STUDENT PROJECT

ON

WOMEN MATHEMATICIANS - I

Submitted by

G. NAVYA SRI **Y191028092**

VISSA PALLAVI **Y191028070**

Under the Guidance of
Dr. S.V.S. Girija
Lecturer in Mathematics

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WOMEN MATHEMATICIANS - I

May 16, 1718 - January 9, 1799

Written by Elif Unlu, Class of 1995 (Agnes Scott College)

Even though her contribution to mathematics are very important, Maria Gaetana Agnesi was not a typical famous mathematician. She led a quite simple life and she gave up mathematics very early. At first glance her life may seem to be boring, however, considering the circumstances in which she was raised, her accomplishments to mathematics are glorious. Enjoy!

During the Middle Ages, under the influence of Christendom, many European countries were opposed to any form of higher education for females. Women were mostly deprived from the fundamental elements of education, such as reading and writing, claiming that these were a source of temptation and sin. For the most part, learning was confined to monasteries and nunneries which constituted the only opportunity for education open to girls during the Middle Ages. After the fall of Constantinople (today Istanbul), many scholars migrated to Rome, bringing Europe knowledge and critical thinking, which in turn gave rise to the Renaissance. However, except in Italy, the status of women throughout Europe changed very slowly.

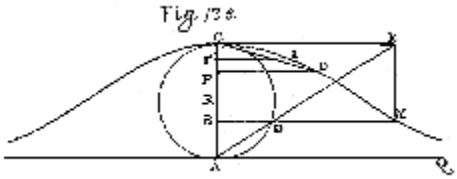
In Italy, however, where the Renaissance had its origin, women made their mark on the academic world. Intellectual women were admired by men, they were never ridiculed for

being intellectual and educated. This attitude enabled Italian women to participate in arts, medicine, literature, and mathematics. Among many others, Maria Gaetana Agnesi was by far the most important and extraordinary figure in mathematics during the 18th century.

"Maria Gaetana Agnesi was born in Milan on May 16, 1718, to a wealthy and literate family" [Osen, 39]. She was the oldest of 21 children. Her father was a professor of mathematics and provided her a profound education. "She was recognized as a child prodigy very early; spoke French by the age of five; and had mastered Latin, Greek, Hebrew, and several modern languages by the age of nine. At her teens, Maria mastered mathematics" [Osen, 40]. The Agnesi home was a gathering place of the most distinguished intellectuals of the day. Maria participated in most of the seminars, engaging with the guests in abstract philosophical and mathematical discussions. Maria was very shy in nature and did not like these meetings. She continued participating in the home gatherings to please her father until the death of her mother. Her mothers death provided her the excuse to retire from public life. She took over management of the household. Her father did not oppose this, because it was difficult and expensive to find a housekeeper to take care of 21 children and a lonely man. It is possible that this heavy duty job was one of the reasons why she never married.

However, she did not give up mathematics yet. In 1738 she published a collection of complex essays on natural science and philosophy called *Propositiones Philosophicae*, based on the discussions of the intellectuals who gathered at her father's home. In many of these essays, she expressed her conviction that women should be educated.

By the age of twenty, she began working on her most important work, *Analytical Institutions*, dealing with differential and integral calculus. "It is said that she started writing *Analytical Institutions* as a textbook for her brothers, which then grew into a more serious effort" [Osen, 41]. When her work was published in 1748, it caused a sensation in



the academic world. It was one of the first and most complete works on finite and infinitesimal analysis. Maria's great contribution to mathematics with this book was that it brought the works of various mathematicians together in a very systematic way with her own interpretations. The book became a model of clarity, it was widely translated and used as a textbook.

Analytical Institutions gave a clear summary of the state of knowledge in mathematical analysis. The first section of *Analytical Institutions* deals with the analysis of finite quantities. It also deals with elementary problems of maxima, minima, tangents, and inflection points. The second section discusses the analysis of infinitely small quantities. The third section is about integral calculus and gives a general discussion of the state of the knowledge. The last section deals with the inverse method of tangents and differential equations.

