

## MARTHA'S DAUGHTERS -- MIDDLE SCHOOL INTERVENTION

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### INTRODUCTION

Martha's Daughters -- who are they? Where can they be found?

The daughters of Martha can be found in any scientific or technological endeavor. They can be found in the hospital laboratory or at the nursing station; they can be found in the math or science classroom or in the academic setting of a university laboratory or lecture hall; they can be found on Wall Street, G Street, or Main Street. Their common bond is that they are not afraid of numbers, scientific facts, or "getting dirty."

We are all Martha's children, and we should be proud of that fact. Our "*alma mater*," Martha, was the one who served, and, yes, "whined," at Bethany almost two thousand years ago. Kipling tells us in his poem <sup>1</sup>, "Sons of Martha," that because she was snappish -- maybe even churlish -- her sons (and daughters!) were forever to serve Mary's sons. Of course Kipling wrote about the engineers of his day -- Roebing, Tesla, Edison, Westinghouse. The emergence of electrical power was pre-eminent in the minds of the educated population in 1907, and wondrous for everyone to behold. But women were still trying to obtain suffrage, and women's rights were nonexistent.

Today, some educational experts report in less than two decades, the workforce in the United States will be composed of 85% women and minorities. <sup>2</sup> This workforce must be more skilled than even today's workers. They will require more technical education; and, as we all know, in order to maintain the lifestyles to which our population has become accustomed, we will need to produce more scientists and engineers -- and they will come from the women and the minorities in our public schools today.

At Mississippi State University, the implementation of recruiting more women into science and engineering has been undertaken by the local (M.S.U.) Society of Women Engineers Student Section. This paper will discuss the evolution of the MADERA Project (Martha's Daughters -- Engineering Role model Activities). The activities and results of "MADERA - PHASE I" will be presented; and future *low-cost, high visibility* plans will be submitted.

## THE EVOLUTION OF MADERA

### The Need

In 1987, the writer was comparing the national averages of young women enrolled in undergraduate engineering curricula with the same statistics from Mississippi State University. It was discovered that over the years, enrollment of young women in the engineering programs at M.S.U. lagged 2% to 5% behind the national averages. The cause of these discrepancies could not be due to the programs at Mississippi State. This university has always been well respected among engineering educators. Our faculty and research staff have consistently been on the leading edge of technological development.

But, Mississippi is a *rural* state. The main source of income is farming; traditionally, the second source of income has been tourism. Many of our engineering graduates leave the state for other areas of the "sun-belt." Many of the schools in the state are in rural areas. Some high school graduating classes are composed of less than 50 young people. Calculus is taught in very few high schools, and most young women do not have the math background to take this course before college. Most high school students know very little about engineering; few actually know an engineer. The lack of visible role models is one of the problems which must be solved. To this end, a program which would introduce young women to the profession of engineering was formulated.

### The M.E.R.M.A.I.D. Proposal

The first "iteration" of the introduction of women engineers as role models to the young women of Mississippi was a proposal to the National Science Foundation, "M.E.R.M.A.I.D. - Mississippi's Engineering Role Model Activities - Initiation and Discovery." The proposal was based on a five year program which included summer camps for 7th and 8th grade women students, traveling "Engineering Fairs" to be held in the various school districts (with the exhibits designed and built by the members of the Society of Women Engineers, M.S.U. Student Section), and teacher-counselor workshops for middle-school educators. The project was not funded, but the dream lived on.

### The MADERA Project

During the academic year 1989-90, the proposal was reworked and presented to the administration of the College of Engineering. A new dean had been appointed who was, and is, interested in the recruitment of minorities and women into the study of engineering. He asked that the proposal be rewritten for possible funding from the M.S.U. Development Foundation, an alumni organization of the university.

Support was requested for employment of women engineering students for the summer. In addition, the decision was made to develop two documents and to present workshops for middle school math and science teachers. The

first document included a series of math and science educational materials; the second was a book of mini-biographies of women who have contributed to the technology which we enjoy today. Funding was received for "Phase I" of the MADERA Project. (The name had been changed in the Fall of 1989 after the discovery of the poem by Rudyard Kipling, "Sons of Martha.") A synopsis of the activities of Phase I will be given in the next section.

## RESULTS OF THE MADERA PROJECT - PHASE I

### Saturday Workshops

The proposal specified that 6 women engineering students be employed for the 10-week summer session (for 20 hours/week) to develop educational materials to be presented in workshops to 7th and 8th grade teachers in mathematics and science. These teachers were to be selected from school districts within a 90 mile radius of the university (the target area). Two Saturday workshops were held in July of 1990. Each of the women engineering students developed several sets of Math and Science educational materials. Each set was limited to one page (printed front and back, if necessary) so that the set could be copied by the teacher for distribution. Each set stated the problem, gave an example of math or science skills required to solve the problem, and presented an engineering application for the type of problem presented. In addition, the teachers were given solutions to the problems which required solutions.

Letters to principals of middle schools within the target area were sent the first of May, 1990. The principals were asked to nominate teachers in their schools for participation in the Saturday workshops. The proposal budget included mileage and meals for the participating teachers. Those who were nominated by their principals were enthusiastic about the workshops when contacted concerning choice of date. The women engineering students were involved with the workshop presentations, so there was interaction between the students and the teachers at the registration period and the lunch break. This was one of the most important aspects of the workshop presentations, and several of the teachers requested site visits by the students and faculty involved in the summer project.

