefeller Foundation, 1983.

Bloch, Eric (Symposium Proceedings, Major Address). "Human Resources for Competitiveness: The Role of Minorities". Washington, D. C.: Howard University, September, 1988.

The College Board. *Getting Into the Equation: Math & Science, Parents and Children*. New York, New York, 1987.

Collison, Michele N-K. "Black Students Cite Finances as Chief Reason for Dropping Out, Oberlin Study Finds", *Chronicle of Higher Education*. Washington, D. C., September, 1988.

Collison, Michele N-K. "Neglect of Minorities Seen Jeopardizing Future Prosperity: U. S. seen 'moving backward'; colleges are urged to act". *Chronicle of Higher Education*. Washington, D. C., May, 1988.

Committee for Economic. Development, Research and Policy Committee. *Children in Need: Investment Strategies for the Educationally Disadvantaged*. New York, New York, 1987.

Daniels, Lee A. "Many Minority Teachers Plan to Quit, Poll Finds". *New York Times.* New York, New York, October, 1988,

DeLoughry, Thomas J. "Panel Urges Colleges to Boost Production of Minority Scientists". *Chronicle of Higher Education*. Washington, D.C., February, 1988.

Hauptman, Arthur M. *Students in Graduate and Professional Education: What We Know and Need to Know*. Washington, D. C.: Association of American Universities, 1986.

Hirschorn, Michael Y. "Doctorates Earned by Blacks Decline 26.5 Pct. in Decade". *Chronicle of Higher Education*. Washington, D. C., February, 1988.

Hodgkinson, Harold. *All One System: Demographics of Education, Kindergarten through Graduate School*. Washington, D. C.: The Institute for Educational Leadership, Inc., June, 1985.

Jaschik, Scott. "College Outlook Grim for Blacks 25 Years After Barriers Fell". *Chronicle of Higher Education*. Washington, D.C., September, 1987.

Johnston, William B. *Workforce 2000: Work and Workers for the Twenty-first Century*. Indianapolic, Indiana: Hudson Institute, 1987.

Malcom, Shirley. *Equity and Excellence: Compatible Goals*. Washington, D. C.: American Association for the Advancement of Science, December, 1984.

National Academy of Engineering. *The Technological Dimensions of International Competitiveness*. Washington, D. C., 1988.

National Research Council, Office of Scientific and Engineering Personnel. *Minorities: Their Underrepresentation and Career Differentials in Science and Engineering*. Washington, D. C.: National Academy Press, 1987.

National Science Board Commission on Pre-college Education in Mathematics, Science and Technology. *Educating Americans for the 21st Century*. Washington, D. C.: National Science Board, 1983.

National Science Foundation. *A Directory of Federal R&D Agencies' Programs to Attract Women, Minorities, and the Physically Handicapped to Careers in Science and Engineering*. Washington, D.C., 1985.

National Science Foundation. *Women and Minorities in Science and Engineering*. Washington, D. C., 1988.

Pitt, Barry; Department of Educational Accountability. *Participation and Performance of Women and Minorities in Mathematics*. Montgomery County Public Schools. Rockville, Maryland, July, 1988.

President's Commission on Industrial Competitiveness. *Global Competition: The New Reality*. Washington, D. C.: Government Printing Office, 1988.

Snider, William. "Negative Peer Pressure Said to Inhibit Black Student Achievement". *Education Week*. Washington, D.C., March, 1987.

U. S. Department of Education, Center for Education Statistics. *Digest of Education Statistics, 1987*. Washington, D.C.: U. S. Government Printing Office, 1987.

Vetter, Betty H.; Commission on Professionals in Science and Technology. "Demographics of the Engineering Student Pipeline". *Engineering Education*. Washington, D. C.: American Society for Engineering Education, Hay, 1988.

Vetter, Betty H.; Babco, Eleanor L. *Professional Vomen and Minorities: A Manpower Data Resource Service*. Washington, D. c., December, 1987.

Washington Post Staff Writer. "Blacks, Hispanics Fall Behind Early, Md. Math Study Says: Gaps in Skills of Boys, Girls Also Cited". *The Washington Post*. Washington, D. C., June 1988.

Weiss, Iris. *Report of 1985–1986 National Survey of Science and Mathematics Education*. North Carolina: Research Triangle Institute, November, 1987.

APPENDICES

TO THE REPORT OF

The Mathematical Association of America

TASK FORCE ON
MINORITIES IN MATHEMATICS

APPENDIX A

Statement by Professor Lee Lorch

APPENDIX A

Lorch Statement

The formation of mathematicians, mathematics teachers at any level, or even of merely mathematically-literate people, occurs necessarily in an educational system. Such education will not be effective, even in the various specialties such as mathematics, unless the students acquire a sense of their own worth and of the worth of others.

In particular, this gives the mathematical community a direct and inescapable interest in the present discussions concerning the control of requisite courses in the humanities, English, history, etc., such as those designated as Culture, Western Civilization or the like. Unless these courses include significant materials emanating from and concerning minorities (as would be the case for women), they will fail to develop the appropriate sense of selfworth urgently needed among the minorities and among majority students of a genuine appreciation of the worth of the minorities.

This is so fundamental to the achievement of the goals set by the MAA for this Task Force, that it requires the MAA to intervene actively and strongly in support of the integration into the educational curriculum, in the humanities, literature and elsewhere, of required materials promoting self-confidence and feelings of vorth among minorities and recognition and respect for that worth among majority students.

APPENDIX B

"Educating Poor Minority Children", by James P. Comer

SCIENTIFIC AMERICAN November 1988 Volume 259 Number 5

Educating Poor Minority Children

Schools must win the support of parents and learn to respond flexibly and creatively to students' needs. A successful program developed in New Haven points the way

by James P. Comer

Thomas Jefferson and other advocates of free public schools believed fervently that an educated populace is the lifeblood of democracy. In their view the school clearly had a political purpose: to socialize children to become good citizens. Jefferson wrote, "I know no safe depository of the ultimate powers of the society but the people themselves; and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion."

It is a long fall from this lofty ideal to the grim reality facing youths at the margins of today's society. Poor minority children are undereducated in disproportionate numbers across the country. Academically such children may lag behind the national average by up to two years. In large cities as many as 50 percent of minority children drop out of school. The failure to educate these children makes ever harder the task of rectifying economic and social inequities. Job opportunities increasingly reside in service and technology industries, but poor minority youths are the least likely to have the social and academic skills these jobs demand. Unless schools can find a way to educate them and bring them into the mainstream, all the problems associated with unemployment and alienation will escalate.

JAMES P. COMER is professor of child psychiatry and director of the School Development Program at Yale University's Child Study Center and associate dean of the Yale University School of Medicine. He received an A.B. at Indiana University, an M.D. from the Howard University College of Medicine and an M.P.H. from the University of Michigan School of Public Health. He writes and consults extensively on school improvement. In his most recent book, *Maggie's American Dream*, which will be published this month by New American Library, Comer writes about his mother, an impoverished black woman who grew up in the rural South.

The task seems overwhelming. And yet it can be done. In 1968 my colleagues and I at Yale University's Child Study Center started an intervention project at two inner-city schools in New Haven. Unlike many of the reforms that are now being tried or proposed, which focus on academic concerns such as teacher credentials and basic skills, our program promotes development and learning by building supportive bonds that draw together children, parents and school. By 1980 academic performance at the two New Haven schools had surpassed the national average, and truancy and disciplinary problems had declined markedly. We have now begun to duplicate that success at more than 50 schools around the country.

The perceptions underlying our approach are partly rooted in my own childhood. In 1939 I entered an elementary school in East Chicago, Ind., with three other black youngsters from a low-income community. The school was considered one of the best in the district; it was racially integrated and served the highest socioeconomic group in town. All four of us were from two-parent families, and our fathers made a living wage in the local steel mill. We were not burdened by any of the disadvantages—school segregation, inadequate schools, single-parent families, unemployment—commonly cited as causes of educational underachievement in poor black children. Yet in spite of the fact that we had similar intellectual potential, my three friends have had difficult lives: one died prematurely from alcoholism, a second spent a large part of his life in jail and a third has been in and out of mental institutions.

Why did my life turn out better? I think it was largely because my parents, unlike those of my friends, gave me the social skills and confidence that enabled me to take advantage of educational opportunities. For example, I became friendly with my third-grade teacher, with whom I would walk hand in hand to school every day. My parents took me to the library so that I could read many books. My three friends, however, never read books—which frustrated and angered their

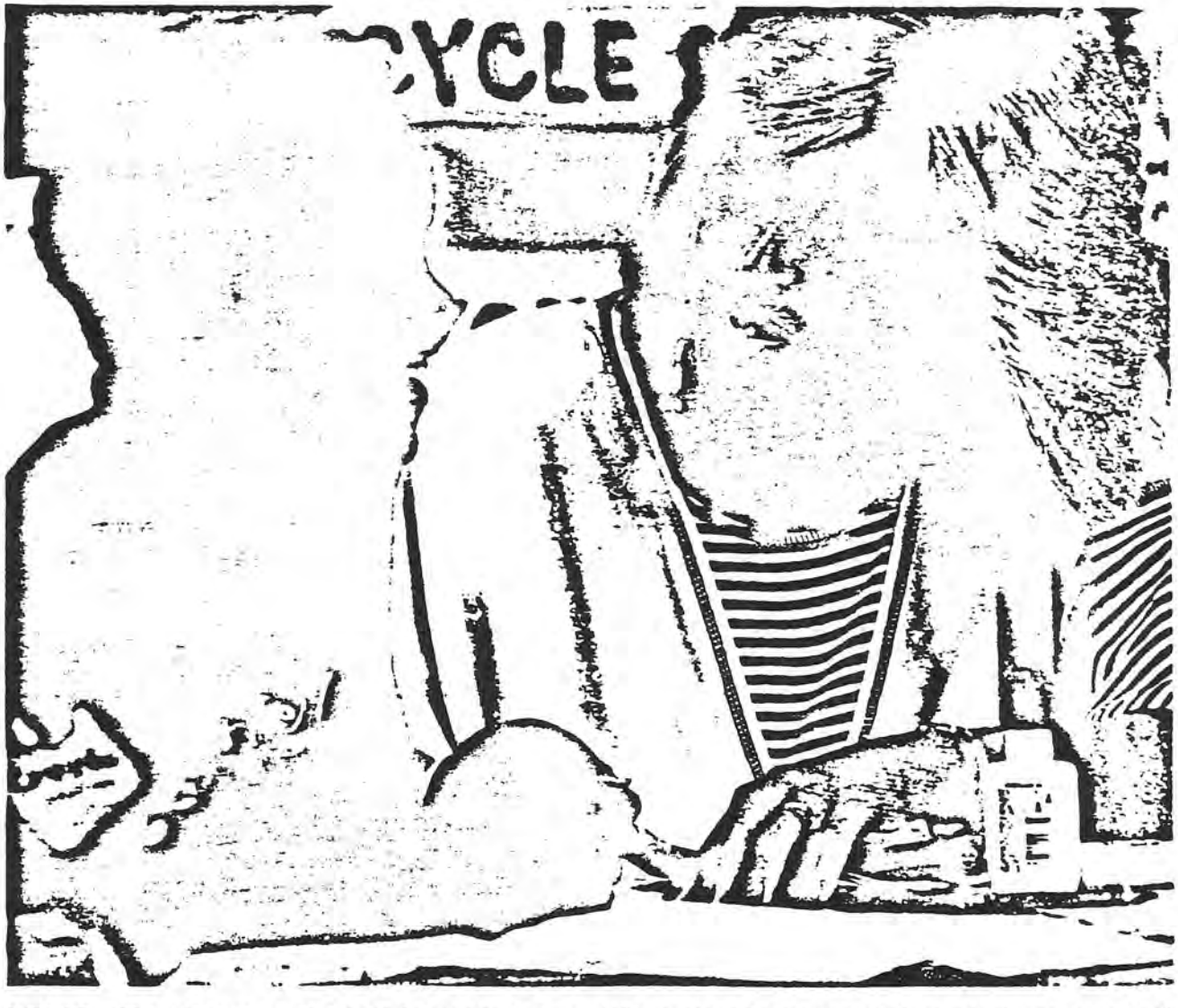
B-1

teachers. What the teachers did not realize was that their parents were afraid to go to the library; indeed, they were uncomfortable around white people in general and avoided them.

In the 1960's I began to speculate that the contrast between a child's experiences at home and those in school deeply affects the child's psychosocial development, and that this in turn shapes academic achievement. The contrast would be particularly sharp for poor minority children from families outside the mainstream. If my hunches were correct, then the failure to bridge the social and cultural gap between home and school may lie at the root of the poor academic performance of many of these children.

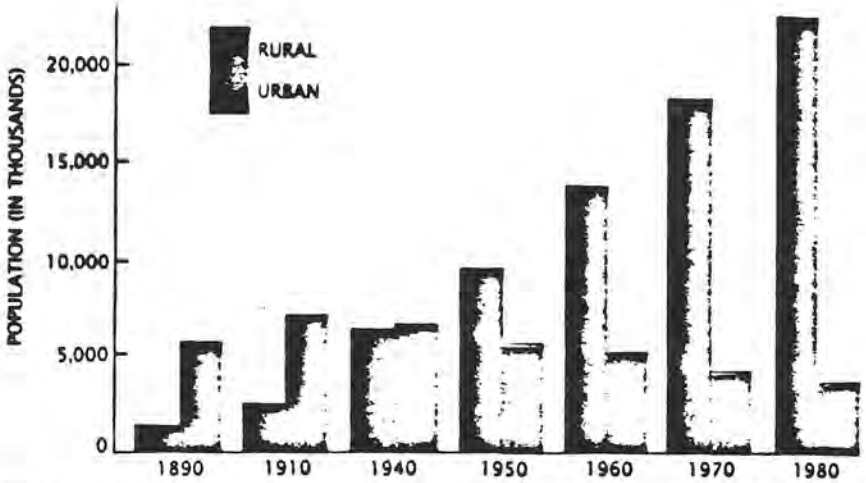
Yet current educational reforms de-emphasize interpersonal factors and focus instead on instruction and curriculum. Such approaches reveal a blind spot: they assume that all children come from mainstream backgrounds and arrive at school equally well prepared to perform as the school expects them to. Reading, writing, arithmetic and science are delivered to students in much the same way as tires, windows and doors are attached to the frame of an automobile on an assembly line. Yet students do not come in standardized frames that passively receive what is delivered. Most educators do not challenge this assumption, however, and the approach has never been systematically evaluated or modified through direct experiments in schools.

In contrast, Albert J. Solnit and his colleagues at Yale's Child Study Center believed educational reformers should develop their theories by directly observing and intervening in schools over long periods of time. Solnit's ideas inspired the school intervention research project that was begun by the center and the New Haven school system in 1968 and continued until 1980. I was asked to direct the project and to work with a social worker, a psychologist and a special-education teacher from the center. We decided to immerse ourselves in the schools to learn how they function and then, on the basis of our findings, to develop and implement a model for improving the schools. We were guided by our knowledge of public health,

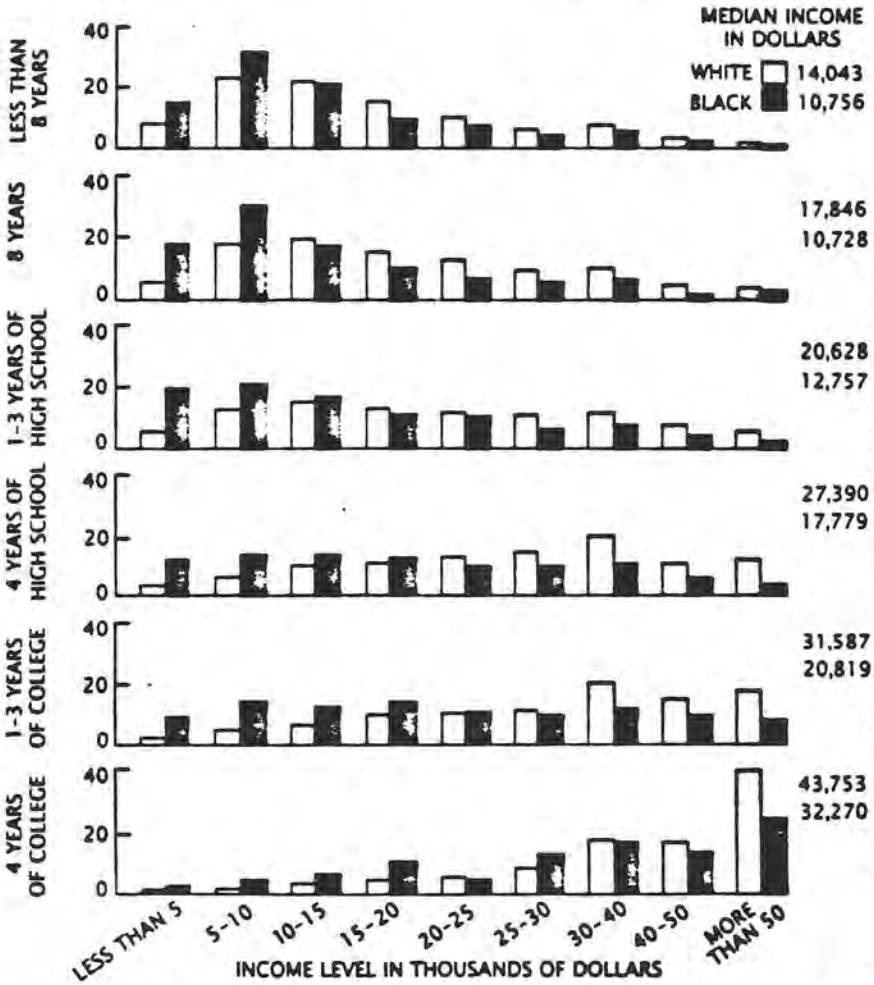


SMILE REWARDS A JOB WELL DONE in teacher Nancy McManus' first-grade class at the Katharine Brennan School in New Haven, Conn. The school, one of two elementary schools in which the author and his colleagues intervened, serves a nearby low-income housing project that suffers from rampant joblessness and crime. The staff is alert to the special needs of developing children, particularly those from marginal homes, and works hard to get parents involved; 92 percent of the parents visited the school 10 times or more in the past year. The school is now academically one of the best in the city.

B - 2



BLACK MIGRATION into urban communities (towns of more than 2,500 people) accelerated after World War II. The rural black population once greatly outnumbered the urban population, but the postwar economic boom led large numbers of blacks to move to the cities in search of jobs. Discrimination and lack of adequate education, however, denied many blacks access to the primary urban job markets.



EDUCATION LEVEL correlated to family income for whites and blacks shows that black incomes are at least a third less than the incomes of whites with equivalent schooling. For a given level of schooling completed by the family head, the graph indicates the percentage of families within each income bracket. Lack of education reduces the income of blacks more than that of whites, and black income rises more slowly with education than white income does. The data, for 1984, are from *Statistical Abstract of the United States 1987*, issued by the U.S. Department of Commerce.

human ecology, history and child development—and by common sense.

Our model evolved in two schools: the Martin Luther King, Jr., School, which had about 300 pupils from kindergarten through fourth grade, and the Katharine Brennan School, which had more than 350 pupils from kindergarten through fifth grade. The pupils were 99 percent black and almost all poor; more than 70 percent were from families receiving Aid to Families with Dependent Children. At the beginning of the project the pupils were ranked near the bottom in achievement and attendance among the 33 schools in the city. There were serious problems with attendance and discipline. The staffs were discouraged; their turnover rate was 25 percent. Parents were dejected, distrustful, angry and alienated.

Both staff and parents approached the first year of the project with high expectations. But because teachers and administrators could not agree on clear goals and strategies, we had a difficult school opening. Some new teachers tried to have open classrooms, but the children soon became uncontrollable. Teachers blamed the administration for not providing adequate resources, and parents became angry—angry enough to march on one of the schools. Needless to say, the students did not learn much.

We, on the other hand, learned a great deal. The spectacular deterioration of the schools illuminated their social dynamics, something that would otherwise have taken us many years to perceive. We learned, first of all, that both the schools and our project needed more structure; we established regular meetings so that the staff could coordinate plans and set goals. More important, our analysis of interactions among parents, staff and students revealed a basic problem underlying the schools' dismal academic and disciplinary record: the sociocultural misalignment between home and school. We developed a way to understand how such misalignments disrupt beneficial relations and how to overcome them in order to promote educational development.

Our understanding is based on the fact that a child develops a strong emotional bond to competent caretakers (usually parents) that enables them to help the child develop. Many kinds of development, in social, psychological, emotional, moral, linguistic and cognitive areas, are critical to future academic learning. The attitudes, values and behavior

B - 3

tered at school will be prepared to achieve at the level of his or her ability. In addition the meshing of home and school fosters further development. When a child's social skills are considered appropriate by the teacher, they elicit positive reactions. A bond develops between the child and the teacher, who can now join in supporting the overall development of the child.

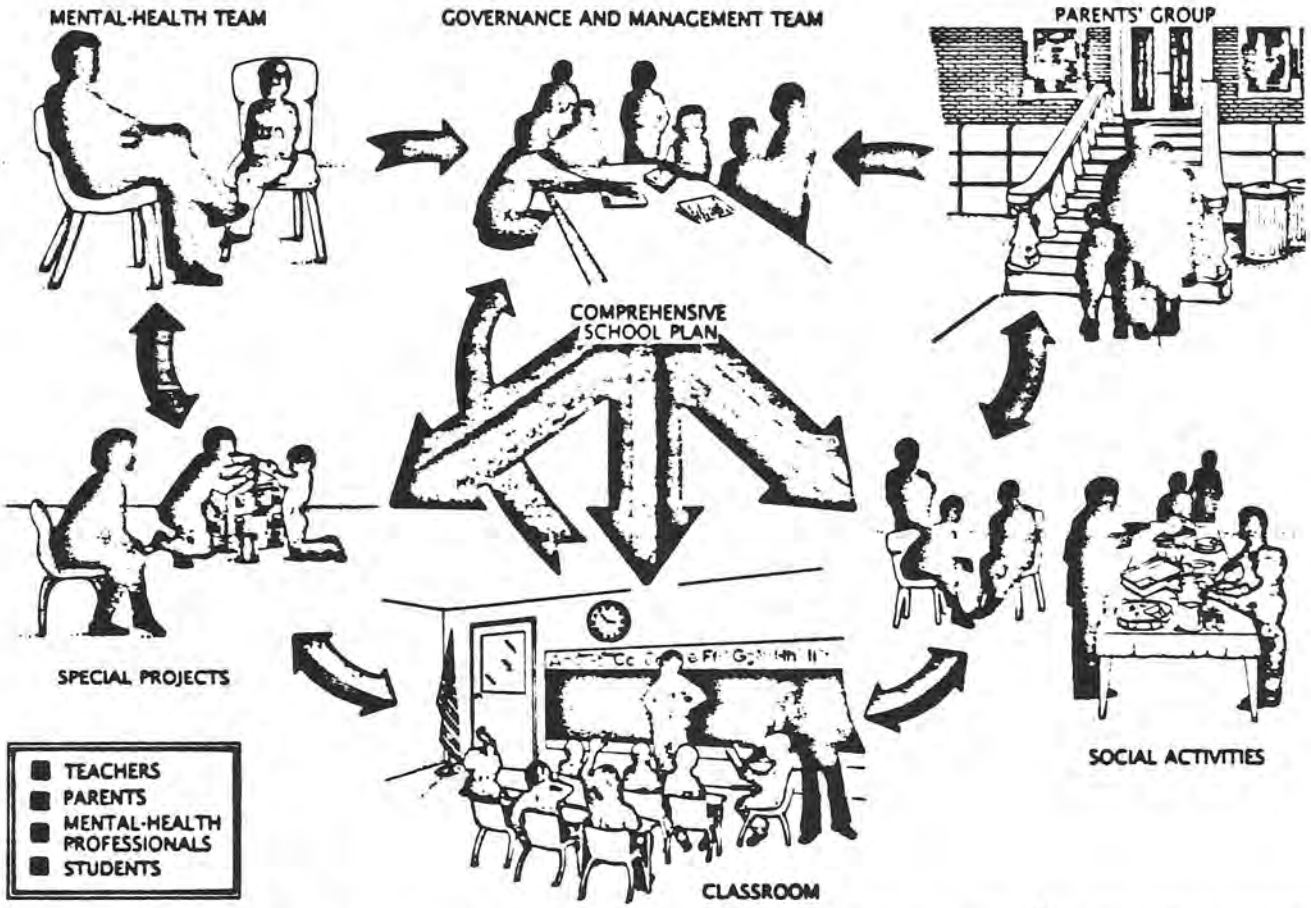
A child from a poor, marginal family, in contrast, is likely to enter school without adequate preparation. The child may arrive without ever having learned such social skills as negotiation and compromise. A child who is expected to read at school may come from a home where no one reads and may never have heard a parent read bedtime stories. The child's language skills may be underdeveloped or non-

And yet the same behavior will get the child into trouble at school.

Such lack of development or development that is at odds with the mainstream occurs disproportionately often among children from the minority groups that have had the most traumatic experiences in this society: Native Americans, Hispanics and blacks. The religious, political, economic and social institutions that had organized and stabilized their communities have suffered severe discontinuity and destruction. Furthermore, these groups have been excluded from educational, economic and political opportunity. These themes are particularly vivid in the black experience.

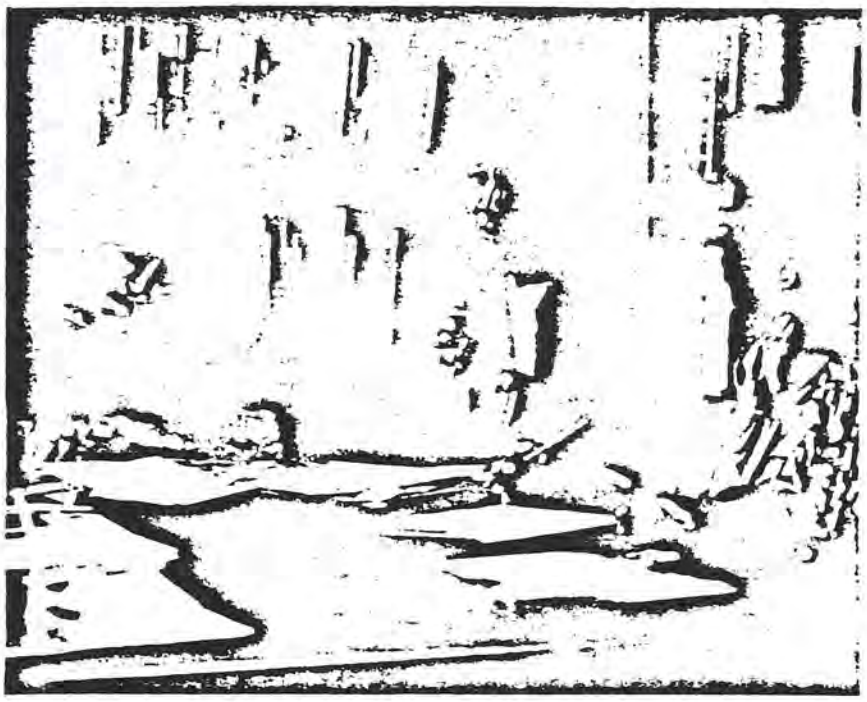
Blacks arrived in this country forcibly uprooted from their own culture, and they had another culture—that of independence and personal advancement. The dominant culture devalued the imposed black culture, and many blacks in turn developed a negative self-image. After the abolition of slavery, widespread discrimination denied blacks access to education and to the political and economic mainstream. Yet in spite of these psychological and social handicaps many poor black families, particularly in rural areas, were able to develop strong religious and cultural support systems and to function reasonably well.

After World War II opportunities for rural work diminished and many black families migrated to cities, but as a result of discrimination they were largely shut out of the primary job markets. Moreover, urban jobs de-



SCHEMATIC of the school-intervention program shows its key components and the relations among them. A governance and management team, consisting of the principal, parents, teachers and a mental-health worker, develops a comprehensive school plan covering academics, social activities and special programs, such as a Discovery Room for children who have lost interest in learning. Social activities, such as potluck suppers, teach children social skills and enable parents to meet teachers. Some parents become teachers' aides. The mental-health team assigns a member to work with a child who is having difficulty. It also tries to prevent behavior problems by recommending changes in school procedures. By reducing behavior problems and improving relations with parents, the program creates a school climate conducive to learning.

B-4



MENTAL-HEALTH TEAM of the Katharine Brennan School meets weekly under the direction of principal Dietria Wells (*center*). Members track the progress of students who are having problems and discuss intervention strategies, which often involve the children's families. Participants include staff member Bridget Hardy (*left*), speech pathologist Judith Campbell (*right*) and psychologist Karen McCleu (*far right*).

manded a higher level of education than rural ones, and blacks, undereducated in prewar years, were at a disadvantage. At the same time, they experienced severe stress resulting from the loss of supportive communities. For all these reasons, many black families began to function less well and could not provide their children with preschool experiences that would enable them to succeed in school.

Furthermore, blacks were able to achieve mainstream success only in limited professional areas. Thus they could not gain a significant share of political, economic and social power in the larger society and thereby help to advance socially marginal blacks. With time, marginal blacks came to resent mainstream blacks and whites for being unable—and apparently unwilling—to help them, and they defensively rejected the mainstream.

In spite of their alienation from the mainstream, many poor black parents still look to the school as their hope—indeed, their only hope—for the future, even though at the same time they expect the school to fail them and their children as other mainstream institutions have. And in fact the schools often do fail them. Typical schools, with their hierarchical and authoritarian structure, cannot give underdeveloped or differently developed students the skills and experiences that will enable them to fulfill expectations at the school. Instead such students are labeled "bad," unmotivated or stupid. Staff people punish the children and hold low expectations for them, often blaming the students, their parents and their communities for the problems. Parents, for their part, take the problems as a personal failure or as evidence of animosity and rejection by the mainstream. They lose hope and confidence and become less supportive of the school. Some parents, ashamed of their speech, dress or failure to hold jobs, become defensive and hostile, avoiding contact with the school staff.

The result is a high degree of mutual distrust between home and school. A black first-grade teacher in an inner-city school with a nearly all-black student body recalled explaining classroom rules on the first day. When she finished, a six-year-old raised his hand and said, "Teacher, my mama said I don't have to do anything you say." Fortunately this teacher understood the underlying problem, but most teachers would have reacted angrily, whereupon any chance of gaining parental cooperation would have quickly evaporated. This degree of alienation between home and school makes it difficult to nurture a bond between child and teacher that can support development and learning.

The consequences of alienation become most apparent when these children reach the age of about eight. Around this age they are expected to progress academically at a rate that begins to exceed their level of development. In addition the children begin to understand how they and their families differ in income, education and sometimes race and style from other people in the school. At this age, moreover, children seek to decrease their dependence on adults and on the approval of adults.

Unable to achieve in school, these children begin to see academic success as unattainable, and so they protect themselves by deciding school is unimportant. Many seek a sense of adequacy, belonging and self-affirmation in nonmainstream groups that do not value academic achievement. Such children are at risk for dropping out, teen-age pregnancy, drug abuse and crime. On the other hand, the decision to pursue academic achievement and to join the mainstream also exacts a heavy price: such a choice means rejecting the culture of one's parents and social group.

Our analysis of the two New Haven schools suggested that the key to academic achievement is to promote psychological development in students, which encourages bonding to the school. Doing so requires fostering positive interaction between parents and school staff, a task for which most staff people are not trained. Such changes cannot be mandated or sustained from outside the school. Our task, then, was to create a strategy that would overcome the staff's resistance to change, instill in them a working understanding of child development and enable them to improve relations with parents.

From our experience during the first difficult year it was obvious that we would make no progress until we had reduced the destructive interactions among parents, teachers and administrators and given cohesiveness and direction to the schools' management and teaching. To this end we created in each school a governance and management team of about a dozen people led by the principal and made up of elected parents and teachers, a mental-health specialist and a member of the nonprofessional support staff—all the adults who had a stake in the outcome. The teams decided issues ranging from the schools' aca-

B-5

health and social program to changes in school procedures that seemed to engender behavior problems.

Several rules guided these teams. First, team members had to recognize the authority of the principal but, equally important, the principal could not push through decisions without weighing the concerns of the team members. Second, we agreed to focus efforts on problem solving and not waste time and energy in placing blame. Third, we made decisions by consensus rather than by vote; this promoted cooperation by reducing the harmful tendency of groups to polarize into "winners" and "losers."

The teams were not fully accepted at first, nor were they immediately effective, because we at the center were viewed as outsiders (from Yale, to boot, which working-class people in New Haven have always regarded with suspicion). But as we helped the principals to see that power sharing increased their own ability to manage the school, and as teachers and administrators benefited, the staff became more willing to apply our expertise in social and behavioral sciences to every aspect of the school.

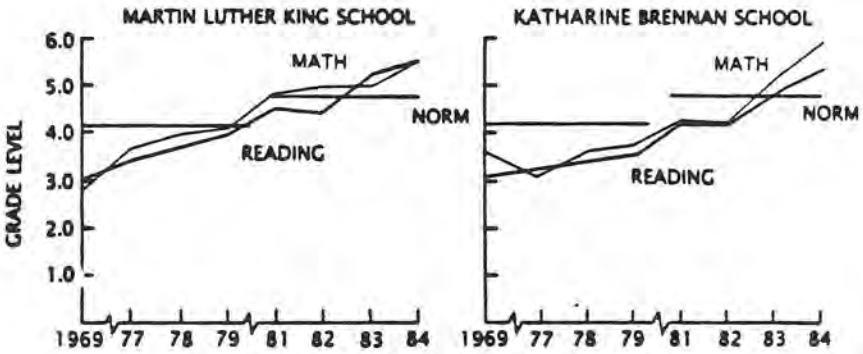
We invited parents from among the group that had protested against us in the first year to join the team. With their input we developed a program that involved parents at three levels: shaping policy through their representatives on the governance and management team, participating in activities supporting the school program, and attending school events.

At one point about a dozen parents worked as classroom assistants and formed the core of the parents' group. (They were paid the minimum wage.) Parents and staff sponsored activities such as potluck suppers, book fairs and graduation ceremonies. These social gatherings fostered good relations between parents and staff, so that when a child was having problems, the staff could discuss the matter with the parents without eliciting defensive reactions. As a result the school climate and student behavior improved, and more parents began to attend school activities.

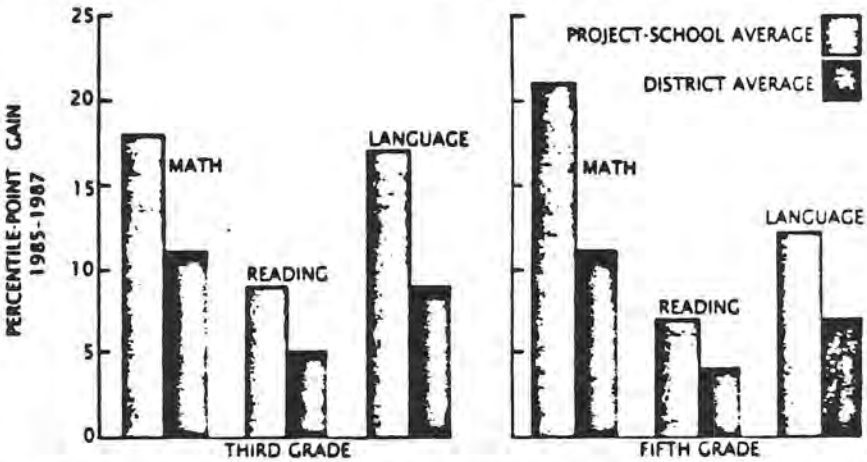
In a typical school, students who have emotional, learning or behavioral difficulties are seen by the school's psychologist, social worker or special-education teacher, who all work independently of one another. In our project, however, they worked as a team. We found this to be more efficient; the team would discuss each case and assign one member to it. The team approach also made it easier to detect patterns of troublesome behavior and to determine whether some aspect of the school was making them worse. Through its delegate on the governance and management team, the mental-health group recommended changes in school policies and practices so that students' developmental needs would be served better and behavior problems prevented.

These actions reduced the sense of failure, the feelings of anger and the loss of confidence that can lead to problem behavior among students. For example, an eight-year-old who was transferred into King from another school was taken directly to the classroom. He panicked, kicked the teacher in the leg and ran out. Usually such a child is punished. If nothing is done to reduce the child's anxiety, the cycle is often repeated until the child is labeled disturbed and referred for treatment. Our mental-health team helped the school staff to understand that the child's anxiety was a natural reaction to being thrust among strangers, and, together with the staff, we developed an orientation program to introduce transfer students and their parents to the school.

In the course of the 12 years we spent in the New Haven schools, other programs emerged in response to students' needs. In one school, children were kept with the same teacher for two years. A Discovery Room enabled "turned off" children to form a trusting relationship with an adult and, through play, rediscover an interest in learning. A Crisis Room provided a



FOURTH GRADERS at the two New Haven schools taking part in Yale University's Child Study Center's intervention program registered steady gains in achievement-test scores from 1969 through 1984. The graphs show mean scores on the Iowa Test of Basic Skills in reading (*red*) and mathematics (*blue*); scores in 1969 are for the Metropolitan Achievement Test. From 1969 through 1979 the tests were given in the fall (when the norm is a score of 4.2); from 1981 through 1984 the tests were given in the spring (norm score 4.8). Scores have stayed near the 1984 levels since then.



AVERAGE PERCENTILE GAINS on California Achievement Test scores from 1985 through 1987 were larger for 10 mainly black schools in Prince Georges County, Md., that use the Comer program than they were for the school district as a whole. Test scores of black students still lag behind those of white students, but the gap is narrowing. The school district, the 15th-largest in the U.S., has 105,000 students, 62 percent of whom are black. The schools using the program are more than 90 percent black; they receive extra staff and funds because they have been hard to integrate.

B - 6

refuge for children who were "out of control." We discovered that this behavior could often be traced to a traumatic home experience, and so staff members helped the children to handle their feelings and regain a sense of control. With each intervention the staff became increasingly sensitive to the concerns of developing children and to the fact that behavior problems result mainly from unmet needs rather than from willful badness—and that actions can be taken to meet these needs.

By 1975 the program was clearly having an effect. Behavioral problems had declined, relations between parents and staff had improved and the intelligence of the children had become manifest. In that year we drew up a formal School Development Program based on the key ingredients of our success: the governance team, the parents' program and the mental-health team.

Having established a way to achieve and maintain a smoothly functioning school, we decided to see whether the school might also play a role in redressing the problem of social misalignment. We argued that it should be possible to teach our nonmainstream students the social skills that are expected of them in school, and that the acquisition of these skills would help them to succeed academically.

Staff and parents devised a curriculum of social skills, with instruction in the subjects children would need to know: politics and government, business and economics, health and nutrition, and spiritual and leisure activity. The staff chose specialists to help develop the program. Children learned how to write invitations and thank-you notes, how to serve as hosts, how the body functions, how to write checks, how to plan concerts, and so on. Each activity combined basic academic skills with social skills and an appreciation of the arts. These activities were an immediate and dramatic success. Students, parents and staff alike all felt a surge of excitement and a growing sense of participating in the mainstream.

The intervention program in New Haven produced significant academic gains. The students had once ranked lowest in achievement among the 33 elementary schools in the city, but by 1979, without any change in the socioeconomic makeup of the schools, students in the fourth grade had caught up to their grade level. By 1984 pupils in the fourth grade in the two schools ranked third- and fourth-highest on the Iowa Test of Basic Skills. By the early 1980's attendance rates at King were either first or second in the city. There have been no serious behavior problems at either school in more than a decade.

In 1980 our group left the schools. The program was fully integrated into the normal practices of the staff, who continued to carry it out. In the same year we began to develop a way to apply our program in other schools. We left intact the key elements of our success in New Haven—the governance and management team, the parents' program and the mental-health team, along with our operating rules—while allowing specific social and academic activities to vary with the needs of a particular school. In a sense the program enables school personnel to engage in a "clinical practice": armed with theories of child development and education, together with observations of children and school systems, they can diagnose problems in the school and develop solutions.