Maria Gaetana Agnesi is best known from the curve called the "Witch of Agnesi" (see illustration from her text *Analytical Institutions*). Agnesi wrote the equation of this curve in the form y = a*sqrt(a*x-x*x)/x because she considered the x-axis to be the vertical axis and the y-axis to be the horizontal axis [Kennedy]. Reference frames today use x horizontal and y vertical, so the modern form of the curve is given by the Cartesian equation $yx^2=a^2(a-y)$ or $y = a^3/(x^2 + a^2)$. It is a versed sine curve, originally studied by Fermat. "It was called a versiera, a word derived from the Latin vertere, meaning 'to turn', but it was also an abbreviation for the Italian word avversiera, meaning 'the wife of the devil'" [Osen, 45]. However, when Maria's text was translated into English the word versiera was confused with "witch", and the curve came to be known as the witch of Agnesi.

After the success of her book, Maria was elected to the Bologna Academy of Sciences. The university sent her a diploma and her name was added to the faculty. However, there is a debate over whether or not Maria accepted this appointment. The consensus is that she accepted the position and served at the university until the death of her father. It seems that her father was the inspiration for her interest in mathematics. When he died, Maria gave up any further work in mathematics. "When, in 1762, the University of Turin

asked her for her opinion of the young Lagrange's recent articles on the calculus of variations, her response was that she was no longer concerned with such interests" [Osen, 47].

Maria was a very religious woman. She devoted the rest of her life to the poor and homeless sick people, especially women. When the Pio Instituto Trivulzo, a home for the ill and infirm, was opened, Maria was given an appointment as the director of the institute. She took care of ill and dying women until her own death.

It seems to me that even though she was a genius, mathematics was only a temporary hobby of hers. It may be that she was only dealing with mathematics to please her father who apparently was expecting his prodigy child to be involved in mathematics. Of course, this is only a personal observation. However, her behavior implies that she was not dedicated to mathematics which I think explains why she gave up mathematics altogether as soon as her father died. She was a very shy and decent person. She was not ambitious to become a well-known mathematician. Her most famous work, *Analytical Institutions*, was intended to be a textbook for her brothers. Her intelligence and talent made it possible to integrate all the state of the art knowledge about calculus in a very clear way. Religious life and helping the needy seem to have interested her more than mathematics.

April 1995

Notes by Larry Riddle

Maria Gaetana Agnesi's younger sister, Maria Teresa Agnesi, was a composer, harpsichordist, singer and librettist. She was born on October 17, 1720. While still a teenager, she would perform in her home while her older sister lectured and debated in Latin. Her first theatrical work, Il ristoro d'Arcadia, was successfully presented in Milan in 1747. She wrote seven operas of which three were based on her own librettos. The Empress Maria Theresia was known to sing from a collection of arias that Maria Teresa

Agnesi had composed for her. In 1752 she married Pier Antonio Pinottini but had no children. She died on January 19, 1795. Her portrait hangs today in the theatre museum of La Scala.

Here are three of the keyboard pieces composed by Maria Teresa Agnesi. To listen to these pieces you will need to configure your browser to play midi files.

Sonata per il Clavicembalo (Allegro and Menuet)
Sonata in G Major
Allegro ou Presto in A Major

The Canadian composer Elma Miller has written a work called "The Witch of Agnesi" for B flat clarinet, bass clarinet, horn, 2 percussion, viola and double bass. The work was commissioned by the Alliance for Canadian New Music Projects and was first performed in late October 1989 in Toronto. Despite its premier performance so near Halloween, the inspiration for the piece was the curve of Maria Agnesi!

2.Florence Eliza Allen

October 4, 1876 - ??

Florence Allen was born on October 4, 1876 in Horicon, Wisconsin. She received her undergraduate and master degrees at the University of Wisconsin in 1900 and 1901, respectively. In 1907 she became the second woman to receive a Ph.D. in mathematics at the University of Wisconsin-Madison, and the fourth Ph.D. overall from that department. Her thesis was entitled "The cycle involutions of third order determined by nets of curves of deficiency 0, 1, and 2." It was published in the Quarterly Journal of Mathematics, Vol. 45 (1914) [Abstract]. She remained at the University of Wisconsin as an instructor in

mathematics for the next thirty years, publishing two more papers on "A Certain Class of Transcendental Curves" and "Closure of the Tangential Process on the Rational Plane Cubic". She was a member of the Phi Beta Kappa Society.