### Martha's Daughters - A Book of Minibiographies

In addition to developing and writing the education materials for middle school math and science classes, the students researched and wrote "minibiographies" of women who have contributed to the quality of life which we know today. During this task, the women engineering students saw their courses of study in a completely different perspective. For the first time, they realized how dependent they were upon engineering for their life style; in addition, they realized that some of the women who developed new methods of scientific or engineering investigation "worked in a vacuum," and in many cases without rewards which we take for granted today. The biographical sketches

were a learning experience for all who were involved with the project. A limited number of the books were printed, and proceeds from the sale of the book will go to support of the Student Section of the Society of Women Engineers at M.S.U. and establishing a scholarship fund for young women from Mississippi.

### SHOESTRINGS AND BOOTSTRAPS – PLANS FOR THE FUTURE

The members of the M.S.U. Student Section of the Society of Women Engineers are committed to further promotion of engineering as a career option for young women. To this end, the section has decided to undertake middle school visitations in their home towns. A S.W.E. student will visit his/her hometown during the semester, and the student can take an extra day - with an excused absence for university business - to give a short presentation to math and science classes of their home town middle school. In addition, the student will leave a copy of the Instructional Materials developed in MADERA - Phase I with the sponsoring math or science teacher.

### PolyPopagons<sup>3</sup> – A Manufacturing Experience

The presentation which will be given by the women engineering students at their home town schools will be based on the idea that

*"Everything that a person has touched since waking has been ENGINEERED at some point in its development."*

Since most items which we use are manufactured, the idea of simulating a factory which makes a multisided solid figure called a "polypopagon" would present an ideal overview of engineering.

The S.W.E. student will give this overview of engineering based on the premise written above. The principles of geometry, precision, and motion along with the properties of the materials to be used will be stated concurrently with a demonstration of the fabrication of the polypopagon.

The students will be presented with rectangular pieces of cardstock, roughly 6-1/2" by 10-1/2". The students will be given a set of instructions which describes what they will do to turn the flat cardboard into a solid, dynamic object. At first the students will work individually – piece-work. Then, having previously been divided into teams, the responsibilities of scoring, folding, taping, and turning will be delegated to each member of the team. At the end of a short period of time, the teams will count the polypopagons produced. The team producing the most polypopagons will be awarded the rulers, ball point pens, and tape which were used in the process. The students will then be given (as time allows) the assignment of using the polypopagons produced by their team to form some sort of structure or sculpture for display in the classroom.

The supplies awarded to the winning teams will be replaced when the S.W.E. student returns to the campus. It is anticipated that the supplies may be donated by companies which support the Mississippi State University S.W.E. Student Section. The pre-cut cardstock will be purchased with funds from the student section treasury. So, the idea of a "shoestring" budget may be adapted by other student sections. In addition, the S.W.E. students should feel a sense of accomplishment at using some of their time at home for a worth-while cause.

The "polypopagon factory" has already been presented to 8th grade women students at a "Horizons-Unlimited" conference sponsored by a south Mississippi Community College. Most of the young women involved had a great time building and developing uses for the simple object. And, unfortunately, this was the first time that most of these students had actually met an engineer.

## DISCUSSION AND RECOMMENDATIONS

### The Communication Gap

Engineering is an exciting profession. It is, perhaps, one of the few professions which allows a certain amount of economic freedom after the completion of a four year course of study at an accredited university. The profession of engineering may not be as glamorous as the legal profession, or as invitingly altruistic as the medical profession, or as caring as the ministry. Engineering actually combines all of these attributes. So, why aren't more young people choosing engineering as a course of study?

In a way, the blame may be laid at the feet of all practicing engineers. Everyone who graduates in engineering is not an Einstein -- but many of us act as though what we do in practice is much too complicated for anyone to understand. "Buzz-words" and acronyms litter the professional (and sometimes social) conversations of engineers. In "rural" Mississippi there are engineers in almost every town, because most towns have some sort of manufacturing operation. If our young people do not know any engineers, it is the fault of the individuals who comprise the profession.

Practicing engineers -- even teaching engineers -- are "simplifiers" and "problem-solvers." The inability to communicate "what an engineer does" may be a form of elitism, or just laziness. The profession of engineering is exciting and rewarding. These facts should be disseminated more widely.

A currently popular comedienne, in promoting her television show, describes herself as "a do-mestic engineer." In his book, Beyond Engineering, Henry Petroski states that, "the archetypal girl who bakes cookies and sews dresses is in fact doing quintessential engineering." <sup>4</sup> As we all know, this "archetypal" girl is only imitating her archetypal mother. And the mothers of this world -- especially in this modern age of two-income or single parent families -- are truly amazing.

A mother is a C.E.O., C.F.O., arbiter, negotiator, and transportation officer for the modern family. If a young woman aspires to running a home, it is not too different than running a small corporation. There is little wonder that a woman engineer is very capable of balancing home, family, and profession. Those who say they knew no engineers before college have no further to look to find themselves caught in a "mispeak" than their own mother's kitchen. Women have a natural talent for organizing and problem solving. The word needs to be spread!

### Recommendations

As Women's Engineering Program Advocates, whether or not we have an engineering degree, we need to talk more about the engineering profession. Several strategies are listed below which may be helpful.

1. Get involved with youth organizations. Take them on field trips to university research labs or local manufacturing plants. Join your local P.T.A./P.T.O. even if you don't have children of school age in residence. Become a resource person.
2. Coerce your professional engineering colleagues to talk to young people in schools and/or youth groups and to simplify their current research/consulting/teaching duties so that any audience can understand.
3. Gather information about the current research activity at your school. Tell your young audiences how it can change their lives. Relate this activity to what they are studying in school.
4. Simplify your "tech-speak." Twelve-year olds don't care about thermodynamics, but they understand cooking and freezing.

This organization has the enthusiasm. We need to "infect" our colleagues. More women in engineering? The DREAM still lives!

### References

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