The Prince Georges County, Md., and Benton Harbor, Mich., school districts, which serve mainly low-income black children, have been using the program for several years; they have achieved successes on a par with those of the two New Haven schools. The program is being introduced to all New Haven schools, as well as to three other districts: Norfolk, Va., Lee County, Ark. (both also serving mainly poor black children), and Leavenworth, Kans. The program is now being implemented in more than 50 schools around the country, including two middle schools and one high school.

All the money and effort expended for educational reform will have only limited benefits—particularly for poor minority children—as long as the underlying developmental and social issues remain unaddressed. Yet most teachers and administrators are not trained to organize and manage schools in ways that support the overall development of students. Nor does their training enable them to analyze, much less solve, the social-misalignment problems of children from outside the mainstream.

The first step toward improving the education of these children, then, is to induce teachers' colleges and schools of education to focus on student development. Teachers who invest time in training will have an incentive to use what they have learned. The efforts of individuals will not be enough; the entire staff of a school must embrace new ways of thinking.

School districts, state and local governments and school boards must actively support these changes. They must recognize that students' social development is as important to society as their academic ability. They must select, certify and reward teachers and administrators who are skilled in nurturing the development of students. They must evaluate schools by their ability not only to produce high test scores but also to prepare students to assume adult responsibilities. And they must provide necessary funds.

The Federal Government must play a leading role in bringing about national educational reforms that can prepare young people to be effective and responsible citizens. Besides appropriating funds and establishing programs, the Government must facilitate the interaction of state and local government, educational authorities and private interests—foundations, businesses, colleges and universities.

To pull all of this together, I believe a National Academy of Education is needed. Its purpose would be to set national priorities, assess current research in education, learn how to implement approaches that work, identify areas for further study and allocate resources effectively. Such an academy must be free from the pressures of political expediency, and the interests of researchers must be balanced against those of educators. It could be created largely from existing Federal programs and governed by those who have a stake in education: educators, parents, government and business. A National Academy of Education could spearhead a process of change that is geared above all to the needs of children and to the national interest. It could set a timetable and move forward at a rational pace that recognizes the urgent need for reform and at the same time is guided by knowledge and common sense.

FURTHER READING

SCHOOL POWER: IMPLICATIONS OF AN INTERVENTION PROJECT. James P. Comer. The Free Press, 1980.

FAMILY LIFE AND SCHOOL ACHIEVEMENT: WHY POOR BLACK CHILDREN SUCCEED OR FAIL. Reginald M. Clark. University of Chicago Press, 1983.

GOOD SCHOOLS: WHAT RESEARCH SAYS ABOUT IMPROVING STUDENT ACHIEVEMENT. Willis D. Hawley and Susan J. Rosenholtz in *Peabody Journal of Education*, Vol. 61, No. 4; Summer, 1984.

WHY THE CURRENT WAVE OF SCHOOL REFORM WILL FAIL. John E. Chubb in *The Public Interest*, Vol. 90, pages 28–49; Winter, 1988.

B - 7

APPENDIX C

Lists of Task Force Members & Committees

Task Force on Minorities in Mathematics

Executive Committee

Louise A. Raphael, Chair
National Science Foundation
Science & Engineering Education
Directorate, Room 414
1800 G Street, N. W.
Washington, DC 20550

Manuel Berriozabal
Division of Math & Computer Science
System Design
University of Texas
San Antonio, TX 78285

Gilbert Cuevas
12340 Southwest 106 Terrace
Miami, FL 33186

Susan Forman
110 Bank Street, #4D
New York, NY 10014

Marilyn Hala
Department of Education
Division of Mathematics
700 Governors Drive
Pierre, SD 57501-2281

Genevieve Knight
7314 Kerry Hill Court
Columbia, MD 21045

Rogers Newman
Departmento f Mathematics
Southern University
Baton Rouge, LA 70813

Uri Treisman
Professional Development Programs
University of California
Berkeley, CA 94720

Correspondents

Efraim Armendariz
Department of Mathematics
University of Texas
Austin, TX 78712

David Blackwell
Department of Mathematics
University of California
Berkeley, CA 94720

Llayron L. Clarkson
Vice President
Texas Southern University
3100 Cleburne Avenue
Houston, TX 77004

Ed Dubinsky
Department of Mathematics
Purdue University
West Lafayette, IN 47907

Etta Z. Falconer
3415 Spreading Oak Drive, S. W.
Atlanta, GA 30311

Florence Fasanelli, Sec'y
National Science Foundation
Science & Engineering Education
Directorate, Room 414
1800 G Street, N. W.
Washington, DC 20550

David Ferguson
Department of Technology & Society
College of Engineering & Applied Sci.
SUNY at Stony Brook
Stony Brook, NY 11794

Tepper Gill
Department of Engineering
Howard University
Washington, 20059

Gloria Gilmer
The Math-Tech Connexion
2001 West Vliet Street
Milwaukee, WI 53205

Nancy Gonzales
Department of Mathematics
University of New Mexico
Albuquerque, NM 87131

Henry Gore
Department of Mathematics
Morehouse College
Atlanta, GA 30314

Leon Henkin
Department of Mathematics
University of California
Berkeley, CA 94720

Reuben Hersh
Department of Mathematics
University of New Mexico
Albuquerque, NM 87131
505-277-4903

Johnny Johnson
Department of Mathematics
Northern Arizona University
Flagstaff, AZ 86011

Raymond Johnson
Department of Mathematics
University of Maryland
College Park, MD 20742

Princess Killebrew
Box 51
Lander, WY 82520

Peter D. Lax
Courant Institute of Mathematical Sciences
New York University
251 Mercer Street
New York, NY 10012

Lee Lorch
Department of Mathematics
York University
North York, Ontario M3J 1P3
CANADA

Bernard Madison
Department of Mathematical Sciences
SE 301 University of Arkansas
Fayetteville, AR 72701

W. Alma Marosz
6122 Rockhurst Drive
San Diego, CA 92120

Cheryl McClelland
Sr. Development Engineer
Defense System Drive
Honeywell Inc. MN48-2300
7225 Northland Drive
Brookly Park, MN 55428

Irene Murphy
P. O. Box 169
Barrow, AK 99723

Arthur Powell, Jr.
109 St. Mark's Place
Brooklyn, NY 11217

Diane Resek
Department of Mathematics
San Francisco State University
1600 Holloway Avenue
San Francisco, CA 94132

Paul J. Sally, Jr.
Department of Mathematics
University of Chicago
Chicago, IL 60637

Michael Starbird
Department of Mathematics
University of Texas
Austin, TX 78713

Harold Stolberg
5052 North 36th Street
Arlington, VA 22207

Richard Tapia
Department of Mathematical Sciences
Rice University, Box 1892
Houston, TX 77251

William Velez
Department of Mathematics
University of Arizona
Tucson, AZ 85721

Phillip Wagreich
Department of Mathematics
University of Illinois
Chicago, IL 60680

Dennis White
91 Craig Avenue
Madison, WI 53705

Nate Whittaker
Department of Mathematics
University of Massachusetts
Amherst, MA 01003

Floyd Williams
Department of Mathematics
University of Massachusetts
Amherst, MA 01003

Gail Young
Department of Mathematics
University of Wyoming
Laramie, WY 82071

TASK FORCE ON MINORITIES IN MATHEMATICS

Report Writing Retreat
June 10-12, 1988

List of Attendees

Dr. Etta Falconer
3415 Spreading Oak Drive SW
Atlanta, GA 30311

Professor James Donaldson
Department of Mathematics
Howard University
Washington, DC 20059

Professor Tepper Gill
Department of Elec. Engineering
Howard University
Washington, DC 20059

Dr. Gloria Gilmer
The Math-Tech Connexion
2001 West Vliet Street
Milwaukee, WI 53205

Professor Raymond Johnson
Department of Mathematics
University of Maryland
College Park, MD 20742

Professor Phillip Wagreich
Department of Mathematics
University of Illinois
Chicago, IL 60680

Professor Beverly Anderson
Department of Mathematics
University of the District of Col.
Washington, DC 20008

Professor Donald Hill
c/o Miss Pat Finan
TW-41 787 7th Avenue
New York, NY 10019

Dr. Christine Stevens
SEE Directorate
National Science Foundation
1800 G Street, NW
Washington, DC 20550

Professor Joaquin Bustoz
Department of Mathematics
Arizona State University
Tempe, AZ 85287

Dr. Rogers Newman
7860 Emile Street
Baton Rouge, LA 70807

Dr. Susan Forman
110 Bank Street, Apartment 4D
New York, NY 10014

Professor Manuel Berriozabal
University of Texas at San Antonio
Division of Math & Computer Sci.
System Design
San Antonio, TX 78285

Professor Gilbert Cuevas
12340 Southwest 106 Terrace
Miami, FL 33186

Dr. Genevieve Knight
7314 Kerry Hill Court
Columbia, MD 21045

Dr. Uri Treisman
Professional Development Programs
Stephens Hall
University of California
Berkeley, CA 94720

Professor Lee Lorch
Department of Mathematics
York University
North York, Ontario
CANADA M3J 1P3

Professor Arnold Ross
Department of Mathematics
Ohio State University
Columbus, OH 43210

Dr. Louise Raphael
Mathematical Sciences Division
National Science Foundation
1800 G Street, NW
Washington, DC 20550

Mr. Richard Witter
Development Officer
Mathematical Association of America
1529 18th Street, NW
Washington, DC 20036

Ms. Donna Murray
(Retreat Organizer)
Mathematical Association of America
1529 18th Street, NW
Washington, DC 20036

Charge to Committee on Local and Regional Action

To make recommendations to the Task Force on ways in which MAA can generate greater minority participation in MAA activities at the local and regional levels. The Committee should survey MAA Section Governors and Chairmen to assess the current state of such participation and to identify documented model local and regional programs and initiatives that have contributed to the improvement of the mathematics education of minorities. The Committee will submit to the Executive Committee a draft of its recommendations by March 1988 and a set of final recommendations for inclusion in the Task Force's final report by May 30, 1988.

Members, Committee on Local/Regional Action

Manuel Berriozabal - co-chair
Marilyn Hala - co-chair
Sylvia Bozeman
Nancy Gonzales
Gail Young

Charge to Committee on Recognition

To make recommendations to the Task Force on ways in which MAA can provide recognition to outstanding efforts to increase minority participation in mathematics at all levels, from kindergarten to graduate school. These efforts can be those of schools or mathematics departments, as well of individual mathematics teachers and mathematicians. The Committee should also propose vehicles by which MAA can encourage and promote the development of mathematically talented minority youth. The Committee will submit to the Executive Committee a draft of its recommendations by March 1988 and a set of final recommendations for inclusion in the Task Force's final report by May 30, 1988.

Members, Committee on Recognition

Etta Falconer - co-chair
Rogers Newman - co-chair
Ed Dubinsky
Lee Lorch
Charles Moore

Charge to Committee on Collaboration

To make recommendations to the Task Force on ways in which MAA can productively collaborate with and/or support the successful efforts of professional associations, colleges and universities, community-based organizations, and other organizations to increase minority involvement in mathematics and mathematics-related professions. The Committee is asked to examine the NCTM Handbook for Conducting Equity Activities in Mathematics Education for possible MAA adoption or adaptation. The Committee might also wish to propose joint activities with other organizations that can address needs not currently being addressed by existing programs. The Committee will submit to the Executive Committee a draft of its recommendations by March 1988 and a set of final recommendations for inclusion in the Task Force's final report by May 30, 1988.

Members, Committee on Collaboration

Gilbert Cuevas - co-chair
Genevieve Knight - co-chair
Gloria Gilmer
Harvey Keynes
Alma Marosz
Margery Palmer

Charge to Committee on Creating Awareness

To make recommendations to the Task Force on ways in which MAA can generate greater awareness in the mathematics community (1) of the status of minority involvement in mathematics and (2) of efforts that have contributed significantly to the improvement of the mathematics education of minorities. The Committee will submit to the Executive Committee a draft of its recommendations by March 1988 and a set of final recommendations for inclusion in the Task Force's final report by May 30, 1988.

Members, Committee on Creating Awareness

Susan Forman - chair
Efraim Armendariz
Henry Gore
Irene Murphy
Phil Wagreich

ADDITIONAL NAMES

Dean John Alexander, Jr.
Wentworth Institute of Technology
550 Huntington Avenue
Boston, MA 02115

Dr. Gary Allen
Executive Director
Native American Science
Education Association
1228 M Street, NW
Washington, DC 20005

Dr. Beverly Anderson
Department of Mathematics
University of District
of Columbia
Washington, DC 20008

Ms. Laura Artis
Math/Science Supervisor
Robeson County Board of Educ.
P. O. Box 1328
Lumberton, NC 28359

Ms. Deborah Baldridge
62 Brams Point Road
Hilton Head, SC 29928

Dr. Ruth Bennett
Department of Mathematics
Humboldt State College
Arcata, CA 95521

Professor Sylvia T. Bozeman
2846 Fairlane Drive SE
Atlanta, GA 30354

Ms. Claudette Bradley
2-203 Peabody Terrace
Cambridge, MA 02139

Dr. Dalton Brooks
Institutional Research
Pembroke State University
Pembroke, NC 28358

Dr. Fred Bowers
3833 Peachtree Road, NE
Apartment 602
Atlanta, GA 30319

Dr. Roosevelt Calvert
Director, Minorities
Institution Programs
National Science Foundation
1800 G Street, NW
Washington, DC 20550

Mr. Daryl Chubin
Office of Technology & Assessment
Washington, DC 20510

Dr. Augustus Cotera
Assistant Provost
Northern Arizona University
Flagstaff, AZ 86011

Ms. Amelia Clark
Magnolia High School
Route 8
Lumberton, NC 28358

Dr. Chuck Cowan
Center for Educational Statistics
Department of Education
555 New Jersey Avenue, NW
Room 400
Washington, DC 20208-1405

Dr. Michael Crawley
National Science Foundation
1800 G Street, NW
Washington, DC 20550

Dr. Tom Cummings
Associate Director
MACESA Durland Hall 144
Kansas State University
Manhattan, KS 66506

Professor Louis Dale
663 Dublin Avenue
Birmingham, AL 35212

Dr. Frank Davis
Graduate School
Lesley College
29 Everett Street
Cambridge, MA 02238

Mr. Richard Davis
Office of Technology & Assessment
Washington, DC 20510

Professor James Donaldson
Department of Mathematics
Howard University
Washington, DC 20059

Dr. John A. Dossey
RR 1, Box 33
Eureka, IL 61530

Revised 10/13/87

Professor Carl Downing
Mathematics & Stats. Department
Oklahoma State University
Stillwater, OK 74074

Dr. Mark Driscoll
Education Development Center
55 Chapel Street
Newton, MA 02160

Mr. Theodore Drury
Federal City Council
1155 15th Street, NW
Suite 301
Washington, DC 20005

Dr. Richard Duran
Department of Psychology
University of California
Santa Barbara, CA 93106

Dr. Leo Edwards
Math & Science Educ. Center
Fayetteville State University
Fayetteville, NC 28301

Dr. Alan Fechter
National Academy of Sciences/
National Research Council
Office of Scientific &
Engineering Personnel
1201 Constitution Avenue, NW
Washington, DC 20418

Dr. Richard Felder
Department of Mathematics
North Carolina State U.
Raleigh, NC 27695

Ms. Audrey Friar
The Instructional Services Ctr.
12675 Fee Fee Road
Crevecouer, MO 63146

Dr. John Fowler, Director
Triangle Coalition/National
Science Teachers Association
1742 Connecticut Avenue, NW
Washington, DC 20009

Leonard Gillman
Department of Mathematics
University of Texas-Austin
Austin, TX 78712

Dr. Joella Gipson
Department of Math Education
Wayne State University
Detroit, MI 48202

Professor Lou Allen Gray
6318 Amblewood Court
Jackson, MS 39213

Dr. Rayna Green
Smithsonian Institution
1000 Jefferson Drive, SW
Washington, DC 20560

Professor Richard Griego
Department of Mathematics
University of New Mexico
Albuquerque, NM 87106

Mr. Frank Hannah
Phillips Academy
Main Street
Andover, MA 08180

Dr. Robert Harvey
Minorities Institution Program
National Science Foundation
1800 G Street, NW
Washington, DC 20550

Dr. Gary Gruber
110 Sarah Drive
Mill Valley, CA 94941

Professor Leonard Haff
Department of Statistics
University of California-San Diego
La Jolla, CA 92093

Professor Isom Herron
Department of Mathematics
Howard University
Washington, DC 20059

Professor Gloria Hewitt
Department of Mathematics
University of Montana
Missoula, MT 59812

Professor Donald Hill
3017 Godfrey Place
Tallahassee, FL 32308

Dr. Norbert S. Hill, Jr.
Executive Director
American Indian Science &
Engineering Society
1310 College Avenue/Suite 1220
Boulder, CO 80302

Professor Mary James
Dept. of Electrical Engineering
University of Maryland
College Park, MD 20740

Professor Martin Johnson
Department of Mathematics
University of Maryland
College Park, MD

Dr. Vera John-Steiner
Dept. of Educ. in Linguistics
University of New Mexico
Albuquerque, NM 87131

Dr. Ted Joloye
Director of Native American Studies
University of New Mexico
Albuquerque, NM 87131

Dr. J. Arthur Jones
Director of Educational Systems
& Human Resources
Decision Information Systems Corp.
1425 K Street, NW
Washington, DC 20005

Dr. Lyle V. Jones
Department of Psychology
University of North Carolina
Davie Hall, 013A UNC-CH
Chapel Hill, NC 27514

Professor Harvey B. Keynes
School of Mathematics
University of Minnesota
127 Vincent Hall
Minneapolis, MN 55455

Dr. Mary Kohlerman
SEE Directorate, DMDRI 63J
National Science Foundation
1800 G Street, NW
Washington, DC 20550

Mrs. Mary Harley Kruter
4552 Shetland Green Road
Alexandria, VA 22312
H 256-9450

Mr. Doug Lapp
National Academy of Sciences/
National Research Council
2101 Constitution Avenue, NW
Washington, DC 20418

Dr. Gordon Lewis
Mathematics Supervisor
Langdon School
20th & Evarts Streets, NE
Washington, DC 20018

Dr. Madeleine Long
Long Island University
Institute for Advancement
of Math & Science Education
Brooklyn, NY 11201

Professor Gilbert Lopez
Department of Engineering
Columbia University
New York, NY 10027

Dr. Edna MacLean
Department of Linguistics
University of Alaska
Fairbanks, AK 99775

DS > Professor Eugene Maier
Division of Continuing Educ.
Portland State University
P. O. Box 1491
Portland, OR 97207

Dr. Shirley Malcom
Office of Opportunities
in Science
1333 H Street, NW
Washington, DC 20005

Professor Vivienne Malone-Mayes
Department of Mathematics
Baylor University
Waco, TX 76798

Dr. J. V. Martinez
Society for Advancement of Chicano
& Native American in Science
P. O. Box 30040
Bethesda, MD 20814

Dr. Cleopatria Martinez de Wilkens
Department of Mathematics
Scottsdale Community College
Scottsdale, AZ 85253

Dr. Shirley McBay
Dean of Students
Massachusetts Institute of
Technology
Cambridge, MA 02139

Ms. Julia Medin
1008 Sampler Way
Potomac, MD 20854

Professor Jose Mestre
Cognitive Processes Research Group
University of Massachusetts
Hasbrouck Laboratory
Amherst, MA 01003

Dr. Charles Moore
Mathematics Education
Northern Arizona University
Flagstaff, AZ 86011

Dr. James Murphy
University of Colorado
Medical School, Department of
Preventive Medicine & Bio Stats
Room B119
4200 East 9th Avenue
Denver, CO 80262

Ms. Barbara Nelson
Urban Proverty Programs
The Ford Foundation
320 East 43rd Street
New York, NY 10017

Dr. S. Brent Norris, Director
Mathematical Sciences Program
National Security Agency
Fort George Meade, MD 20755-6000

Dr. Lawrence Oliver
Computers Research Division
National Science Foundation
1800 G Street, NW
Washington, DC 20550

Dr. Marjorie Palmer
American Association for the
Advancement of Science
1333 H Street, NW
Washington, DC 20005

Professor David Payne
Department of Mathematics
California State University
Fullerton, CA 92634

Dr. Rolando E. Peinado
P. O. Box 5366
Mayaguez, Puerto Rico 00708

Dean Al Puccino
School of Education
University of Georgia
Athens, GA 30602

Dr. Senta Raizen, Study Director
Science & Technology Education
National Academy of Sciences
2101 Constitution Avenue, NW
Washington, DC 20418

Ms. Joan Ratterway
Institute for Independent Education
1313 North Capitol Street, NE
Washington, DC 20002

Dr. Helen Redbird
Department of Sociology
Western Oregon University
Monmouth, OR 97361

Ms. Maryann Reyes
La Raza
548 South Spring Street, #802
Los Angeles, CA 90013

Dr. Argelia Rodriguez
MISIP Department of Education
ROB 3, Room 3022, M S 3327
7th & D Streets, SW
Washington, DC 20202

Ms. Lynda Rolls
Hess Reference Services
Waldo Library
Western Michigan University
Kalamazoo, MI 49808

Professor Kenneth Ross
Department of Mathematics
University of Oregon
Eugene, OR 97403

Professor David Sanchez
Department of Mathematics
San Antonio College
1300 San Pedro
San Antonio, TX 78284

Ms. Ann Scanley
Research Roundtable
National Academy of Sciences/
National Research Council
2101 Constitution Avenue, NW
Washington, DC 20418

Dr. Margaret J. Seagers, Exec. Dir.
White House Initiative on
Historically Black Colleges & U.
Room 3682-ROB 3
400 Maryland Avenue, SW
Washington, DC 20202-3307

Dr. Mahendra Singhal
Department of Mathematics
University of Wisconsin
Parkside, Box 2000
Kenosha, WI 53141

Professor Donald Small
Department of Mathematics
Harvey Mudd College
Claremont, CA 91711

Professor Lynn Arthur Steen
Department of Mathematics
St. Olaf College
Northfield, MN 55057

Dr. Christine Stevens
National Science Foundation
SEE Directorate, Room 414
1800 G Street, NW
Washington, DC 20550

Ms. Sybil J. Stevenson
Manager, Corporate Contributions
One Stamford Forum
Stamford, CT 06904

Professor Thomas Storrer
Department of Mathematics
University of Michigan-Ann Arbor
Ann Arbor, MI 48109

Dr. Dorothy Strong
Director, Bureau of Mathematics
Chicago Public Schools
Department of Curriculum
1819 West Pershing Road
Chicago, IL 60609

Dr. Judith Sunley, Director
Division of Math Sciences
National Science Foundation
1800 G Street, NW
Washington, DC 20550

Professor Joseph Surina
College of Curriculum
& Instruction
University of New Mexico
Albuquerque, NM 87131

Dr. Marcia Sward, Director
Mathematical Sciences Education Bd.
National Research Council
818 Connecticut Avenue, NW
Suite 325
Washington, DC 20006

Professor Elias H. Toubassi
Department of Mathematics
University of Arizona
Tuscon, AZ 85721

Professor Nellouise Watkins
Department of Mathematics
Bennett College
Greensboro, NC 27401

Dr. Robert Watson, Director
National Science Foundation
SEE Directorate, USEMEE
1800 G Street, NW
Washington, DC 20550

Dr. Iris Weiss
Research Triangle Institute
Survey & Computer Science
P. O. Box 12194
Research Triangle Park, NC 277

Mr. Orlando H. White
Special Assistant to the President
South Carolina State College
Orangeburg, SC 29117

Dr. Nathanial Whittaker
Department of Mathematics
University of Massachusetts
Amherst, MA 01003

Professor Gerald Vanderberg
Blackfeet Community College
P. O. Box 819
Browning, MT 59417

Dr. Leona Zastrow
c/o NASEA
1228 M Street, NW
Washington, DC 20005

APPENDIX D

History of the Task Force on Minorities in Mathematics

HISTORY OF THE TASK FORCE ON MINORITIES IN MATHEMATICS

The Task Force on Minorities in Mathematics (TFMM) was the first created in November 1986 by MAA President Lynn Steen. He envision that the Task Force would show the Association how to expand its efforts toward improving the mathematics education of minority students and increasing minority participation in mathematics. The Task Force defined "minority" as blacks, Hispanics, and Native American. Asian students, although a minority as far as numbers in the United States, cannot be considered by any means as falling behind in their participation in mathematics. Thus, we define our use of "minority" in the context of mathematical education.

The Task Force consists of an eight-member executive committee, chaired by Louise Raphael of Howard University and formerly program officer at the National Science Foundation. A Committee of Correspondents, comprised of more than 30 mathematicians representing a wide spectrum of interests, lent itself to various tasks such as surveys, data collection, panel discussions, writing of the final report, volunteering for the Minority Consultants Bureau, setting up and running a mini-course, and general counseling in their areas of expertise. Blacks, Hispanics, Native Americans, and Caucasians were represented on the Task Force. A list of Task Force members appears in Appendix C.

Twenty mathematicians and mathematics educators committed to solving the problems faced by minorities in mathematics education met with representatives of the MAA staff for the first time January, 1987 at the Joint Mathematics Meeting in San Antonio, Texas. Suggestions and ideas from this group helped to shape the Task Force and outline how it would proceed to respond to its charge. Issues and problems were raised by individuals from diverse backgrounds concerning how to work with students, parents, and schools and post-secondary institutions to achieve better mathematical education for minorities and how to "sensitize" faculty members to the special problems of minority students.

In May 1987, the Task Force sent a Planning Document to more than 130 mathematicians, mathematics educators, and others involved in mathematics education for minorities. The purpose of this document was to go beyond the Task Force itself to "collect ideas on how the MAA can contribute to the improvement of mathematics education for minority students at all levels, from kindergarten through graduate school." See Attachment 1 to this appendix.

The Task Force met for the first time as a complete entity during the 1987 Joint Mathematics Meetings in Salt Lake City on August 6. At that time, members of the Task Force reviewed the results of the Planning Document survey and further discussed the charge to the Task Force and strategies for accomplishing its mission.

Most importantly, the Task Force agreed that it would take a three-tiered approach to its charge. Firs and foremost is that it would begin its work by

looking within the structure of MAA itself. Professional organizations, as well as schools and universities, often address questions related to minority undergraduates by developing or adopting add-on programs and activities that are peripheral to the central functioning of the organization. They rarely garner support from majority constituents, and even less often from minority constituents. Programs constructed in this way typically vanish as soon as external funding runs out, and the organization remains unchanged. Members of the Task Force decided that they could avoid the same result by first looking inward, at the MAA's current programmatic operations, and then exploring possible cooperative efforts with sister organizations. The last step would be to look outward to new and existing intervention programs, of which there are hundreds scattered throughout the country.

Also at this August 1987 meeting, charges and action agendas for the Task Force's subcommittees were established for the purpose of drafting recommendations to the Association. They were the Committee on Creating Awareness, Committee on Collaboration, Committee on Recognition, and the Committee on Local and Regional Action. Appendix C contains the charges and members of the subcommittees, as well their final reports.

In addition, MAA Development Officer Richard Witter, presented a preliminary report (gleaned from the resources of the Foundation Library) of projects funded over the past two years at a level of $5,000 or more that were aimed at improving the mathematics education of minorities. Finally, plans were made to sponsor a panel on "Minorities, Mathematics, and the MAA: How Do They Fit Together?" at the January 1988 Joint Mathematics Meetings in Atlanta.

During the fall of 1987, the subcommittees were formally organized, given their charges, and asked to prepare reports for the January 1988 meeting of the TFMM. The work of the subcommittees and their reports brought much of the external assessment to a conclusion and formed the basis for a large portion of this report.

The Task Force met again on January 8, 1988 at the Joint Mathematics Meetings in Atlanta. The agenda for that meeting included progress reports from each of the subcommittees, a discussion of plans for a report-writing retreat to be held at the MAA headquarters in Washington in June, and a review of the panel discussion that had been held the day before. The panel discussion was well attended, and there had been a lively exchange of ideas between panelists and the audience concerning the issues that were raised and potential strategies for increasing the participation of minorities in mathematics. (See Appendix E for the proceedings of the panel.)

In addition to the full meeting, Task Force members met with a group of chairs of MAA committees related to the work of the Task Force. Committees represented were David Ballew, Sections Committee; Gerald Goldstein, Committee on the Teaching of Undergraduate Mathematics; Donald Kreider, MAA Treasurer; and, Kenneth Ross, MAA Secretary and Mini-course and Membership Committees member. During the discussion that occurred, TFMM members had to opportunity to create awareness among members of the other committee members regarding the underrepresentation of minorities in mathematics. TFMM members also described activities that various MAA members had undertaken, without the Association, to help reverse the trend.

The Task Force sought funding in March 1988 to hold a writing retreat and was awarded in May $15,000 from the Ford Foundation to support that activity. Members of the TFMM's Executive Committee, subcommittee chairpersons, and other Task Force members met in Washington, DC, on June 10-12. They pooled their resources to write a draft of the report. In addition to the subcommittee reports, additional input for the final report was collected at three regional meetings (two in Washington, DC, one in Albuquerque, NM) and the panel discussion held at the 1988 Joint Mathematics Meetings. A final review session followed a luncheon meeting of the Task Force at the AMS Summer Meeting in Rhode Island in August.

Many other sources and activities have contributed to the TFMM's final report. The Appendices, Footnotes, and Bibliography give a full accounting of these sources.

The MATHEMATICAL ASSOCIATION of AMERICA
1529 Eighteenth Street, N.W. ■ Washington, D.C. 20036 ■ Telephone (202) 387-5200

May 1, 1987

Dr. Harold Stolberg
5052 North 36th St.
Arlington, VA 22207

Dear Dr. Stolberg,

We are writing to bring you up to date on the status of the now-forming MAA Task Force on Minorities in Mathematics and to ask for your help in shaping the task force's structure and mission. We'd also like to collect some information from task force members that will enable us to begin organizing the task force's working subcommittees. But first, for those who haven't seen it yet, our charge from MAA ex-president Lynn Steen is reproduced below.

Charge to Task Force on Minorities in Mathematics

To make recommendations to the officers and Board of Governors of the Mathematical Association Of America on what MAA can do to help improve the mathematics education of black, Hispanic, and Native American students at all levels, from kindergarten through graduate school. The task force's recommendations should be broad in scope and should include plans both for building on the successful work of BAM and for establishing effective collaboration with other national efforts aimed at increasing minority involvement in mathematics and mathematics-related disciplines. The task force's recommendations should be action-oriented and should contain detailed plans for implementation.

We'll begin this status report with reflections on the conversations we've been having with a variety of mathematicians about the problems that the task force will address. First, there is a widespread view that there are now new and special opportunities for increasing minority involvement in mathematics, at least at the college and high school levels. These opportunities stem, in part, from recent rapid demographic changes in American society. The proportion of minority children in the school age population is growing quickly, but the college eligibility and retention rates of these students are substantially lower than those of majority students. The effect is that many colleges and universities are facing severe enrollment crises. These institutions often find, for example, that they no longer have the enrollment base for upper-level courses in mathematics and mathematics-related departments. Thus, a growing number of

colleges and universities find that they must now address the underrepresentation of minorities in their institutions not only for moral and legal reasons, but also for reasons related to their institution's survival. The effect is that we may have a new set of allies in battles that we have been fighting for so many years.

Mathematicians play a special role in the above. There is substantial evidence that mathematics, or more properly, failure in mathematics, plays a disproportionately large role in the attrition of minorities from higher education, and perhaps, even from middle and high schools. Freshman-year college mathematics courses, in particular, have been burial grounds for the aspirations of all-too-many minority students seeking careers in such math-related fields as business, medicine, science, and engineering.

On the other hand, there have recently emerged some promising new efforts that have resulted in substantial numbers of minority high school and university students excelling at mathematics. These efforts have been well documented and appear to work in a diverse collection of institutions. Although they differ in many structural details, they do share two features: (i) the central involvement of mathematicians or of mathematically sophisticated high school and middle school teachers, and (ii) a non-remedial focus. They build on the strengths of their participants rather than on their weaknesses, and they typically provide exposure to exciting and challenging mathematics. More on these efforts in future correspondence.

Finally, several of the individuals with whom we've been speaking report that they feel "burnt out"--that they have been working to increase minority involvement in mathematics throughout their professional lives, and that the last few years have been especially wearing. It is easy to understand this feeling. We hope that this task force will become a vehicle for renewal and reinvigoration. Now to business.

On May 20th, the Executive and Finance Committee of the MAA will hold a meeting in Washington, D.C. Louise has been asked to provide a status report on our work to date. In preparation, we are seeking your reaction to a preliminary set of recommendations generated by an ad hoc committee that met on March 20th in Washington, D.C. The participants were Jim Donaldson of Howard University, J. Arthur Jones of Decision Information Systems Corporation, Mary Harley Krater of Fairfax Public Schools and of NCTM, Donna Murray of MAA, Louise Raphael of NSF and Howard University, Uri Treisman of University of California at Berkeley, and Al Wilcox of MAA.

The ad hoc committee's recommendations have been listed on the enclosed planning document in a form that we hope will make it easy for you to contribute your ideas. I (LR) am especially interested in learning from you the specific areas in which you would like to work. I will organize the task force's subcommittees, and perhaps some additional ad hoc subcommittees that will include some non-task force members, accordingly. I also encourage you to amend, add to, and strengthen the ideas we have presented. We need your input. Please send your recommendations and comments either on the enclosed form or in any other form that you'd like to Donna Murray c/o the MAA, or call Louise at the NSF at (202) 357-7074.

A note on structure--the task force when appointed will consist of an eight-member executive committee and a large general committee representing a wide spectrum of mathematical interests. Most of the task force's work will be accomplished through

its subcommittees. The organization of these subcommittes has yet to be decided.

I reiterate that the Task Force welcomes all suggestions and extends an open invitation to all to our meetings. Our first meeting will be held on August 6 at 12:30-2:30 at the MAA meeting in Salt Lake City; the second will be at the MAA/AMS January meeting in Atlanta. As most of you know, the Task Force must raise its own funds. Uri Treisman will begin work on this and invites your help. He can be reached at (415)-642-2115.

We are looking forward to working with you,

Sincerely yours,

Louise A. Raphael, Chair
TFMM

Uri Treisman, member
executive committee

MAA Task Force On Minorities In Mathematics
--A Planning Document--

The purpose of this document is to collect your ideas on how MAA can contribute to the improvement of mathematics education for minority students at all levels, from kindergarten through graduate school. Of particular interest are suggestions for ways in which MAA and the task force might

(1) encourage universities and colleges to institutionalize effective intervention programs where they exist, and develop them where they do not;

(2) encourage mathematics departments to develop programs that will enable minority students to participate in the full range of departmental offerings, not only in entry-level courses; and

(3) encourage individual mathematicians to increase their professional involvement with minority students.

In the left column, below, are some ideas generated by an ad hoc committee that met in Washington DC on March 20. The right column is left blank for your general comments. Please add to the list of ideas using as many extra sheets as you like. I will collect and organize this information and will get the results back to you well before our August 6 meeting in Salt Lake City. I would appreciate it if you could return this form to me within the next 10 days. If you'd prefer, feel free to discuss your ideas with me by phone. I can be reached at NSF (202)-357-7074.

A. Creating Awareness	Comments
1) encourage the publication of articles whose aim is to keep the mathematical community abreast of the status of minorities in our profession	
2) organize panel presentations at MAA meetings that address issues of relevance to the task force	
3) establishing a clearinghouse for information about exemplary programs that would be of use to both policy makers and to practitioners (this, of course, would require substantial funding and the participation of people willing to set up the clearinghouse, evaluate the information, organize the material in a useful form, and disseminate it)	
B. Collaboration	
1) establish collaborative efforts with other national organizations working on increasing minority involvement in mathematics and	

mathematics-related disciplines
(Concrete suggestions are especially welcome here.)

2) examine and publicize within the the mathematics community the successful efforts of other professions to more fully include minority individuals in their ranks

Comments

C. Recognition

1) sponsor special competitions, designed and administered by MAA, perhaps jointly with NCTM, for junior and senior high schools which serve high minority populations
2) seek ways of recognizing and supporting outstanding efforts by individual teachers of minority students
3) find ways to encourage and to promote the development of mathematically- talented minority youth, e.g. through specially created MAA Fellowships
4) showcase successful programs at MAA meetings

D. Regional or local programmatic action

1) set up regional or local groups of the Task Force which will be responsible for implementing programs in their region
2) create teams of local mathematicians and mathematics educators that will provide technical assistance to universities and colleges, mathematics departments, and individuals who want to set up programs for minorities in mathematics
3) advocate for high quality mathematics programs in areas with substantial minority populations

TASK FORCE ON MINORITIES IN MATHEMATICS

August 6, 1987
Salt Lake City, Utah

MINUTES OF THE MEETING

MEMBERS PRESENT

Louise Raphael, chair
Efraim Armendariz, Manuel Berriozabel, Ed Dubinsky, Florence Fasanelli, Reuben Hersh, Harvey Keynes, Lee Lorch, Alma Marosz, Irene Murphy, Michael Starbird, Uri Treisman

GUESTS

Deborah Haimo, Don Hill, Bernie Madison, Charles Moore, Donna Murray, David Sanchez, Christine Stevens, Richard Witter

I. Introductory Remarks

Richard Witter, MAA Development Office, began the discussion by stating that he had begun work on building a database of funded mathematics programs for minorities, and that this collected information will be available to the Task Force. Louise Raphael indicated that there was interest among some Task Force members in creating a national clearinghouse of information on "Minorities In Mathematics," and that, if we proceed in this direction, the database might be made more broadly available through such a clearinghouse.

Uri Treisman bemoaned the fact that it is 1987, and we are beginning yet another effort to increase minority involvement in our discipline. He looked forward to the day when we can convene a meeting celebrating the successful end of such an endeavor. Several individuals pointed out that the problems we had come together to address were still a long way from being solved, and that, indeed, there were frightening indications that we are rapidly losing ground. Manuel Berriozabel suggested that many mathematically able minority students were being drawn away from mathematics and toward computer science and

engineering because of the excellent employment prospects that degrees in these fields offer.

Louise Raphael expressed the view that our goal should not only be to provide opportunities for minority students to succeed in mathematics, but in math-related disciplines as well. Harvey Keynes pointed out that mathematics is often the primary barrier and that success in mathematics necessarily creates options in these related fields. Alma Marosz advocated making the training of minority mathematics teachers a Task Force priority. Ed Dubinsky concurred and suggested that, looking more broadly, we should be concerned not only with minority involvement in mathematics but also in mathematics education.

The group proceeded to discuss various barriers to minority participation in mathematics. Mentioned were inadequate teacher training, lack of opportunity, hostile math departments, and the paucity of culturally relevant instructional materials. There was an extended discussion about the last of these. Garfield High School and Bell Junior High School, both in California, were mentioned as "counter-examples"--schools with high minority enrollment in college-track math courses but with traditional curricula. Louise Raphael stated that all the above issues would be studied further and addressed in subcommittees, which are in the process of being formed.

Uri Treisman proposed a three-tiered plan of action for the Task Force. The first would be a look inward, at MAA's structure and operations. Two related questions to be addressed in this stage should be: (1) How can we strengthen MAA in ways that will generate greater minority involvement in MAA itself? (2) How can MAA's existing resources be brought to bear on the problems that the Task Force has been created to address? The second stage would be directed toward sister organizations such as NCTM, AMS, & SIAM. The Task Force should determine what these organizations are already doing and, then, find productive ways to collaborate with them or, at least, support their efforts. The third stage would be directed outward. We must assess the remaining unmet needs. The hard question will be to find the best niches for MAA in what ultimately must be a major, coordinated, national effort aimed at ameliorating the problems associated with the under-representation of minorities in mathematics. Once such niches have been determined, we can begin to propose activities and even, perhaps, changes

in MAA that will be useful to members interested in the mathematical education of minorities. Treisman concluded his remarks with the assertion that unless we begin by looking inward there is little hope that our work will be taken seriously by the various minority communities.