3.Annie Dale Biddle Andrews

December 13, 1885 - April 14, 1940

Annie Dale Biddle was born in Hanford, California, the youngest child of Samuel E. Biddle and A. A. Biddle. She received her B.A. degree from the University of California in 1908, and in 1911 she became the first woman to receive a Ph.D. in mathematics from the University of California at Berkeley. Her dissertation was on "Constructive theory of the unicursal plane quartic by synthetic methods" [Abstract].

Biddle was an instructor in mathematics at the University of Washington in 1911-1912. On October 7, 1912 she married Wilhelm Samuel Andrews. They had a daughter, born in 1913, and a son, born in 1919. Annie Andrews was an instructor in mathematics at the University of California during various years between 1915 and 1932. For example, during 1922-23 she taught Mathematical Theory of Investment; Plane Analytic Geometry and Differential Calculus; Solid Analytic Geometry, Integral Calculus, and Infinite Series; College Algebra; and Introduction to Projective Geometry. About 1933 she presented a research paper at a meeting of the American Mathematical Society in Palo Alto, which was published in the Society's journal. After a two year illness, she died on April 14, 1940, survived by her husband and two children. During the last four years of

her life, in addition to her mathematical research, she took an active interest in public affairs and charitable work.

4.Hertha Marks Ayrton

April 28, 1854 - August 23, 1923

Phoebe Sarah Marks was born in Portsea, England in 1854. She changed her first name to Hertha when she was a teenager. After passing the Cambridge University Examination for Women with honors in English and mathematics, she attended Girton College at Cambridge University, the first residential college for women in England. Charlotte Scott also attended Girton at this time, and she and Marks helped form a mathematics club to "find problems for the club to solve and 'discuss any mathematical question that may arise'" [1]. Marks passed the Mathematical Tripos in 1880, although with a disappointing Third Class performance. Because Cambridge did not confer degrees to women at this time, just certificates, she successfully completed an external examination and received a B.Sc. degree from the University of London.

From 1881 to 1883, Marks worked as a private mathematics tutor, as well as tutoring other subjects. In 1884 she invented a draftsman's device that could be used for dividing up a line into equal parts as well as for enlarging and reducing figures. She was also active in devising and solving mathematical problems, many of which were published in the Mathematical Questions and Their Solutions from the "Educational Times". Tattersall

and McMurran write that "Her many solutions indicate without a doubt that she possessed remarkable geometric insight and was quite a clever student of mathematics."

Marks began her scientific studies by attending evening classes in physics at Finsbury Technical College given by Professor William Ayrton, whom she married in 1885. She assisted her husband with his experiments in physics and electricity, becoming an acknowledged expert on the subject of the electric arc. She published several papers from her own research in electric arcs in the Proceedings of the Royal Society of London and The Electrician, and published the book *The Electric Arc* in 1902. According to Tattersall and McMurran,

The text included descriptions and many illustrations of her experiments, succinct chapter reviews, a comprehensive index, an extensive bibliography, and a chapter devoted to tracing the history of the electric arc. Her historical account provided detailed explanations of previous experiments and results involving the arc and concluded with the most recent research of the author and her colleagues...The book was widely accepted as *tour de force* on the electrical arc and received favorable reviews on the continent where a German journal enthusiastically praised if for its clear exposition and relevant conclusions.

Hertha Ayrton had been elected the first female member of the Institution of Electrical Engineers in 1899. In 1902 she became the first woman nominated a Fellow of the Royal Society of London. Because she was married, however, legal counsel advised that the charter of the Royal Society did not allow the Society to elect her to this distinction (this advice was reversed in 1923, but the first woman was still not admitted to the Royal Society until twenty years later.) However, in 1904 Ayrton did become the first woman to read her own paper before the Royal Society. This paper was on "The origin and growth of ripple-mark" [Abstract] and was later published in the Proceedings of the Royal Society. In 1906 Ayrton received the Royal Society's Hughes Medal for her experimental investigations on the electric arc, and also on sand ripples. She was the fifth recipient of this prize, award annually since 1902 in recognition of an original discovery in the

physical sciences, particularly electricity and magnetism or their applications, and as of 2005, the only woman so honored.

After her husband's death in 1908, Ayrton continued her research. One set of experiments validated Lord Rayleigh's mathematical theory of vortices. She also invented a fan that could create spiral vortices to repel gas attacks. These became known as Ayrton fans, but were never widely used.

Ayrton was an active member of the Woman's Social and Political Union and participated in many suffrage rallies between 1906 and 1913. She was a founding member of the International Federation of University Women and the National Union of Scientific Workers. She served as vice-president of the British Federation of University Women and vice-president of the National Union of Women's Suffrages Societies. Two years after her death in 1923, her lifelong friend Ottilie Hancock endowed the Hertha Ayrton Research Fellowship at Girton College.

Clara Latimer Bacon

August 23, 1866 - April 14, 1948

Clara Latimer Bacon was born in Hillsgrove, McDonough County, Illinois of a pioneer New England family. She was graduated from Hedding College, Abingdon, Illinois in 1886. After a year of teaching she entered Wellesley College. In 1890 she received her

B.A. degree from Wellesley College, then taught secondary school in Kentucky for one year and in Illinois for five years. In 1897, at the invitation of Dr. Goucher, she began teaching at the Women's College of Baltimore (now Goucher College) as an instructor of mathematics. She arrived in Baltimore with her sister Agnes, their mother, and servant, Ida Lindsay, who took care of Clara for the rest of her life. During her time at Goucher she continued her graduate studies at the University of Chicago during the summer quarters from 1901-1904, earning a master's degree from the University of Chicago in 1904 with a thesis on " The determination and investigation of the real chords of two conics which intersect fewer than four real points." In October 1907 she began graduate work at Johns Hopkins University in mathematics, education and philosophy. A fellowship from the Baltimore Association for Promotion of University Education of Women allowed her to spend the 1910-1911 academic year at the university. In 1911 she became the first woman to receive a Ph.D. in mathematics from Johns Hopkins University. Her dissertation was on "The Cartesian oval and the elliptic functions p and σ," later published in the American Journal of Mathematics, Vol. 35, No. 3. (July, 1913), pp. 261-280. [Abstract]

Bacon was promoted to associate professor at Goucher in 1905 and to full professor in 1914. She continued to teach at Goucher College until her retirement in 1934 as Professor Emeritus of Mathematics. She was by all accounts an outstanding teacher. One student wrote of her [4]:

She believed in us so simply and so deeply that we could not disappoint her. When she felt that circumstances prevented us from doing all she hoped, she tried to change the circumstances. It was her support that made graduate study possible for me. Her patience and understanding as a teacher opened up the beauty of mathematics. For many years her faith in all of us made life seem good.

At least eight of her students went on to earn the Ph.D. degree in mathematics, including Marguerite Lehr. Lehr writes in the Goucher Alumnae Quarterly [3]:

The four college years for this particular math major at now a curious mixture of memories of Dr. Bacon—of "Freshman Analyt" (in Katy Hooper, of course), boardsfull of figures for "projective," deep despair over Invariants, and after-class consultations on Dr. Scott's book (those sessions known as the after-math); but also of picnics at Herring Run, tea at 231 6 with Ida reassuringly at the door, and of 1919's *Donnybrook* with its page "There are smiles" headed by Dr. Bacon herself. The fifteen years since have added new details, but they have given color to the old ones, showing them as only part of what Dr. Bacon has brought to year after year of students. Going back to college means seeing Dr. Bacon if only for a second, to say how work is going; to have the spur of her satisfaction if it is going well, and the support of her understanding if the road is hard.

Bacon was a member of the American Mathematical Society and the Mathematical Association of America, serving for a time as president of the Maryland-Virginia section of the MAA. She served for many years on the College Entrance Examination Board. In addition, Bacon was involved with several associations for peace as well as the Foreign Policy Association and the League of Women Voters.