II. Planning For The Panel Discussion

Louise Raphael reported that the Task Force is organizing a panel discussion/presentation at the January 1988 joint AMS/MAA meetings in Atlanta. Important goals of the panel are:

(1) to broaden awareness of the issues related to minorities in mathematics,
(2) to develop a sense of what mathematicians think the MAA can do to promote greater minority involvement in mathematics, and
(3) to explore concrete ways in which MAA might be able to encourage mathematicians to become involved in minority education.

Louise Raphael pointed out that just as there are vehicles to help department chairs to improve their managerial skills, so should there be vehicles for mathematicians who are involved in programs for minority students to improve their skills.

The panel is scheduled for Thursday, January 7, 1988 from 2:15 to 4:15 p.m. and is titled: "Mathematics, Minorities, and the MAA: How do they fit together?" Reuben Hersh will be the moderator. Presenters are: Rogers Newman, Southern University; Manuel Berriozabal, University of Texas-San Antonio; Paul Sally, University of Chicago. Respondents are: Lida Barret, Mississippi State University; Wade Ellis, Jr., West Valley College; Kenneth Ross, University of Oregon.

III. Response to the Task Force Planning Document

Louise Raphael reported that responses to the Task Force Planning Document had been compiled and summarized and are ready for distribution. This compilation is appended to these minutes as Attachment A. Manuel Berriozabel raised the issue, not addressed in the

planning document, of accountability. He suggested that the MAA might serve as an accrediting agency, validating the quality of both proposed and existing efforts.

There was general agreement that information about existing successful programs should be compiled, summarized, and distributed widely. Additionally, many felt that vehicles should be identified to enhance the preparation of teachers involved in minority mathematics education. Don Hill stated that much of the Task Force's work could be irrelevant to the historically black colleges, which now need core funding for their institutions, not just for mathematics education. He felt it was important that MAA look at state laws and make contact with the minority members of legislatures who are responsible for state education departments. He noted that Florida, for example, has a tuition forgiveness policy for teachers teaching in inner city schools. He noted also the importance of Black Caucuses, powerful groups in several Southern States.

IV. TFMM Report Due October 1988

The group was informed that Leonard Gillman, MAA President, has asked for a final report from the Task Force to be submitted in October 1988. Louise Raphael briefly described the four areas identified in the Planning Document: Creating Awareness, Collaboration, Recognition, and Local/Regional Programmatic Action. She indicated that each would be addressed further in subcommittees, the deliberations of which will be summarized in our final report. Charges for these subcommittees have been written and will be distributed to the full Task Force membership in the near future.

Minutes of the **Task Force in Minorities in Mathematics** breakfast meeting held at the Hyatt Regency in Atlanta, Georgia on January 8, 1988.

The meeting began with the charge to the Task Force read by Louise Raphael. She then outlined the plan of the Task Force to look inward at the structure of the MAA, look at the MAA Committees and finally look outward to increase the membership by identifying the unmet needs and make recommendations.

A review was held of the previous day's Panel Presentation (Notes from that Panel are attached) regarding its effectiveness and reactions to the panel. Susan Forman pointed out that all comments were favorable.

II **Committee Reports:**

A. Committee on Creating Awareness:

Susan Forman reported that she sent the committee's agenda to the members and is awaiting responses. The concerns of this committee are recognition and how to create awareness. The plan is to look for improvement. A suggestion was made to publish in the "Monthly" and "Focus." She pointed out that "Focus" will have a special issue late in 1988 and that Peter Renz should be contacted. Recommendations of the Task Force should be made to the board and ENF committee that each new doctorate in mathematics and mathematics education will be awarded one year free membership.

.....

Chris Stevens reported on the MAA committee on publications. Since mathematicians usually read "Focus" as well as the "Monthly," the committee is about to recommend that the status-quo is fine with "Focus" and the "Monthly." She urged members of the Task Force to get in touch with Sylvan Burgstahl to say there should be more articles about the professional status of mathematicians.

B. Committee on Recognition:

Etta Falconer, chair, questioned the overlapping of the committees. She gave an extensive report which included the following comments:

- There needs to be more minority visibility in the MAA.
- At the present time there are very few role models.
- It should be possible to appoint able minority mathematicians to the editorial board, to nominate minorities to various positions, specifically to all committees, not only those with a minority focus.
- The same people tend to be used over and over.
- It should be possible to have minorities who are able in research to give the invited addresses at the sectional and regional meetings. Names can be found by NAM, etc..
- The MAA should seek articles which show sympathies for minorities.

- Articles should be solicited from historically black colleges and universities.
- Mathematicians from those institutions should be invited to come and participate in the meetings.
- MAA Sectional and regional meetings could be held at minority institutions.
- Minority mathematicians should be considered for prizes and awards.
- When meetings are held in the Southeast or Southwest, where there are a large percentage of minorities, the MAA should fund at least a small group to attend the meetings, if they would not be able to do so otherwise.
- Each college could nominate a delegate (not just minorities).

.....

Louise Raphael pointed out that The Recognition Committee includes recognition at all levels from grade school to college.

Susan Forman stated that the same women are on the committees over and over again. The burden of responsibility should be shared by others. The network has got to be two way among minority matters.

Lee Lorch said this is provided for in Etta Falconer's report. There should be an organized solicitation from NAM. Some of us are willing to be brash. Others don't know the machinery.

Louise Raphael stated that the chairs of the MAA committees will contact people to obtain a list of candidates with their mathematical specialties.

Gloria Gilmer, Chair of the AMS-MAA-AAAS Committee, asked to be used to solicit names. Many times organization have good ideas but when good people leave there is no structure for passing on. It depends on the leadership. Lynn Steen and Lida Barrett are both strong leaders and their policies should be part of the organizational structure.

.....

IV. Committee on Collaboration:

Manuel Berriosabol said that Governors were being surveyed. The committee is drawing up its survey form and will have a report ready in March.

.....

Manuel Berriosabol reported on "accountability" for running successful programs for minorities based on number of students receiving bachelors degree in mathematics or science.

Louise Raphael pointed out the importance of accountability. Many people run programs but afterwards we don't know what worked.

Ed Dubinsky said this sounds like setting up structures to produce numbers.

Phil Wagreich said there are many people running projects we

don't know about.

Gloria Gilmer suggested we highlight some programs, e.g., Alan Tucker, SUNY; Clarence Stephens, Potsdam; Uri Treismann and Leon Henkin.

Susan Forman reported that a publication is being put together listing effective intervention programs.

Peter Lax asked will people read it?

Reuben Hersch says submit everywhere.

Susan Forman suggested circulating a letter.

Harold Stolberg suggested we assemble a list of electronic addresses to further the network.

Gloria Gilmer suggested Shirley Malcolm's office at AAAS.

Argelia Velez-Rodriguez stated that BAM should be encouraged and enhanced, but maybe in a different form.

.....

Louise Raphael reported that a proposal has been written to fund the writing of the report. The Ford Foundation feels the MAA should contribute more. As a Program Officer at the National Science Foundation she can not solicit.

Richard Millman suggested that maybe a University could support the effort.

.....

Florence Fasanelli drew to the attention of the committee the fact that the diorama illustrating the work of Benjamin Banneker in his work assisting Andrew Ellicot in surveying the District of Columbia at the National Museum of American History would be taken done in the museum's policy of changing displays and that there are no plans to have any display about Banneker.

Lee Lorch recommended the committee make a formal protest to the museum.

Rogers Newman said this should be reported to NAM.

.....

Don Hill urged that minorities apply to NCTM for the NSF travel grants to ICME VI in Budapest.

Lee Lorch suggested there are PhD's in education at historically black colleges who would like to have the possibility to go. It has been announced that there is a $700 flight from NYC to Budapest and that there is a Youth Hostel on the Campus.

.....

Don Hill spoke of the actuarial program at his University that he directs. He also pointed out that new PhD's in math or math education get sidetracked into administration because that is where the money is. Under the auspices of NAM incoming students should be given the name-someone they have seen before--

to ensure the participation of the undergraduates.

The following were among those attending the Task Force Breakfast Meeting:
Manuel Berriozabal
Renell D. Blackwell
Ed Dubinsky
Etta Falconer
Florence Fasanelli, Secretary
Vicki Renee Feacher
Susan Forman
Gloria F. Gilmer
Reuben Hersch
Don Hill
Janice Yvonne Hughes
Raymond Johnson
Peter D. Lax
Jose Lopez
Lee Lorch
Richard Milliman
Rogers J. Newman
Arthur Powell
Louise A. Raphael, Chair
Man M. Sharma
Don Small
Dick Stanley
Chris Stevens
Harold Stolberg
Judy Sunley
Argelia Velez-Rodriguez
Phil Wagreich

The MATHEMATICAL ASSOCIATION of AMERICA
1529 Eighteenth Street, N.W. ■ Washington, D.C. 20036 ■ Telephone (202) 387-5200

REGIONAL MEETING OF MAA TASK FORCE ON MINORITIES IN HOME OF PHYLLIS AND REUBEN HERSH, ALBUQUERQUE, NEW MEXICO, JANUARY 28, 1988

PRESENT: Richard Greigo, Nancy Gonzales, Reuben Hersh, Louise Raphael and Uri Treisman.

It was unanimously recommended that:

1) In order to broaden the base of involvement in mathematics programs for minorities, the MAA should sponsor regional workshops which disseminate information about:
- o successful intervention programs which are faculty based and centered;
- o consultant services for implementation, evaluation and follow-up activities for new intervention programs;
- o funding possibilities.

These workshops could take place at MAA sectional meetings.

2) Minority sessions or panels should be convened at every sectional, regional, national meeting of the MAA. Panels of successful programs should be featured.

3) A standing MAA committee, chair and an associate director should be appointed to organize the activities recommended by the new committee and approved by the MAA E&F committee.

4) MAA should sponsor regional summer schools for minority students and Chautauqua-like courses for faculty members on how to run successful mathematics programs for minorities.

5) Compile regional lists of mathematicians from TFMM, FYI, panel attenders in Atlanta, with hopes that they will interact and form a subcommittee on minorities in their MAA sections.

5) Request a half page for minorities in FOCUS.

6) Form teams of regional consultants to interact and advise those who are putting programs into place.

7) Form group of mathematicians who answer letters, give advice, discuss possibilities with those who are trying to modify existing programs or establish new ones.

8) Establish vehicle of dissemination
- o regional consultants;
- o publish MAA notes (30- 40 pages) on resource materials;
- o partition committee in sections to serve as consultants.

NATIONAL MUSEUM OF AMERICAN HISTORY

SCIENCE, TECHNOLOGY, AND CULTURE

Office of the Director

March 28, 1988

Dr. Alfred B. Willcox
Executive Director
The Mathematical Assocation of America
1529 Eighteenth Street, N.W.
Washington, D. C. 20036

Dear Dr. Willcox:

Further to my letter of February 12 -- this is to offer you some proof that taking the trouble to write does sometimes make a difference. A number of letters received about Benjamin Banneker have emphasized the importance of the continuing presence of a black scientist and engineer as a role model that should be presented here regardless of what other plans there may be. There is no way to avoid the necessity of completely gutting the quadrant of the Museum in which the Benjamin Banneker tableau is now presented, because of the necessity to remake the heating, venting and fire protection in that area, and we certainly intend to treat Banneker's life in a substantial way in our future exhibition on the history of American science.

But, in order to maintain the physical presence of the figure of Banneker, so that that role model may be available, we will install an updated and improved version of the current tableau in one of our permanent reinstallations, "After the Revolution." At the same time, we will deploy some staff to find what modern research about Banneker is telling us, particularly as a result of the archaeological work at Ellicott City, so that, as scholarship yields new information about his career, we will be able to integrate that new information when we come to the consideration of his role in the advancement of American science.

I have myself experienced a sense of considerable frustration in writing to large and apparently faceless bureaucracies about the obvious symbolic values of certain figures in educating the American public and I simply wanted to write to you to be sure that you did not feel that the Smithsonian is entirely faceless.

Sincerely,

APR 1 1988

Roger G. Kennedy
Director

79mm

NATIONAL MUSEUM OF AMERICAN HISTORY

SCIENCE, TECHNOLOGY, AND CULTURE

Office of the Director

February 12, 1988

Dr. Alfred B. Willcox
Executive Director
The Mathematical Association of America
1529 Eighteenth Street, N.W.
Washington, D. C. 20036

Dear Dr. Willcox:

Thank you for your letter of the 5th about Benjamin Banneker. Here's a copy of my response to Dr. Raphael which is still true. I've seen the opening outlines of our treatment of the history of science and I can assure you that Benjamin Banneker will be a part of that treatment.

Sincerely,

Roger G. Kennedy
Director

Enclosure

FEB 8 1988

D - 19

NATIONAL MUSEUM OF AMERICAN HISTORY

SCIENCE, TECHNOLOGY, AND CULTURE

Office of the Director

January 21, 1988

Dr. Louise A. Raphael
Division of Mathematical Sciences
National Science Foundation
1800 G Street, N.W.
Washington, D. C. 20550

Dear Dr. Raphael:

Thank you very much for your welcome letter of January 11th. As you point out, we are in the process of reinstalling all of our major collections, and the area in which the small case in which Benjamin Banneker and Andrew Ellicott appeared will be replaced by entirely different subject matter.

I'm not sure how much you've had a chance to explore our exhibits, such as "Engines of Change," "After the Revolution - Life in America, 1780-1800," and "Field to Factory," but there's no doubt that this Museum, perhaps more than any other in the country, is stressing the contribution of black people to our diverse culture. We intend to recognize Mr. Banneker's story in our treatment of the history of science, toward which we are planning for the early '90s. Your letter is a welcome reminder that we should stress blacks in science, in technology and in all the realms of American experience in which they have had a part.

Sincerely,

Roger G. Kennedy
Director

Smithsonian Institution · Washington, D.C. 20560

D-20

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

May 2, 1988

Professor Sylvan Burgstahler
Department of Mathematics
University of Minnesota -- Duluth
Duluth, Minnesota 55812

Dear Professor Burgstahler:

Thank you for your prompt reply to my letter of February 3, 1988, and for the copy of your letter to Reuben Hersh. Since Reuben served as moderator of the panel discussion sponsored in Atlanta by the MAA Task Force on Minorities in Mathematics, I can easily understand why you might have thought him to be the Task Force's chair. I appreciate your invitation to respond to some of the questions you raised in your letter to him.

Let me begin by saying that I strongly endorse your concern for the quality of the MAA periodicals and I appreciate your desire to broaden their scope without diminishing their high quality. Your letter identifies a number of potential problems that might arise if the periodicals tried to publish a more varied collection of articles. I think that a few remarks about the history of the Monthly may help to put these problems in perspective.

As a perusal of back issues suggests, there is ample precedent in the Monthly for printing articles that are not about "mathematics as a discipline." Until 1982, the Monthly had a section on "mathematical education," which was devoted, in the words of editor Alex Rosenberg, to "discussions of all educational aspects of our profession." During the 1970's, the Monthly carried articles on such diverse topics as mathematics courses for "disadvantaged" students, the role of history in the mathematics curriculum, teaching calculus as an "experimental science," and a proposed re-structuring of the mathematics major to take account of the growing importance of discrete mathematics (It will come as no surprise, I am sure, that the author of this last article was Alan Tucker.). As a 1965 article by R.W. Hamming on "The Impact of Computers" demonstrates, the Monthly did not simply "stick to mathematics," even outside the section on mathematical education. Thus the proposed expansion of the range of articles in the MAA periodicals would be very much in keeping with the history of the Association's publications.

Let me now respond to each of your "objections" in turn. The first, that "mathematics journals should stick to mathematics," is probably the most serious one. Just as some analysts believe theirs to be the only "genuine" branch of

mathematics, there may be some mathematicians who simply are not interested in issues affecting "mathematics as a profession." One cannot expect to persuade them that the MAA periodicals should deal with anything besides "mathematics as a discipline," because they are not interested in anything else.

The behavior of MAA members at local and national meetings, however, indicates that the number of such mathematicians is relatively small. Anyone who is familiar with the paucity of bachelor's and doctoral degree candidates in mathematics, or with the shortage of appropriately educated mathematics teachers at all levels, knows that our profession faces enormous challenges. That MAA members are deeply interested in these problems is revealed by the well-attended panels and sessions on issues of the profession that have been a feature of recent regional and national meetings.

Of course, as you point out in your letter, there are also some people who, though interested in articles about "mathematics as a profession," fear that introducing articles of this genre into the MAA periodicals would inevitably turn them into overtly political and shamelessly political publications without any lasting value. I believe that this argument overlooks the care with which editors and referees are selected and underestimates the dedication and expertise with which they go about their task. As I have already pointed out, MAA editors in the past have found it possible to maintain quality control over articles that were not about the discipline of mathematics. I believe that current and future editors could do the same. That good articles are still being written on these topics is evidenced by the high quality of such journals as The Mathematical Intelligencer.

This observation also points to a response to your second "objection," namely, the tendency of administrators to judge a faculty member's publications by the company they keep. If, as I have argued, it is possible to broaden the scope of the MAA periodicals without diminishing their quality, then I think that this objection should not be a source of concern. If, in evaluating faculty scholarship, deans wish to assign different weights to articles about the discipline of mathematics and those concerning the profession of mathematics, then it is their prerogative to do so. It is also their responsibility to distinguish the former from the latter. In any event, I do not think that the MAA should allow the structure and content of its periodicals to be determined by the attitudes of administrators, most of whom are not even mathematicians.

Finally, there is the problem of finding space for the proposed new (or revived) genre of articles. At present, this problem must be solved by ad hoc means, such as the special vote of the MAA Executive and Finance Committee to authorize the publication in the Monthly of Lynn Steen's Retiring Presidential

Address. Only a committee like yours, which can examine the financial status of the periodicals and the nature and extent of their backlogs, can really address this issue.

My personal preference might be to expand one of the periodicals slightly, in order to accommodate a modest number of articles (say, one every issue or two) about the status of the profession. If this experiment proved successful (and popular with the readers), then the editors might wish to accept more articles of this kind. In any case, the long delay between the submission of an article and its appearance in print would tend to discourage articles of ephemeral interest and would work to the advantage of pieces addressing issues of long-term concern.

As chair of the Task Force, of course, I believe that the problem of recruiting more minorities into mathematics is one issue that fits this description. As a research mathematician, I recognize the importance of identifying and fostering mathematical talent, as Arnold Ross' program at Ohio State University has done with the gifted youngsters fortunate enough to have participated in it. Both of these problems deal with the very perpetuation of our profession, and I believe that MAA members would like to read about possible ways to solve them.

I hope that these remarks of mine adequately address the "objections" you cited in your letter to Reuben Hersh, and that this response will reach you before the committee has settled upon its final recommendations in this matter. Please feel free to contact me if I can provide any further information, and accept my thanks for including the Task Force's views in your deliberations.

Sincerely yours,

Louise R Raphael

Louise Raphael, Chair
MAA Task Force on Minorities
in Mathematics

APPENDIX E

Proceedings of the Panel Discussion
held at the Joint Mathematics Meetings

Atlanta, Georgia

TASK FORCE ON MINORITIES IN MATHEMATICS

January 6, 1988 - Atlanta, GA
AMS/MAA Joint Mathematics Meetings Panel Discussion

"Mathematics, Minorities, and the MAA: How Do They Fit Together?"

MODERATOR (Reuben Hersh, University of Arizona)

This will be, not exactly a report but rather, a discussion sponsored by the Task Force on Minorities in Mathematics, which has been created by the MAA. We have two hours which, of course, won't be enough to solve the problems, but, maybe enough to come to some conclusions and make some progress. Our format will be first, three panelists will speak, then three respondents will speak, then we will have a one-minute break to stretch and get your blood circulating. I ask you not to leave the room because following that [the panel presentations] we will have discussion from the audience. It is, of course, really encouraging to see all the seats taken.

Our three discussants are: Paul Sally, Rogers Newman, and Manuel Berriozabal. And, then the three respondents: Ken Ross, Wade Ellis, and Lida Barrett. I think we will just go ahead now and call for the first discussant which is Professor Rogers Newman who is ... at Southern University in Baton Rouge, earned his doctorate at the University of Michigan, has been for five years president of the National Association of Mathematicians, [and is a] member of the Board of Governors of the MAA.

ROGERS NEWMAN

I want to express my appreciation to the MAA for inviting me to participate in this panel, in particular to Louise Raphael for inviting me. I have been asked to lead off this Panel Discussion by stating the problem: getting more minorities involved in mathematics.

The fact that the number of minorities in mathematics or statistics (those are called mathematical scientists, as my colleagues tell me) is small, is well documented. When I speak of minorities, I am referring mainly to Blacks, Hispanics, and Native Americans. I believe that is the way the National Science Foundation defines minorities according to Argelia Rodriquez [Department of Education's Fund for the Improvement of Post-secondary Education]. She may correct me on that if she wishes. My remarks will refer primarily to blacks. Similar comments may be applied to other minorities, but I will not attempt to make definitive statements about them. I am not as knowledgeable.

To get some idea of the problem to be solved, let us play the numbers game for a moment. According to the National Science Foundation report entitled Women and Minorities in Science and Engineering dated 1986, there were in 1973 100 black doctoral level mathematicians employed in the U. S. out of a total of 12,100, or 1 8/10's of 1%. By 1981, the number of blacks had doubled to 200. Sounds very encouraging with a percentage rise to 1.3%. The number was the same in 1983, but the percentage had increased to 1.2.

Now we are talking about a sub-population of the American spectrum that makes up between 20-25% of the total population. Thus, we see that the number of Blacks is minuscule when you look at those comparisons. The numbers are identical, incidentally (I do know this), for Hispanics. One hundred and then 200, remaining the same. And the numbers remain the same for Native Americans, too, [for whom] the number was so small, that the report could not be definitive about it. It just had some numbers in parentheses indicating that they really did not want to make a report on it.

These appallingly low numbers on minorities in the mathematical sciences represent to me a waste of potential talent, a waste that our country can ill afford. Particularly in view of the fact, also well documented, that the enrollment of Americans, generally, in the mathematical sciences is experiencing a sharp decline. Increasing the number of minorities will help to show up the number of Americans on the whole. Questions on why such small numbers and what can be done to improve them are quite pertinent. And, I am sure you who have come here today would like to get some answers, to get the questions well posed, as it were.

In my view the position of Blacks in the field is due largely to a lack of (or a tradition of) studying mathematics in the Black community. Let me share with you a bit of history, just to put this in perspective. Now let me issue a disclaimer right off: I am not a historian. Much of my information I have received by word of mouth and from my own experiences. So if anybody questions these facts I am going to give you, please feel free to do so. I have lived long enough to become sort of thick-skinned to that sort of thing.

The first black to receive a Ph.D. in mathematics received his degree in 1925. That was E. F. Cox who received his degree from Cornell University. Now this date is a very short time before I was born. I was born just shortly after that, and while I do not make any claim on youth, neither am I an ancient man. So you will see that Blacks involved in mathematics does not have a long history behind it. Secondly, I want to compare that to the first Ph.D. awarded to a black in America in any field, and that was awarded in 1876 to a man by the name of Edward Alexander Bouchet. He received his degree from, I believe it was, Yale University. So mathematics had to wait almost another fifty years before a black would receive a Ph.D. ...

Even after 1925, the numbers are small. We can count them, 1929, 1933, 1934, 1941, 1942, and so on. I may be a bit off on some of these, but not too far. To put the shortness of this history in more perspective, if you will pardon the personal reference, most by far of the Ph.D.'s awarded to blacks in this country have been awarded in my lifetime. I made that point a moment ago. Except for the two or three earliest ones, I have known them [all] personally. I had the good fortune of studying under Joe Dennis who received his, during that time, from Northwestern University while he was teaching at Clark College in Atlanta. He received his degree under Wahl at Northwestern. Joe Pierce who was at Atlanta University (or Lane) when I was a student there, was a mentor of mine. He was a statistician. By the way, Joe Pierce [was] the only statistician in the group at that time. There may be some more statisticians now.

David Blackwell was beginning his career at Clark University when I was an undergraduate at Morehouse. Just as an aside, we used to observe this young fellow (we didn't know who he was) walking down the street in the rain reading

mathematics. We thought that fellow was about to go off the deep end until we found [out] who he was, this child prodigy mathematician. And, so we tried to walk in the rain too, reading our books. It didn't do us much good. I also recall meeting J. Ernest Wilkins at about the same time, and he was the phenomenon who had received his degree from the University of Chicago at age 19. I remember meeting him at a football game, and there was a crowd around this gentle fellow and we didn't know what it was about. We were told that that was J. Ernest Wilkins who had received his Ph.D. at age 19. [Audience: "He is here." Newman: "Well then, I had better mind what I say." Laughter]

I make these points merely to emphasize the fact that the serious study of mathematics among blacks has had, indeed, a short history. I am also aware of the fact that the history of mathematical study in America is not extremely long, but other groups have inherited some tradition of mathematical study from the "old country". We don't have that luxury.

The numbers begin to pick up, albeit very slowly, in the forties. The first black women to receive Ph.D.'s in mathematics were Marjorie Brown, Marjorie Lee Browne. She received her's from the University of Michigan. Evelyn Boyd Granville received her Ph.D. from Yale University, both in 1949. I was not able to determine which one received it first. So I am just giving them both first 1949.

Incidentally, I might comment that NAM is sponsoring a banquet tomorrow night honoring black women in mathematics. It is going to be held at Pascal's and those two women will be cited, particularly. Unfortunately, Marjorie Browne is deceased, but Evelyn Boyd will be here to receive her citation. So I invite all of you to come and you can see me as soon as the panel is over for ticket information.

In terms of institutions granting Ph.D.'s to blacks, I might mention Pennsylvania, because that is where the second blacks to receive Ph. D.'swere. One was Woodard, the other was Cox. No vice versa, both from Pennsylvania. Am I right?

[Hersh: "Cox was at Cornell, Woodard, Claytor, Talbot from Pennsylvania."] Okay, thank you very much.

We have a person here in the audience who did some work on Claytor's research for his Ph.D. dissertation. But [it was] Pennsylvania, Cornell, Michigan, Chicago, and Illinois in those early days. Michigan used to hold the record, and may still, for the number of Ph.D.'s awarded to blacks. For so called liberal institutions, Wisconsin stands out as being the slowest to award. Has it ever? A few years ago, it had never awarded a Ph.D. to a black. At least one black student whom I have known left Wisconsin in frustration and went to the University of Texas (and the University of Texas is not noted for its work on black Ph.D.'s in mathematics because of the More influence, of course). But this fellow did receive his degree from the University of Texas. Of course, More was no longer the guiding light there at that time. I should point out though, that although More was famous for his hostility toward black academics, toward some of his students, in particular Gail Young and Auriel Wilder whom I know personally, he was very progressive minded. In fact I am told that Wilder tried to get the University of Michigan to hire Claytor to come down and join the faculty. But, he was not successful at that time.

Almost any black Ph.D. can cite other professors who have played significant roles in their careers, major professors, and mine was G. L. Earlman at the University of Michigan. Everybody can cite those examples. But what has tradition to do with the issue at hand? I contend that Black students in large numbers do not have either the parental community support or encouragement to study mathematics. Too few black students opt for the hard mathematics courses. Many people come to college without having taken Algebra I because the course was required. It is only recent vintage that there is a national trend to increase the mathematics requirements in the high school. Louisiana is only just getting around to it. Students, until a couple years ago, come out of Louisiana high schools without having Algebra I. But, since the NCAA Rule 48 became widely publicized, school systems are now trying to catch up, as it were.

It is significant to me that it took an athletic organization like the NCAA to bring about adequate changes and improvements in the academic field. The conventional wisdom is that the school counselors tend to shunt black students into non-demanding curriculum. This wisdom is probably correct. But if the counselors and other school officials are doing the directing, they are doing it with the cooperation of the effective students and their parents. The students cooperate because they are seeking easier ways out, having developed no clear career goals. And I think the parents just don't get involved, in large numbers, in their children's secondary school education. The concerned mathematics community can, and I think must, get into the counseling act by:

1) Mobilizing the cooperation of teachers, school counselors, parents, and community leaders to encourage these students to pursue the tougher academic curriculum.

2) Identify minority youth who have real talent in mathematics and provide one-on-one counselling to these young people in much the same way as the athletic coaches do.

(We can get a lot of good examples from the good athletic coaches.) I use that in my teaching all the time when students don't want to study. I have some football players in there and I ask them, "Well how do you learn how to play football", 'Well the coach tells me how to play it'. What do you do? 'I go out there and beat my head until I learn how it goes'. Well you can start beating your head with mathematics." It doesn't always work but I try.

NAM has submitted a proposal to NSF to do exactly what I have just proposed. We would appreciate the support of the MAA and even individuals. Whatever support that you can give for getting this proposal funded and also with implementing the proposal. I don't mean just to emphasize the funding, but implementing the proposal as well. We are not going to wait until the proposal is funded, by the way, to get started. Some of these things can be done immediately as we pointed out in our meeting today. For, while a majority share the responsibility for carrying out the spirited proposal, it must be shouldered by minority mathematicians. I want to make that point. It is encumbered on Rogers Newman to carry out the spirit of this proposal. Rogers Newmans replicated over and over. Okay. But although that's true, the project must also be adopted by the entire mathematics community as its very own project. Because the positive results of the project has beneficial fallout for the entire country. Not just for minorities, but for everybody.

Although this proposal focuses attention on pre-college students, I do wish to emphasize that the current college and graduate students must not be neglected. All of us can be on the watch for mathematical talent at these levels, because all of us are college and university professors and [must] encourage that talent whenever we find it. Financial support in the form of scholarships, teaching assistantships, and research assistantships must continue to be provided and increased in numbers.

Now according to the data which I have studied, that is one area in which minority graduate students do not participate very well that is, research assistantships. I don't know why that is the case, but I'll throw it out just in case you want to give that some attention.

Finally, the doors and windows of opportunity must be continued to be opened, and ever wider, until minorities are equitably represented in the work force. It is not difficult to realize that a good-paying and secure job at the end of the line is an incentive, an incontestable incentive, for most people -- for nearly all people. It may be a bit more acute with blacks, because black people tend not to enjoy all the benefits of the material [society] as some other people have. I remember some years ago when the Peace Corps came to Southern to recruit. It wasn't very successful because our students were not interested in going to Africa and living in the woods on farms. They just came off the farms, they wanted other things. An incentive is stronger perhaps among minorities.

I might mention that among those early Ph.D.'s in mathematics, only a very few of those worked outside of black institutions. Most of them by far were at black institutions. I thought that Wade Ellis was an exception, I thought that Wade had not worked in a black institution; but Wade Ellis Jr. corrects me, he too got his start in black institutions. I believe that J. Ernest Wilkins, at least one time, worked at Tuskeege. When I met you, I think you were at Tuskeege. I have made the point that Blackwell was at Clark, but he moved on to Berkeley. And that phenomenon is increasing. I am very proud of it, but those doors of opportunity must continue to be opened. I call upon all of us to join hands and forces in this effort and thus help bring about full participation in mathematics and in the American dream by all people in this country. Thank you very much.

MODERATOR HERSCH

Thank you very much Rogers. Our next speaker is Manuel Berriozabal. He is a professor at University of Texas at San Antonio. He is the director of San Antonio PREP and coordinator of Texas PREP and I am sure he will tell us what that means.

MANUEL BERRIOZABAL

Thank you Reuben. I certainly appreciate the opportunity to be invited to the meeting this afternoon to talk about San Antonio Pre-freshman Engineering Program and Texas Pre-freshman Engineering Program. Now let me tell you what this is about. We are going to be discussing two programs, one at the pre-college level and one at the college level, which have been influential in

getting more minority students interested in careers in science and engineering and have these students successfully pursue college work. I am going to restrict my discussion to a pre-college program and later on, a colleague of mine, Dick Stanley of the Professional Development Program at Berkeley, is going to say a few words about his program. Now, while I am talking I am going to flash a transparency about the Texas Pre-freshman Engineering Program. I have also asked one of my colleagues here to pass out some information on these programs to any of you who might be interested in getting some material on the PREP or TEX PREP programs.

PREP is the acronym for the San Antonio Pre-freshman Engineering Program which was started in 1979. TEX PREP is a shortened version of the Texas Pre-freshman Engineering Program, and it started in 1986 as a state-wide replication of San Antonio PREP. Now, what we have tried to do is create academic enrichment intervention programs for high-ability middle school and high school kids in San Antonio and the state of Texas. [They are] primarily targeted to women and minorities in order to identify these students and prepare them for studies in science and engineering. That's the whole goal of the program.

Now, the information I have here is on TEX PREP. What I'll primarily talk about is San Antonio PREP of which the others are simply replications. Since 1979, the San Antonio Pre-freshman Engineering Program has been in operation. We've had over 1,700 students complete at least one summer of a three-summer component of this program. The academic component of the program for the first year includes an eight-week course in logic, an eight-week course in problem solving, four weeks introduction in engineering, and four weeks introduction to computer science. The students get assignments, examinations, final examinations, and a grade for the program. The students have to maintain a 75 [percent] average in order to stay in the program. In order to get into the program, the students have to have at least B averages and need recommendations from a math teacher and another teacher or counselor.

Since the program has begun, approximately 78% of the students in the San Antonio program have been minority while 49% have been women. Actually the number of women has increased since '79. We started with 30% women in '79. It kind of grew in small increments in subsequent years. In fact, last summer, of the 420 students who finished the eight-week program, 59% were women. So it looks like we are getting more and more women interested, at least exploring learning, in science and engineering.

Now I feel one of the big things about this program is with the demands that we make of the students to maintain a 75 average in the program. The students realize, who successfully complete the program, that they can successfully complete such a program of studies in a college setting through hard work and commitment. And this is something that they experience until it is time for them to come to college, and in a sense they have broken the ice for college. But, on top of that, they also get some good solid academic enrichment in areas of mathematics that would never be available to them while they are in high school.

Of course, some of you might ask: Well if the program has been around so long, how successful have we been in getting students into college? Well, as things stand now from a follow up that we took from last summer, we identified (now this is the San Antonio program, the other hasn't been around that long to

have any significant figures), 649 former participants who would be of college age. We got responses back, in our follow up, from 555. That was no easy task, I assure you. But most of that was through telephone calls and things like this after they wouldn't return our form. But we still got responses back from 555 of whom 88% said they were either going to college in the fall of '87 or had graduated from college. And, two-thirds of these students said they were going to major in either science or engineering. In fact, of the 73 graduates that we have had, three fourths of the students have been majors in science and engineering. And as I said earlier, 78% of these students had been minority students. So we are quite pleased that this has happened.

So, how has this program come about? Well, we get a great deal of in-kind manpower support from outside sources. For example, the U. S. Air Force and U. S. Navy have, each summer, supplied us with a large number, a great number, of recent academy graduates to teach in the program for the eight-week period. Now these are primarily graduates who have all been engineering or science trained or are engineering or science majors, most of whom are untrained in teaching skills but have a great deal of interest in doing something like this.

As far as content is concerned, they have the ability to teach things like problem solving and introduction in engineering and introduction to computer science. We have college people teaching the logic classes and we have some premier high school teachers who are donated to the program who also teach courses. They may be teaching logic or problem solving and also assist the young officer instructors in the program.

Because of the results of the program, a couple of years ago we were able to get a partial supporting grant from the Coordinating Board of Texas to disseminate this program in six other locations in Texas and they are listed right here. In Corpus Christi, Denton, Edinburg, Laredo, Lupig, and San Antonio. I believe I saw the Denton Director here, Dr. Rosemarie Smith. And, we also have here a former instructor from the San Antonio program. We are very pleased that we have been able to work with other parts of the state to replicate the program.

Someone had asked me a couple of weeks ago, what are some of the PREP characteristics. I have a listing of them.

1) Selection of students who are achievers for their ages and getting them into the pipeline.

2) Special efforts to recruit women and minority students.

3) High but reasonable expectations from students. Topics are taught so students are expected to keep up in the courses.

4) Conduct of the program in a college environment.

5) Academic enrichment programs stressing topics, subjects, and areas covered in depth, and important for success in high school and college.

6) Well-organized and highly-structured program.

7) Program duration which requires commitment of time and expended effort.

8) Encouragement of competition among the students.

9) Involvement of parents, counselors, and teachers.

10) Development and maintenance of external linkages. (Which I mentioned to you.

11) Extensive tracking and follow up.

12) Direction and participation by mathematicians and other science and engineering professionals.

13) Significant involvement of minority professionals and staff members.

Now, I think it's time to see what's being done at the college level. So I am going to introduce and ask my colleague, Dick Stanley, to come up here.

DICK STANLEY

I have been asked to talk about a program at the University of California at Berkeley. Unfortunately the person who initiated that program can't be here. His name is Uri Treisman. But, I'll try to say a few words about what that program has done. This is a program for undergraduates at the University of California, Berkeley. It's about 10-years old now and has had a large degree of success and recently quite a bit of national attention. The problem that that program was addressing was the non-retention of minority students who came to the university desiring to pursue science and engineering majors. These students, it was found, were failing calculus in large numbers. This was true despite the fact that many of these students were very well prepared, [they] had excellent high school preparation. It was found, however, that they were not able to compete successfully in the undergraduate environment at Berkeley.

Another part of the problem that we are addressing [the program] was the fact that the well-established programs at the university in the student learning center, the tutorial programs, were having virtually no effect on the failure rate of minorities. Another aspect of the problem was that it was very difficult to convince these students themselves, as they entered into the university, that there was in fact a problem. We knew statistically that a very large percentage of these minority students were going to fail, or at least do very poorly in their desired fields of science and engineering. But, these students ..., as they entered the university, did not know this. They ... had been very successful in their high school careers and it would be very difficult to convince them to participate in any special program. So let me say a few words about what the program actually was.

First we had to recruit the students to the program. And, as I said, this was difficult because most minority students have a fear and a distaste for any program which hinted of remediation. They tend to stay from any such program in large numbers. So, the first thing we had to do in this program is to get students to come. The way we do it is to present the program as we actually

run it, as an honors program which is the opposite of the remedial program. Specifically, we focused the mathematics part of that program on the particular specific mathematics course which they are taking as a freshman, which is freshman calculus. We run workshops which parallel that freshman-calculus course. These workshops meet twice a week for two hours at a time, and the content covered in those workshops closely parallels the content being dealt with in the course itself. These workshops are non-credit and they are not connected in any way with the mathematics department.

The format for these workshops is that each workshop has a worksheet that we prepare for it. The worksheet is distributed to the students at the beginning of the workshop and the students set to work on the worksheet. There are typically 15-20 students in one of these workshops. The setting is informal, they sit around tables, there is a workshop leader, and I'll say a little bit more about him in a minute. But, in many ways the workshop doesn't share a lot of features of the typical classroom environment. The workshop leader is not up there lecturing or showing the students how to do problems. In fact often when I lead workshops, I don't address the students at all from the front of the room. The students have the worksheets in front of them and they begin working on these problems.

The problems that we select for these worksheets, it's very critical what type of problems we select for these worksheets (it's very critical what problems we select) are problems which are similar to the kinds of problems they are dealing with in their course work but are more difficult than those problems. It's a fine line here. We have to get problems which challenge these students. These students are, after all, bright students and are capable of doing the problems. It is important not to get the problems that are so difficult that a student will feel completely lost. The students work on these problems by themselves. The workshop leader and the workshop leader assistant circulate through the workshop. The main work on these problems is done by the students in collaboration with each other.

There is much about these workshops which isn't typical of the normal classroom atmosphere. The atmosphere is informal, there is a lot of noise in the workshop, students are free to move about. Sometimes the discussion shifts to non-academic subjects, but always the students return to working on the problems. And the result is that there is a lot of significant and excellent mathematics done by these students in this context.