2. Grace Marie Bareis

1875 - June 15, 1962

Born in Canal Winchester, Ohio. Received her A.B. degree (first honors) from Heidelberg College, Tifton, Ohio in 1897. She was a graduate student at Bryn Mawr College from 1897 to 1899 and also did graduate work at Columbia University. From 1902 until 1906 she taught mathematics and science at Miss Roney's School in

Philadelphia, PA. She then became a graduate student at The Ohio State University, and in 1909 became the first person (male or female) to receive a Ph.D. in mathematics from The Ohio State University. Her dissertation was on "Imprimitive Substitution Groups of Degree Sixteen" [Abstract], written under the supervision of Harry W. Kuhn and published by the Lancaster Press, Lancaster, PA. Bareis became an assistant professor of mathematics at The Ohio State University in 1908. She taught at Ohio State until her retirement in 1946. However, she continued to teach for two years after her retirement because of the shortage of mathematics instructors to teach the returning veterans.

In December, 1915, Bareis attended the organizational meeting for the purpose of establishing the Mathematical Association of America. It was at this meeting that the assoocations's constitution and by-laws were approved. Bareis was a charter member of the Mathematical Association of America, as well as a member of the American Mathematical Society. In addition, she was also a member of the Daughters of the American Revolution. In 1935 Bareis was appointed to the Board of Trustees of Heidelberg College.

In 1948 Bareis gave $2000 to The Ohio State University for a fund to award prizes on the basis of written contests open to sophomores at Ohio State. The first Grace M. Bareis Mathematical Prize was given in 1949. Information about the Bareis Competition is available at http://www.math.ohio-state.edu/undergraduate/RBG/about/.

3. Nina Karlovna Bari

November 19, 1901 - July 15, 1961

Written by Giota Soublis, Class of 1998 (Agnes Scott College)

Nina Karlovna Bari was a woman whose contribution to mathematics was great. She lived in a period when mathematics started to become more and more popular in Russia. She gained the respect from all mathematicians of her time not only because of her work but also because of her excellent personality.

Bari was born on November 19, 1901 in Moscow, Russia. She was a woman who developed great mathematical abilities and skills while she was in high school. After high school she attended Moscow State University, and she was its first woman student. At Moscow State, she became a member of several mathematical groups. In 1918 she joined a group called "Luzitania." It was a group of students who followed Nikolai Nikolaevich Luzin's mathematical ideas. Luzin was a professor at Moscow State University. ["Luzitani" came from his name] The members of that group were called "Luzitanians" and their goal was to investigate the mathematical field of function theory. Even after the group broke up, Bari decided that function theory was going to be the major subject in her research. Bari was a very good student at Moscow State. For that reason she graduated early in 1921, and she started working as a teacher at the Moscow Forestry Institute and the Communist Institute. Shortly after she began teaching, the Research Institute of Mathematics and Mechanics opened at Moscow University. She became a student at the Institute to do research on trigonometric series, while at the same time she continued to teach. She specifically focused on the analysis of various trigonometric series. She was eager to solve the problem of the uniqueness of trigonometric series. "The basic question in her thesis was: Under what conditions is a trigonometric development of a given function unique?" (Women of Mathematics, A Bibliographic Sourcebook, p.10) In 1922, she presented her principal conclusions on trigonometric series to the Moscow Mathematical Society (the first woman to do so). In 1923, she published those results. In 1926, she was given the Glavnauk Prize for her explanations to various difficult problems on trigonometric functions.

The same year she went abroad to study. She studied and worked for six months at the Sorbonne and the College De France in Paris. One year later she visited Lvov, Poland, where she attended the Polish Mathematical Congress. In 1928 she went to Bologna, Italy. There she gave speeches at the International Congress of Mathematics. Later the same year, she was awarded the Rockefeller bonus which gave her the great chance to continue her studies in Paris until 1929. By 1935 she had progressed into a very well established professor. She really enjoyed being a teacher and she participated in many mathematical seminars. One of them was the Third-All Union Congress in Moscow in 1956 where Bari gave lectures about her work on trigonometric series. She also gave many other lectures at the Moscow Polytechnic Institute, Sverdlov Communist University and the Moscow Lenin State Pedagogical Institute. In 1935, she was awarded the degree of Doctor of the Physical-Mathematical Sciences.