The fact that there is no person up there telling them what the answer is, the fact that they have to struggle with the problems, and the fact that they arrive at the answers very frequently themselves or in collaboration with each other, is a very important feature of this workshop. You can see the students go through stages of being extremely frustrated in working on these problems, because the problems are very difficult and this frustration is very real. But, you can also see when they figure how to actually solve the problems. The satisfaction they gain and the things they learn from having done this is so much better and so much more lasting than an approach that simply shows them how to do the problem.

This program, as I say, has been running for ten years. We've been successful in the sense of the students who go through our program tend to do very well in the calculus course, they get grades in the A to C range, typically. And,

they are not discouraged from going on and studying further mathematics. In fact, we also run workshops at the sophomore level as they continue on to sophomore mathematics.

Some keys to the success of this program are, I think, first it's very important that we remove all traces of a remedial approach with these students. And, something in our very attitude is important. I mean we don't come to the students with the attitude of "You need help, we're gonna give you help". In fact, the way I think of it is that the university as an institution is what needs help. It hasn't provided, typically, a satisfactory environment for these students to learn and to develop their abilities.

Another key to the success of this program is that it is run by competent mathematicians. We develop the worksheets, [and] the leaders in the workshops are competent mathematicians. That makes a whole lot of difference to the students. If you have someone who is not competent, who does not know the material, leading a workshop of this sort, then the students sense it immediately. They sense that they are being relegated to some secondary status and they don't like it. In fact, they tend to leave such a program. They respect the fact that there are competent mathematicians working with them on significant problems.

Another key to the success of this program is that students, when they attend this program, are able to form friendships based on academic excellence. Nevertheless, friendships which typically last through their undergraduate career. In fact these workshops have a non-classroom setting in the sense that the workshops are not run in the classroom but are run in a space which is available to the students during non-workshop times. They work together on homework. Also coming to this space are students from previous years who tend to kind of hang out at PDP, and there is a lot of contact between the upper classmen and freshmen coming in, which is very helpful to these students.

One other, final, feature which I will mention, these programs are not racially-isolated programs. We feel it would be a mistake to run such a program as a racially-isolated program. The majority of the students are Blacks and Hispanics, but by no means all. There are white students [and] Asian students, in fact it is the very mix of these which I think is another component to the success of the program. Thank you.

MODERATOR HERSCH

Thank you Dick. Our final panelist or discussant is Paul Sally of the University of Chicago. He is a professor there and also Director of the Chicago School Mathematics Program. You may have already received the sign-up sheet which is going around the room. If you haven't, please make sure you do so before leaving. We would like to be able to not only know who is here, but be able to call on you in the future, back at your home institution, to help create programs of this kind.

PAUL SALLY, JR.

Well if I manage not to fall down, I might be able to get through a few remarks. I have some very coherent notes here which I would like to talk to you about.

An interesting title for a panel, "Mathematics, Minorities, and the MAA", three very interesting and diverse topics. I could address any one of them for some period of time. It's trying to connect them that we get into a little bit of a problem. It is interesting what's happened.

First of all, panic has hit the mathematics community. There are no domestic mathematicians coming through the pipeline. "No" is perhaps an exaggeration. There are not enough domestic mathematicians coming through the pipeline to do what? Teach. To teach where? To teach kindergarten, to teach elementary school, to teach high school, to teach undergraduates in college, to teach graduate students, to do mathematics, and so forth, and so on. There just aren't enough. So, in our wisdom, where do we turn. We look around, 20 percent of the American population is black. There must be some mathematicians. I love the enlightened view that takes place once panic hits. "Oh gee, there they are. You know we can go get them now."

I can't imagine why any kid on the Southside would want to become a mathematician. I tell you quite frankly, I know lots, and I don't know why they'd want to become a mathematician. And, what we have to do? What we have to do is tell them why they want to become a mathematician. I think this is what Rogers was telling us. We've got to make them understand what the game is all about and why there are rewards in it. Now, I have some plans for that which I'll tell you about later on. But first of all, I don't think we have taken what would be called an enlightened approach towards this problem in the past. What we want to do is remediate these kids. Well, there are lots of bright kids on the Southside of Chicago, on the Westside of Chicago, and on the Northside, and they are not all black either. And, the idea is to get into the city somehow, into the cities of this country, and extract these kids from their schools and get them into a system that helps them to develop their mathematics at an early age.

There is an organization at the University of Chicago, it is called the Office of Special Programs. It is run by a guy I consider to be an absolute saint, Larry Hawkins, [who] coached basketball at Carver High School in Alkart Gardens in 1963 when they won the State Championship. And, he is a god in the city, because that's how you become a god in the city of Chicago. But Larry Hawkins runs the Institute for Athletics and Education, and he tells kids, "you can't play sports unless you learn at the same time". He's really got a handle on a whole bunch of kids. When he says, "sit down", those kids don't even look for a chair -- I mean they are on the floor. So, I have been working with Larry for about 20 years, and we've done certain things, and we've found some answers. But, not the kind of answers we are looking for in the mathematics community.

Let me tell you where I am coming from. I want to create research mathematicians. And, I want to create them from the entire American population, including the minorities population. So, I am not worried about the average kid.

We have a program at Chicago called the University Chicago School Mathematics Program. I am not the director anymore. I am now working with teacher development in grades K-8 to structure programs, to put math teaching specialists into the elementary grades, especially grades 4-6. And, we have six good schools on the Southside of Chicago. One in the university neighborhood which is upper middle class with plenty of black kids, and the other five in the

ghetto. They are tough, and we have gotten specialist teachers in there and we are after the average kids in those schools. We want the kids to get out of the eighth grade and go to high school. But that's not what I want to talk about today. I want to make mathematicians. And so it is a question of how the AMS, how the MAA, how NCTM get at the problem of creating mathematicians from the minority population.

Well, what we did started 20 years ago, working with Larry Hawkins. We started a mathematics competition for 30 of the city high schools. That's about half of them, and we had about 1,000 kids in one weekend in the spring, one Saturday. Freshmen and sophomores in the morning, the juniors and seniors in the afternoon. We give them an hour and a half of multiple questions to prep them to take the SAT and hope that they will take it back to the high schools, and the teachers would use these exams to teach their kids. The other hour and a half, we give them six Putnam type problems at their level, which doesn't mean easy, which is at the high school level. They were called brain busters. Not many kids solved them, but it was a useful experience. But, out of those that were able to solve some of these, we would extract about 30 kids each year and bring them into the university every Saturday and just teach them a course in number theory or whatever subject appealed to us. Probability and statistics was another course. But, we never really got this all together. We sent these kids on and they went on to college, many of them became math majors.

I can recount anecdotal evidence, no formal evaluation whatsoever. But, last summer I was asked to go out and give a talk to gifted kids. Don't you love the word "gifted". Ten percent of any school district in Illinois has gifted. The word "smart" has gone out of their vocabulary. Do you notice that? I mean there is no such thing as a smart kid anymore, they're all gifted. Well, they aren't. They may be smart though. Anyway I was asked to go out and talk to a gifted program out at Northshore Country Day School -- just what it sounds like. And, to my delight, surprise, half of the program had been funded by the City of Chicago Board of Education in a weak moment of enlightenment, which is rare enough. They had a bunch of kids from the city schools, not the Catholic schools in the city, they had them from the City of Chicago schools in this program along with a bunch of kids from the Northshore suburbs. So, I was a little worried. How do you handle these kids? Well it was one of the most beautiful experiences I had ever had because, the black kids from the city were all over me. They were terrific.

So, I have heard here today, people talking about their various programs. And the kind of program we are going to gear up in Chicago, starting this summer, is a program for gifted kids from the city. The idea is to take an Island, you have heard of Paris Island. Well sort of in the same framework with a little more flexibility perhaps. You know, we are going to teach them mathematics. We are not going to make them sign away their life so that they have to be mathematicians, but we want to train them how to do mathematics.

Now, how does this take place? Where does one get money? Well naturally, the National Science Foundation is going to provide some funds (they don't know that yet). We have not even written a grant, but of course they are, along with the city of Chicago and some private foundations in the Chicago area. The plan goes like this: How many kids do you take? I claim that you can get by my definition of mathematically talented, out of the city of Chicago's

sixth and seventh grades, probably 20 kids who are going to fit the guidelines that I am talking about. So, it is a limited program. We are trying to get real talent and turn them on.

What are going to do with them? Well we are going to run them through their paces, whether it be number theory, which has been pretty successful in terms of these high-ability high school programs, or some other aspects of mathematics. We are going to keep them for about six to eight weeks during the summer, and we are going to provide them with regular university faculty to teach these courses. Along with that, we are going to provide them with seminar leaders.

Now, here is where this new concept of vertical integration has nothing to do with racial integration. It has to do with people at different levels who commonly seperate like oil and water, like elementary school teachers and pupils, and high school teachers and pupils, and college teachers and pupils, and graduate school teachers and pupils. We are going to try to integrate these people. So, the idea is to take this program at the National Science Foundation in Division of Mathematical Sciences called Research Experience for Undergraduates. I don't know if you have ever read the description of that, but you are supposed to take these undergraduate math majors and give them research to do. Of course, that is nonsense to begin with because no undergraduate math major can really do any research in mathematics. But, they can investigate serious mathematics.

Well, what we would like the NSF to do is fund us to have these kids do this. And, we [will] read some mathematics and work with senior faculty and work with seminar leaders with these talented junior high school students so that there is some sort of interaction among bright college undergraduates and bright junior high school kids in the city. So then these kids, the junior high school kids, [will] see some future in what goes on in mathematics and can have some knowledge about what goes on in undergraduate college mathematics imparted to them by these [other] kids who are already there and are doing other things as well.

So, although this has not been written in a request for proposals, I expect that NSF will leap on this opportunity to fund us. Now of course the idea here is (and one of the failings of some programs that have been run, never mind for minority kids, for any kids) you bring them in for a summer. You give them a great time, they play frisbee, they do mathematics, they get turned on, and you send them home. So we are doing this with local kids. What are we doing? We are going to follow up every Saturday. They will be in maybe three hours, maybe four hours. Who will work with them? The same seminar leaders that worked with them during the summer because they will still be undergraduates at the university. The idea is to plan this so that we actually get a two- or three-year program running for these junior high school kids with regular follow through. So, if we can actually run it for two or three years, we can end up involving maybe 50 kids. But the idea is ultimately to create mathematicians.

Now how does the MAA get involved in this? I think what the MAA should create is their own young scholars program. This is the reinstitution of what was formerly called the Summer Science Training Program for High-ability High School Students where you whipped in 30 or 40 of the brightest math kids from all over the country, you ran them through their paces, seven or eight days a week and you really sent them home all fired up about mathematics.

I think the MAA could well get into the game by combining the two things that I have suggested. Mainly, take bright undergraduates, give them research experience, give them a seminar-type experience, but at the same time promote this vertical integration of interaction between the bright college students and the bright junior high school students, and of course bright high school students, that I haven't talked about at all in this program.

We don't have bright high school students in there because I think it is crucial, but, of course, if anybody tells me sixth grade is much too late, then the question is where can you start. Ordinarily, we have been starting at the high-school level, but that is late, way too late. It is gone by then. You might be able to affect the mathematical talent, but you won't be able to affect the social outlook -- I'll tell you that, not at the high school level. You might have a shot at it in the sixth grade.

So, I think that the MAA (and this is what I am supposed to talk about, what should the MAA do about this. The MAA, minorities, and math. Remember I mentioned that in the beginning), I think what the MAA should do is get on the stick and try to promote a program, which not only involves bright undergraduates and bright high-school students, but some interaction between them. Of course, it would have to create a committee which is almost the death of any idea, but there will certainly have to be a committee.

I think that they should also study these programs that have been mentioned here. The programs that we are hearing about today are really quite remarkable, and knowledge about them needs to be disseminated much more widely than it is. I heard about the Berkeley program for the first time today. We should have knowledge about that at every university in the country, there is no question about it. I hope that it gets disseminated. Manuel's program in San Antonio, I have heard about before. I love this, we can get the sailors from Great Lakes Naval Station down and teach the kids. A touch of genius.

So, all I think is the following (on talking about the problems and potential solutions). It is up to mathematicians to renew their field, and it's in mathematicians' self-interest to promote the development of talented kids in the minorities. I don't care what you feel about minorities or anything like that. The point is, mathematicians, as such, have really got to renew their field. This is an area where lots can be done, but people are going to have to pay attention, and people are going to have to interact at various levels. Because, if mathematicians at the research level don't interact with the college faculty, with the high school faculty, with the junior high school faculty and the students, then the program is doomed to failure. Most programs in the past simply operated at one level without promoting this vertical integration. Thank you.

MODERATOR HERSCH

Thank you Paul. We have three respondents who are all primed to respond and dozens of people in the audience want to speak. I will call on our three appointed respondents and ask them to try to limit their remarks to under five minutes because of time, and we would like to hear as much as possible from the audience. I don't know if an order has been chosen, let me just look. Let me first call on Professor Lida Barrett. Dean Lida Barrett, rather, of the Mississippi State University and President-elect of the MAA.

LIDA BARRETT

I think we might call this gathering m^3a^2. I think we need an m^3a^2 activity. Mathematics, minorities, and the MAA need to look at the opportunities and challenges in two ways. I think that there are particular opportunities for the organization and challenges for the organization, and for the minority community. I think the two ways they need to be addressed are reflected in the kind of conversations we have heard today.

We have to have activities that meet the need of the minority student, but they have to be integrated within the overall activities of the organization. I congratulate Louise Raphael who chairs the MAA [Task Force] on minorities, because in my sum 30+ years as a member of MAA and AMS, I believe this is the best integrated audience I have seen on minority concerns. I have been to NAM programs. I can remember a particularly excellent one in Anaheim, talking about how to attract minority students to graduate school, in which the room was predominantly minority. I believe that until we can address the issue in an integrated fashion, to move minority activities into the mainstream of the organization, we won't get those activities fully addressed.

I look forward to this as the beginning of a number of activities of this sort. Thank you.

MODERATOR HERSCH

Thank you Lida. Next, I would like to call on Ken Ross, Professor of Mathematics at the University of Oregon, Secretary of the MAA.

KENNETH ROSS

I haven't figured out how I got to be here, although the University of Oregon graduate school has a perfect record with blacks, I am happy to report. Every black in the 22 years that I have been at the University of Oregon, received a Ph.D. at the University of Oregon, and he went back to Liberia. Correction, Nigeria.

I have been teaching a long time there. I think I have had one or two black students in my undergraduate courses in the last twelve years. I am from a really lily-white area where we have so few blacks that it is hard to have a program. That's not why I am here, though. I just thought I would start out with that.

It seems to me that we have several groups working together now. We have the Task Force that is sponsoring this panel today, we have Gloria Gilmer's Joint Committee on Under-represented Minorities, and we have NAM representing three organizations. We have increasing interest and support from the NRC on one hand, and the NSF on the other hand. I think there is real hope because what we need is the dedication that we have already had for a long time and money. These model programs in San Antonio are really impressive, I think -- they cost money. Somebody is going to ask me (maybe I will ask first), [since] these kids have to eat, do they get paid to go to school. I am sure it costs money, and I am certain it costs dedication.

I just want to say somethings about the people who had the dedication when there wasn't any money. We should appreciate that small number of individuals in the last 30 years who have worked very hard on behalf of minorities. There would be a lot less in this room if it wasn't for them, I can't remember their names. I'll mention two but it is not exclusive. I know Lee Lorch, and I know Don Hill have done a lot, and there are a lot of others, I am sure.

Well, I am a representative of the MAA and am the facilitator. So, my point of view is, we can provide the cooperation, we can provide some technical expertise. But, we are going to need the leadership, a large part from the Task Force and committees that have been discussed here today. That's all, thank you.

MODERATOR HERSCH

Thank you Ken. And, our last respondent is Wade Ellis, an instructor at West Valley Community College, San Jose, California, the author of several mathematics textbooks, including Calculus Illustrated. I asked him for the publisher and the price, but he refused to say. He is chairman of the Two-year College Committee. Welcome Wade, and thank you for being with us.

WADE ELLIS, JR.

Thank you Reuben. I would like to second some of the things that have already been said. The need for students to work together on mathematics is not just a need that black students have. I think it is something that needs to be done uniformly with all of our students. I feel this particularly at a community college where I teach, which is a drive-up and drive-away kind of college. They come for a couple of classes (most of the students are part-time), there is no community of scholars kinds of activities. I see that as (having come from Oberlin College where you can speak over dinner about what happened in the mathematics classes) a real problem. Not just for minority students. Perhaps it is more acute for minority students, but it is something we all need to think about when we deal with our students and their learning of mathematics. It is very important to mathematicians' students to talk to each other, and we should be providing that opportunity. I think the sixth grade is also, perhaps late, as Pauly Sally has said.

My mother is a kindergarten teacher. Or was, she is now retired. She believed that kindergarten (contrary to what we see these days) was not for reading, writing, and arithmetic, but for students to learn how to play and get socialization, and that they should do all sorts of things. One of the things they should do is draw. When they drew, you could give them something that might have lines on it so that they could draw inside, but they didn't have to draw inside. And, there weren't numbers on the places where they were supposed to draw, so that they could see that this is blue, this is orange, and this is yellow.

So, you would see men that were bright orange with funny colors for their shoes and socks. All of that sort of thing. They would leave her kindergarten and go to first grade. Many of the intervention programs that we are hearing about seem to say that we are going to take them out of their school situation, and we are going to do something for them in the summer and on

weekends. Then we are going to put them back in the old classroom setting where, instead of being thought of as ... bright, young, energetic students, [instead] they are discipline problems.

We need to deal with that. Especially for minorities. A black student (although I see in the newspaper almost everybody is supposed to be hyperactive, or some incredibly large number), an active, intelligent, young minority, is a threat to the teacher and a threat to the society of the classroom. This is particularly troublesome for black males perhaps, but black males and females. And, I would assume, for other kinds of minorities. We need to deal with that in our teaching training programs, and I think it is important for us to do that.

We do certainly need to train our teachers to know mathematics and be able to deal with that, that is first and foremost. They have to be competent and know what they are doing. But, they also have to know something about how not to say, "No, you are wrong", but "Gee, that was an interesting idea". As you go into classrooms you can sometimes see different reactions. You know this one looks one way and gets a certain kind of response, this child looks another way, same kind of thing, but gets a different response. We have to deal with that, from the lowest level all the way up.

Well, when my mother's little kids went on to the first grade, the kind of thing that happened was, in the first couple of days, they were given things to draw on and they were told it was wrong. They used the wrong color or they drew outside the lines. So that, they were no longer in control of their drawing, the school and the teacher were. They were learning outside themselves. But, some of the kids would come by on Thanksgiving. They would come over to my mother and they would have these completely, perfectly drawn things and then they would flash one of these orange turkeys. So, it is something that is true everywhere. We have to work on it across the curriculum and all the grade levels, up through the reentry, men and women that we see that are 45 and 50. It is true that lots of mathematicians did things early in life but there are older people that can do something too. Thank you very much.

MODERATOR HERSCH

Thank you Wade.

MEMBER OF AUDIENCE

I am interested in producing minorities, [mathematicians], of all kinds. I think back at the things that interested me in mathematics, and I think well, gee, was it money. Why did I choose mathematics over music or writing, or the things that interested me at that time. What it was was a real interest by mathematicians in me at a young age. Now, let's see, I have had seven people who wanted to study their Ph.D. with me. And, though we like to speak of role models, none of them had been black, Hispanic, or Native American as others have said. It has been a really sad thing for me, but what can I do. I want to do research, I don't want to be involved, really, in all these programs. I want to do mathematics. What can I do? I have an NSF grant, as many people here have grants. Somehow, I bet, you might do some things I have tried. Oh, maybe give a little bit, find some money for a

student to hang out with and put together your papers. Then talk with the person for a couple of hours a week. Or one hour a week, or even a couple of hours every two weeks. Just do things like that. Maybe even more.

I know that a few years ago the NSF actually would give a little extra money if you were to engage the help of an undergraduate minority in your grant, [that is] extra funds. You know, none of my colleagues (except for me) applied for those extra funds to my knowledge. None of my colleagues. And, still there are many things we can do, I think, to interest people. I think money for a student is the main thing. I have many, and have seen a few good minority students come through my calculus classes. Unfortunately, they like engineering and medicine because they like the financial rewards. Just to keep that in mind as an extreme measure that might be applied.

MEMBER OF AUDIENCE (Pat Kenschaft)

I have been working this year, I am Pat Kenschaft from Montclair State College in New Jersey, and I did run a summer program for seventh graders a couple of years ago where they came out of Newark. Thirty-four took two buses up to the Montclair State College campus for six weeks running for one course in math and one in science. That's 34 for three days and six weeks. It was closed for lack of interest, lack of appropriate topics for sixth graders, [that is] seventh graders. So, we have got to work on that.

I started with a program that came down from the state (this was discouraging) that had to do with teacher training. My first adventure with public school. Elementary school teachers working in minority areas, most of whom were not minorities themselves, but some were. I discovered that very few could find the area of a rectangle. This runs up to sixth grade. They had never seen a number line. They claimed they had never been taught how to find the area of a triangle. They confessed they had forgotten how to find the area of a rectangle. And, I thought I would tell you about a couple of the things one can use for ones own children or working with such adults who are motivated, smart, very nice people. They learn fast when given an opportunity and they want to do better. It has been a very rewarding experience.

I want to mention two books, Math Games for the Young Child by Agnes Axileno. Hot off the press, designed for children two through eight, but would be very helpful to parents. It is designed for parents, but would be very helpful for teachers in the young grades and maybe even higher.

MODERATOR HERSCH

Could you name the publisher?

PAT KENSCHAFT

There are cards, let's see, I can. Math Contest Incorporated, 81 First Street, Seaport, New Jersey. She is speaking tomorrow morning at 8 o'clock on writing in the curriculum and you can get cards like this. I believe, I put a batch on the AWM table. You can also ask me. This is new. The best, the only thing I know for young kids. The other that I have been using a lot is Family Math fro

the Lawrence Hall of Science, full of ideas that you imaginatively can adapt. I have finally got the teachers creating games of their own based on those, and we are beginning to get the kids to create ways of learning new ideas. It has been one year for me. It is exciting. I recommend it.

MODERATOR HERSCH

Thank you. I believe Beverly Anderson has asked to speak.

MEMBER OF AUDIENCE (Beverly Anderson)

I would like to tell you about a program that we have run at the University of the District of Columbia since 1982. A summer program, five-week summer program, for what we call academically-oriented junior high school students. [They] are students who are recommended by their math teachers as being good students in their classes and who are interested in working. We bring the students to the university. We work with them on somewhat unusual topics in mathematics, mostly finite mathematics, so as to encourage them, stimulate their interest in math. And, at the same time, we have a career awareness component. They are encouraged by the faculty and by the speakers in the career awareness part of the program to take mathematics throughout their high school years and to pursue the rigorous courses in mathematics.

Now, this program has been funded by the Navy. The students are paid $50 a week to participate in the program. We did a follow-up in the spring of 1986 and we learned that 91% of those who had enrolled in college were pursuing careers in a math-based field. We were very pleased with that. And, the vast majority of the participants in the program take mathematics throughout each of their high school years following their participation in the program.

MODERATOR HERSCH

Thank you very much. Yes?

MEMBER OF AUDIENCE (David Sanchez)

I am David Sanchez from San Antonio College. I would like to ask, first, a question and then make a point. If non-minority students are not attracted to mathematics, then why should we think that minority students should be attracted to mathematics? Secondly, I think that Dr. Newman pointed out what I think we can do with the resources we have available to us today. And, that is simply to recognize. Once you have recognized a student, give that student some time. And, I think that when that student knows that you have interest him and they have the ability, you would be shocked at what can occur. Thank you.

MODERATOR HERSCH

I think Richard Bayne has requested to have the floor.

MEMBER OF AUDIENCE (Richard Baine)

It is not clear that this goes along with the discussion here, but it seems like it might be something to think about. I don't know whose fault it is, I am sure it spread both among the members of the organizations that are what has been classified as minority, as well as the greater part of the organization. But, I think that whosever's effort is needed, and probably both groups are needed, I think that to serve the purposes of the goal of this panel, it might be to our benefit to do everything that we can to cause minorities in the organization to be more involved in all activities in the organization. In particular, on certain committees. And, I think in that way, we will be able to get input from those people as well as to have a better image presented to students that are undergraduates as well as in high school and below, as role models.

MODERATOR

Thank you very much. Go ahead Lee.

MEMBER OF AUDIENCE (Lee Lorch)

Lee Lorch, York University, Toronto, Canada. Richard Baine has just finished speaking from the bottom of my heart. Paul Sally and his remarks emphasized that the mathematical community is seeking mathematicians. Professor Sanchez pointed out that we have to ask ourselves, "Why place the burden on the minority mathematicians?". Why suddenly is it their problem to make up this gap, why do we turn to them in our hour of need when we didn't look at them during their hour of need? The point that Professor Blaine made is a very deep point. Unless minorities and women are seen in policy-making activities in all aspects of the organizations, not merely in those aspects which concern them directly as special charity cases, only then will they acquire the confidence needed to get them to join our ranks in the teaching and research community. Now, this has to go very far.

The American Mathematical Society has long failed in this respect. While I was on its Council, I sought often to have David Blackwell nominated as president of the AMS. David Blackwell is a member of the National Academy of Sciences. Of the 1500 members of that academy, he is the only black member. When J. Ernest Wilkins and I were sitting side by side for mutual comfort at the Council meetings of the AMS one year, he was elected to the National Academy of Engineering Science. One of the high officers of the AMS read off the names of people who had received honors that year, somehow he forgot the name of J. Ernest. I had the embarrassing task of getting up and informing the person who had read off the names. But, this has been characteristic.

Lida Barrett pointed out that this meeting has attracted a better mixture than she has seen at other meetings. That's good for this meeting. We ought to ask about the other meetings. Hardly any black members attend meetings of the sections of the Math Association. Why not? Don't blame the blacks. Why isn't the Association conducting its affairs in such a way as to attract black attendants. And enthusiastic black attendants. Back in the days before I dyed my hair grey to get the cheap fares on transportation, blacks were in fact excluded from meetings. Directly excluded.

And as Paul Sally pointed out, we have a product to sell. We are the salesmen. We are trying to recruit people. Unless the people we are addressing have confidence in us in all aspects of what we do, why should they come? Why should they come? And, they won't come under those circumstances. Let me give more, we should have officers and committees members and so on.

But, let me give one other example directly with the Association. In [the] November-December 1981 issue of FOCUS, there appeared one article, by a prominent mathematician, urging the mathematical community to disregard the United Nations appeal to boycott South Africa. He appealed for U. S. mathematicians to visit South Africa. Then he described South Africa (and I am now quoting the exact words) in the following way. "South Africa is not a police state. It is a functioning democracy, albeit a terribly limited one, with the franchise restricted to 4 million whites in a country of over 30 million habitants."

If anybody wants to call South Africa a functioning democracy, so be it. But, I don't want to analyze the South African situation. What I want to point out is that such an article in an organ of the Math Association is a direct slap in the face of our black constituency. Moreover, a letter was sent in reply to this article and FOCUS, replied from a teacher at Malcom X College in Chicago, against characterizing South Africa as a functioning democracy. How are we going to ask them [blacks] to join our ranks and become mathematicians and active members of the Mathematical Association? My point is only this: in everything we do, we have to seek out the confidence of the people whom we wish to attract in aspect of our work.

LIDA BARRETT

I would like to point out that 1981 is not quite as far back as some of the other things that have been referred to, our first black doctorates. But, it is far back in the history of the Mathematical Association. Two things have happened since 1981. One that was a catalyst was the addition of Rogers Newman to the Board of Governors, and at one of his early meetings as a member of the Board of Governors, he raised the whole issue of South Africa. Reasonably promptly, the Association moved to divest its stock in South Africa. Action was taken by the vast majority of the Board of Governors of the Math Association. The Math Association has invested part of its funding in the Calvert Social Responsibility Fund. Furthermore, a representative of the Math Association attended a meeting of a mutual fund, in which the Math Association at that time owned stock, and asked the mutual Fund to divest of DeBeers. [Gloria Gilmer President of The Math-Tech Connexion in Milwaukee] represented the Association and made a speech that was quoted very broadly. I do not think it's fair, given this activity that was substantial in the last year, to hang us for what we did in 1981. I believe in forgiveness, we need a lot of it, we hope you will extend it to us.

MEMBER OF AUDIENCE (Lee Lorch?)

Just one question. Has this, what Lida has told us, has that been printed any place?

LIDA BARRETT

Yes.

LEE LORCH

Where?

LIDA BARRETT

Well, certainly in FOCUS.

MODERATOR HERSCH

Susan Forman, were you going to speak next.

MEMBER OF THE AUDIENCE (Susan Forman)

Well, I guess I was. I had an experience using some of Uri Treisman's techniques for pre-calculus students at Bronx Community College where 95% of our students are black and Hispanic. Average household annual income is $8,000. Eighty-five percent of our students come in needing remediation level of arithmetic or elementary algebra.

During the pre-calculus class which met on Mondays and Wednesdays from 4-6 p.m., (by that time if I am not in my aerobics class, I want to be in my bed, my absolute down time of the day) I asked students to spend an extra 20 minutes during each class session with me. I was fortunate because the next class didn't begin until 6 p.m. When they asked why, I said that I wanted them to be able to have the opportunity to work in groups doing some extra work, either problem solving, or reading together, or talking about what had gone on in class, or on examinations. The technique was successful in the following way. Of the 36 students that had started in the course, 34 finished the course, which at our institution was quite remarkable. The two students that had left the course, had withdrawn from the college altogether.

Several groups of students worked together on weekends. One of the young women who had started the course with about a 68 average, finished the course and got a 91 on the final, went on in the following semester to work on her own and got an A in the calculus course. So these kinds of techniques that folks are describing, can be adapted at your own institution. Hopefully without additional resources, because we can put our hands in our own pockets and pull them out. But, if you are aware of what other people are doing (and I think we have had some excellent examples here today) you can think about ways that you can apply them in your own teaching. Then perhaps we can begin to have an impact and draw more students, both minority and non-minority to mathematics.

MEMBER OF AUDIENCE (Louise Dale)

I am Louis Dale from Alabama. If you want to know, really, how to get minorities involved in research, really into the mainstream of mathematics, then you ought to ask these 100 black mathematicians that are professors. Like Rogers who talked awhile ago.

Of the 100 or so mathematicians, Rogers, what do they do? How many of them are working at white institutions? It gets pathetic. You see I am a mathematician because I had good math teachers, not because of any program anybody had, but merely because I had good math teachers in elementary school, high school, and college. In fact, one of my math teachers, Professor Crawford, is sitting back here (I recognize him in the audience) and had left the university. But, I had role models.

When I came through college (or when I came through high school) I had to decide between being a lawyer, a boxer (because Joe Louis was world champion when I was in school), or a mathematician. But, Joe Louis was not there. He was merely an idol, a role model. You know all the young kids wanted to be world champions because we had a black world champion. As far as a lawyer was concerned, I like law. I had good math teachers and this is why I became a mathematician. Because of my teachers, not because of anything else.

I would say that MAA, Lida, the MAA can do things about helping the problem. But, I contend that the members of the MAA can do a lot more than the MAA can. I contend that the members of the organization really hold the key in their hands. When you are ready to recruit faculty, how many of you actively try to recruit blacks on your faculty?

LIDA BARRETT

I tried real hard to recruit you at one time. That's where I know him from.

LOUIS DALE

You tried Lida, you tried. But, the point is this, you ask a black kid to go to Berkeley to become a mathematician. When he gets there and he looks at an all-white faculty, everything around him is white, you get a little feeling. It's like taking a Mexican, or an African, or a Hispanic, or a white, or you have taken a female, a women, and throw her on a campus where there is nothing there but men. And you say, alright, become a mathematician. It is not that minorities or women or anybody else need anything extra. You know I don't want to be treated any differently from anyone else. It is just that you feel a little better, just a little bit better.

I remember Wayne State University, and I felt a lot better at Wayne State University because Berusha Reeves was there. There was a black professor there, I felt better because there were other black students on the campus. You can do a lot in the membership when you get ready to hire somebody (and I know how hiring takes place, the faculty picks the people at most institutions). So, when you get ready to recruit, try to recruit some of the 100 black mathematicians in the country to come to work on your faculty. And, try to, at least here, get blacks into this organization and I think that will do a big job to help you. Thank you.

MEMBER OF AUDIENCE (Maria Reed)

My name is Maria Reed and I am from the Barmank Community College of the City University of New York. I am a professor of mathematics, I have been for many years. Professor Rogers Newman mentioned that there is a lack of parental support and also community support in the black community which hinders black students from studying mathematics. And, I would like to emphasize that we really shouldn't put all the blame on the black parents, we ought to blame teachers also.

I have had the privilege of doing research in three black disadvantaged neighborhoods a few years ago. And I had the privilege of working with the teachers in the classrooms. And, I can tell you that these were predominantly black and Hispanic neighborhoods and these kids were at the eighth grade level. I can tell you the advice given to the minority students and the other students were completely different.

The teachers also, in many instances, responded differently towards the classroom. I remember once, in one of the classes, I had to visit the teacher and evaluate the teacher. Before he left the classroom, he said to me "How do you teach these kids? Are your kids as stupid as these are?" Now this was coming from a Caucasian teacher and the classroom was of black and Hispanic students. I just mention this [because] when I took over the class, he had to leave, I took over the class on that particular day because I had to train the teachers to do the statistics that I wanted them to leave and he was in a hurry to leave, and I said okay you may leave and I will do the work. And, I asked the students, "Why do you behave so terribly to your teacher?" They said, "Well, he behaves terribly with us. He doesn't like us, so we don't like him either."

And let me tell you, I have had other instances in other schools. For example, one teacher was having a terrible time with the students and in private he says to me, "You know, I hate mathematics." And so I said, "Why are you teaching mathematics?" He said, "Because I couldn't find another job". He had a master's degree in counselling, yet he was teaching math. This story goes on and on, and so I feel that we need to educate our teachers and the teacher-training institutions. We need to educate our teachers that we are putting in the classrooms and not blame the parents.

Now I also spend a lot of time, I have been serving on the judges committees, MAA local metropolitan chapter since 1977, I give my time every year with the math fair committee, the competition. And, there are very few black students coming, I have seen. And, since 1977, through last year, do you know I have seen only two black students in my group. Very few overall. In my group those two. But I was very curious and I spoke to one Hispanic kid at the time, he was terrific, he won a silver medal. And I asked him what made him, why was he so interested, or where did he get his interest to make a presentation at the math fair. And he, you know professor, he said, in the history of my school which is Roosevelt High School in New York City, he said I am the first minority to come to make a presentation at the math fair. I am the first one to receive a silver medal. He was so excited, and I said "Well, how come?". He said, one of my teachers. His math teacher who also served as a judge in the MAA, that teacher inspired him and helped him present a paper from which he received a silver medal.

The second student that I came across another time was a black kid, he told me the same thing: the teacher. Not the parent so much, but the teacher. And I stress and emphasize that we ought to educate the teachers that send into the classrooms, educate them mathematically. Not only that but also that they should not make distinctions between the students they are advising.

MEMBER OF AUDIENCE (William Hawkins)

William Hawkins, University of the District of columbia. I just wanted to mention an aspect of the problem that people might not consider. What I am concerned about is the fact that among the population and the faculties and the four-year colleges, there are a lot of people who might originally have plans to pursue terminal (?) degrees and for one reason or another, have not been able to do so. One thing that I think that would be very beneficial to the profession is to link these schools with a doctorate granting university in their neighborhood or nearby. The NSF, right now, I think has grants concerning faculty enhancement and I don't think there is anything quite along these lines, but this is something that many institutions could probably do and it would be a way of upgrading large numbers of faculty. There are people with a great deal of talent who simply have not had the opportunity to go as far as they wanted to go. This is something I would like to see considered as part of the whole picture.

MODERATOR HERSCH

Thank you very much. Yes, you may speak.

MEMBER OF AUDIENCE (Carl Pomerance)

Carl Pomerance, University of Georgia. I wanted to ask more about the Berkeley program that was described earlier. I didn't understand a lot of things. Is there a place to read more about this. I would like to know, is it funded by the university? If the students don't think it is a remedial program, what do they think it is? I would like to know what is the definition of students that get into this program, etc.? How can we learn more about this so we can try it on our own campuses?

DICK STANLEY

There is actually very little that has been written, there are a few things. dissertation on the implementation of the program at Berkeley. If you talk to me later, I can have a copy of that sent to you.

(Upon being asked the address and phone number in Berkeley, Stanley responded by writing the information on the blackboard.)

LIDA BARRETT

Let me ask a question, while he is getting that up on the board, or screen. If we were to ask Professor Treisman to put on a minicourse at an MAA meeting on how to start such an activity, how many people here would be interested in

attending? Let me count, this is the kind of ammunition we need. Stand up and we'll just get a rough count. Have a minicourse at an MAA meeting by Treisman and people on how to put on these kinds of workshops, do these kind of programs. What, 25, 40? 55, enough to populate one, we'll see if we can put one on. This would have to be at the Phoenix meeting, there won't be many courses at the AMS [Centennial] meeting. There will be courses, but they are already planned.

MEMBER OF AUDIENCE (Phil Wagreich, University of Chicago)

I would like to mention something relevant to Lida's remark. We hope there will be a workshop this summer for mathematicians interested in mathematics education projects. And, in fact, one of the presenters at this workshop will be Professor Treisman and there will be presentations by other people. It will be a three-day workshop. I think the dates are July 6 through 8, assuming funding.

(What is the place of the meeting?)

It will be at the University of Illinois in Chicago.

(It will be announced?)

Yes, it will be announced. It is actually the first in a series, again assuming the program is funded, there may be a series of workshops.

(Who at your university should be contacted?)

I guess me, Phil Wagreich. You can send it to the Department of Mathematics, and the last name is W-A-G-R-E-I-C-H. Phil is the first name. I am organizing this along with Harvey Keynes at the University of Minnesota.

(So this is a workshop with Treisman.)

Uri Treisman will appear at the conference, he will give a presentation.

PHIL WAGREICH

Here is one more reference from Calculus for A New Century, which I understand is still available downstairs.

LIDA BARRETT

For $10 pre-publication, is the initial publication cost. It is the latest MAA Notes and is a report on the Calculus Conference that was held in October.

PHIL WAGREICH

In this publication on page 129 there is an article by Uri Treisman and Shirley Malcom describing this program.

MEMBER OF AUDIENCE

Let me just quickly comment about program that I am running at GMI in Flint, Michigan. It is a program for minority students. It is a six-week program called "Academically Interested Minorities Program". I get corporate support for this program. I get $2400 per participant. What we do is bring them on campus for six weeks and put them a course of chemistry, mathematics, computers, and communication skills. We think that those are four important components to help such a program.

Many times we have been asked, "Why communication skills?". And, we like to tell them, because if you solve the greatest problem in the world, you will have to be able to explain to someone what you did." And, that's important.

We have been very successful with this program. The only thing is, to start, we are 100% supported by GM Corporation and the downturn in the economic issue, we are some of the things they cut back on. So maybe the National Science Foundation or some of these other granting agencies can give us a few dollars to support this program. In addition to that, my

community, my church, has started a Saturday afternoon academic enrichment program. We are working with kids from our community through our church.

MODERATOR HERSCH

Thank you very much. I wish we had another hour, but I think we don't. So, just a couple of final things. First of all, the NAM hospitality room is 1803, all are invited for fellowship. When? Now: 1803. Secondly, the sign-up sheet. Who has it? Where is it? Okay, don't lose them. Finally, here is an announcement that was made earlier about some books that are being put out for you to read about. Any other final word before we ...

PAT KENSCHAFT

The jargon among educators is discovery mathematics. And the idea is that people can learn mathematics best when they are enjoying it and while they are learning it for themselves and not just being taught to do drill. This book is advertised for kids age 5 through 15. I thinks it certainly could be used for kids younger than 5, but certainly up to 18. And, this one is advertised for 2 through 8 and can certainly go higher than 8. It has lots of interesting ideas on how you work with little children. So I would suggest them. They are both for fun, for discovery, for setting up research mathematics.

MODERATOR HERSCH

Thank you very much. Another announcement?

ROGERS NEWMAN

Just one other announcement. This is an appeal. All of you can participate in our talent identification program. If you have nice, "challenging" exercises for junior high and high school students that are appropriate for them, send them to me so that we can make them part of our identification program. I am Rogers Newman, Southern University.

MODERATOR HERSCH

If there are no other last words.

ROGERS NEWMAN

Oh, yes. Tickets for the banquet, I have them right here. I hope all of you will purchase one, I have a few left.

MODERATOR HERSCH

Do you want to speak. Do it fast. Fast and loud.

MEMBER OF AUDIENCE (Gloria Gilmer)

I would like to invite you to a panel. The panel discussions are Ethical Mathematics that is being held on Saturday, 1 to 3 [p.m.]. I think it will be an eye-opener about the condition of mathematics. In addition, I would like to say, (you may already know this) but I seconded the motion at the Nicholas Fund [proxy meeting] on behalf of the Mathematical Association for divestment [of the Fund's holdings in South Africa].

APPENDIX F

Surveys Conducted by the Task Force

SURVEY-1

The current state of awareness of or participation in regional minority intervention programs and initiatives by MAA sections.

(This survey was sent to all 29 MAA Sections.)

SUMMARY

1. Number of Sections: 29
2. Number of Section Responses: 10
3. Number of reported intervention programs: 5

CONCLUSIONS

1. The MAA Sections are not actively involved in the formation or operation of Intervention Programs.

2. A vehicle for communication does not appear to exist between currently operating intervention programs and MAA sections.

3. Beatriz Chu Clewell, Margaret Thorpe, and Bernice Anderson, prepared a report entitled Intervention Programs in Mathematics, Science, and Computer Science for Minority and Female Students in Grades Four through Eight for the Educational Testing Service in Princeton, New Jersey which was published in May 1987. This report cited and summarized 163 intervention programs conducted in 33 states, the District of Columbia, and Puerto Rico. The difference between these figures and those of the MAA Survey indicate that the MAA sections are generally not aware of the intervention programs operating in their regions.

RECOMMENDATIONS

1. The MAA should encourage its sections to get involved directly or indirectly with the formation or operations of quality precollege intervention programs.

2. The MAA should make sections aware of current intervention programs operating in their regions. A copy of the aforementioned report, or appropriate sections, should be sent by the MAA office to each location.

3. At its annual meeting, each MAA section should schedule a report from regional intervention programs. This would serve to stimulate an interest among members to get involved with these programs, and encourage replication of successful programs.

SURVEY-2

Minority participation in MAA activities of the local and regional levels.

(This survey was sent to all 29 sections and all 54 Historical Black Colleges and Universities.)

SUMMARY

1. Number of Sections: 29
2. Number of Section Responses: 12
3. Number of Historical Black Colleges and Universities: 54
4. Number of Responses from HBCU: 6
5. Number of Minorities Section officers or committee chairs: 4
6. Number of minorities serving on committees: 3
7. Number of minorities who have given presentations at regular sectional meetings over the past five years: 37

CONCLUSION

MAA regional sections have not had many minority officers, committee chairs, committee members, or presenters.

RECOMMENDATIONS

1. National and regional strategies should be developed to encourage more minorities to become involved with the MAA at the national and regional levels in the following ways:

   a. Appoint minorities to important regional committees with responsibilities which will make them wholesomely visible;

   b. Appoint minorities to important national committees with responsibilities which will make them wholesomely visible;

   c. Move minorities up to positions of national and section officers and committee chairs.

2. Since travel funds may be limited in the less affluent colleges and universities, particularly, the historical black institutions, MAA funds should be made available to these institutions so that their members can afford the aforementioned professional involvement.

Some Recommendations for Addressing and Solving the Problem of Minority Underrepresentation in Science and Engineering through Intervention Programs

Intervention Program Features

1. Organize intervention programs for elementary school, middle school, and high school students from six to eight weeks in length during the summer which stress academic enrichment and which have high expectations of participants.

2. Establish the intervention programs on college campuses so that successful participants realize that they can negotiate studies in a college setting through commitment and hard work.

3. Develop both residential and commuter intervention programs.

4. Offer transportation and lunch support to intervention program participants who qualify for school district free lunch and reduced cost lunch program but do not qualify for a JTPA program. Offer small stipends (determined by a point system based on academic performance) to [illegible] participants (i.e., the better the performance, the higher the stipend).

5. Require strong accountability and reporting components which will emphasize the tracking of participants through high school and college. The only meaningful payoff for a high quality intervention program is measured by the number of students who graduate from high school, the number who go to college, the number who major in science and engineering, and the number who graduate from college.

6. Offer long term support for successful intervention programs, so that the director does not constantly have to spend an unreasonable portion of his/her time in money raising activities.

Linkages

1. Encourage linkages between intervention programs conducted by colleges in minority impacted areas and other colleges committed to recruitment of minority students. A cooperative college might provide inkind manpower support to a summer intervention program; then in a subsequent summer invite some outstanding minority participants for eight weeks of academic enrichment at the expense of the college. If a participant does well in the local school, the cooperative college might then agree to offer automatic admission (all needed academic scholarship, and financial aid) to this student upon graduation.

2 Develop linkages with well-known private prep schools interested in recruitment of minority students. A private school may offer to staff a program with one of its own teachers; in turn, the program will agree to share participant lists with the school so that the school can recruit minority students.

3. Develop linkages between intervention programs and military services whereby the latter will contribute the services of officers to teach in the program. A potential pool of no cost military assistance is the most recently commissioned officers of the military academies and the ROTC units. Many of these officers are commissioned in May and do not report to a long term assignment until August or September. Rather than giving them orders for temporary assignments at some military base, the skills of these individuals might be used most effectively in summer intervention programs. These officers serve as strong role models for the program students and it would be a very inexpensive contribution of the military services to the development of our human resources.

4. Develop linkages between local Job Training Partnership Act (JTPA) Sponsors and intervention programs so that poverty level students can participate in summer intervention programs and have this experience serve as work experience in the JTPA program. In this way, poverty level participants can earn up to $800 during the summer months.

5. Develop linkages between intervention programs and local science and engineering professions whereby the latter will sponsor limited activities with the program participants during the academic year.

6. Establish linkages between intervention programs and participants' parents. At the beginning of a recruiting cycle, hold orientation programs for parents of prospective applicants; after recruitment is completed, hold another orientation for parents of selected applicants; at the end of the program, hold a closing day assembly to which participant families and friends are invited.

7. Give credit incentives to public and private industry and agencies for responsibly and consistently supporting good intervention programs as opposed to giving P.R. donations to doubtfully beneficial programs.

8. Encourage local school districts to contribute services of premier teachers to summer intervention programs and to give independent studies credit to successful program participants.

ACCOUNTABILITY IN SCIENCE-ORIENTED MINORITY INTERVENTION PROGRAMS

Currently, 5% of the annual output of baccalaureate degrees in science and engineering are being awarded to students who come from minority groups traditionally underrepresented in the science and engineering professions. The 5% figure is at best one-third of parity. An effective means for getting minority students into the pipeline for college science and engineering studies is through precollege intervention programs. Consequently, many of the successful intervention programs in this country which are dedicated to rectifying this inequity deserve to receive adequate support for continuation, expansion, and replication.

The funders of all intervention programs have an obligation to their constituencies and to this nation to demand an accounting, specifically requiring documented evidence of the success in producing minority college graduates in engineering and science. The successful programs should be supported and enhanced while the unsuccessful programs discontinued.

In the future funding of all programs, it is recommended that a component of accountability be required. The objectives of all these programs should be to show an increase in the number of minorities who receive baccalaureate degrees in science and engineering.

Some aspects of accountability should include the following:

1. An intervention program should include a tracking and reporting mechanism for its minority participants specifically covering the following items:

   a. College admission
   b. Choice of college majors
   c. College graduation
   d. College major at the time of graduation

2. All public and private funding agencies should require annual reporting from the programs which they are supporting and should have the prerogative to audit these reports.

3. The MAA, Mathematics community, and the science and engineering community, in general, should formulate guidelines for accrediting successful intervention programs. These accreditions could be used by the recognized intervention programs to gain needed financial support to maintain, expand, or disseminate information about the program.

MAA Task Force on Minorities in Mathematics
Committee on Local/Regional Action

Survey-1

Please respond to this survey at your earliest convenience. It has been formatted to make it quick and easy to answer.

Thank you for your cooperation in this matter.

1. Name of Respondent: _____

2. Address: _____

City: _____ State _____

3. Office Telephone: _____ 4. Home Telephone: _____

5. Name of MAA Section: _____

The next page forward elicits information of the various precollege intervention programs which may be sponsored by your section or administered by an institution in your sectional region. For each program, please make a copy of the survey form and provide as much information as you can.

Additional information will be welcomed.

Please make copies of all the information you submit for your files.

Return this form by February 19 to:

Dr. Manuel P. Berriozábal
PREP Office
The University of Texas at San Antonio
San Antonio, Texas 78285
(512) 691-5530

Precollege Intervention Program Information
(Please supply as much information as possible)

A. Name of Program: _____

B. Program Director's

Name and Title: _____

Institutional Address: _____
_____

Office Telephone: _____

Academic Discipline: _____

C. Program Locations (if different from institutional address):
_____
_____

D. Geographical Locations Served (if different from or larger than institutional location):
_____

E. Program Components:

_____ Academic subject areas (specify) _____
_____

_____ Laboratories (specify) _____
_____

_____ Other (speakers, field trips, etc., - specify)
_____
_____

F. Number of years in operation: _____

G. Annual operational period (summer, academic year, etc., - specify)
_____

H. Grade levels served: _____

I. Number of student participants during program life: _____
Number of students currently participants: _____

J. Total number of ethnic minorities during program life: _____
Distribution of ethnic minorities: Alaska Natives _____, American Indian _____, Black _____, Mexican American _____, Native Pacific Islander _____, Puerto Rican _____.

K. Number of College Age Former Participants: _____
* Number of College Graduates: _____
  Majors: Engineering _____ Science _____ Other _____
* Number of Current College Students:
  Majors: Engineering _____ Science _____ Other _____

L. Costs since program inception: _____

How are cost met? (Please check appropriate sources)

_____ CONTRIBUTIONS FROM OUTSIDE INSTITUTIONS AMOUNT _____	_____ INKIND CONTRIBUTIONS AMOUNT _____
_____ Institutional Grants _____ Government Grants _____ Foundation Grants _____ Private Industry _____ Local School Districts _____ JTPA Sponsors _____ Individuals _____ Other	_____ Institutional Sources _____ Government Agencies _____ Private Industry _____ Local School Districts _____ JTPA Sponsors _____ Individuals _____ Other
Give names of supporting Federal Agencies: _____ _____ _____	Give names of supporting Federal Agencies: _____ _____ _____

M. Program Staff (Please check appropriate types in Matrix below)

	Mathematics	Science	Engineering	Other
College Faculty				
High School Faculty				
Private Industry Personnel				
Federal Government Personnel (Civilian)				
State Government Personnel				
Military Personnel				
Graduate Students				
Undergraduate Students				
High School Students				
Other (Specify)				

N. Program Tracking:

Does the program conduct a periodic tracking of former participants?

_____ Yes _____ No

If Yes, give a brief description.

O. Comments (Optional)

If any brochures, program summaries, or statistical studies are available, please submit them.

MAA Task Force on Minorities in Mathematics
Committee on Local/Regional Action

Survey - 2

This survey elicits information on the minority participation in MAA activities of the local and regional levels.

1. Name of Respondent: _____

2. Address: _____
   City: _____ State: _____

3. Office Telephone: _____ 4. Home Telephone: _____

5. Name of MAA Section: _____

6. Geographical location served: _____

7. Number of higher educational institutions in section: _____

8. Number of institutions who regularly have representation at annual meetings: _____

9. Number of those in 8 which are predominantly minority schools: _____

10. Number of section officers and/or committee chairs: _____

11. Number of those in 4 who are ethnic minorities: _____
    Distribution of ethnic minorities: Alaskan Natives _____
    American Indian _____ Black _____ Mexican American _____
    Native Pacific Islander _____ Puerto Rican _____
    Other (Specify) _____

12. Number of committees in the sectional structure: _____

13. Number of minorities serving on committees in 9: _____

14. Number of participants who give presentations at regular meetings of the region (Use any of the past 1 - 5 years in counting but indicate the period of time that our figure reflects): _____

15. Number of those in 14 who are ethnic minorities: _____
    Specify the distribution of these using the categories in 8.

16. Do you have a regular publication of the section?_____
If so, give your impression of the extent to which minorities or minority schools contribute to the publication.

17. Number of invited addresses at sectional meetings that have been given during the past 10 years by minorities:_____
Specify the distribution of minorities using the categories in 11.

18. Indicate the kind of contact that is made with minorities by those arranging meetings to get recommendations for persons to chair sessions or serve in similar capacities.

19. Comments (optional)

Please return this survey be February 19 to:

Dr. Manuel P. Berriozábal
PREP Office
The University of Texas at San Antonio
San Antonio, Texas 78285
(512) 691-5530

INFORMAL SURVEY* OF MINORITY MATHEMATICAL SCIENCE MAJORS

TASK FORCE ON MINORITIES IN MATHEMATICS

Statistical Profile Questionnaire

1. How many non-white students have declared a major in any of the following mathematical-related majors at your institution?

   A. Mathematical Sciences _____

Number	Afro American	135
"	Hispanic	49
"	Native American	23
"	Other (specify)	224

   B. Mathematics Education _____

Number	Afro American	16
"	Hispanic	7
"	Native American	3
"	Other (specify)	16

   C. Engineering _____

Number	Afro American	1,068
"	Hispanic	660
"	Native American	38
"	Other (specify)	1,760

   D. Computer Science _____

Number	Afro American	790
"	Hispanic	185
"	Native American	90
"	Other (specify)	628

2. What is the total number of students in the following majors at your institution? (number please)

   A. Mathematical Sciences 4,713

   B. Mathematics Education 1,040

   C. Engineering 23,168

   D. Computer Science 8,378

*QUESTIONNAIRES MAILED TO 745 NORTHEASTERN COLLEGES AND UNIVERSITIES

3. Is your institution a: 7 a two-year college?

34 a four-year college?

23 a four-year university?

1 a Historically Black institution?

4. Does your institution have a graduate school for:

A. Mathematical Sciences? 18

B. Mathematics Education? 19

C. Engineering? 15

D. Computer Science? 19

5. Does your institution award Ph.D.'s in any of the above subjects? yes _____ no _____

Which? _____

MATH. SCI.	MATH. ED.	ENG.	COMP. SCI.
12	7	14	12

Percentage of Black and Hispanic Students Enrolled at 75 Respondent Schools

RACE	MATH. SCI.	MATH. ED.	ENG.	COMP. SCI.
Black	2.9%	1.5%	4.6%	9.4%
Hispanic	1%	0.7%	2.8%	2.2%
Native Amer.	Figures are insignificant			

5/88

APPENDIX G

Partial List of Black Mathematicians
Compiled by Professor Raymond Johnson

LIST OF BLACK MATHEMATICIANS

compiled by Professor Raymond Johnson

A list of Black mathematicians and a partial list of their research publications was compiled by Professor Raymond Johnson, University of Maryland-College Park in 1976-78. Professor Johnson looked up the names of Black mathematicians that he and Professor James Donaldson of Howard University knew. His handwritten list is available upon request.

In some cases, Professor Johnson was unclear about the ethnicity of a few authors. For example, Wade Ellis, Jr. is Black, but is he the same person as W. J. Ellis in MR #40? There is a Black Joshua Leslie, but it is unclear if he is Joshua A. or Joshua C. There is a Leslie listed at Northwestern who recently had an article published in the Bulletin (#16, 1987, pp. 105-108). There is a Black J. White, but only James H. White is listed and Professor Johnson is not certain he is Black.

Works by a L. K. Williams are listed. Later Professor Johnson learned that Lloyd Pearce Williams is Black. Thus L. K. Williams is probably incorrectly listed. All the questionable names need to be cross-checked. Professor Johnson is confident that the remainder of the mathematicians listed are Black.

LIST OF BLACK MATHEMATICIANS
(Compiled in 1976-78 by Raymond Johnson)

A = Added to Johnson's list.
D = Deceased.
F = Foreign.
R = Retired.

Ralph Abernethy
R. Amazigo
Adeneron Adeboye
Garth Baker
Earl Barnes
Charles B. Bell
A. T. Bharuche-Reid (D)
David Blackwell
Sylvia Bozeman (A)
Warren Brothers (D)
Johnny Brown
George Butcher (R)
Jeremiah Certaine
Gerald Chachere
E. Chukwu
Jesse Clay
James Curry
Lloyd Demetrius
Joseph Denton
James Donaldson
Wade Ellis
J. A. Ewell
Etta Falconer
Amassa Fauntleroy
Will T. Fletcher
A. (Abraham?) Fletcher
Tepper Gill
Everett Gipson
Arthur Grainger
E. Boyd Granville
Jarett Hall
William Hawkins (A)
Melvin Heart
Isom Herron
Gloria Hewitt
Fern Hunt
David James
Raymond L. Johnson
James Joseph
Ronald Kartram (F)
Manuel Keepler
Donald E. King
Genevieve Knight (A)
Nathaniel Knox
C. Dwight Lehr
Joshua Leslie
Noel Luhone (F)
E. W. Madison
Bernard Mair

Vivianne Malone-Mayes (A)
Donald F. Saint Mary
Clement McCalle
Rogers Newman (A)
Kennard Reed
Beauregard Stubblefield (R)
D. Weddington
James H. White
J. Ernest Wilkins
Floyd L. Williams
Lloyd Pearce Williams
Lawrence R. Williams
Scott Williams

APPENDIX H

Initiatives Created by Professor Donald Hill

Ideas for the Increased Participation of Minorities in Mathematics

We all know the severe underrepresentation of minorities in mathematics. With the changing demographics of our nation's youth, now is the time to review and renew our commitment to enhancing opportunities for minorities in mathematics.

Would you take a few minutes to read the enclosed pages and react to the ideas with handwritten comments on the pages?

These ideas come from years of reflection and discussions with individuals like you(including some last week at the summer meetings in Salt Lake City), and recent membership on MAA's Blacks and Mathematics Evaluation Committee, MAA's Task Force on Minorities, and NAM's* Executive Board.

I am most interested in activities that directly use the strengths of MAA and NAM.

Dr. Don Hill
Mathematics Department
Florida A & M University
Tallahassee, FL 32307

(904) 599-3595

* For those who may not be familiar with NAM, a statement of purpose is enclosed.

I. Talks by Recent Black Ph.D's at National Meetings

Don Hill
Florida A & M University

New Black Ph.D's in mathematics, and perhaps mathematics education, will be identified as they receive their degrees. For the January joint meetings those whose doctoral age will be 12- 24 months will be invited through the auspices of the National Association of Mathematicians(NAM) to give short talks about their dissertations or any other research area of interest to them. They will prepare 4- 8 page summaries of their talks. These will be published as part of the NAM proceedings.

Comments:

1. Encouragement will be provided by NAM, MAA, and AMS members for these new Ph.D's to become/stay involved with professional activities. They will meet successful role models and also form an age cohort of their own.

2. The invitation to speak at a national meeting and have the paper published should be attractive to them at that stage of their careers as promotion and tenure loom ahead.

3. The talks will be short(8- 15 minutes) depending on the number of Ph.D's and the % who choose to participate. The papers will be added to other NAM presentations, xeroxed, spiral bound, sent to NAM members, and be made available to others at nominal cost. Gracious introductions for the talks and biographical information in the proceedings form an integral part of this endeavor.

4. National MAA and AMS officers might wish to attend the talks. The speakers could then be considered for committee appointments, etc., within those organizations.

5. MAA sectional officers could be invited to attend a talk given by someone from that section. Again, the speaker could eventually be invited to serve on a sectional committee, give a sectional talk or panel presentation, etc.

6. The costs should be minimal. It is expected that the speaker's university pay his entire expenses. The "Proceedings" would be produced for NAM members as part of their dues. If outside funding could be obtained it could pay for(in this order):

a. A reception.

b. A higher quality publication than the currently envisioned xeroxed, spiral bound book.

c. Some of the expenses of the speakers.

d. Some of the project director's expenses.

7. MAA and AMS could help through publicity, officers attending the talks, and endorsements if funding is sought.

8. This project will occur during the Phoenix, 1989, winter meetings. Don Hill of Florida A & M University will run it. NAM will decide if it will be a regular undertaking. For this initial time the speaker's doctoral age may be more than 24 months.

II. Attendance at the Joint Winter Meetings
by
Undergraduate Minority Students

Don Hill
Florida A & M University

Thirteen minority undergraduate mathematics majors from Florida A & M University attended the joint winter meetings in New Orleans in 1986. I plan a similar outing for the 1988 Atlanta meetings. It is desirable to extend this opportunity to other minority institutions and individuals.

Comments:

1. Minority institutions and undergraduate minority students at other institutions tend to be isolated from the larger mathematical community. Attendance at the meetings would allow students to form an age cohort as well as to meet successful role models within NAM, MAA, AMS, etc.

2. To maximize benefits students would prepare themselves before attending the meetings. Reading materials could contain information about:

a. Specific individuals, to get a feeling for what it is like to become a mathematician--- David Blackwell, Julia Robinson, Henry Pollak,...
b. MAA, NAM, AMS, NCTM, etc., and how they function--- journals, meetings, committees, officers, affiliates, general membership, etc.
c. Invited addresses and panel discussions---- vitae of speakers and summaries of their presentations.

3. Representatives of graduate schools could arrange meetings with these minority students.

4. On returning home, students would be expected to give talks in local high schools and junior highs about being a math major and what they learned at the meetings.

5. External funding could be obtained by MAA. Minority institutions could apply for several students. Other minority students could apply directly. A committee could decide who gets the money based on statements as to how they would do #'s 2 and 4, as well as their planned activities at the meetings.

6. This idea could be extended in other directions-- minority grad students, recent minority Ph.D's, undergrads in general, student MAA chapters, minority undergrads attending sectional meetings, etc.

III.

Small Grants for Projects Involving Minority Students

Don Hill
Florida A & M University

MAA could seek external funding for a "Small Grants for Projects Involving Minority Students" program. There must be several individuals across the nation working with minority students(K-grad school) who could profitably use $500- $1000 to enhance their activities. These individuals are so busy doing things that they have little time, and less inclination, to write a formal proposal for such a small amount.

MAA would obtain the large grant and guarantee that the money was spent well. Publicity could come through FOCUS and the newsletters of NAM and NCTM. A committee could hand out the money. MAA could operate like it did in getting the NSF travel grants for the Fifth International Congress on Mathematical Education(Australia, 1984). The proposals to MAA could be very simple - on the order of MAA's "Aid to Sections" requirements.

APPENDIX I

Intervention Programs

Manuel Berriozabal Programs

Paul Sally Programs

Uri Treisman Program

Other Intervention Programs

The Texas PreFreshman Engineering Program: A Model For A Statewide Pre-College Minority Intervention Program

Manuel P. Berrioza'bal
Professor of Mathematics
Coordinator, Texas PreFreshman Engineering Program
The University of Texas at San Antonio
San Antonio, Texas 78285

Abstract

Since the summer of 1986, the Texas Prefreshman Engineering Program (TexPREP) has been organized and conducted in Texas. TexPREP is the statewide replication of the San Antonio Prefreshmen Engineering Program (PREP) which started in the summer of 1979. It currently operates at institutions of higher education in seven cities.

The purpose of TexPREP is to identify high achieving middle and high school students who are potential engineers or scientists and to give these individuals needed reinforcement to successfully pursue future college engineering and science studies. Women and minority students are special target groups.

The program is an academically intense eight week program which stresses the development of abstract reasoning skills, problem solving skills and career opportunities in engineering and science.

The program participants must agree to commit themselves to eight weeks of intellectually demanding classes and laboratories. The participants are given class assignments and laboratory projects. They also take scheduled examinations including a final examination in each course. All participants are expected to maintain a 75 average or better performance standard during the program. Each student earns a final grade which is reported to his/her school.

Over 2000 students have completed at least one summer in a PREP; 77% have come from minority groups under-represented in science and engineering and 49% of whom have been women.

During the summer of 1987, TexPREP locations conducted a follow-up of former participants. As of fall 1987, 680 former participants were of college age. Responses were received from 584; 416 said they would attend college in the fall of 1987, while 73 had graduated from college. Of this number, 68% indicated that their majors are in science or engineering.

Since the summer of 1979, The University of Texas at San Antonio has conducted the San Antonio Prefreshman Engineering Program (PREP). The purpose of this program has been to identify high achieving middle and high school

students of the Greater San Antonio area who are potential engineers or scientists and to give these individuals needed reinforcement so they can successfully pursue future college engineering and science studies.

Overview

The program is an academically intense eight week program which stresses the development of abstract reasoning skills, problem solving skills and career opportunities in engineering and science.

The program participants must agree to commit themselves to eight weeks of intellectually demanding classes and laboratories. The participants are given class assignments and laboratory projects. They also take scheduled examinations including a final examination in each course. All participants are expected to maintain a 75 average or better performance standard during the program. Each student earns a final grade which is reported to his/her school.

In the fall of 1985, the Texas Pre-freshman Engineering Program(TexPREP) was organized. Currently TexPREP is a collaborative effort of higher education institutions in Brownsville, Corpus Christi, Denton, Edinburg, Laredo, Lubbock and San Antonio. Each location has its own director and the director of San Antonio PREP serves as TexPREP Coordinator. San Antonio PREP has been replicated in these six more recent locations and the partnership of San Antonio PREP and its benefactors and supporters have been extended to the new locations.

Financial and full-time inkind manpower staff support has come from local, state and national colleges and universities; local school districts; military commands and other government agencies; private industry; along with the Texas Alliance for Minorities in Engineering, Inc. and its local chapters.

In the combined 1987 TexPREP, 841 started the program and 668 successfully completed it. Eighty-six poverty level participants were supported by the local SYETP Programs and each participant earned at least $700 during the summer. Seventy-seven (77%) of the successful participants were minority while 53% were women.

The combined 1987 staffs include 14 college faculty members, 15 high school instructors, 5 Navy offices, 489 Air Force officers, 2 practicing engineers, 1 graduate student and 44 program assistants.

Each summer TexPREP takes follow-up of former participants. In the fall of 1987, 680 of approximately 2000 former participants were of college age. Responses were received from 584 of whom 445 said they would attend college in the fall of 1987 while 73 had graduated from college. Thus, 88% of the respondents were college undergraduates or college graduates. Of this number, 68% indicated that their majors are in science or engineering. Statistical summaries are presented later in this paper.

Since a significant number of minority students come from low income families, TexPREP charges no tuition or fees. In this way, low income does not become a barrier for application. Also, all PREP's have been designated a Summer Youth Employment and Training Program (SYETP) worksite. Thus, some poverty level participants earn up to $700 by their work experience in PREP.

In 1980, the population of Texas was approximately 14.2 million, of whom 1.7 million were Black and 3.0 million were Hispanic. Thus, these minorities constituted 33% of the State's population. According to a 1987 study of the Texas Higher Education Coordinating Board, these minorities were awarded only 12% of the 1986 Baccalaureate degrees from public institutions in science and engineering. These figures reflect the serious under-representation of Texas minorities in the sciences and engineering professions.

Goals

The goals of TexPREP are the following:

1. To acquaint these students with professional opportunities in engineering and science;
2. To increase the number of competently prepared minority and women high school students from the TexPREP area who will ultimately pursue engineering or science studies in college;
3. To reinforce the mathematics preparation of these students in the pursuit of mathematics and science/engineering studies at the precollege and college levels; and
4. To increase the retention rate of these students in college.

Over the years significant awards have been achieved by TexPREP and the TexPREP participants. Among the notable awards are the following:

1. **Camille Moody (1981, San Antonio PREP).**

   In 1984 Camille was the Grand Prize Winner of the Alamo Regional Science and Engineering Fair. In the same year, she won third place in the Mathematics Division of the International Science and Engineering Fair.

2. **John Gutierrez (1986, 1987 Laredo PREP).**

John was the First Prize Winner in the Geophysics Division of the 1987 International Science and Engineering Fair.

3. **Karl Rodriguez (1984 San Antonio PREP).**

Karl was one of the forty finalists in the 1988 Westinghouse National Science Talent Search.

4. **1986 TexPREP.**

In December 1986, the 1986 TexPREP was designated as exemplary EESA Program by the Department of Education.

5. **San Antonio PREP.**

In March 1987, the United Negro College Fund, Inc. presented the program with the Fred D. Patterson Award for rendering outstanding service in the interest of and the support of the minority community.

6. **TexPREP.**

In April 1987, Texas Senate Resolution No. 480 commended the work of TexPREP.

1987 Follow-Up Survey of Former TexPREP Participants

During the summer of 1987, the TexPREP locations conducted a follow-up of former PREP participants. Of the 680 former participants who are now college age, responses were received from 584, of whom 445 indicated that they will attend college in the fall of 1987 while 73 have graduated. Summaries of results follow:

Table I

PREP YEAR	NO. OF COLLEGE ELIGIBLE	NUMBER OF REPLIES	ATTENDING COLLEGE				NOT IN COLLEGE	COLLEGE GRADUATES			
			ENGINEERING	SCIENCE	OTHER	TOTAL		ENGINEERING	SCIENCE	OTHER	TO
1979	42	40	1	1	1	3	9	10	9	9	
1980	49	40	4	4	2	10	4	17	4	5	
1981	64	54	14	3	10	27	13	6	4	4	
1982	154	140	42	29	35	107	28	4	1	0	
1983	213	186	62	42	75	179	7	0	0	0	
1984	96	75	33	24	14	71	4	0	0	0	
1985	21	20	13	3	3	19	1	0	0	0	
1986	31	29	13	12	4	29	0	0	0	0	
TOTALS	680	584	182	119	145	445	66	37	18	18	

Table II

University And Major Selections Of In-College Former TexPREP Students (1987 Survey)

INSTITUTION	ENGINEERING	SCIENCE	OTHER	TOTALS
Angelo State University	1		1	2
Austin College		1		
Baylor University		2	1	3
Boston College	2			2
Cedar Crest College			1	1
Colorado Scho. of Mines	1			1
Columbia University	1			1
Cornell University	1			1
Creighton University		1		1
Dallas Baptist College		1		1
Duke University			1	1
Florida College		1		1
Hallmark University		1		1
Hardings University			1	1
Houston Comm. College			1	1
Howard University			1	1
Illinois Inst. of Tech.	1			1
Incarnate Word College	1		2	3
Laredo Jr. College	2	1		3
Larmar University		1		1

Table II(Continued)
University and Major Selections Of In-College

Former TexPREP Students
(1987 Study)

INSTITUTION	ENGINEERING	SCIENCE	OTHER	TOTALS
Mass. Inst. of Tech.	3			3
New Mexico Mil. Inst.		1		1
North Texas St. Univ.		1		1
Norwich University	1			1
Our Lady of the Lake Univ.	2	1	5	8
Palo Alto College			1	1
Pan American University		2	2	4
Penn. State University	1	1		2
Prairie View A&M Univ.	2	1	3	6
Princeton University		1		1
Rice University	3	1		4
San Antonio College	7	10	6	23
Southern Methodist Univ.	3		1	4
Southwest Texas St. Univ.			1	1
Stanford University	3	1		4
St. Edward's Univ.			1	1
Stephen F. Austin St. Univ.			1	1
St. John's College	1			1

t. Mary's University	3	10	16	29

Table II(Continued)
University And Major Selections Of In-College
Former TexPREP Students
(1987 Survey Cont'd.)

NSTITUTIONS	ENGINEERING	SCIENCE	OTHER	TOTALS
St. Phillip's College	1		4	5
Texas A & I University	2		1	3
Texas A&M University	54	17	10	81
Texas Christian Univ.		1	1	2
Texas Lutheran College			1	1
Texas Tech. University	2	2	3	7
Trinity University	2	5	2	9
University of Alabama	1			1
University of Colorado		2		2
University of Dallas		1		1
University of Houston		1		1
University of Miami		1		1
University of New Mexico	1			1
University of Notre Dame	1	1	2	4
University of Pennsylvania	1	1	1	3
University of Texas-Austin	51	19	24	94
University of Texas-El Paso			1	1
University of Texas-San Antonio	26	22	43	91
U.S. Air Force Academy	2	1		3
U.S. Military Academy			1	1
U. S. Naval Academy	3	1		4
Wilson College	1			1
Yale University		1		1
Undecided		1	2	3
TOTALS	184	117	144	445

TABLE 3

DISTRIBUTION OF COLLEGE GRADUATED FORMER PREP PARTICIPANTS (1987 SURVEY)

MAJOR INSTITUTIONS	ENGINEERING												SCIENCE												OTHER												TOTALS											
	AMERICAN INDIAN		ANGLO		BLACK		HISPANIC		ASIAN ORIENTAL		TOTAL		AMERICAN INDIAN		ANGLO		BLACK		HISPANIC		ASIAN ORIENTAL		TOTAL		AMERICAN INDIAN		ANGLO		BLACK		HISPANIC		ASIAN ORIENTAL		TOTAL		AMERICAN INDIAN		ANGLO		BLACK		HISPANIC		ASIAN ORIENTAL		TOTAL	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
BRANDEIS UNIV.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
COLUMBIA UNIV.	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0
M.I.T.	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1
PRINCETON UNIV.	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	1	0	0	1	1	2	1
RICE UNIV.	0	0	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	1	2	1	4
S.M.U.	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	4	0
ST. MARY'S UNIV.	0	0	1	0	0	0	1	0	0	0	2	0	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0	1	2	0	0	1	2	0	0	1	1	0	0	3	2	0	0	4	3
TEXAS A & I UNIV.	0	0	1	0	0	0	1	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	2	1
TEXAS A & M UNIV.	0	0	1	2	0	0	3	2	1	1	7	5	0	0	2	0	0	0	3	0	1	0	6	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	3	2	0	0	0	3	2	1	13	6
TRINITY UNIV.	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	1	1	0	0	1	1	0	0	2	2	0	0	1	1	0	0	3	1	0	0	6	2
U.S.A.F. ACADEMY	0	0	0	0	1	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	2	0
UNIV. OF DENVER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0
UNIV. OF HOUSTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
U.T. AUSTIN	0	0	1	0	0	0	3	1	1	0	5	1	0	0	0	0	1	0	1	0	0	1	2	1	0	0	0	0	0	0	2	2	0	0	2	2	0	0	1	0	1	0	6	3	1	1	9	4
U.T.H.S.C.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1
U.T.S.A.	0	0	0	0	0	0	2	1	0	0	2	1	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	1	3	3	0	0	3	4
TOTALS	0	0	4	2	1	0	19	8	2	1	26	11	0	0	3	1	2	0	8	2	1	1	14	4	0	0	1	2	0	1	7	7	0	0	8	10	0	0	0	5	3	1	34	17	3	2	48	25

Table III:

Distribution of College Graduated Former PREP Participants (1987 Survey)

Summary

1987 Texas PreFreshman Engineering Program

1. PERIOD OF OPERATION: June 8-July 31,1987

2. DISTRIBUTION OF GRADUATING PARTICIPANTS:

(BY GRADES)

	5TH	6TH	7TH	8TH	9TH	10TH	11TH	TOTALS
Brownsville				7	9	7	5	28
Corpus Christi				14	13	9	15	51
Denton			1	16	10	4	4	35
Edinburg				31	10	12	9	62
Laredo				16	10	15	6	47
Lubbock				9	10	4	2	25
San Antonio	1	89	105	114	60	46	5	420
TOTAL	**1**	**89**	**106**	**207**	**122**	**97**	**46**	**668**

Minority Representation: 77% Women Representation: 53%

3. SCHOOL DISTRICTS:

All School Districts (Public, Private, Parochial) in the Greater Metropolitan Areas of Brownsville, Corpus Christi, Denton, Edinburg, Laredo, Lubbock and San Antonio.

4. PROGRAM:

- Logic and Its Application to Mathematics (1st year students)
- Algebraic Structures (2nd year students)
- Vector Algebra and Vector Geometry (3rd year students)
- Introduction to Engineering
- Introduction to Computer Science
- Problem Solving Seminars
- Practice SAT Examinations
- Guest Speakers
- Field Trips

5. ADMINISTRATIVE STAFF:

San Antonio Director and TexPREP Coordinator:	Dr. Manual P. Berrioza'bal
UTSA Co-Director:	Dr. Darwin Peek
Palo Alto Directors:	Mr. Leandro Esparza
	Captain Robert Wallin
Brownsville Director:	Dr. Erasmo Saenz
Corpus Christi Director:	Dr. William Mareth
Denton Director:	Dr. Rose Marie Smith
Edinburg Director:	Mr. William Shockley
Laredo Director:	Dr. Ramon Alaniz
Lubbock Director:	Dr. Derald Walling

INSTRUCTIONAL STAFF:

14	College Faculty Members
12	High School Teachers
2	Practicing Engineers
48	U.S. Air Force Officers
5	U.S. Navy Officers
1	Graduate Student
44	Program Assistants

INSTITUTIONAL FACILITIES:

Brownsville:	Pan American University Texas Southmost College
Corpus Christi:	Del Mar College
Denton:	Texas Women's University
Edinburg:	Pan American University
Laredo:	Laredo State University
Lubbock:	Texas Tech University
San Antonio:	The University of Texas at San Antonio Palo Alto College Trinity University

8. **PROGRAM COSTS:** Approximately $ 600,000

The total support for 1987 TexPREP includes financial $250,000) and inkind ($350,000) contributions from local, state, and national colleges and universities; private industry; military commands and other government agencies; professional organizations; local school districts; and JTPA Summer Youth Employment and Training Programs.

9. <u>Recommendations and Accountablity in Science-Oriented Minority Intervention Programs</u>:

See "Summary" Section

Additional Recommendations for Addressing and Solving the Problem of Minority Under-representation in Science and Engineering through Intervention Programs

Manuel P. Berrioza'bal
Professor of Mathematics
Coordinator, Texas Pre-Freshman Engineering Program
The University of Texas at San Antonio
San Antonio, Texas 78285

Intervention Program Features

1. Organize intervention programs for elementary, middle and high school students, six to eight weeks in length during the summer, stressing academic enrichment and which have high expectations of participants.

2. Establish the intervention programs on college campuses so that successful participants realize that they can negotiate studies in a college setting through commitment and hard work.

3. Develop both residential and commuter intervention programs.

4. Offer transportation and lunch for to intervention program participants who qualify for school district free lunch and reduced cost lunch program but do not qualify for a JTPA program. Offer small stipends (determined by a point system based on academic performance) to those participants (i.e., the better the performance, the higher the stipend).

5. Require strong accountability and reporting components which will empha size the tracking of participants through high school and college. The only meaningful payoff for a high quality intervention program is measured by the number of students who graduate from high school, go to college, major in science and engineering, and the number who graduate from college.

6. Offer long term support for successful intervention programs, so that the director does not constantly have to spend an unreasonable portion of his/ her time in money raising activities.

Linkages

1. Encourage linkages between intervention programs conducted by colleges in minority impacted areas and other colleges committed to recruitment of minority students. A cooperative college might provide inkind manpower support to a summer intervention program; then in a subsequent summer invite some outstanding minority participants for eight weeks of academic en richment at the expense of the college. If a participant does well in the local school, the cooperative college might then agree to offer automatic admission (all needed academic scholarship and financial aid) to this student upon graduation.
2. Develop linkages with well-known private prep schools interested in recruit-

ment of minority students. A private school may offer to staff a program with one of its own teachers; in turn, the program will agree to share participant lists with the school so that the school can recruit minority students.