In 1952, Bari published a remarkable article on primitive functions and trigonometric series converging almost everywhere. "A primitive of a function f(x), defined on an interval [a,b], is any continuous function F(x) for which F(x)=f(x) almost everywhere on [a,b]." (Women of Mathematics, A Bibliographic Sourcebook, p.10) In that article Bari tried to prove that "every function that is finite and measurable almost everywhere has a primitive whose Fourier series, differentiated term by term, converges to the function almost everywhere." (Women of Mathematics, A Bibliographic Sourcebook, p.10) She also obtained significant results about properties of orthogonal and biorthogonal systems. Some of those systems were the Bessel system, Hilbert system, and Riesz-Fischer system. Bari also wrote a monograph of nine hundred pages. In this book she talked about all kinds of problems involving trigonometric series. Her monograph has become the basic reference for all mathematicians focusing on the theory of functions and the theory of series.

Bari was considered to be the principal leader of mathematics at Moscow State University. She helped many students earn their Ph.D. and improve their theses. She did everything she could to give to others the spirit of her work. Besides mathematics, Bari had other interests too. She used to hike and be a tourist and she really liked poetry and music.

Her death on July 15, 1961 was a lost to all mathematicians. She was a special person and even now is known and remembered for her marvelous work.

December 1995

4. Ruth Aaronson Bari

November 17, 1917 - August 25, 2005

Ruth Bari earned a Master's degree at John Hopkins in 1943 but because of work and family responsibilities, did not complete her Ph.D. until 1966. Her dissertation was on "Absolute reducibility of maps of at most 19 regions" [Abstract]. She taught at George Washington University until her retirement in 1988. Her work in graph theory has been recognized as influential, especially in the area of chromatic polynomials. One of her three daughters is Gina Kolata, one of the nation's best known science journalists covering mathematics and science for the New York Times. Following is an essay about her mother that Gina Kolata graciously agreed to write for this web site in 1997. Ruth Bari died in 2005 of complications from Alzheimer's disease.

By Gina Kolata

My mother, Ruth Bari, does not have a computer in her house--and she never uses one. She does not have e-mail; she has never surfed the internet. And she prefers printing the abstracts she still writes for Mathematical Reviews, with her careful slanting handwriting, to typing them on a typewriter.

But although times have changed and technology has invaded our world, my mother's story has resonance still. It shows, I believe, how a passion for mathematics, along with an inborn gift for the subject, can overcome quotidian obstacles.

Mathematics always came easily to my mother. When she was in high school in Brooklyn, she effortlessly got a nearly perfect score on the New York Regents exam, a tough test designed to weed out the talented from the mediocre. But she knew nothing of the depths of the subject. She honestly believed that mathematics ended with calculus.

At Brooklyn College, she learned otherwise, and after taking a course in abstract algebra, she fell in love with the beauty and purity of the subject and decided to major in mathematics. In fact, after graduating from college, she even decided to get a Ph.D., enrolling in a doctoral program at Johns Hopkins University.

But the end of World War II changed her plans. The women in the graduate program were asked to give up their fellowships so that the men, returning from the armed forces, could continue their studies, and my mother complied, leaving Johns Hopkins with a master's degree.

She spent the next period of her life raising me and my two sisters, encouraging us to find a subject that enthralled us and to pursue it, paying no heed to whether there would be a job for us at the end of our studies. Although I suspect she would have been delighted if one of us had become a mathematician, none of us had her talent. But she supported us with no reservations in the fields we did select. I became a journalist at the New York Times, my sister Judi became an environmental activist with Earth First and Martha became an art historian.

When I was in high school, my mother decided to fulfill her dream and get a Ph.D., in mathematics. She applied to Johns Hopkins, which admitted her provisionally. She had to re-do the course work for a master's degree, both to show she could still do mathematics and to make sure she had the preparation she would need for her doctoral research. She did it--working in the wee hours of the night when the house was quiet and no one would interrupt her. Then she went on to get a Ph.D. She was 47 years old.

Her thesis, I'm told, was extraordinary. Shortly after she got her degree, William Tutte, a renowned mathematician in her field, invited her to spend two weeks in his department at the University of Waterloo in Canada, lecturing on her work. He paid all of her expenses and gave her $500 a week, which, my father reminds me, was quite a lot of money in those days.

The next task was to find a job as an academic. My mother only applied to universities in the Washington, D.C. area, where we lived. But it was a halcyon time for academics and she had job offers from nearly every school she applied to. She selected George Washington University and in a few years, as a testiment to her research, she was promoted to full professor. She remained there for the rest of her career, teaching and doing research until she was forced by the law at the time to retire at age 70.

My mother loved every aspect of academic life. I asked her more than once if she ever got bored teaching the same subjects over and over. Oh no, she would say. Every class is different.

And my mother relished her life as a researcher. Every graduate student was a pleasure, every conference an honor and a joy. She has delighted in her life, and seized opportunities as they arose, even if it meant getting a Ph.D. at an age when most academics are already full professors. Could every woman who likes mathematics pull this off? I doubt it. But, as my mother would be sure to tell you, in her romantic way, what matters most is that you follow your heart.

5. Mabel Schmeiser Barnes

July 29, 1905 - February 22, 1993

Mabel Schmeiser was born in Wapello, Iowa. She always enjoyed mathematics, beginning with her education in a one-room country school in Iowa. She entered Cornell College, however, with the intention of majoring in Latin. Taking calculus changed her mind and she graduated from Cornell in 1926 with a B.A. degree in mathematics. She received her M.A. degree from the University of Wisconsin in 1928, and her Ph.D. from the Ohio State University in 1931 with a dissertation on "Some Properties Of Arbitrary Functions Concerning Approach To A Straight Line" under the direction of Henry Blumberg. This was published in *Fundamenta Mathematicae*, Vol. 22 (1934) [Abstract].

After graduation, a temporary job as acting department chair at Nebraska State Teachers College stretched into three years. In 1933 Schmeiser became one of two young women accepted into the first group of mathematicians at the newly opened Institute for Advanced Study in Princeton (Anne Stafford was the other). At an AWM panel in 1988, Schmeiser said about this experience [1]:

"Even in remote Nebraska I heard about a place called the Institute for Advanced Study opening in far away Princeton. I applied for admission and was accepted. For some years the School of Mathematics was the only School of the Institute and was housed with the mathematics department in Fine Hall at Princeton. Soon after I arrived the Director of the School of Mathematics took me aside and warned me that Princeton was not accustomed to women in the halls of learning and I should make myself as inconspicuous as possible. However, otherwise I found a very friendly atmosphere and spent a valuable and enjoyable year there. Had I not gone east, I would not have met Olga Taussky as early as I fortunately did."

It was during her year at the Institute that Schmeiser met John Barnes, a Ph.D. graduate student in mathematics at Princeton. They were married a year later after Mabel spent time as a substitute math teacher in a New York City high school. Mabel moved to Massachusetts where her husband was an assistant professor at Tufts College. There she was able to attend the mathematics colloquia at Harvard University. Their son was born

in 1936 and a daughter a few years later. Though she had no official position at Tufts, Barnes helped her husband by grading papers and teaching for him when he was away. She also assisted in editing the mathematics sections of the second edition of Oval Eshbach's *Handbook of Engineering Fundamentals*. During World War II the Barnes moved back to Princeton while John Barnes worked at Bell Labs. They returned to Tufts after the war ended and John became chairman of the Department of Applied Mathematics. As Mabel said in her AWM talk,

"By that time there was a heavy influx of war veterans. The afternoon before classes were to begin [John] came home and said 'Mabel, you'll be teaching in the morning.' It seemed that no man could be found, the last lead having just failed. Nepotism and my being a woman were overlooked. Desperation again overcame prejudice. I was rehired for the next year."