Develop linkages between intervention programs and military services whereby the latter will contribute the services of officers to teach in the program. A potential pool of no cost military assistance is the most recently commissioned officers of the military academies and the ROTC units. Many of these officers are commissioned in May and do not report to a long term assignment until August or September. Rather than giving them orders for temporary assignments at some military base, the skills of these individuals might be used most effectively in summer intervention programs. These officers serve as strong role models for the program students and it would be a very inexpensive contribution of the military services to the development of our human resources.

Develop linkages between local Job Training Partnership Act (JTPA) Sponsors and intervention programs so that poverty level students can participate in summer intervention programs and have this experience serve as work experience in the JTPA program. In this way, poverty level participants an earn up to $800 during the summer months.

Develop linkages between intervention programs and local science and engineering professions, whereby the latter will sponsor limited activities with the program participants during the academic year.

Establish linkages between intervention programs and participants' parents. At the beginning of a recruiting cycle, hold orientation programs for parents of prospective applicants; after recruitment is completed, hold another orientation for parents of selected applicants; at the end of the program, hold a closing day assembly to which participant's families and friends are invited.

Give credit incentives to public and private industry and agencies for responsibly and consistently supporting good intervention programs as opposed to giving P.R. donations to doubtfully beneficial programs.

Encourage local school districts to contribute services of premier teachers to summer intervention programs and to give independent studies credit to successful program participants.

Accountability In Science-Oriented Minority Intervention Programs

Currently, 5% of the annual output of baccalaureate degrees in science and engineering are being awarded to students who come from minority groups traditionally under-represented in the science and engineering professions. The 5% figure is at best one-third of parity. An effective means for getting minority students into the pipeline for college science and engineering studies is through precollege intervention programs. Consequently, many of the successful intervention programs in this country which are dedicated to rectifying this inequity deserve to receive adequate support for continuation, expansion, and replication.

The funders of all intervention programs have an obligation to their constituencies and to this nation to demand an accounting, specifically requiring documented evidence of the success in producing minority college graduates in engineering and science. The successful programs should be supported and enhanced while the unsuccessful programs discontinued.

In the future funding of all programs, it is recommended that a component of accountability be required. The objectives of all these programs should be to show an increase in the number of minorities who receive baccalaureate degrees in science and engineering.

Some aspects of accountability should include the following:

1. An intervention program should include a tracking and reporting mechanism for its minority participants specifically covering the following:

   a. college admission
   b. choice of college majors
   c. college graduation
   d. college major at the time of graduation

2. All public and private funding agencies should require annual reporting from the programs which they are supporting and should have the prerogative to audit these reports.

3. The Mathematical Association of America, Mathematics community and the Science and Engineering community in general, should formulate guidelines for accrediting successful intervention programs. These accreditations could be used by the recognized intervention programs to gain needed financial support to maintain, expand or disseminate information about the program.

THE UNIVERSITY OF CHICAGO DEPARTMENT OF MATHEMATICS

A PROGRAM FOR MATHEMATICALLY TALENTED SEVENTH AND EIGHTH GRADERS

In this proposal, funding is requested for a program for mathematically talented students who have just completed Grades 6 and 7. The program will begin with a four week session in July of 1988, specifically, July 5 to July 29. During the academic year 1988-89, the students in the program will meet bi-weekly (on Saturdays) to continue the mathematical development which was started in the summer. The students who are successful in the first two segments will be invited to return for a second intensive course in the summer of 1989. We expect that a few additional students will be asked to join the program for the second summer.

STUDENTS: The students in the program will be identified thorugh several sources. (1) We will receive information about mathematically talented students entering Grades 7 and 8 from the Gifted Program Office of the Chicago Board of Education. (2) The Office of Special Programs (OSP) at the University of Chicago will provide us with the names of students from the Chicago schools who have demonstrated extraordinary mathematical ability in their work with OSP. (3) We will request the Illinois Educational Service Centers to distribute information about the program to the coordinators for Gifted and Talented Programs who deal with students within commuting distance of the University of Chicago. Twenty five (25) students will be invited to participate in the program for the summer of 1988. We intend to recruit minorities and women in an active way.

TOPICS: The mathematical content of the program for the first year will center on a study of basic number theory. This topic is a rich source of interesting mathematics. It builds on a student's understanding of the integers and the arithmetic operations which are studied in elementary school. The course for Summer, 1988, will cover primes and prime factorization, congruence and the algebra of congruence classes, additive and multiplicative functions on the integers, and the basic properties of rational numbers. The number theory course will be supplemented with an introduction to the use of computers in which applications of computers to the theory of numbers will be explored.

STRUCTURE: Monday-Friday 9:30 AM - 10:30 AM. Basic Number Theory course. These lectures will present the material outlined above. Student participation will be an essential component.

Monday-Friday 11:00 AM - 12:00 Noon. Problem solving seminars. For the problem solving seminars, the students will be divided into five groups, each group having a seminar leader who is an undergraduate mathematics major at the University of Chicago. In these seminars, the students will be encouraged to present their solutions to homework problems and to discuss the ideas underlying the lectures.

Monday, Wednesday 1:30 PM - 2:30 PM. Computer activities.

Tuesday, Thursday 1:30 PM - 2:30 PM. Lecture Series. During this time period, scientists from fields other than mathematics will be invited to discuss activities in their area of research with the students in the program.

STAFF: The Director of the program will be Professor Paul Sally of the Mathematics Department of the University of Chicago. Professor Sally has had extensive experience working with mathematically talented students at all levels.

The Lecturer for the basic number theory course will be Dr. Diane Herrmann, Associate Director of Undergraduate Studies in the Mathematics Department of the University of Chicago. Dr. Herrmann has more than ten years experience teaching at different levels. She is a specialist in the theory of finite groups, an area which is directly related to basic number theory.

There will be five Seminar Leaders selected from the top undergraduate mathematics majors at the University of Chicago.

The Counselors for computer science instruction will be selected from the advanced graduate students in the Department of Mathematics who have a thorough working knowledge of computers.

REPORT ON THE SUMMER PROGRAM IN MATHEMATICS FOR ENTERING MINORITY STUDENTS

Since 1985, the Department of Mathematics has participated in the Summer Program for Entering Minority Students. Initially, we taught a series of topics which reviewed material from high school mathematics courses. It soon became apparent that this approach was unsuitable since many of the students in the Program had already studied some calculus at the high school level. For the past two summers, we have developed a curriculum based on the book, How to Read and Do Proofs, by Daniel Solow. In the present course, the students learn to think about and do mathematics in a general context. Topics from precalculus are included as specific examples, thus providing the necessary review in an innovative setting. The approach in the course is not content-specific and, hence, can be used effectively with the entire group of students despite the great diversity in their backgrounds which range from elementary algebra through calculus. Our goal is to prepare the students to do serious mathematics at the college level. We do not try to prepare them for advanced courses in mathematics, but only to provide the tools to enter the College mathematics program at a level suitable to their talents.

For the past four years, we have been fortunate to have Diana Watson as the Instructor in the Summer Program. Ms. Watson was an undergraduate mathematics major in the College, and she is now a graduate student in mathematics at the University of Michigan. It appears that Ms. Watson will not be available for Summer, 1989, and we would expect to staff the Program with one of our own graduate students from the Department of Mathematics. This student will have been trained in our College Fellow Program, will have served as a Lecturer in the College, and will be chosen carefully as one who will be sensitive to the special needs of the students in the Summer Program.

To staff the Program properly, we need timely commitments from the College.

1. Before the beginning of Spring quarter, 1989, we need a firm commitment that the Program will run in Summer, 1989.

2. We must offer a stipend which is equal to that offered as summer support to graduate students by the Department of Mathematics. For Summer, 1989, this stipend will be $2900.

Unless these commitments are made, we will find it very difficult to staff the Program for Summer, 1989.

University of Chicago - Loop College Partnership

Statement of Proposal

This proposal requests support for a pilot program that will link the University of Chicago and Loop College, an institution within the Chicago City College System. Through this partnership, small groups of Loop College students will become part of a special academic achievement program at Loop College and tutorial activities at the University of Chicago that will offer an enhanced educational experience. Its goal will be the eventual transfer of these students to and graduation from selective, four-year colleges. It will build upon the very successful program for minority high school student advancement conducted for the last seventeen years by the University's Office of Special Programs. It is an expectation of this proposed program that a few of these Partnership students will gain admission to the College of the University of Chicago. A second, major goal of this program is to work out the curricular issues that will precede a sustained relationship between the City College System and senior, four-year institutions like the University of Chicago. We will aim to determine the nature and level of support necessary to enable the best of the young people who enroll in the City College System to transfer successfully to selective four-year institutions and complete the baccalaureate degree. Finally, a third goal of this program will be to initiate a change in the perceptions of the city's minority communities of what can be achieved by young people in the City College system. We want to restore the view that the Chicago City Colleges can lead ultimately to graduation from selective senior institutions.

Background

The Chicago City College System, especially several of its campuses, has been historically the path to higher education for minority students in the metropolitan area. In The Chicago Study of Access and Choice in Higher Education, issued in the fall of 1984, Professor Gary Orfield and his group from the University of Chicago described the situation existing for Chicago-area minority students in regard to post-secondary educational alternatives. "The fundamental educational problem is that minority students in the Chicago-area are strongly channeled into community colleges that have weak retention and transfer records." Thus, once they enter a program at these so-called "minority community colleges," the outlook is poor. "Few students in minority community colleges transfer anywhere. Those who do transfer to B.A.-granting institutions tend to go very disproportionately to the least selective institutions in the metropolitan area."

College prospects for the best students in Chicago's minority high school population are further complicated by the fact that, though at the top of their classes and having earned high grades, they generally do not do well on the ACT and SAT tests. They have not gained sufficient proficiency in the basic skills of textual analysis, writing and mathematics to be admitted to the strongest four-year institutions. The City College system often may be their only chance to advance toward the B.A.

Orfield and his group also found that minority access to higher education in the Chicago metropolitan area has declined over the period of the late 70s and early 80s. During a time when the minority college age population has grown the fastest, the number of baccalaureate degrees earned by Blacks has declined. A pattern of decreasing minority representation has developed in institutions of higher education.

Since 1968, the University's Office of Special Programs has endeavored to encourage and prepare educationally disadvantaged but academically able Black students to succeed in high school and gain admission to, and graduate from, institutions of higher education. Relying on the cooperative efforts and resources of local high schools and various units of the University, Special Programs identifies and selects students from low income families who have potential for pursuing a college education, and then reaches them directly through counseling and guidance; academic classes and tutorial services, cultural, social and recreational enrichment; and testing services. Several hundred students participate in these activities each year. A significant number of the minority students admitted to the College of the University of Chicago in recent years has come from Special Programs. As a result of these years of experience, the Office of Special Programs has gained considerable knowledge about what techniques and support service are effective in advancing the college aspirations of Black high school students. This experience will be invaluable for the Partnership Program.

The University of Chicago-Loop College Partnership project will open a channel to enable the best minority City College students to compete successfully for admission to selective, four-year colleges. We will use the successful techniques developed within the University of Chicago's writing program, the textual analysis skills that form the heart of the University of Chicago's College Common Core experience, and the basic mathematics skills imparted through the College's pre-calculus program, to develop a comprehensive curricular support plan that will serve as a model for how a major university and a primarily minority community college can produce successful transfer between institutions.

Loop College was founded in 1962 and is located in the center of

Chicago's downtown area. Its student body of about 8,000 is between 60 percent and 70 percent minority. Its curricular emphases are business, data processing, accounting, and the liberal arts and sciences. Dr. Bernice Miller, President of Loop College, and members of its faculty and staff have participated enthusiastically in preliminary discussions about the Partnership proposal.

The University of Chicago is a major teaching and research university which has a college of approximately 3,000 students. In the fall of 1985, 2.8 percent of its undergraduate student body was Black. Very few City College students have transferred to the University's College in recent years, with one such transfer in each of the last two years.

Outline of Partnership Activities

Identification of the Partnership students should take place during their senior year in high school, before matriculation into Loop College; but could occur during the first semester at Loop. They will be selected by a group consisting of Loop College and University of Chicago faculty, and staff from the University's Office of Special Programs. Those selected will be those showing potential for successful academic work at a senior, four-year institution, but with some deficiencies in reading, writing and mathematics skills, i.e., low ACT or SAT scores but high high school grades. They could also be students with sufficient skills to compete successfully in four-year institutions, but who lack the confidence or financial resources to matriculate immediately after graduating from high school.

Two groups of about twenty students each will be formed. They will begin work in the Partnership Program in two consecutive years. First, they will engage in a dual program of academic work toward an A.A. degree at Loop

College and intensive tutorial activities at the University of Chicago. Upon completion of their two-year City College degree, or earlier if possible, it is the goal of this program that they will be ready for admission to senior four-year institutions, including the University of Chicago, where it is expected that they will need to work another two and two-thirds years to complete their baccalaureate. Thus, we anticipate conducting this as a pilot program that will see two groups of students complete a series of activities during a total of about six years.

Summer I

For those provisionally accepted into the program while in their senior year in high school, they will begin, upon graduation from high school in June, an eight week probationary program at the University of Chicago campus and at Loop College. They will be entering the latter institution in the fall. Two or three Loop College faculty who will be working with these students during the next two years in mathematics, the humanities and the social sciences will be invited to join the Partnership Program. Our preference would be to involve Loop faculty who are alumni of the University of Chicago, especially its College, and who would therefore be familiar with the Common Core curriculum which is the central feature of the College's academic program. They would team with University graduate students, under the supervision of University faculty, and staff of the University's Office of Special Programs in order to provide classes that would introduce the work that these Partnership students will be expected to do in the fall at Loop College. The emphasis will be on techniques in analytical reading, writing, and mathematics skills. A University tutor will be assigned to each of the classes to work with the Partnership students as they participate in these

special introductory classes. The Partnership students will begin receiving an introduction to the University campus and its facilities and have some contact with University faculty in luncheon discussions. Visits to Loop College will provide an introduction to its facilities. While at the University, there will be opportunities for the Loop College faculty to become more familiar with the Common Core of the College of the University of Chicago through special presentations by and discussions with University faculty. The Partnership students will receive weekly stipends based upon the minimum wage and a forty hour week. In addition to their academic work, they will serve as tutors themselves in the National Youth Sports Program administered by the Office of Special Programs for minority youngsters aged ten to sixteen. This coupling of their own academic enrichment work and service as tutors to elementary and high school youngsters will be a pattern continued throughout the years of the Partnership Program. We see this as demonstrating the importance of returning to their communities some of the investment being made in their futures. Finally, another key aspect of the program that will be continued throughout will be opportunities for cultural enrichment, organized by the University's Office of Special Programs, involving a series of visits to concerts, operas, dance performances, lectures, visits to restaurants, etc.

Academic Year I

For those partnership students identified in their senior year of high school, a special academic program will be provided immediately at Loop College in which they will be grouped together. We will identify other students at Loop College during the first semester and move them into the special academic group as soon as possible. Ultimately, twenty students will form this group. We anticipate that the Loop College faculty involved in the

Partnership program will be the key instructors in the special academic program. Beginning toward the end of the first semester at Loop College and continuing for sixteen weeks, this group of special academic achievement students will come to the University of Chicago campus two afternoons each week to engage in three, fifty minute tutorials each of those days. We will design these classes to enhance academic skills in three basic areas:

Expository Writing:	These sessions will review the mechanics and structure of clear, intelligible writing.
Mathematics:	These sessions will include instruction in elementary algebra, geometry and functions. Students will develop skills for the command of fundamental mathematics.
Analytical Reading:	These sessions will carry students through basic understanding of textual readings and investigation. Students will augment their readings with discussion of selected literature.

The classes will be taught by University of Chicago graduate students under the guidance of University faculty. We will make available University of Chicago student tutors to assist the Loop students with their work in the Partnership Program. The University's Office of Special Programs will provide administrative direction for the Partnership as well as extensive counseling to help these young people with the adjustment to the extra demands of the

program. The Office of Special Programs will maintain contact with the parents of the students through regular monthly meetings at the University. The cultural enrichment experiences, mentioned earlier, will continue. On Saturdays, the participants will work for the Office of Special Programs as tutors themselves in that office's Open Tutorial program for high school students from the city's south side. The partnership participants will be paid a transportation allowance and a stipend for their Saturday tutoring activities.

Second Summer

For those students who were identified for the Partnership program during their senior year in high school (it would be the first summer for those identified later), the summer after their first year in Loop College will consist of eight weeks spent at the University of Chicago campus in three major activities. First, they will continue their intensive academic work each morning in the three key skill areas--reading, writing and mathematics--under the instructorship of Loop College faculty, and graduate students from the University under the supervision of University faculty. Second, during the afternoons, these twenty partnership participants will sit in on Common Core courses offered by the College of the University of Chicago in order to gain an understanding of the expectations set for students at the University. Third, the partnership participants will serve once again as tutors for the academic classes conducted for south side upper elementary and high school students by the Office of Special Programs at the University. They will be paid a weekly stipend, consisting of the Federal minimum wage for a forty-hour week during each of the eight weeks. Finally, the summer academic experience will be augumented by luncheons with University faculty,

cultural enrichment activities, regular counseling meetings, both on a group and individual basis, and occasions for parent involvement consisting of monthly meetings and chaperoning activities. The coordination of these efforts will be the responsibility of the staff of the Office of Special Programs.

At the same time, during that summer, the formation of a second group of Partnership students will have been begun, recruited from the best students to be found at inner city high schools who are planning to begin post high school academic work in the Chicago City College system in the fall. They will have a summer experience at the University of Chicago similar to that offered the first group of Partnership students recruited for the previous summer.

Academic Year II

This year's activities for the partnership students in the first cycle will mirror their first year's experience. They will be kept together at Loop College as a group and come to the University two afternoons a week for their academic tutoring in the three central skill areas. On Saturdays, they will work as tutors in the Office of Special Programs' Open Tutorial Program for minority high school students from the city's south and west sides. The counseling and cultural enrichment activities will also continue.

We hope to have the continued participation of the same Loop College faculty. We will have arranged for them to becomed familiar with the academic expectations of the College of the University of Chicago and thus become able to assess what the Partnership students will need to make a successful transfer. Whether that transfer will be to the University of Chicago or to another four-year institution will be determined by their ability to meet the standards for University admission of the institution to which they have applied.

For the twenty new Partnership students in the second cycle, this year will be their first in the intensive, academic year tutorial work at the University of Chicago. They will engage in a similar, but separate sixteen-week experience of two days per week at the University in three fifty minute classes in the primary skill areas already defined.

Third Summer

During this last period before transferring to a four-year institution, the partnership students of the first cycle who seem most likely to be able to transfer to the University of Chicago will enroll in one or more Common Core courses offered by the College. As they work alongside regularly admitted University of Chicago students, they will have the support of University tutors and the staff of the Office of Special Programs. This academic work will be augmented by introductory experiences with the major facilities and offices of the University, including its Library, the College Advisors staff, the Student Health Center, and other support services provided by the University for its students. Counseling and cultural enrichment activities will continue. Depending upon how well they achieve, these students will gain University credit for this work.

For those Partnership students expected to attend other four-year institutions, this third summer will provide an optional continuation of the tutorials in the three skill areas emphasized throughout the program. These will be taught by University of Chicago graduate students and coordinated by OSP. It is expected that most, if not all, of the Partnership participants will gain admission to selective four-year institutions. Admission to the College of the University of Chicago will depend upon the Partnership students' ability to meet the standards of admission required of any transfer student applicant.

The second cycle of Partnership students will be engaged during this summer in the series of activities outlined previously in the section entitled "Second Summer."

Transfer to the College

As we have indicated, we expect that several of the Partnership students will transfer to the College of the University of Chicago. We anticipate that most, if not all, of the credits earned at Loop College will be accepted by the College. In addition, we expect that most of these students will need to work another eight quarters (three per academic year) in order to attain their baccalaureate degree. Financial support for tuition and expenses to the extent accorded students with the greatest financial need will be necessary. Academic support will be available through the extensive opportunities for tutoring provided for undergraduates at the University. Personal counseling and follow-up will be provided by the staff of the Office of Special Programs, as well as the College advisers staff, through the Office of the Dean of Students in the College.

The second cycle of Partnership students will complete their second year at Loop College and at the University in the tutorial classes. They will then engage in a summer program similar to that provided the first cycle students before they matriculate into senior college. We anticipate the same number of tranfers from the second cycle of the Partnership Program to the University's College, approximately four students. Financial support for these students, while they are completing their baccalaureate work in the College, is included in the budget attached to this proposal.

Evaluation

The ultimate measure of the success of the Partnership program will be

the numbers of Partnership students gaining baccalaureate degrees from selective four-year colleges. As the students in both cycles of the Partnership program advance through their combined academic and tutorial programs, the University's Office of Special Programs will be assessing the student's attitudes and rates of progress, as well as providing special personal and academic support on an individual basis where required. The Partnership program will also help the students learn how to prepare most effectively for the SAT and ACT examinations--two important determiners in the transfer process. We will arrange repeated test-taking experiences followed by counseling sessions to help the students improve their performance on these tests. Student files will include attitudinal surveys, a record of grades, test results and any significant anecdotal information, together with the results of their application for transfer to four year institutions. We will also record the progress toward the BA of students transferring to institutions other than the University of Chicago. At the end of each year of the Program, the coordinator will use these files to develop an evaluative report.

Professional Development Program

The Mathematics Workshop: A Description

Rose Asera, Ph.D.
March 2, 1988

PROFESSIONAL DEVELOPMENT PROGRAM
The Mathematics Workshop: A Description

In 1974 the Special Scholarship Committee of the University of California Academic Senate, Berkeley Division, created the Professional Development Program (PDP) with a mandate to address the severe underrepresentation of minorities and women in mathematics-related professions. In 1978, after a period of basic research on the problems encountered by minority students in University of California math courses, PDP initiated a novel intervention project, the Mathematics Workshop Program. This project challenges many of the traditional assumptions for assisting minority students at institutions of higher education (Treisman, 1985).

In brief, the project operates an honors program, in contrast to most minority programs which are remedial in character. Students are provided with a setting, rich in mathematical expertise. In the workshop environment, students work individually and collaboratively on difficult mathematical problems. Many otherwise distinct services such as counseling, advising, and personal support are provided within this academic environment.

The workshop program has had a dramatic, positive effect on both the mathematics performance and the graduation rate of participating students (Fullilove, 1986; Treisman, 1985; Culler, 1982). The following description is of minority students who are doing very well in their academic course work. The reader should note, however, that these students are very similar both in background and in prior academic achievement to minority students in the past who routinely failed these same classes (Treisman, 1985).

The program has recently received national recognition for its accomplishments; the recognition has brought considerable attention to the program's innovations and efficacy. This document presents a narrative description of the educational setting and the day-to-day process of the undergraduate math workshop. The descriptions and conclusions are based on an observational study done by an educator, commissioned by PDP. This is not intended as an evaluation, nor as a technical research project, but rather as a critical observer's report written for those with an interest in developing programs in a similar spirit. This report provides the vicarious experience and impressions which an informed observer might have visiting the workshop for about a week.

THE WORKSHOP

The PDP workshop takes place in a large, sprawling room. Three long tables laid out in a U shape fill the room's center. Freestanding chalkboards amble across the front of the room. Along the west side, an area has been partitioned into a computer lab open for student use all day and evening. A portion of the east side of the room is sectioned off by file cabinets and portable walls to provide an office for the student affairs advisor. People move through frequently: some students coming to use the computers, others stopping by to chat in the office, and workshop participants coming to study at the long tables. Students know that this space is provided for them, and that resources will be available if help is needed.

• • •

> At 2:50 four students sit at the tables: two have been there for an hour, working together on homework; two others work alone. For the next twenty minutes, students continue to drift into the room. Conversations move back and forth: upcoming tests, homework problems, baseball scores. Students greet each other as they sit down, organizing their pencils, papers, erasers, calculators and books. They take some time in conversation as they settle down. One student goes to the worksheet file and pulls out the solution sheet for the last worksheet; she begins reading it on the way back to her chair. By 3:10 there are twelve students distributed around the tables.

• • •

Describing the students who come to PDP is not simple. Their style of clothes is typical of the wave of fashion currently moving across college campuses. Most of the students are dressed in jeans or an occasional denim mini-skirt, oversized tee shirts or sweatshirts, and name-brand running shoes. A studied, somewhat expensive casualness marks the clothing, but those are only the trimmings. The students themselves vary. Skin color runs from pale to dark, hair from light and straight to dark cascades of braids. To the observer some are obviously "people of color" while others are not. The group is, in fact, interracial. Although predominantly minority students, the group also includes women of all races, students who have gone through PDP high school programs, and some White and Asian students invited by friends to join the workshop.

Status as a minority is self-designated on university applications forms. Being "minority" is a shared quality, but not a shared experience. There is a diversity of personal ethnic awareness. While some students grew up in ethnic communities, with language, culture, and tradition around them, others lived in acculturated settings and interacted socially with the majority population. Among students of Hispanic background, some spoke Spanish before English, while others plan to learn Spanish in college.

The family and educational backgrounds are equally diverse. Over the ten years that the PDP undergraduate program has been in existence, the backgrounds of the participating students have changed somewhat. Early in the program, a large percentage of the students came from inner city settings. Currently a larger proportion come from middle class communities. Many of the present students have grown up in families that are economically and socially middle class, but this generation is the first in their family to attend college.

While there is no typical workshop student, the following four stories are representative of the range of experiences that students bring with them.

> Daniel is a young Black man who grew up in Los Angeles. His mother taught elementary school classes at very good academic public schools in economically upper class areas. She enrolled her sons in the school where she was teaching. On the way to school each morning in the car, his mother made games of the multiplication tables and Daniel grew up with a sense of math being fun. That enjoyment continued through junior high and high school. He was in top math classes through graduation from Beverly Hills High School. Daniel's older brother also attended UC Berkeley, and was a PDP workshop participant. Daniel still enjoys discussing math with his step-father, a math professor.
>
> Felipé was the only child in his immediate family, though part of a very large extended Hispanic family. Of the approximately sixty cousins in the nearby area, Felipé saw at least twenty-five on a daily basis. Of the ten or twelve older than him, none have finished high school. That made him want to be the first of his generation to attend college. Felipé always did well in school, especially in English and math. One of his uncles, a construction worker, loved to play with him on math problems. Since junior high Felipé has known that he wants to be an electrical engineer. He has always been curious about electricity, and enjoys finding what makes mechanical things work.
>
> Linda and Victoria share the experience of growing up in supportive families that encouraged them to do well, without pressuring them.
>
> Linda's mother is Mexican, and her father is White, both had some college background. Her mother attended a few years of junior college, and now works in an office. After her parents divorced when she was in third grade, Linda and her older brother lived with their mother. Her mother provided a supportive model: homework had to be done before television, but the accent was on learning, not just on grades. Linda attended private parochial schools and did very well. Starting in eighth grade Linda was in advanced math classes and took calculus before coming to Berkeley. Calculus has been her first serious and stimulating mathematical challenge, in high school and now in college. She points to the excitement presented by her professors and the workshop leaders, realizing that there is more to math than has been presented to her in the past.
>
> Victoria describes herself as the first generation in her family to attend university. The only child of a single mother, she grew up in an extended family household composed of her mother, uncle and grandmother. Her mother has worked as a registered nurse and successfully supported her family, but wanted more

opportunities for her daughter. She didn't want Victoria to fall into the typical rut of single Black mothers. Victoria feels her family encouraged her natural instinct for learning; the message has been, 'Do what you want, we are behind you.' When she was invited to take accelerated classes in junior high school, her mother replied that it was Victoria's choice. Victoria decided to pursue the opportunity. As a result of advanced math classes, she took calculus in her senior year in a private class with a junior college teacher who loved math and teaching.

• • •

The ethnic diversity of students can be seen in the arrangement around the tables. At one side table a Hispanic woman, a young man whose blonde hair does not seem to reflect his Hispanic background, and an Asian woman sit together. At the table on the other side, a close group of two Black women and a White woman who live in the same dorm and study together outside the workshop, are joined by a Black man whose features show a mix of races. The group at the front table consists of a woman of mixed ethnic background which includes Native American and Chinese, a Hispanic woman, and a White man. At the desk in the back of the room, a Black man and Hispanic man who regularly study together sit with a local math teacher who is developing a high school adapation of PDP.

At 3:10, Charles, the workshop leader, comes into the large room. Moving around the tables, he distributes the new worksheet. For a short time, a silence falls in the center of the room; noises from the computer lab, the office, and two students who have been working with a chemistry tutor surround the central quiet.

PROBLEM 1. (See Appendix II for typical worksheets)

a. Show that $\sin x < x$ for $0 < x < \pi/2$. [Hint: Mean Value Theorem]
b. Show that $\tan x > x$ for $0 < x < \pi/2$.
c. Show that for small x, $\sin x \approx x \approx \tan x$.
d. Graph the functions x, $\sin x$, and $\tan x$ on $[0, \pi/6]$.

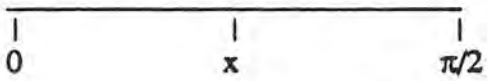
Charles and the workshop assistant, Matt, a Black third year Engineering major who has gone through the PDP workshops, walk around the tables, listening and ready to help if someone requests it.

The students look at the work sheet and begin to write. Slowly conversation picks up with questions. One woman turns to the student next to her: "How does the mean value theorem work here?"

Charles comes over and asks, "What do you think on number 1a? Any ideas?"

A student at the table responds, "Use the mean value theorem on the function sin x?" His voice makes it a statement with a slight question on the end.

"Okay," Charles continues, nodding. "Now how would you decide which interval to use?" Kneeling on a chair and sprawling across the table he indicates two intervals on the student's paper. The rest of the table joins in and watches as he begins a sketch of the problem using the left-hand interval, continuing to ask questions of the students.



Across the table a woman looks at him questioningly, "Couldn't you use the right-hand interval there?"

"You could try, but you should see what happens if you do." Charles continues on with the problem, drawing the information from the students. "To see if you understand this now, do problem 1b."

• • •

The workshop leader and assistant roles differ from the traditional role of teacher. They give up center stage and do not view their main task as dispenser of didactic information. Rather they are guides whose questions, promptings and insertions of information support the students' development and ownership of knowledge. This is not always an easy role to adopt. One workshop leader admitted that it was sometimes frustrating to have abandoned facets of traditional, formal teaching style which had been a past source of satisfaction for him. He could only do this because he saw the efficacy of the PDP model. Training for workshop leaders includes observation and, sometimes, volunteering, before leading a workshop.

One of the most difficult tasks of the workshop leader is design of each session's worksheet: finely tuning the problems to both pertinent class material and the threshold of students' current understanding of math. The problems must be challenging enough to hold interest, but not so impossibly hard that the students lose interest. The workshop leader also chooses when to draw the group together and give a short formal explanation. This is always done within the context of solving a specific problem.

Interactions between students and workshop leaders are friendly and teasing, more like the joking with a camp counselor than the customary formality between student and college professor. The style of feedback to the students may also take on a teasing tone. Feedback is always supportive, though sometimes challenging. False praise is never given. Minority students are especially sensitive to the underlying message when receiving inappropriate praise for a simple task.

• • •

At the table Charles has just left, the conversation stays animated as they review the problem. "Okay," a student says across the table, "that's that! Now explain it to me."

His partner begins to go through the steps, but is cut off in midsentence, "But that doesn't work right. The mean value theorem has an equality and we have to prove an inequality."

Two students from the front table supply the next piece of information, their words overlapping, "But you can get the inequality from the fact that cos x is always less than 1 in this interval."

The discussion is serious about the math but filled with laughing. One woman pounds on the table and points her finger across the table, "I let you talk me into that! It's only equal to 1 outside this interval." Matt comes up behind her grinning and mimics her pointing finger. The students dissect the problem until they arrive at a solution.

• • •

Originally the practice of group work was chosen in reaction to the impossibility of the workshop leader knowing every student's precise level of understanding the mathematics. In an environment with challenging problems and solid math expertise, the group process will tend to move all participants towards accepted math norms. Within the group, math knowledge becomes public; misconceptions surface and can be addressed. Even when a group of students agree on something that is incorrect for a time, the group process tends to be self-correcting.

The patterns of student interactions shift with the problems. Each student begins on the problem alone, going along to completion, or to a place where he or she has questions.

The interactions between two students take different forms. A student may check a completed problem or check the way the answer was arrived at with another student working on the same problem. One student may talk through the problem aloud, with a neighbor listening in. Two students may formally attack the problem together, taking different strategies to see which is effective. Other students know that they can join in on any of these interactions. Occasionally the leader will suggest two students work together.

When someone is stuck he or she may talk through the questions, or the person who has already arrived at the answer may go through step by step, explaining. Some of the students have absorbed the workshop model, and with promptings and queries lead the questioner toward the solution without providing it.

On the more challenging problems, the problem-solving group size expands to include the whole table, or two overlapping tables. Students from the other side of the room may also get up and join in. Often when the workshop leader or assistant goes through a problem, what follows is like a game of telephone, with the message carefully maintained. One student re-explains the steps, and the student who receives the explanation, in turn passes it on to the next student. In the act of articulating the information, responding to questions, and fitting the explanation to the next student's perceptions, the student's knowledge is strengthened.

• • •

While this is going on, students continue to enter the room, sit down at the tables and start on the worksheet or join existing conversations. By 3:25 there are seventeen students around the central "U". Many students sit in regular places, and work with the same partners, while a few circulate and sit wherever seats are available.

At 3:30 the students are heavily involved in the problems; unlike a lecture room, the noise level is high. Matt is at one side of the room, working with two students at the board. A different workshop leader walks through on his way to the computers and gets drawn into working with students.

Karyn, whose staff title is Student Affairs Officer, shorthand for the person who has the most daily, non-academic contact with the students, walks through, hollering to get attention. She announces a midterm review on Sunday at 1:00 to be followed by a softball game. "So bring your mitts," she reminds them.

• • •

Softball games and weekend reviews fit into the PDP philosophy that reaches beyond the math to be sure that students have social stimulation and support as well as academic challenges. Throughout the semester there are lunches or activities about once a month for the students to interact in a social setting.

These gatherings were initiated several years ago in response to one student's expression of a common need. A Black, middle class student found himself up against the walls of institutional racism and was feeling progressively isolated. He wondered if other students were experiencing the same feelings. Now the monthly get-togethers serve as an informal time for students to meet those in other workshops, other leaders, and older students. It is also a time for Karyn to check in with any of the students she has noted who are having some kind of difficulty, whether academic or emotional adjustment.

• • •

For a few minutes after Karyn's announcement, the conversations stay on the review and the upcoming midterm. Then it winds its way back to the math problems. At the front table, students discuss how to draw the graph for problem 2.

At 3:45 Charles hushes the group temporarily, "Everyone, pay attention to this for a minute." He works the first part of problem 2 on the board. Not all the students are on problem 2 at this time, some are not there yet, and some are ahead, but all pay attention.

PROBLEM 2:

We are given a differentiable, odd function f defined on $[-3, 3]$ which has zeros at $x = -2, 0, \& 2$ (and nowhere else) and critical points at $x = -1, \& 1$ (and nowhere else). Also we know that $f(-1) = 1$. Define a new function F on $[-3, 3]$ by the formula

$$F(x) = \int_{-2}^{x} f(t)\, dt$$

a. Sketch a rough graph of f.
b. Find the value of $F(-2)$, $F(2)$, and an upper and lower bound on $F(0)$.
c. Find the critical points and inflection points of F on $[-3,3]$.
d. Sketch a rough graph of F on $[-3,3]$.
e. Interpret the points found in (c) in terms of the graphs of both f and F.

A woman sits at the side table talking through problem 2 while her friend listens. The first woman's face shows frustration and concentration. Her hand shoots up in the air for help. While she's waiting for assistance, she looks at the example on the board. The look on her face changes to excitement, "Oh, I'm wrong, I see it, never mind." Both arms shoot up in the air, hands in fists, exultant "All right, I got it! I don't believe it! Look at this."

• • •

The math problems are difficult by design. At a midsemester feedback session students were asked, "The worksheets are meant to be difficult. Are they?" Students responded with a roaring "Yes." The problems are designed this way for a number of reasons:

-The problems are designed to stimulate mathematical thinking. Mathematical problems in calculus, as it is taught at UC Berkeley, require the integration and application of mathematical concepts. Students who have done well in math through secondary school have most often done so by memorizing formulas and plugging in numbers. This strategy is no longer effective for calculus; Math 1A tests at a level of comprehension and application for which simple memorization will not suffice.

-The problems are challenging enough that students must cooperate to solve them. In the process it is necessary to ask questions. Questions are viewed as positive interactions with the material, not as indications of ignorance.

-It is also necessary to make the problems difficult so that the students who have taken calculus in high school, over 60% of workshop participants, do not coast through the material. Students who rest on their acquired knowledge and do not actively study in Math 1A run into great difficulty when the familiar material runs out in Math 1B.

• • •

Conversations weave in and out of the math problems. At most times the math predominates, though often two or three conversations are going on simultaneously. Questions are left hanging in the air, and answered at a later time. People switch from a math problem to the weather, or talk of a party and then go back to the math. The personal conversations may provide a break, an interlude while a math concept sinks in, or a short period of distraction. At a few minutes after 4:00, the distraction takes over. At one table the students talk animatedly about going home for the weekend, and the Eddie Murphy concert they plan to attend. The distraction lasts about ten minutes, and with no clear demarcation, the conversation shifts back to math.

• • •

The loose boundaries around noise and space are intentional. The workshop environment is meant to be similar to the students' residential environment so that study skills and group sharing are more likely to transfer back to that natural environment.

• • •

On the other side of the room, at 4:15, five students and the assistant are bent together over a problem. A student is going through how he arrived at the answer, "I'm still having trouble with substitution, so I did it my way." The rest of the table spontaneously breaks into the refrain from "I Did It My Way," with the student at the head of the table conducting. "Actually," another student comments, looking over the sheet, "for this problem, your way is better."

4:25: A woman at the front table waves her hand in the air, "Charles, oh Charles, this isn't working."

Charles looks up from the chalkboard where he is writing the answers to problems 1 and 2. He comes over, pulls up an empty chair and sits down next to her, "Okay, let's see what you've got here." Two students from the other table come over to watch.

PROBLEM 3:

a. If $\int_a^b f(x)\,dx = b^3 - a^3$ for all numbers a and b, what is $\int_a^b f'(x)\,dx$?

b. If $d/dx\left(\int_a^x f(t)\,dt\right) = x^3 - 1$, what is $\int_a^b f'(x)\,dx$?

c. If $\int_a^b f(u(x))\,u'(x)\,dx = (2/3)(b^2+1)^{3/2} - (2/3)(a^2+1)^{3/2}$ for all numbers a and b, what might f(x) and u(x) be? Are they unique?

• • •

Worksheets usually have six or seven problems. By this point in the workshop, some students are further along than problem 3, others are continuing to work with earlier problems. It is a rare yet major event when a student finishes a worksheet. A basic characteristic of the worksheet is its length; they are not homework assignments that must be completed. A long worksheet makes it possible to challenge even the brightest student. Solutions are available after the worksheet has been used; students can go over the problems at home and use them for test review.

• • •

> Throughout the workshop there has been no clock watching, no restless fidgeting. Students come to work on math, and they use the time well. A few leave early; at a few minutes before 5:00 most begin to pack up books and papers and leave. Right as the workshop is ending, a student asks the workshop leader a math question. Another workshop leader comes over, and the three stay an additional fifteen minutes, working together on the problem.

• • •

All problems –math, personal concerns, or program logistics– are met by the staff with equal attention. Students are as comfortable asking about how to find out a math prof's office hours or find housing as they are inquiring about math concepts. They know their concerns will be addressed, or they will be directed to an appropriate resource.

STUDENT PERCEPTIONS

The students feel strongly that the program is for them. It is perceived as challenging and supportive. In regard to the math the students say:

> -It's challenging to figure out the problems, and sometimes frustrating. When I first saw these problems, my jaw dropped, 'They want me to do this?' I thought we'd have to be geniuses to get it, but then I saw everyone struggling with it. The problems are tricky, and you really have to think about them. But when you figure out a problem, you feel SO good because you know it's hard.
>
> -I always got through on memorizing and plugging in. It was just mechanical: plug into a formula, crank it out. Here they teach you how to think, to learn why you do what you do, not just what to do. Somewhere around the end of my senior year in high school I started realizing the importance of knowing why something goes on. Now if I don't know why, I don't want to do it without understanding.
>
> -I like that people don't just tell me the answer, and don't just tell me what to do. They ask me, 'What do you think you should do?' If I have it right they encourage me, if I have it wrong they explain it.

-It really helps on the tests. The test problems are more like the workshop problems than they are like the homework. I felt really good on the last midterm, for two of the problems I'd seen similar type problems and I knew how to solve them.

-The workshop helps me spend more time on math than I might on my own. It especially helps to spend time on subjects that I wouldn't otherwise. For the last midterm, my weakest area was min-max problems, but I couldn't make myself go over them. I knew when I came to reviews that we'd go over min-max in workshop.

• • •

In regard to the group process and the environment students comment:

-College classes are so formal. It's so intimidating in large classes; here you can just be yourself. Here it's personal; you only share the workshop leader with a small group. He knows you by name, and sits down next to you and works with you.

-I really like that it's not competitive here. I've been competitive all through school, even with my friends. I didn't really like it, but it was always there. Here I don't have to be competitive.

-In other places it's not okay to ask questions, it means you're dumb. Here you don't feel bad if you ask questions, it's okay not to know. I feel like I can ask any question here.

-It's more fun to work with a group. It's easier when you're not just on your own. Others see things that you'd never see on your own.

-This is a warm, friendly place to come. All the people here know you, care about you. They really want to talk to you.

• • •

The students are just as articulate about difficulties and frustrations:

-The worksheet is aimed at the section that most students are enrolled in. For students who have a different professor, and are in a different place in the curriculum, the worksheet problems can be too far ahead or behind.

-The workshop puts too much attention on grades. They give us this line about how this workshop will help us get A's, or how one year everyone in the workshop got A's. They don't really pressure us to get good grades. I guess they use it as a way to get people to come, but I think it's overdone. It seems unrealistic. I know people in here who didn't pass the first midterm, and they shouldn't make them feel bad.

-I spend about 60% of the time feeling frustrated in workshop. The problems seem too hard, and I NEVER finish them here. I mean to do them at home, but I rarely do. Sometimes I feel so stupid when there's an easy problem and I can't see it.

-I didn't have calculus in high school, and I feel lost a lot of the time. Everyone else seems to know what's going on. The class is taught as if everyone knows the basics. They tell us that statistics show that students without a calculus background do as well in the long run, but I've spent a whole semester feeling lost and behind.

• • •

CONCLUSIONS

The PDP math workshop challenges traditional approaches to minority programs in higher education. Several central characteristics of the project are delineated below:

1) PDP is a faculty-initiated and maintained effort. It is regarded as a serious academic endeavor, and workshops are run by mathematically competent people. The focus is on readying talented students for graduate school, preparing future scholars.

2) The math program is not remedial. The assigned problems are challenging: those which separate 'A' students from 'B' students. Expectations are high and tasks are difficult. The program focuses on student strengths, not weaknesses. When gaps in a student's background become apparent, they are addressed within the context of difficult problems.

3) The program is relentlessly demanding of student presence, participation and hard work. Students attend two two-hour workshops per week. In addition, students are instructed to stay ahead of class lectures, and come to workshops with homework completed. However, the students are also warned against overload. Although they have taken five "solid" subjects in high school, and expect a similar schedule in college, they are advised to take only three classes along with the PDP workshop.

4) The workshop provides an academically-focused community for participants. Students are immersed in a setting rich in mathematical expertise and personal resources: an environment which is simultaneously challenging and supportive. Students have the opportunity to work individually or collaboratively with peers and faculty.

   The community extends beyond the workshop boundaries. Students encounter personal and social contacts which help break down the sense of isolation which minority students often feel at the university, without diminishing the self-reliance which originally enabled them to come

The PDP workshop program has effectively demonstrated that with high standards, serious academics, and a supportive environment, minority students can and do excel in mathematics and mathematics-related disciplines.

BIBLIOGRAPHY

Culler, K., "Helping Minority Students to Excel in University-level Mathematics and Science Courses--The Professional Development Program at the University of California, Berkeley" Prepared for the United States Department of Education, National Commission of Excellence in Education, 1982.

Fullilove, R.E., "Sealing the Leaks in the Pipeline: Improving the Performance and Persistence of Minority Students in College" University of California, Berkeley, 1986.

Treisman, U. A Study of the Mathematics Performance of Black Students at the University of California, Berkeley (doctoral dissertation), University of California, Berkeley, 1985.

"The Professional Development Program's Mathematics Workshop, an Update on the Performance of Black Participants" Professional Development Program, University of California, Berkeley, 1986

APPENDIX I: NOTES ON THE OBSERVATION

Rose Asera, Ph.D.

The background I brought to this observation was in social, multicultural foundations of education, not mathematics. I brought an eye trained in naturalistic research to watch the social interactions and the process of learning in the workshop.

The observations took place during the 1987-1988 academic year. The timing in the semester proved relevant because the level of student independence in the workshop develops over the period of the semester. Workshops earlier in the semester are more structured and directed until students become accustomed to working on their own and in groups with a workshop leader present as a resource.

I observed workshops with different leaders. The workshop leader presented in the narrative description is a composite character. This was done based on the observation that different personality styles (introverted and extroverted) could be effective in the workshop leader role.

Non-scheduled time in the workshop space and social activities were also observed. Interviews were held with six staff members, four former students who are workshop assistants, three former students who frequent PDP and fifteen current freshmen (25% of enrolled students) in the workshop. Interviews were unstructured and lasted from a half hour to two hours.

The observation focused on the PDP program. I attended one large Math 1A lecture (500 students) but did not study other non-PDP students or other university math programs. Upper division students interviewed were those with a strong bond to PDP who continue to use the space as a study site and a source of social contact. Former students no longer in close communication with the program were not pursued.

As an observer, I found congruence between the program's stated intentions, staff perceptions, student perceptions, and my observations as an outsider.

APPENDIX II: WORKSHEETS NUMBER 20 AND 21

PDP Math 1A WS#20 Fall 1987

1. Find the following antiderivatives.
   a) $\int x\,(1-x^2)^{1/2}\,dx$ b) $\int x^2\,(1-x)^{1/2}\,dx$ c) $\int x^3\,(1-x^2)^{1/2}\,dx$

2. We are given a differentiable, odd function f defined on $[-3, 3]$ which has zeros at $x = -2, 0, \& 2$ (and nowhere else) and critical points at $x = -1, \& 1$ (and nowhere else). Also we know that $f(-1) = 1$. Define a new function F on $[-3, 3]$ by the formula

$$F(x) = \int_{-2}^{x} f(t)\,dt$$

   a) Sketch a rough graph of f.
   b) Find the value of $F(-2)$, $F(2)$, and an upper and lower bound on $F(0)$.
   c) Find the critical points and inflection points of F on $[-3,3]$.
   d) Sketch a rough graph of F on $[-3,3]$.
   e) Interpret the points found in (c) in terms of the graphs of both f and F.

3a) If $\int_a^b f(x)\,dx = b^3 - a^3$ for all numbers a and b, what is $\int_a^b f'(x)\,dx$?

b) If $d/dx\left(\int_a^x f(t)\,dt\right) = x^3 - 1$, what is $\int_a^b f'(x)\,dx$?

c) If $\int_a^b f(u(x))\,u'(x)\,dx = (2/3)(b^2+1)^{3/2} - (2/3)(a^2+1)^{3/2}$ for all numbers a and b, what might $f(x)$ and $u(x)$ be? Are they unique?

4a) Consider the points on the graph of $y = x^2$ whose y coordinates are y_0. How far are these points from the y-axis?

b) Find the area bounded by $y = x^2$ and the line $y = 1$ by integrating along the y-axis.

c) Find the area of the triangle formed by the line $y = -2x + 4$ and the x- and y- axes in two ways: first integrate along the x-axis and then along the y-axis.

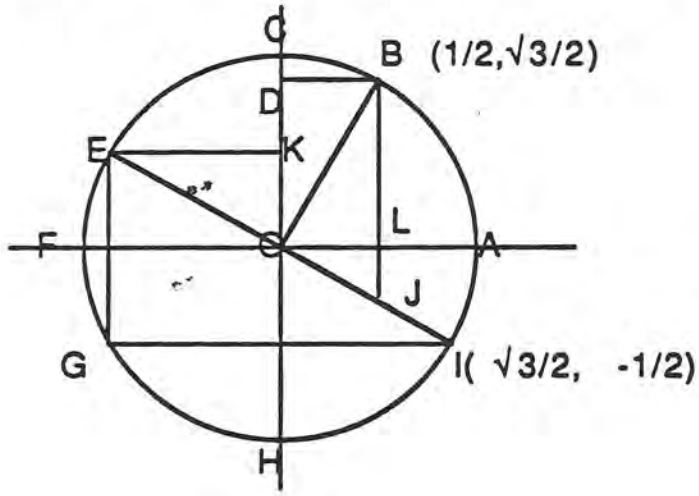
d) Find the area bounded by the parabola $y^2 = 4x$ and the line $y = 2x-4$ in two ways: first integrate along the x-axis and then along the y-axis. Which method is easier?

5. Find formulas for the values of these definite integrals, where a, b, c, and d are constants. Do any restrictions apply?

a) $\int_a^b (cx + d)^n \, dx$

b) $\int_a^b x\,(cx^2 + d)^n \, dx$

6. Consider the unit circle sketched below. Write as a definite integral (or sum or difference of integrals) the areas of the regions listed to the right of the figure. **DO NOT EVALUATE THE INTEGRALS**



(i) half-cap ABL
(ii) half-cap BCD
(iii) wedge COE
(iv) triangle EGI
(v) triangle BOJ
(vi) cap GHI
(vii) region EFGHO
(viii) region BLJIA

1. a) Show that $\sin x < x$ for $0 < x < \pi/2$. [Hint: Mean Value Theorem]
   b) Show that $\tan x > x$ for $0 < x < \pi/2$.
   c) Show that for small x, $\sin x \approx x \approx \tan x$.
   d) Graph the functions x, $\sin x$, and $\tan x$ on $[0, \pi/6]$.

2. Evaluate

   a) $\int \sin^2 x\, dx$ b) $\int \cos^2 x\, dx$ c) $\int \sec^2 x\, dx$

   d) $\int \tan^2 x\, dx$ e) $\int \sin^5 x\, dx$ f) $\int \sin^5 x \cos^5 x\, dx$

3. Graph the following functions, showing zeros, maxima, minima, and inflection points.

   a) $f(x) = \sin x + \cos x$ b) $f(x) = \sin x \cos x$

   c) $f(x) = \sin^2 x$ d) $f(x) = \sqrt{(\sin^2 x)}$

4a) Evaluate $\int_0^{2\pi} (1-\cos^2 x)^{1/2}\, dx$ (We hope you didn't get zero.)

b) Show that for any integer n, $\int_0^{\pi/2} \cos^2 nx\, dx$ is independent of n.

c) Let $f(x) = \int_0^x |\cos t|\, dt$, $\pi/2 \le x \le 3\pi/2$. Write f without using integrals.

5. Find an equation of a line through the point $(-3,2)$ making an angle of $\pi/4$ with the line $3x - 2y - 7 = 0$.

6. Find the area between $f(x) = \sin x$ and $g(x) = \sin^3 x$ on $[0,p]$.

7a) Find the equation of the tangent line to $\tan x + \cot y = 2$ at $(\pi/4,\pi/4)$.

b) Also try the equation $(2x\sin y)^2 - x + 2\sin y = 1$ at $(1,\pi/6)$.

8a) By inspection, find a solution of the equation $\tan x = x$.

b) Using your calculators, find to three decimal places a number x_0 on $(\pi, 3\pi/2)$ which is also a solution to $\tan x = x$.

c) Define the function $f(x) = \sin x/x$ at $x = 0$ so as to make f continuous, then sketch the graph of f on $[-2\pi,2\pi]$.

CHEMICAL & ENGINEERING
NEWS
Volume 65, Number 38
CENEAR 65 (38) 1-128
ISSN 0009-2347
SEPTEMBER 21, 1987

Precollege Science, Math Education Enhanced by Volunteers

Project involving use of volunteers to interact with junior high school students exceeds expectations in terms of participation, benefits

A pioneering effort to improve science education in inner city schools has just completed its first phase in Washington, D.C. The project involves the use of volunteer scientists, engineers, and mathematicians to interact with junior high school students and thus enhance their interest in science and math. So far, the program has met with unanimous enthusiasm and is being seen as a model for school systems around the country.

The program—"Scientists in the Classroom"—has been sponsored by the Federal City Council, an organization of business and civic leaders. Begun in the 1985-86 school year, it brings professional scientists, engineers, and mathematicians into school classrooms to work directly with students. In November, the council is relinquishing its management and financial support of the program, and the D.C. school system will take it over. About 170 volunteers are involved during the current academic year, 20% of them women.

By all accounts, the project has surpassed the modest expectations foreseen for it when it began, according to an evaluation just completed by Richard N. White of the Bureau of Social Science Research in Washington, D.C. Classroom achievement was not measured, but attitudes toward science and mathematics went up compared with a control group.

White's report concludes: "The number of professionals applying to become part of the project exceeded the expectations and preparations. Those who participate in the program wish to continue to participate. Teachers and principals view the project as beneficial and are willing to continue to apply for volunteers for their schools. Finally, there is evidence that working with a volunteer is enjoyable for students, that they feel they do perform better as a result of working with a volunteer, and that their attitudes become more positive about science and math coursework and careers."

Besides the evaluation, a report on the first two years has just been published by the council, entitled "Scientists in the Classroom." (The report can be purchased for $10 from the National School Volunteer Program, Suite 300, 701 North Fairfax St., Alexandria, Va. 22314.)

The project is the brainchild of Theodore D. Drury, who dreamed it up back in 1984 while on the public affairs staff at the National Science Foundation. Drury recalls observing how NSF support for science and math education had been waning over the years. But by 1983, NSF was prodded by Congress to reactivate support for the subject. A National Science Board commission was appointed to look into national needs in precollege science and math, and in its final report the Commission found them ailing badly and called for a renewed national effort to improve the situation.

Drury, who had been public affairs director for Volunteers In Service To America (VISTA) in the early 1960s, thought the volunteer concept could be applied effectively to science education. "I thought the idea was so simple," he recalls, "that

C&EN staff photo

Drury: volunteers were rolling in

it was probably going on in several places." But after a spot survey, he couldn't find a project like what he was planning, the recruiting of professionals from government, industry, and universities. Although some corporations would themselves provide volunteers, he says, there was nothing on the scale of recruiting from the entire reservoir of scientists in a single metropolitan area.

A natural place to start, he thought, was Washington, D.C.'s preponderantly black school system. Believing that success required the backing of Washington's power structure, Drury took the concept to the council. The council was willing to commit $118,000 and asked Drury if he would run it. Meanwhile, NSF gave him a leave of absence under the Intergovernmental Personnel Act, "a mechanism," as Drury describes it, "to send government people out as volunteers for one to four years."

Council science/math task force

chairman Thomas G. Pownall, who is also chairman of Martin Marietta, sent letters to 25 high-technology firms in the Washington metropolitan area asking for their support in launching the program. Other letters went out to various federal agencies and the area's colleges and universities. About 20 volunteers offered their services by spring 1985. "But by the next fall, the volunteers were rolling in," Drury recalls.

The first year was far from easy, however. Although the number of professionals volunteering was not a problem, teachers had difficulty knowing how to use them. Moreover, they were treated like ordinary lay volunteers, not the specialists they were. As a result, some dropped out of the program, lacking anything to do. The following summer, Drury organized a training institute and several workshops for teachers on how to use volunteers. "Science and math volunteers were a new thing," he explains. "We had to figure out how to use them."

One of the volunteers is Georgetown University neurochemist Joseph Neale, who puts in about one hour a month at Jefferson Junior High School. He was involved from the first year and is enthusiastic about the program. "Jefferson is really only an ordinary junior high school, not a special magnet school," he says, "so it's a good example of the kind of kids you get anywhere. What I found is that the students attend to what you're saying and they're excited that someone professional in the outside world has an interest in science and in them. They sense my commitment and it reinforces theirs.

"Moreover, volunteering isn't something that demands an inordinate amount of time. And you still have that impact on people. I don't care if anyone can prove to me that this population changes two or three percentage points on some index. It's clear to me that this will have some impact on their lives."

Neale worked with biology teacher Patty Spady. She says she has used volunteers in the past to give talks to the students or help with science projects. "I also use the volunteers to speak about what it's like to be professionals in terms of salaries, work hours, and the kind of work involved. It's not the kind of information students get in a book."

Spady says the benefit of having someone like Neale as a volunteer was the opportunity to motivate the students. "I've never gotten a really negative response from the students about the volunteers," she says. "They'll often say something like, 'He was really interested in me. He really wanted to hear what I wanted to say.' "

Spady says the presence of volunteers has no effect on the self-esteem of the teachers. The science teacher is still the one in charge. "I try to plan for the volunteer just as I would any other activity," she says. "I wouldn't ask volunteers to come unless I had something special for them to do. So it's no problem for me. Sometimes I'd like to have students hear something differently."

Adds David Merenda, executive director of the National School Volunteer Program in Alexandria, Va., "The role of the teacher as the sole imparter of knowledge is no longer valid. They are managing resources in the classroom, and volunteers are another one of those resources."

Merenda's organization, a nonprofit corporation, is in the business of introducing volunteer programs in school systems around the country and is preparing a how-to-do-it booklet on setting up volunteer programs for science and math in schools. It is also in the process of introducing a science/math volunteer program in the Salem, Ore., school system, modeled after the D.C. effort. It is being supported by a $148,000 grant from the U.S. Department of Education.

"We're excited about what Ted [Drury] has done," says Merenda. "He proved that it was possible to recruit this category of person and that they would in fact come forward and volunteer if they were asked."

Whether the idea will really mushroom around the country is anyone's guess. The science and engineering community is worried that interest in science and math among precollege students is continuing to decline. A series on Washington, D.C., high schools published in the *Washington Post* last week described how good scholastic performance was discouraged through ridicule by other students in the classroom. That is why Drury's program focused on the junior high level and below, where attitudes could be formed and solidified.

Where chemists fit into the picture is questionable. In D.C., fewer chemists offered their services than those of any other discipline. But voluntarism is beginning to become a part of American Chemical Society educational activities, at least as something desired. Sylvia A. Ware, director of ACS's Education Division, says implementation plans for the society's Chemistry in the Community curriculum call for "encouraging teachers to invite working scientists into the classroom to add their perspectives."

Wil Lepkowski, Washington

STRATEGIES FOR REDUCING THE NEED FOR MATHEMATICS REMEDIATION IN COLLEGE

by Anneli Lax and Lynne Ipina

The charge given to this Task Force was to make recommendations towards reducing the need for remediation in college. The Task Force must therefore specify how it interprets "remediation", consider a large spectrum of institutions included in the word "college", and focus its attention on the students, the "raison d'être" of all educational institutions. Moreover, the recommendations must be sufficiently flexible to address not only the different types of postsecondary institutions and their varieties of student populations, but they must also adapt to, perhaps even influence, changes in course offerings and changes in the backgrounds of student populations within each institution.

We recognize that the need for "remedial" mathematics in college is a symptom of a more pervasive problem in the mathematical education of not only college bound students, but of the population at large. It is being addressed by educational reformers nationwide, and an increasing number of members of the mathematical community in colleges of all kinds are becoming actively involved. Concerns for increasing the pool of mathematically trained people for the pipelines into scientific work and into the teaching profession and the need for a mathematically literate, non-alienated citizenry are making reformers aware of flaws in some earlier recommendations, such as barring underprepared students from college level courses by stiff college entrance requirements (which highschools cannot now meet) or mandating that entering students have taken 3 or 4 years of highschool mathematics (which ignores the quality of such instruction and the teacher shortage). Educators are breaking out of the pattern of "blaming" students' deficiencies on the instruction given at the previous level; instead they transcend the barriers in the level hierarchy. They find much common ground and their conversations help combat not only the isolation of the classroom, but also the fragmentation of curricula. Our recommendations on College-Highschool Articulation are based on the belief that the problem of underprepared college students will be with us for some time and will diminish gradually only with a serious commitment of the mathematical and educational communities to work responsibly on a broad front.

We believe, on the one hand, that "remedial" programs deemed "successful" are institution - dependent, student-dependent, often dependent even on the personalities of its administrators and instructors, hence not easily replicable; and on the other hand, that an effort should be made by all concerned to learn

as much as possible about strengths and pitfalls of existing programs as well as about trends indicated by ongoing implementations of currently recommended educational reforms affecting both, highschool and college curricula and instructional formats.

To this end, we recommend an inter-institutional network into which information can be fed by each institution (on specific programs) and by all professional societies (on relevant activities of their committees) leading into a national clearing house. The organization that seems best suited at this point to act as such a clearing house for data which can be accessed by all interested institutions might be the Mathematical Sciences Education Board (MSEB). Each institution should be encouraged to maintain an updated data base of information on its programs for underprepared students, and at least one person on its staff should be responsible for feeding the information into the national network.

Our recommendations fall into four not totally disjoint categories:

I Student Advisement and Placement

II Curricular and Instructional Concerns

III Organizational Support for Remedial Courses and Staff

IV College-Highschool Articulation and Prospective Teacher Preparation

Before spelling out the recommendations in each category, we need to say a few words to clarify what we include under "remedial" programs.

It is important to distinguish between two kinds of services to underprepared college students:

1. The goal is to have students acquire as quickly and efficiently as possible, a set of minimal skills deemed prerequisite for specific courses or career training.

2. The goal is to develop in students the habit of reasoning, of organizing and interpreting data, of formulating and solving problems, of learning to use computational and other tools in these contexts, so that they acquire the confidence and background needed for various options involving further mathematical work.

Courses of type 1 were born out of the urgency to serve large numbers of students, especially in big municipal and state public institutions. An efficient transition from highschool to college was the main aim. Many methods have been developed to address student differences and program cost effectiveness (e.g. self-paced learning, CAI, video enrichment, math labs, tutorials, etc.)

Recent recommendations (most notably CUPM 1983 and NCTM 1980 reports) urge the implementation of courses of type 2. The evolution of such courses has been slow and their evaluation is more complex than that of type 1 courses, because their goals are long term and difficult to quantify and measure.

Courses of type 2 are more commonly found in relatively small liberal arts colleges than in large institutions charged with the preparation of technical personnel, e.g. engineers. Thus programs of type 2 have enjoyed the luxury of running small classes and experimenting with less traditional curricula and instructional formats that take into account individual learning styles and interests of students. As such, they provide a fertile field also for incorporating advances from cognitive psychology, observing attitude changes and attending to other pedagogical and curricular issues of particular interest to prospective and in service teachers.

Most programs combine features of type 1 and type 2 courses.

Some institutions allow their students to enroll in regular freshmán mathematics classes and help them fill gaps in workshops or labs which are closely coordinated with the course in question and staffed by dedicated tutors. These parallel support systems have been more successful when participation by underprepared students was mandated than in cases where it was voluntary.

In all types of programs, the staff has found that students need a great deal of encouragement and support in order not to give up.

RECOMMENDATIONS

I. STUDENT ADVISEMENT AND PLACEMENT

Those working in the placement trenches know the arduous nature of the task of placement. It is hard to disappoint students with their poor placement results. Students who feel that they did "well" in highschool are frustrated and perplexed by poor placement results; students with poor academic records are not encouraged by yet another indication of failure. Students with strong backgrounds may resent being tested "unnecessarily", especially when no individualized advising accompanies the placement exam.
Evaluation should play a vital role in the placement process and the placement process should influence reforms of course offerings and curricula. Program evaluation should detect discrepancies between what is taught and mastered and what is expected of students enrolled in remedial courses. Placement advice relies on well coordinated course offerings, and a suitable placement exam must accurately identify deficiencies in student preparation and predict student readiness for various courses.

WE RECOMMEND:

(a) IMPLEMENTING A MANDATORY ADVISEMENT PROCEDURE AT EVERY COLLEGE.

We propose a two-step procedure which includes a mechanism for counselling undecided students and students with undeclared majors as well as students who are unhappy with their placement as tentatively determined by an exam score. The central advising instrument should be a placement exam, appropriate for the program in question.

Many colleges now use placement exams[1] and many more feel that exams should be used.[2,3,4] While a placement exam gives an objective idea of which courses a student is prepared to handle, one or two test items other than "multiple choice", i.e. requiring a thoughtful response in the form of a sentence or paragraph, would help assess a student's mathematical level. ACT and SAT scores may not be reliable predictors[5], and highschool grades may be too uniformly high to differentiate among students[6] but factors such as age, highschool rank[7] and desired college major[7A] may be helpful in placing students. If tutoring support is available in a math lab or CAI center students may be allowed to enroll in classes provisionally. Some research

indicates that both arithmetic and algebra skills can improve without formal instruction.[8,9]

Mechanisms which provide for one-on-one advising are not prevalent at colleges[10] and have not been widely described in recent literature; at least one college attributes considerable merit to this component of placement.[11] Program evaluation procedures that reflect program objectives would influence placement policy and would, in turn, be influenced by placement practices.

(b) IMPLEMENTING, AS PART OF THE ADVISING PROCESS, A MECHANISM FOR LONGITUDINAL STUDIES.

Longitudinal studies can be extremely useful for evaluating and modifying remedial programs.[12,13] Such studies serve to assess the efficacy of the placement procedure, its exam and the advice given. It should be a major part of program evaluation.

(c) THAT REMEDIATION DISCUSSIONS BE CONDUCTED ALONG COURSE CONTENT AND PHILOSOPHICAL LINES RATHER THAN ACCORDING TO COURSE TITLES.

Since "remedial" means different things to different people in different institutions[14], it is misleading to use designations such as "sophomore level" which presume a linear ordering of courses. Ranking courses by intellectual demands and content is a futile effort.[15] Descriptions of content and instructional format are more informative and stimulate more fruitful discussions.

(d) DEVELOPING A MINIMUM CHECKLIST OF DATA TO BE COMPILED BY INSTITUTIONS WITH REMEDIAL PROGRAMS. THESE DATA WOULD BE PERIODICALLY FED INTO A NATIONAL CLEARING HOUSE.

Some groups have demonstrated experience and expertise in the area of data collection and have already published at least limited surveys. Pertinent educational research reviews of college teaching[16] may also be helpful in the formulation of assessment items. Data collected and compiled in a standard format will facilitate reliable interpretation of data describing diverse programs.

(e) IMPLEMENTING A MECHANISM FOR SHARING PLACEMENT AND LONGITUDINAL STUDY RESULTS WITH HIGH SCHOOLS AND COLLEGES SERVING A COMMON STUDENT POPULATION.

Possibilities include early (prognostic) testing in highschools[17] and joint sponsorship of placement exams to aid in the identification of local trends and problems. Legal difficulties of information sharing need to be considered.

II. CURRICULAR AND INSTRUCTIONAL CONCERNS

A recent study of two-year colleges indicates that the dropout rate in basic mathematics courses may be as high as fifty to sixty percent.[18] Although students who complete remedial courses often do so successfully[19], a bottleneck is often created at this level by students who don't, but who keep re-enrolling in remedial courses.

Much of the instruction in remedial courses is based on mastery learning of arithmetic and basic algebra skills; the curriculum is broken into "bite-sized" pieces in an attempt to provide students with immediate, positive feedback. The type 2 courses described earlier share this goal of providing encouragement and reenforcement, but in a more global instructional context.

Research indicates that individualized mastery learning often compares poorly with other instructional methods in mathematics courses.[20,20A] However, some students "thrive" in a mastery learning environment; some teachers are more effective in this setting. Some suggest that the integration of new technologies (e.g. microcomputers and handheld calculators) into the remedial setting may improve the present situation without creating a "slavish" dependence on calculators.[21]

<u>WE RECOMMEND</u>:

(a) PROVIDING STUDENTS WITH THE OPTION OF ENROLLMENT IN A TYPE 1 OR A TYPE 2 COURSE AND ALLOWING INSTRUCTORS A CHOICE IN THEIR TEACHING ASSIGNMENT.

(b) THAT CURRICULAR CONTENT OF TYPE 1 COURSES BE ADJUSTED TO KEEP PACE WITH CHANGING COLLEGE COURSES, THE LEVEL OF ALGEBRA SKILLS OF HIGHSCHOOL SENIORS AND THE NEW TECHNOLOGIES.

Recent recommendations[22,23] set a high priority on placing technologies in the elementary and high school curricula. College entrance exams predicated on handheld calculator use will soon be employed. Such changes will affect student populations in future remedial classes. Dissemination of information about new developments and responses to them can be handled by the proposed clearing house.

(c) THAT INFORMATION AND RECOMMENDATIONS RELATING TO THE EVOLUTION OF THE CONTENT AND PEDAGOGY OF TYPE 2 COURSES BE MADE MORE ACCESSIBLE.

The CUPM report[24] relating to type 2 courses clearly states that the curriculum of such courses needs to be in flux. It also goes into

considerable detail in outlining ingredients including examples of topics necessary for a successful type 2 course; emphasis is placed on the pedagogy and instructional format appropriate for a course designed to promote mathematical literacy. The proposed clearing house would go much further in gathering and disseminating information about projects from many institutions.

(c) THAT MATHEMATICS DEPARTMENTS RESIST ADMINISTRATIVE AND LEGISLATIVE MANDATES FOR "QUICK FIXES" WHICH INVOLVE UNSOUND TEACHING AND CLASS MANAGEMENT PRACTICES.

A clear message regarding the priority that must be placed on thoughtful reform coming from the mathematical community will support efforts of individuals and institutions working for rational change.

III. ORGANIZATIONAL SUPPORT FOR REMEDIAL COURSES AND STAFF

Thoughtful approaches to difficult educational problems should allow for experimentation, setbacks and reflection. Reformers and educators involved in remedial instruction employed by colleges and universities qualify for the academic privile ges that academic employment affords other faculty. Every effort must be made to mitigate the onerous remedial task by at least making the working conditions as favorable as possible. Administrators of remedial programs should know about related efforts of professional organizations. They should also be aware of recent National Science Foundation guidelines that outline funding opportunities for faculty enrichment, research on teaching, etcetera...

WE RECOMMEND:

(a) THAT INSTRUCTIONAL SUPPORT SERVICES BE PROVIDED.

(b) THAT SUPPORT BE PROVIDED FOR RECORDKEEPING AND DATA COLLECTION.

(c) THAT PERSONNEL AND MONETARY SUPPORT BE GIVEN FOR CAREFUL PERIODIC REVIEWS OF REMEDIAL PROGRAMS, WITH SPECIAL ATTENTION TO COORDINATION WITH MATHEMATICAL OFFERINGS.

Limitations in budget and space has forced many institutions to hire part-time adjuncts (often just before the term begins), provide no office space (so that they meet students on a campus bench), and generally make them feel excluded from the life of the department. Selection and retention of competent remedial staff are essential for the coherent operation of the whole department. Remedial programs in reading/writing seem to make better provisions for selecting and training staff.[24a]

(d) THAT RELEASETIME AND TRAVEL MONEY BE MADE AVAILABLE TO REMEDIAL PERSONNEL FOR PROFESSIONAL ENRICHMENT AND ARTICULATION. THIS SHOULD BE CONSISTENT WITH SIMILAR ARRANGEMENTS AVAILABLE TO OTHER FACULTY.

(e) THAT INSTITUTIONS DEMONSTRATE COMMITMENT TO REMEDIAL PROGRAMS BY ESTABLISHING EMPLOYMENT POLICIES THAT REWARD COMPETENCE AND DEDICATION AND THEREBY AVOID DISRUPTIVE STAFFING UPHEAVALS.

(f) THAT POSTSECONDARY SCHOOL INSTITUTIONS WHOSE BUDGETARY CONSTRAINTS MAKE (a) - (e) DIFFICULT TO IMPLEMENT APPLY FOR FUNDS BECOMING AVAILABLE THROUGH NSF (SEE) AND OTHER FUNDING AGENCIES, AND THAT THEY MINIMIZE WASTE AND DUPLICATION OF EFFORT BY CROSSING TRADITIONAL BOUNDARIES IN COLLABORATIONS WITH OTHER PROGRAMS.

IV. COLLEGE-HIGHSCHOOL ARTICULATION & PROSPECTIVE TEACHER PREPARATION

Recent reform movements in education call for close collaboration between "content" and methodology; the Holmes Group advocates that Schools of Arts and Sciences be responsible for the undergraduate majors of prospective teachers. Some reports emphasize the fact that colleges impact upon instruction in highschool by the very fact that college professors serve as models for the teaching profession. Mathematics departments, by ignoring prospective precollege teachers enrolled in college courses, miss opportunities for beginning dialogues leading to cooperative ventures with young teachers before they become overburdened and cynical in their precollege teaching positions. Educators point to the differences between the circumstances of the current reform movement and that of the 1960's. (See for example Interdisciplinary Research in Mathematics, Science and Technology Education, a report by a Committee of the National Research Council chaired by J.G. March of Stanford University.) In particular, it is suggested that the teachers who will be involved are those in the system. The profession is not growing or experiencing the turn-over of the 1960's. This situation confirms the importance of improved dialogue between colleges and highschools. Since the remedial programs and the introductory mathematics courses are shared concerns, it seems appropriate to consider college-highschool articulation when addressing the

issue of remediation. We emphasize the shared responsibility of colleges and highschools towards today's young people in the same sense that schools of education emphasize the shared responsibility for future teacher training.

WE RECOMMEND:

(a) THAT PROSPECTIVE HIGHSCHOOL TEACHERS BECOME INVOLVED IN SOME ASPECTS OF REMEDIAL PROGRAMS, PERHAPS AS INTERNS.

Large institutions already employ undergraduates to staff tutorials and math labs. Recommendations concerning the reforms of Schools of Education are discussing "fifth year" programs coupled with early (during the four undergraduate years) experiences to recruit talented students into the teaching profession. A program coordinated with remedial programs could serve as such an experience. Interns would have the opportunity to study the problems of underprepared recent highschool graduates without the pressures of being a full time classroom teacher. Mathematics majors who eventually become graduate students would have the opportunity to work with remedial students before taking up duties of graduate teaching assistants. Part of the internship might involve a workshop where pedagogy and educational philosophy are discussed along with the curriculum in light of internship experiences with students in transition from highschool to college mathematics courses.

(b) THAT FORMAL CHANNELS OF COMMUNICATION BETWEEN HIGHSCHOOLS AND COLLEGES BE ESTABLISHED.

Issues ranging from day-to-day topics of program content and changes in courses, prerequisites and the like to concerns about type 2 courses versus type 1, the wisdom of singling out "college bound" students[25] need be discussed regularly on a local basis as well as a national level. Remedial programs can benefit from the input of highschool teachers who have taught the same students or at least the same curricular items to students with comparable backgrounds.

(c) THAT THE MAA AND AMATYC STRIVE TO MAINTAIN AN ACTIVE ROLE IN THE CURRENT REFORM MOVEMENT IN TEACHER EDUCATION.

In particular, the recruiting of teachers among undergraduate mathematics majors, their involvement in tutoring and teaching experiences (especially in connection of Type 2 courses), discussions NCTM recommendations, curriculum modifications, textbook critiques and selection all are activities of concern to MAA, AMATYC and other professional organizations.

New Jersey Institute of Technology

The Center for Pre-College Programs at NJIT is opening the fields of engineering and science to increasing numbers of minority pre-college youngsters in Newark and other urban areas of northern New Jersey through programs which stimulate interest, enrich backgrounds in science and mathematics, and provide counseling, career guidance, and exposure to successful minority role models. More than 1,000 4th to 12th grade students and their teachers participate annually in one of twelve regularly conducted pre-college programs at NJIT.

To maximize the impact of these programs, the university has also been working with local school districts to conduct in-service training for teachers; to improve curricula through development of new learning materials and teaching strategies; and to provide supplemental, hands-on science experiences for students in their classrooms.

Follow-up studies of former participants show that the programs have a significant impact: more than 90% of students in the more intensive programs attend college, and roughly 70% chooose college majors and careers in engineering and other science and math-based fields.

The Center for Pre-College Programs

The Center for Pre-College Programs at NJIT develops, conducts and directs a wide range of programs for students and teachers in Newark and surrounding urban areas of northern New Jersey. These programs are designed to raise aspirations, enrich

backgrounds in mathematics and science, and encourage prepartion for higher education and careers in engineering and scientific fields.

Eighty to ninety per cent of participants in summer programs are inner-city youngsters. The other ten to twenty per cent are suburban students from more affluent school districts. This mix has been successful in expanding the horizons of all participants and in improving their self-confidence and self-esteem. Young women comprise nearly half the group each year.

The Center is headed by a Director who is a member of the NJIT faculty; the staff includes Program Directors who also are faculty of the university, as well as graduate students, teaching assistants, and selected secondary school teachers and counselors. An Advisory Board composed of corporate sponsors, a representative from the Newark Board of Education, and members from academia, plays an active role in helping to establish and conduct programs, and in developing private sector funding. (Corporate and foundation support has nearly tripled since 1980, representing more than $200,000 of the total $765,000 received in 1985-86).

Enrollment in student programs has expanded from an original class of 20 high school seniors in 1971 to 600-800 4th to 12th grade youngsters in summer and extended academic year programs each year, and another 200-300 in shorter courses and one-day workshops. To maximize the impact of these efforts, Institute faculty and staff also work directly with 200-300 pre-college teachers both at NJIT and at their respective schools. Separate efforts are directed toward the secondary grade levels (7-12) and elementary grades (1-6).

Secondary Grade Level Programs

The different needs of students in grades 7-12 are met through a diversity of summer programs. Each program provides enrichment in math, science and engineering-related topics, along with college and career information, particularly related to

engineering. Minority role models serve as teachers, teaching assistants, seminar participants, career advisors and plant trip tour guides.

Computers are utilized extensively throughout the pre-college curriculum, with instruction provided in the Pre-College Computer Center , a major facility equipped with 10 IBM PCs, 10 IBM compatible AT&T PCs, and appropriate peripherals. Lessons are provided to students and teachers in several programming languages (BASIC, FORTRAN, PASCAL, LOGO, C) and in the use of word processing, spreadsheets and databases.

Each summer program targets specific grade levels and a particular audience:

- The High School Urban Engineering Program for students completing grades 9-11, and companion Introduction to Urban Engineering course for students completing grades 7-8, is designed to expose students to the problems of the cities and to how engineers and scientists go about solving these problems. Newark serves as the instructional laboratory. The level of instruction and emphasis differs for the two programs.

- The ChIME (Chemical Industry for Minorities in Engineering) Programs are designed to encourage students to pursue careers in chemical engineering and related disciplines and to show the diversity of employment opportunities in the chemical industry. The High School Workshop serves students completing 10th and 11th grade; the Junior High School Workshop serves post-eighth and post-ninth grade students.

- The FEMME (Females in Engineering...Methods, Motivation, Experience) Program is designed to encourage ninth grade girls to take advanced courses in math and science and to pursue careers in engineering and science.

- The Experimental Mathematics and Communication Program for post-seventh grade Newark students is designed to make mathematics more enjoyable and stimulating through use of applied and constructive activities.

- The Summer Science and Mathematics Program for Disabled Students is designed to generate interest in engineering and scientific careers by providing disadvantaged students with special activities in math, science and engineering-related topics.

- The Project SEED - Catalyst Program provides post-eleventh grade students with special research experiences in university laboratories.

The major academic year program for secondary school students is the High School Scholars Program, which provides urban high school seniors with the opportunity to earn college credits in calculus and physics (through a one-year Integrated Calculus/Physics course), computer science and chemistry. Such opportunities are generally not available in urban schools. In addition, several high school students participate as members of university research groups comprised of undergraduate and graduate students, and NJIT faculty.

NJIT's approach to conducting pre-college programs is reflected in a number of joint efforts between the university and ChIME, Inc. (Chemical Industry for Minorities in Engineering). Beginning in 1980 with the first workshop for 10th and 11th grade students, start-up funds from ChIME, Inc. for additional efforts has assisted the university to expand its programs to meet the needs of a larger cross-section of participants.

A program for junior high school students was initiated in 1985 with ChIME funding, along with a course for local secondary school science teachers. Both programs have received supplemental support to continue beyond the pilot phase. In addition, a one-day workshop was established last year for a group of secondary school guidance counselors and teachers. Several students also participated.

The newest pilot effort is the ChIME Minority Research Apprenticeship Program. This two month project will involve two students--a high school student entering the senior year and an undergraduate from a New Jersey college or university--working

together in a NJIT research laboratory on a selected topic. As with other initiatives, this program represents a natural extension of existing efforts (e.g., Project SEED).

An important goal of the teacher programs, including the various ChIME workshops, is to disseminate curriculum and guidance materials developed and utilized in student programs. Materials developed in a junior high-middle school curriculum improvement project, for example, have been tested and used in several of the student projects. In one instance, teachers explored the classroom implementation of a new hands-on activity by observing and working with a group of ninth grade students participating in a special academic year program conducted on Saturdays.

In some instances, both dissemination to teachers and from teachers has occurred. For example, energy activities used in student programs have been disseminated through in-service training programs for secondary school science teachers and for elementary school teachers . Activities from the teacher training programs have also been used in student programs.

Elementary Grade Level Programs.

A major thrust of NJIT in recent years has been to develop offerings that impact on students earlier in their school experience. Recent studies confirm that the time to motivate and excite students to science and technology is in elementary and middle schools. Intervention should begin as early as possible in order to provide appropriate opportunities for inner-city youngsters.

Initial efforts provided programs for 4th, 5th and 6th students at nearby elementary schools. An engineering-science outreach effort involved a teacher corp of undergraduate students, primarily from disadvantaged backgrounds. In addition to serving as successful role models, these "NJIT teachers" have gone into the elementary school classrooms to share their academic and career interests and accomplishments with the youngsters, conduct problem solving sessions in scientific and technological subjects, and direct a

related project emphasizing direct student involvement. Other classes of students have come to NJIT's Pre-College Computer Center during the school year to receive instruction in computer programming.

In a different approach directly involving the classroom teacher, NJIT faculty work with Newark elementary school teachers in their classrooms to enhance science instruction. Lessons feature hands-on, investigative activities, and math and communications skills, where appropriate. The aim of the program is to provide teachers with the necessary training and the necessary background to build skills and confidence in their ability to teach science.

The Center for Pre-College Programs is also involved in NETS (Network for Excellence in the Teaching of Science), a consortial effort of four New Jersey universities, including NJIT, and a group of urban community colleges, to provide inservice training for elementary teachers in urban areas throughout the state. Workshops focus on hands-on, investigative science activities selected to enhance classroom instruction, motivate students, and provide a stimulating learning environment. The activities focus on process skills, higher order cognitive skills, math problem solving skills, and language arts and reading development.

Success of Students

Follow-up studies of the "alumni" of NJIT's pre-college programs indicate that participation has a major impact: more than 90% of students in the more intensive programs attend college, approximately 70% select majors in engineering, science or math based fields (Figure 1), and an equally high percentage complete degrees and enter rewarding professional careers.

Many of these students are attending among the best known colleges and universities in the country. Several have already graduated from Princeton University, the University of Pennsylvania, the University of Virginia, Rutgers University, and NJIT. A few are

currently pursuing advanced degrees at other institutions, including Georgia Tech and Stevens Institute of Technology.

These achievements stand in striking contrast to the low statistics for college enrollment and completion rates for minorities in the targeted fields. Data on freshmen engineering enrollment show that the percentage of minorities enrolled in engineering programs exceeded 10% in 1984 and reached 10.4% in 1985. The percentage of minority students successfully achieving B.S. degrees in engineering, however, is still less than 5%. These percentages are significantly lower than the percentage of minorities in the college-age and general populations.

Arthur D. Cox, a veteran of two pre-college programs, is an example of NJIT's success in motivating and preparing minority pre-college youngsters for college and eventual careers. In his words, "The courses at NJIT over the past two summers have helped me raise my math grades from the 70's to the 90's. This enormous improvement has helped me receive a Naval B.O.O.S.T. Scholarship and acceptance to Stanford University." Participation also has encouraged him to aspire to a master's degree and, ultimately, "to work for N.A.S.A. as ...the first black to pilot the Space Shuttle." His achievements reflect the tremdendous potential of minority students who, when provided with adequate experiences and opportunities, can and do succeed.

An Overview of The Saturday Academy- A Pre-College Mathematics Based Intervention Program

Winson R. Coleman
Director, The Saturday Academy
University of the District of Columbia

Overview

In September of 1982 the Saturday Academy began as an academic intervention program housed on the campus of the University of the District of Columbia and supported by the College of Physical Science Engineering and Technology. This pre-engineering program was developed in response to a proposal by Dr. Beverly J. Anderson, then Chairperson of the Department of Mathematics at the University of the District of Columbia. The program was accepted for funding by NASA and has been in existence and growing ever since. In 1982 the program consisted of 60 students and 6 teachers. Presently the program serves 300 students per year using 20 part-time teachers and over 40 teaching assistants who for the most part are program alumni and UDC students.

The program has been designed to meet rather unique needs, and there are many, ranging from single parent families to drug infested neighborhoods, of an urban inner city pre-college population in grades seven through nine. Materials have therefore been designed with this in mind. The actual recruitment of participants has also been geared to this population. Resource persons from the schools, communities and area businesses have graciously accepted our invitation to work in the program. Parents are, by program design, intimately involved from the onset of their child's participation, and are able to take comfort in the fellowship provided by other parents who, in all probability, are going through some of the same problems.

The relative newness of these intervention programs inhibits both the quantity and quality of available research, documenting successes and failures of these approaches. The Saturday Academy began, for example, as a ninth grade program in 1982 and alumni from that period are at best sophomores in colleges throughout the country.Data obviously can not be gathered on the success of this intervention program with regards to college graduation. In a recent study done in partial completion of the requirements for a Doctoral degree at American University, soon to be Dr. Linda Hayden, was able to collect and analyze pertinent data relative to the present performance of Saturday Academy alumni when compared to a peer group. Using a random sample of 38% of the total alumni group involved as participants in the first two sessions of the program as the experimental group and a 37% sample from a like sized peer group, data was collected. Briefly the results indicated that there were indeed significant differences in high school graduate rates, in college enrollments and in the number of students choosing science as a collegiate major.

She was also able to demonstrate some rather interesting information relative to gender that was supported through both experimental and control group data. The data supporting our three major contentions was as follows:

Category	Experimental	Control
Participants Completing High School- *	98%	46%
Participants Entering College -**	91%	46%
Participants Choosing Science Majors- ***	45%	20%

In national comparisons with other pre-college programs aimed towards increasing minority participation in mathematics based fields, we identified two major programs, namely The Mathematics Engineering and Science Achievement (MESA) and The Minority Introduction to Engineering (MITE). MESA is the oldest(founded in 1969) and largest such program of its type being funded by the state of California and the private sector ($4 million/year). MITE, on the other hand, is a relatively new program sponsored by the state of Florida as part of a ten year plan to increase the number of minorities in scientific technical fields. According to information published in the September,1987 edition of Black Issues in Education, the following comparisons were made:

Program	High School Graduate	In College	Science Major
SEC-Washington D.C.	98%	92%	45%
MESA-California	N/A	85%	60%
MITE-Florida	N/A	90%	47%
NSF			
White	87%	49%	36%
Black	78%	48%	33%

As these programs age more data will be collected and analyzed to further determine the potential of these early interventions in eliminating the waste of minority scientific talent in the public schools throughout our nation. At the present our efforts are only attempts to provide early stimulation in mathematics and the sciences for this population with the hope that this early motivation will allow/cause the young student to remain "turned on" to education and not turn his/her back on the opportunity that it presents.

The Role Of A Summer Program In Attracting Blacks And Hispanics Into Mathematics-Based Fields

Beverly J. Anderson
Professor of Mathematics and Director
A Summer Program in Mathematics and Computer Science
University of the District of Columbia

Background

Although institutions in America have devised programs to encourage non-Asian minorities to seek careers in mathematics-based fields, many of these institutions start too late-their programs usually consist of academic intervention on the senior high or college level. By this time, a significant number of the brighter non-Asian minority students have not been channeled into the introductory (algebra and geometry) or intermediate (intermediate algebra) calculus track courses, and they do not benefit optimally from the programs. Hence, many of these students have been virtually eliminated from careers in the sciences because they were not exposed to the calculus-track courses in high school.

As a result, blacks and Hispanics are sorely under-represented in careers in the sciences and mathematics. Although the black minority comprises roughly 12% of the total population in America, this ethnic group represents only 2% of the employed scientists and engineers in this country. Equally distressing is that the Hispanic population which comprises roughly 6% of the total population represents roughly 1.5% of the employed scientists and engineers in America (Employed Scientists and Engineers in the U.S. National Science Foundation, 1985).

In recognition of the under-representation of blacks and Hispanics in mathematics and mathematic-based fields, and the apparent need to provide appropriate counseling to some of these students, the Department of Mathematics and the Department of Electrical Engineering and Computer Science at the University of the District of Columbia have come together to implement several academic intervention programs, mainly for **junior high school students**, designed to stimulate their interest in mathematics and to enrich their experiences in mathematics and mathematics-based fields. The departments realize the need to provide opportunities to intrigue capable students while exposing them to career opportunities in engineering and other mathematics-based fields.

Since the summer of 1982, two hundred sixty-eight (268) junior high school students participated in a program entitled, **A Summer Programin Mathematics and Computer Science for Academically Oriented Students.** This program has been funded by the Office of Naval Research, Department of the United States Navy since 1982 and has been awarded approximately $500,000 over that period.

Program Goals

The goals of the program have been developed in response to the need to increase minority representation in the sciences and mathematics. The four major goals of the program are (1) to stimulate interest in mathematics and mathematics-based fields; (2) to encourage students to pursue the more rigorous mathematics courses in their remaining high school years; (3) to allow students an opportunity to become aware of the role of mathematics as the invisible filter; and (4) to improve the reasoning skills of students and equip them with facilitative strategies to learn concepts and solve problems in mathematics.

Program Components

This five-week summer program, meeting from 9:00 AM until 2:30 PM, Monday through Friday, has two major program components: (1) the instructional component in three content areas-General Mathematics, Computer Science, and Statistics, designed to intrigue students and improve their reasoning skills; and (2) the career education component, designed to provide participants with an opportunity to see "mathematics at work" in everyday life and allow them an opportunity to interact with appropriate role models in the sciences and mathematics.

Program Objectives

The instructional objectives of the program serve as a guide for developing lessons and selecting films. The six instructional objectives are for students to (1) demonstrate increased facility in the technical language of mathematics, computer science, statistics and operations research; (2) formulate problems; (3) evaluate ways to solve problems; (4) apply basic knowledge to the solutions of the problems in the three content areas; (5) draw valid conclusions from data given; and (6) create an appropriate computer program for a problem from a word statement. These instructional objectives are supplemented by two major career education objectives. Students are expected to (1) name at least ten mathematics-based fields wherein blacks and Hispanics are under-represented; and 2) communicate how they can become better prepared in high school, especially in the area of mathematics, to increase their college and career options by the time they reach college.

Program Personnel

The program staff consists of four (4) members of the University of the District of Columbia faculty-two from the Department of Mathematics and two from the Department of Electrical Engineering and Computer Science, one administrative assistant and two teaching assistants whose services are employed mainly in the computer laboratory. The program director and associate director handle the administrative duties as well as teach the mathematics course and chaperone all field trips.

Program Participants

The program is designed for "academically oriented" black and Hispanic students rising to the ninth or tenth grade. For the purpose of this program, "academically oriented" students are those identified by their teachers to be "good" or "outstanding" on sixteen (16) characteristics, such as achievement, attitude and interest in school work. Some students not satisfying the racial and grade classifications have been accepted into the program. However, from 1982-1987, over 95% have been black or Hispanic.

The Instructional Component

The instructional component of the program consists of three courses of study: General Mathematics, Computer Science, and Statistics. Both the Computer Science and Statistics courses meet for one hour and fifteen minutes each morning and the mathematics course meets for one and one half hours each afternoon, except on Friday. The computer classes are held in the computer laboratory (a classroom with twenty terminals) three days a week, and the statistics classes are held in that laboratory two days a week.

An interdisciplinary approach is used to reinforce learning in the three courses, as similar topics are covered in each course. The goals of the courses follow:

General Mathematics

- to improve the students skills in recognizing patterns and drawing conclusions;
- to improve the students' facility with the technical language of mathematics;
- to improve the students' knowledge of the structural nature of mathematics; and
- to improve the students' techniques in formulating and solving problems.

Computer Science

- to prepare the students to become literate in computer science and knowledgeable of the hardware;
- to prepare the students to construct flowcharts for algorithmic development; and
- to prepare the students to construct and debug programs in the BASIC language using control statements; string variables and arrays, data files and graphic techniques.

Statistics and Operations Research

- to expose students to probability theory
- to enable the students to transfer the skills developed in their computer course into problem solving tools in statistics; and
- to expose students to some of the significant mathematical models underlying statistics.

The Career Education Component

This component of the program provides the students with an opportunity to see mathematics employed in everyday life and to interact with some professionals engaged in mathematics-based fields. The major aspects of this components are field trips, videos, films and a forum. Although career education in the sciences and mathematics is an inherent part of the program and teachers encourage the students to remain in the calculus tract so that they will have more career options when they reach college, the time specifically designated for career education is on Friday afternoons. The field trips generally include a tour of the Naval Research Laboratory in Washington, D.C. and a tour of the David Taylor Naval Ship Research and Development Center in Caderock, Maryland where students get to meet personally with physicists, mathematicians, statisticians, and other scientists.

In addition to the tours, the students view several video tapes and films. The tapes "Mathematics at Work in Society", developed through a grant awarded to the Mathematics Association of America, show many mathematics-based career opportunities and role models; and the tapes "Challenge of the Unknown", developed through a grant to the American Association for the Advancement of Science, show the role of mathematics in solving many problems in everyday life. The students also have enjoyed the film, "Donald in Mathemagic Land" which shows how mathematics grows from simple ideas; heroes in mathematics of African Heritage; and the applicability of mathematics.

The career education component also includes a career awareness forum, which has been a highlight of the program. This forum provides an opportunity to bring a special group of professionals to the university and to hear them speak to the amount of mathematics needed in preparing for their careers and the use of mathematics in carrying out their jobs. This program has included a black female oceanographer, a black male mathematician, a black female engineer, a black female meteorologist, a white male meteorologist, a white female meteorologist, a black female physician, a black male professor of mathematics and a black male statistician. During this one and half hour program followed by a reception, students and their parents exchange ideas with these professionals.

Unscheduled guest presentations have been provided by officials from the Office of Naval Research and the University of the District of Columbia.

Program Evaluation

Students are encouraged to provide formative evaluations daily in some classes and/or after each unit of study in other classes. The techniques used in evaluation include worksheets, tests, informal observations, discussions and anecdotal records. Summative evaluations are submitted by students at the end of the program.

The formative evaluations have been used as a basis for refining the curriculum and teaching strategies. The summative evaluations have been used to further refine the curriculum and for making recommendations regarding the continuation programs.

The faculty engaged in the program meet periodically throughout the summer program to discuss the progress of the students, their readiness for the instructional material, their motivation, attendance, skills attained and program effectiveness. Summative evaluations also are submitted by faculty at the end of the program.

Follow-up

A follow-up study is conducted every two years on all of the students who participated in the program up to that time. The last follow-up study was to determine the effect of the five-week intervention program on its participants. Specifically, we were interested in the level of student enrollment in mathematics courses; their interest in mathematics-based fields as career goals; the effect of the program on their preparing for and/or majoring in mathematics-based fields; and their perception of the value of the program.

A ten-item questionnaire was mailed to the home addresses on file for the 151 students served by the program from the summer of 1982 through the summer of 1985; 135 were deliverable.

The study revealed that the respondents generally enroll or have enrolled in mathematics courses during each year of high school following their participation in the program and that they intend to take courses in mathematics through the calculus while in college; that the vast majority of the respondents plan to attend college and major in a mathematics-based field; and that the vast majority would be willing to participate in a similar program and would recommend the University of the District of Columbia-Navy program to a friend.

The Student

Of the 151 students served by the program prior to the spring of 1986, 65 responded to the questionnaire. This number reflects nearly 50% of the 133 students whose mailings were not returned to the university. A breakdown of the number and percent of respondents from each of the summer programs appears in Table 1. Of note is that there is a direct relationhip between the number of respondents and the recentness of the program. That is, 31% of the 1982 students responded, whereas 55% of the 1985 students completed their questionnaires.

Table 1

Number and Percent of Students Responding to the Questionnaire In the Follow-up Study

Year Of Program	Total No. In Program	Number Responding	Percent Responding
1982	32	10	31%
1983	40	14	35%
1984	39	19	49%
1985	40	22	55%

Interest in Mathematics

The interest in mathematics was measured by the extent to which the students enrolled in mathematics courses in high school and the extent to which they enroll or intend to enroll in mathematics courses in college. The report revealed that 77% have taken or intend to take at least one course in mathematics during each high school year. Also, 94% plan to take at lease Calculus I in college. Of note is that 37% plan to take at least one course in mathematics above Calculus III.

Interest in Mathematics-Based Fields

Although roughly 12% of the students did not express an intended occupation, 80% of the respondents (91% of those expressing an intended occupation) indicated a mathematics-based field. The most popular areas mentioned were engineering (34%), medicine (23%), computer science (8%), and mathematics (8%).

Affective and Cognitive Effects

Three items on the questionnaire were related to the affective and cognitive effects of the program. The fact that 97% of the respondents would recommend the program to a friend and 89% would participate in the program again reflects to us that the program had a positive effect, at least affectively, on the students. The cognitive effect of the program in the follow-up was measured in terms of how the students perceived of the cognitive gains. The study revealed that 81% of the respondents felt that the program improved their reasoning skill or strengthened their background in mathematics.

Unsolicited Comments from the Students

The many warm expressions sent by the students provided the program administrators with the desire to continue this program and perhaps have reach a greater number of students. Many of the students expressed gratitude for having participated in the program. Additionally, students freely commented on some other effects of the program.

Several of the students claimed that they initially became interested in computers, in the summer program and that they have pursued that interest ever since their summer session. Other students commented on the career awareness aspect of the program contending that the program lead to a heightened awareness of many fields of engineering and other areas in science; and still other students addressed the friendships made during their session-friendships which appear to be important to them.

Summary

From all indication, the participants who responded seemed to have had a wonderful learning experience in the summer program. We are pleased that the goals of the program have been attained; that is, students are taking courses in mathematic throughout their high school years and a large percentage of our students are planning to seek or are currently seeking careers in mathematics-based fields. Since this study was conducted, some 117 students have participated in the summer program. We plan to implement a similar study on the entire group of 268

students in 1988.

For Further Information Contact:

- Beverly J. Anderson, Director
  A Summer Program in Mathematics and Computer Science
  University of the District of Columbia
  Department of Mathematics
  Washington, D.C. 20008

  Telephone: (202) 282-3171

- Bernis Barnes, Associate Director
  A Summer Program in Mathematics and Computer Science
  University of the District of Columbia
  Department of Mathematics

  Telephone: (202) 282-3171

PLACEMENT OF RETIRED PROFESSIONALS IN SECONDARY SCHOOLS FOR TEACHING SCIENCE AND MATHEMATICS (REVISED 1/22/88)

I. PROJECT SUMMARY

The National Executive Service Corps proposes to the National Science Foundation a two-year program to test the placement of qualified retired men and women in public secondary schools in roles influencing the teaching of mathematics and the sciences. The objective of such placement is to enhance the teaching and the curriculum to the greatest possible extent demanded by department chairpersons, the teachers and students.

It has become widely recognized, after study by a number of highly-qualified commissions, that precollege education in science and mathematics in the United States is dangerously inadequate to meet our needs for economic growth and national security. Nor will it provide an electorate which can address scientific and technological issues intelligently in an age when such issues are increasingly important.

It is NESC's intention to create a successful model which can be replicated in other cities by local Executive Service Corps or other organizations, so that students across the country can benefit from the knowledge of retired scientists, engineers, and mathematicians. A key product of the project will be a replication booklet which will be disseminated nationally by professional societies, NESC and other organizations.

The test would occur in two high schools in each of two demographically-distinct school areas in Baltimore. Three retirees are to be enlisted, recruited, trained and placed in each school from the active membership of organizations represented by the Council of Engineering and Scientific Society Executives (CESSE). Several such societies, e.g. AIChE, Sigma Xi, IEEE, ACS, will be the focal point of the initial test placement. Executive directors of several societies have already been briefed on NESC methodology and are supporting the proposal.

Special emphasis will be placed on recruiting women and minority candidates as volunteers and on encouraging minority and female students to play a strong role in activities generated by This project.

APPENDIX J

Industry Collaboration Model

Justification and Approach for Improving Mathematical Skills of Minorities

- Establish a consortium of business establishments in both the manufacturing and service sectors to work jointly with the Mathematical Association of America to identify the mathematical skills needed to develop a work force able to use not only the current technology employed by industry and business, but the emerging technologies as well. The role of the consortium is to provide the intercompany cooperation and funding needed to implement the recommendations contained in this study.

  Deputy Secretary of Commerce Clarance J. Brown, in a June 9, 1987 briefing on emerging technologies, pointed out that one of the generic barriers to achieving maximum benefits from emerging technologies is the lack of cooperation and integration among institutions in the U.S.

- Define and introduce the term "Industrial Mathematics" to highlight the fact that the recommendations of the Task Force on Minorities in Mathematics will enhance U.S. industry's ability to compete successfully in today's and tomorrow's world economy.

- Enlist the resources of the Federal Government Laboratories to provide technical support.

- Identify those Federal Government Agencies and programs that are addressing the competitiveness issue. Both the Congress and the executive agencies are deeply concerned about the decline of the competitiveness of U.S. companies. It can be argued that an "Industrial Mathematics Program" is needed to improve the competitive position of American firms.

- Focus the Industrial Mathematics Program on existing high-technology industries, and those industries that will be using the emerging technologies.

  The National Bureau of Standards, in it's report, <u>The Status of Emerging Technologies: An Economic Technological Assessment to the Year 2000</u> (U.S. Department of Commerce, June 1987), has identified the emerging technologies, the products and processes affected, as well as the industries that are or will be using the emerging technologies. (See appendix A)

  The Congressional Budget Office, in it's report, <u>Federal Financial Support for High-Technology Industries</u> (Washington, D.C., June 1985), published a composite list of high-technology industries. (See appendix B)

Preliminary indictions are that Federal Statistical Agencies are not collecting skill specific information by industry. However, using the occupational information from the Bureau of Labor Statistics' Industry/Occupation Matrix it would be possible to pinpoint those occupations requiring various levels of mathematical skill needed by existing high-technology industries and those industries that will be using the emerging technologies.

Incorporating the recommendations of this study through an "Industrial Mathematics Program" implements one of the recommendations of the National Bureau of Standards.

The National Bureau of Standards' report, The Status of Emerging Technologies: An Economic Technological Assessment to the Year 2000, points out (a) the need for greater cooperation between industries and universities to achieve a more rapid application of new technologies and (b) the need for intercompany cooperation to jointly address generic or structural technical problems of a longer term nature.

The Mathematical Association of America, by establishing an "Industrial Mathematics Program," will provide U.S. industry with a skilled work force able to use not only the current math-dependent technology, but the emerging technologies that will keep U.S. industry and business competitive in today's world economy.

APPENDIX A

Table 1

EMERGING TECHNOLOGIES

Technology	What does it do new or better?	Applied to what products or processes?	Used by What Major Industries?
1. Advanced Materials			
A. Ceramics	Better high temperature strength-to-weight properties	Heat engine components, turbine blades, heat shields	Automotive & aircraft engines
(high performance structural and electronic ceramics)	Better dielectric & optical properties	Electronic substrates, integrated optics	Electronic components
B. Polymer Composites	Higher strength-to-weight ratio	Structural components	Aerospace, automotive, ind. const.
(high strength fiber reinforced plastic resin)	Design flexibility because of spatial asymmetry	Structural components	Aerospace, automotive, ind. const.
C. Metals	Improved strength & high-temp performance	Structural components Super conducting components	Manufactured components
(rapid solid-ification, & metal matrix composites)	Improved magnetic properties	Electro-magnetic equipment	Electrical machinery
2. Electronics			
A. Advanced Microelectronics	Improved performance in speed, size	Semiconductor devices	Electronic &, optical components & systems
(enhanced VLSI and VHSIC chips)	Improved magnetic properties	Information storage	Information processing
	Higher efficiency photovoltaic conversion	Solar cells	Energy generation

Technology	What does it do new or better?	Applied to what products or processes?	Used by What Major Industries?
B. Optoelectronics (optical fiber and light wave processing)	Improved performance in speed, size, capacity, and security	Electronic equipment, information processing	Communications & computers
	Higher density information storage	Computer systems of all sizes	Computers
C. Millimeter Wave Technology	When replacing radio systems it frees RF spectrum for other uses	Voice & data communication systems	Telecommunications carriers & corporate use for private circuits
3. Automation			
A. Manufacturing (computer integrated and flexible systems)	Flexible reconfiguration of production processes	All manufacturing processes	All manufacturing
	Integrated control of all production operations		
B. Business and Office Systems (computer applications within an organization)	Efficient information storage, retrieval, & exchange	Networking, word processing, & data base management	All organizations
C. Technical Services (computer applications in the provision of commercial services)	Efficient high-volume information storage, retrieval & exchange	Information retrieval and distribution, data base management, education and training	Financial services, electronic mail, telecommunications, professional service

Technology	What does it do new or better?	Applied to what products or processes?	Used by What Major Industries?
4. Biotechnology			
A. Genetic Engineering	Improved diagnostic and therapeutic drugs	Health Services	Medicine, Pharmaceuticals
(design & production of highly selective agents)	Improved plants, pesticides, & animal supplements	Foods and pesticides	Agriculture Food processing
	Neutralize pollutants	Environmental control processes	Chemical manufacturing & treatment
B. Biochemical Processing	Improved control of chemical processes, outputs, and yields	Chemical separations and reactions, biosensors	Chemical manufacturing
5. Computing			
A. Computing Equipment	Faster, lower-cost computing	Information processing and computer control	Potentially all
(supercomputers, parallel processing, computer arch.)			
B. Artificial Intelligence Techniques	Improved computer replication of human judgment	Information processing and computer control	All applications using computers
(includes expert systems, natural language, and robotic control)			

4-5

Technology	What does it do new or better?	Applied to what products or processes?	Used by What Major Industries?
6. Medical Technology			
A. Drugs (other drugs are included in category 4 - Biotechnology)	Improved immunology and treatment	Health Services	Medicine, Pharmaceuticals
B. Instruments & Devices	Improved diagnostic and therapeutic systems	Magnetic Resonance Imaging & CAT scanning, radiation treatment	Medicine
7. Thin Layer Technology (semiconductor applications also are included in Electronics)			
A. Surfaces & Interfaces	Improved control and yield of chemical reactions	Chemical catalysis	Chemical manufacturing, food processing
	New electronic & optical properties	Semiconductor devices, surface modification and coatings	Electronic components, computers
B. Membranes	New chemical properties, better chemical separation techniques	Chemical separations	Chemical manufacturing, food processing

Table 2

EMERGING TECHNOLOGIES RANKED BY ECONOMIC IMPACT

Group A	(Highest)	Advanced Materials; Composites Biotechnology; Genetic Engineering Electronics; Optoelectronics Electronics; Advanced Microelectronics Computing; Computing equipment Automation; Manufacturing
Group B		Automation; Business and Office Systems Biotechnology; Biochemical Processing Medical Technology; Drugs Advanced Materials; Ceramics Automation; Technical Services Computing; Artificial Intelligence Tech. Medical Technology; Devices
Group C		Thin Layer Technology; Membranes Advanced Materials; Metals Thin Layer Tech.; Surfaces & Interfaces Electronics; Millimeter Wave Technology

Appendix C.--List of High-Technology Manufacturing Industries (By Standard Industrial Classification)

Industry group	SIC code	A	B	C	D	E	F
Industrial inorganic chemicals ----	281	x	x	x	x	x	
Plastic materials, synthetics -----	282	x	x	x	x	x	
Drugs ----------	283	x	x	x	x	x	x
Soap ----------	284		x	x			
Paints ----------	285		x	x			
Industrial organic chemicals ------	286	x	x	x	x	x	x
Other chemicals ----------	287		x	x		x	
Miscellaneous chemical products ---	289	x	x	x	x		
Petroleum refining ----------	291	x	x	x	x		
Reclaimed rubber ----------	303		x				
Ordnance ----------	348	x	x	x			
Engines and turbines ----------	351	x	x	x			
Construction, related machinery ---	353	x	x				
Metalworking machinery ----------	354		x				
Special machinery ----------	355			x			
General industrial machinery ------	356	x	x				
Office and computing machines -----	357	x	x	x	x	x	x
Electric distributing equipment ---	361		x	x	x	x	
Electrical industrial apparatus ---	362	x	x	x	x	x	
Radio/TV receiving equipment ------	365	x	x	x	x	x	
Communication equipment ----------	366	x	x	x	x	x	x
Electronic components ----------	367	x	x	x	x	x	x
Other electrical machinery --------	369			x	x	x	
Motor vehicles ----------	371				x	x	
Aircraft ----------	372	x	x	x	x	x	x
Railroad equipment ----------	374		x				
Missiles ----------	376	x	x	x	x	x	x
Instruments ----------	380	x	x	x	x	x	x

NOTES

A. Catherine Armington, Candee Harris, and Marjorie Odle, "Formation and Growth in High-Technology Businesses: A Regional Assessment," Brookings Institution, September 1983.

B. Amy Glasmeier, Ann Markusen, and Peter Hall, "Defining High-Technology Industries," Working Paper 407, Institute of Urban and Regional Development, University of California, Berkeley, June 1983.

C. Richard Riche, Daniel Hecker, and John Burgan, "High-Technology Today and Tomorrow: A Small Slice of the Employment Pie," Monthly Labor Review, Bureau of Labor Statistics, U.S. Department of Labor, User Group III, November 1983.

D. Above-average 1981 R&D expenses as percent of value added.

E. Above-average 1981 R&D expenses per thousand employees, National Science Foundation, Research and Development in Industry, 1981, 1983.

F. CBO report.

Source: Congress of tne United States, Congressional Budget Office, Federal Support for High-Technology Industries, (Washington, DC: June 1985), p. 10.

APPENDIX K

Link-strategy Model

A "Link-Strategy" Model for Implementing the Recommendations of the Task Force on Minorities in Mathematics

The model described below is an example of how various recommendations of the Task Force could be implemented. The "link-strategy" model incorporates the basic assumptions of the general strategy, i.e., it assumes:

a. The establishment of a national program sponsored by MAA in collaboration with other associations and organizations.

b. The participation of the MAA's regional Sections in achieving the goals of the program.

c. The cooperation of regional consortiums of high-technology industries.

d. The implementation of a funding strategy based on U.S. industries' and governments' need for mathematicians, scientists, engineers and technicians.

The "link-strategy" program

The concept of a "link-strategy" model for an integrated primary, secondary and postsecondary program to improve the mathematical skills of minorities is to initiate an integrated program that would (a) link individual high-technology industries with minority students at the secondary and postsecondary levels and (b) link minority students at the secondary level with minority students at the primary level.

A "link-strategy" encompassing the educational process from the primary to the postsecondary level would "forge a chain of opportunities" for minority students:

a. At the primary level the program would develop an interest in mathematics as the seminal skill for science and engineering.

b. At the secondary level the program would develop an interest in both the teaching and the uses of mathematics in science and engineering.

c. At the postsecondary level the program would guide and encourage other minority students to continue their studies as undergraduates in the science and engineering fields and to participate in work-study programs with high-technology industries.

A key element for the success of the primary and secondary link is the introduction of a series of effective (not sophisticated) software mathematics programs that can be used by secondary students as tutorials to develop the interest of primary level students in mathematics. The role of secondary level students would be, in addition to serving as role models, to encourage primary students to develop their mathematical skills by using the computer as a learning device. It is essential that as they develop their mathematical skills and interest the minority students develop confidence in their ability to use computers. The earlier that minority students' interest in mathematics is awakened and their confidence in their ability to use interactive math programs is developed, the greater the likelihood that they will sustain their interest and understanding of the importance of mathematics to their futures.

A "link-strategy" program addresses all levels of the education process and can easily be segmented into the appropriate pedagogical units. It utilizes U.S. industry's current technological lead in software development, graphics and computer enhanced imagery. Most importantly it would be a method for making available to predominantly minority schools the best pedagogical talent of the mathematical community.

Regional implementation of the "link-strategy" program

The implementation of the "link-strategy" program would require the participation of MAA Sections in collaboration with other associations.

Initially selected MAA Sections could implement the "link-strategy" in those metropolitan areas or other locations with high concentrations of minority students and with those high-technology industries employing mathematicians, scientists, engineers and technicians that are concerned with improving their productivity and competitiveness.

Selected Resources

The National Bureau of Standards in The Status of Emerging Technologies: An Economic Technological Assessment to the Year 2000 has identified the emerging technologies, the products and processes affected, as well as the industries that are or will be using the emerging technologies. (See appendix A)

The Congressional Budget Office in Federal Financial Support for High-Technology Industries has published a composite list of high-technology industries. (See appendix B)

Table 1

EMERGING TECHNOLOGIES.

Technology	What does it do new or better?	Applied to what products or processes?	Used by What Major Industries?
1. Advanced Materials			
A. Ceramics	Better high temperature strength-to-weight properties	Heat engine components, turbine blades, heat shields	Automotive & aircraft engines
(high performance structural and electronic ceramics)	Better dielectric & optical properties	Electronic substrates, integrated optics	Electronic components
B. Polymer Composites	Higher strength-to-weight ratio	Structural components	Aerospace, automotive, ind. const.
(high strength fiber reinforced plastic resin)	Design flexibility because of spatial asymmetry	Structural components	Aerospace, automotive, ind. const.
C. Metals	Improved strength & high-temp performance	Structural components Super conducting components	Manufactured components
(rapid solidification, & metal matrix composites)	Improved magnetic properties	Electro-magnetic equipment	Electrical machinery
2. Electronics			
A. Advanced Microelectronics	Improved performance in speed, size	Semiconductor devices	Electronic & optical components & systems
(enhanced VLSI and VHSIC chips)	Improved magnetic properties	Information storage	Information processing
	Higher efficiency photovoltaic conversion	Solar cells	Energy generation

Technology	What does it do new or better?	Applied to what products or processes?	Used by What Major Industries?
B. Optoelectronics (optical fiber and light wave processing)	Improved performance in speed, size, capacity, and security	Electronic equipment, information processing	Communications & computers
	Higher density information storage	Computer systems of all sizes	Computers
C. Millimeter Wave Technology	When replacing radio systems it frees RF spectrum for other uses	Voice & data communication systems	Telecommunications carriers & corporate use for private circuits
3. Automation			
A. Manufacturing (computer integrated and flexible systems)	Flexible reconfiguration of production processes	All manufacturing processes	All manufacturing
	Integrated control of all production operations		
B. Business and Office Systems (computer applications within an organization)	Efficient information storage, retrieval, & exchange	Networking, word processing, & data base management	All organizations
C. Technical Services (computer applications in the provision of commercial services)	Efficient high-volume information storage, retrieval & exchange	Information retrieval and distribution, data base management, education and training	Financial services, electronic mail, telecommunications, professional service

Technology	What does it do new or better?	Applied to what products or processes?	Used by What Major Industries?
4. Biotechnology			
A. Genetic Engineering	Improved diagnostic and therapeutic drugs	Health Services	Medicine, Pharmaceuticals
(design & production of highly selective agents)	Improved plants, pesticides, & animal supplements	Foods and pesticides	Agriculture Food processing
	Neutralize pollutants	Environmental control processes	Chemical manufacturing & treatment
B. Biochemical Processing	Improved control of chemical processes, outputs, and yields	Chemical separations and reactions, biosensors	Chemical manufacturing
5. Computing			
A. Computing Equipment	Faster, lower-cost computing	Information processing and computer control	Potentially all
(supercomputers, parallel processing, computer arch.)			
B. Artificial Intelligence Techniques	Improved computer replication of human judgment	Information processing and computer control	All applications using computers
(includes expert systems, natural language, and robotic control)			

K-6

Table 2

EMERGING TECHNOLOGIES RANKED BY ECONOMIC IMPACT

Group A	(Highest)	Advanced Materials; Composites Biotechnology; Genetic Engineering Electronics; Optoelectronics Electronics; Advanced Microelectronics Computing; Computing equipment Automation; Manufacturing
Group B		Automation; Business and Office Systems Biotechnology; Biochemical Processing Medical Technology; Drugs Advanced Materials; Ceramics Automation; Technical Services Computing; Artificial Intelligence Tech. Medical Technology; Devices
Group C		Thin Layer Technology; Membranes Advanced Materials; Metals Thin Layer Tech.; Surfaces & Interfaces Electronics; Millimeter Wave Technology

Appendix C.--List of High-Technology Manufacturing Industries
(By Standard Industrial Classification)

Industry group	SIC code	A	B	C	D	E	F
Industrial inorganic chemicals ----	281	x	x	x	x	x	
Plastic materials, synthetics -----	282	x	x	x	x	x	
Drugs ----------	283	x	x	x	x	x	x
Soap ----------	284		x	x			
Paints ----------	285		x	x			
Industrial organic chemicals ------	286	x	x	x	x	x	x
Other chemicals ----------	287		x	x		x	
Miscellaneous chemical products ---	289	x	x	x	x		
Petroleum refining ----------	291	x	x	x	x		
Reclaimed rubber ----------	303		x				
Ordnance ----------	348	x	x	x			
Engines and turbines ----------	351	x	x	x			
Construction, related machinery ---	353	x	x				
Metalworking machinery ----------	354		x				
Special machinery ----------	355			x			
General industrial machinery ------	356	x	x				
Office and computing machines -----	357	x	x	x	x	x	x
Electric distributing equipment ---	361		x	x	x	x	
Electrical industrial apparatus ---	362	x	x	x	x	x	
Radio/TV receiving equipment ------	365	x	x	x	x	x	
Communication equipment ----------	366	x	x	x	x	x	x
Electronic components ----------	367	x	x	x	x	x	x
Other electrical machinery --------	369			x	x	x	
Motor vehicles ----------	371				x	x	
Aircraft ----------	372	x	x	x	x	x	x
Railroad equipment ----------	374		x				
Missiles ----------	376	x	x	x	x	x	x
Instruments ----------	380	x	x	x	x	x	x

NOTES

A. Catherine Armington, Candee Harris, and Marjorie Odle, "Formation and Growth in High-Technology Businesses: A Regional Assessment," Brookings Institution, September 1983.

B. Amy Glasmeier, Ann Markusen, and Peter Hall, "Defining High-Technology Industries," Working Paper 407, Institute of Urban and Regional Development, University of California, Berkeley, June 1983.

C. Richard Riche, Daniel Hecker, and John Burgan, "High-Technology Today and Tomorrow: A Small Slice of the Employment Pie," Monthly Labor Review, Bureau of Labor Statistics, U.S. Department of Labor, User Group III, November 1983.

D. Above-average 1981 R&D expenses as percent of value added.

E. Above-average 1981 R&D expenses per thousand employees, National Science Foundation, Research and Development in Industry, 1981, 1983.

F. CBO report.

Source: Congress of the United States, Congressional Budget Office, Federal Support for High-Technology Industries, (Washington, DC: June 1985), p. 10.