John Barnes joined the College of Engineering at UCLA in July, 1947, and the family moved to California. In 1950 Mabel was hired by Occidental College as an Instructor by Special Appointment for one semester. That one semester turned into a 21 year career at Occidental until her retirement in 1971 as Professor Emerita of Mathematics. John Barnes died in 1976. At that time of Mabel Barnes' death in 1993, Professor Benedict Freedman presented the following memorial tribute to the Board of Trustees and the Occidental Faculty:

"Her versatility, her mathematical ability, and her enthusiasm for teaching quickly made the appointment permanent. She had a deep understanding of young people, their hopes and their problems, and guided them not only into successful careers but in many cases better lives. She brought to her classes many innovations in pedagogy that today are being rediscovered as major advances, such as undergraduate research, emphasis on problem-solving, and group study. In a day when it was unpopular, she tirelessly promoted careers for women in mathematics. The culmination of this work was an address she gave to the centennial meeting of the American Mathematical Society in 1988, celebrating women in mathematics. In her department she was a loyal, dependable, and congenial coworker, especially dedicated to projects such as Math Field Day which

advanced the interests of the entire mathematical community. This continued in her years after her retirement, and her home was always open to colleagues and former students, who will miss her but not forget her.

The Barnes's daughter, Lynne Barnes Small, received her Ph.D. in mathematics from Yale University in 1967. She is now a professor of mathematics at the University of San Diego.

Sharon Menard

Other Resources on Women Mathematicians and Scientists

- Books and Articles about Women in Mathematics
- Association for Women in Mathematics
  Home page for the AWM
- European Women in Mathematics
  EWM is an affiliation for women bound by a common interest in the position of women in mathematics. The organization was founded in 1986 and has its office in Helsinki, Finland.
- Emmy Noether Lecturers
  Profiles of the women who have given the Emmy Noether lectures for the Association for Women in Mathematics.
- Biographies of Women Mathematicians at the AWM web site.

- MacTutor History of Mathematics
  Biographies of many mathematicians, including a growing list of biographies of women mathematicians.
- The Davis Archives: Mathematical Women in the British Isles, 1878-1940
  This archive contains details of the approximately 2500 women who graduated in mathematics from universities in Britain and Ireland before 1940.
- Math Medley
  From the archives of the weekly radio show hosted by Professor Pat Kenschaft. Discussions with Judy Green ("Women in Mathematics"), Gloria Hewitt ("From My Life and Thoughts"), Jean Taylor ("The Many Facets of Mathematics"), Evelyn Boyd Granville ("Looking Back...Looking Forward"), James Tattersall ("Women in Mathematics"), and Gloria Gilmer ("Ethnomathematics"), among many others.
- Black Women in Mathematics
  Web page by Scott William describing the first thirty years of Black Women doctorates in Mathematics, with information about the women and other interesting and important historical occurences.
- A Brief History of Women and Mathematics at Wisconsin
  A chronological list of some women mathematicians who received their PhDs at the University of Wisconsin. Also includes a list of all women who received a PhD in mathematics from Wisconsin.
- 4000 Years of Women in Science
  The stories of creative women of the past. This includes inventors, scholars and writers as well as mathematicians and astronomers.
- Distinguished Women of Past and Present
  This site has biographies of women who contributed to our culture in many different ways. There are writers, educators, scientists, heads of state, politicians, civil rights crusaders, artists, entertainers and others. Some were alive hundreds of years ago and some are living today.
- The Ada Project
  A collection of resources about women in computing.

- Women In Mathematics
  A web service from the Canadian Mathematics Society for the promotion and celebration of women in mathematics.
- Posters Celebrating Women in Mathematics, created in honour and recognition of some of the world's renown female mathematicians, as part of the displays during the Workshop "Connecting Women In Mathematics Across Canada," December 7-8, 2006 at the Fields Institute, Toronto, Canada.
- History of Mathematics
  Links to many topics in the history of mathematics. maintained at Clark University.
- Women in Math (WIM) at UMCP
  Women in Math is an organization at the University of Maryland College Park dedicated to serving the needs of women mathematicians.
- ECHO Science and Technology Virtual Center
  This site was established to catalog, annotate, and review sites on the history of science, technology and medicine. It includes a section on mathematics.
- Women of Science at the Marine Biology Laboratory (Woods Hole Inst.)
  Features women scientists representative of the many distinguished women who studied at the MBL in its earliest days.
- Women of NASA
  The "Women of NASA" resource was developed to encourage more young women to pursue science and math based fields.
- Contributions of 20th Century Women to Physics
  An archive presenting and documenting some important and original contributions made before 1976 by 20th century women.
- Archives of Women in Science and Engineering
  The Iowa State Univesity Library documents the history of women in science and engineering--their social history as well as the story of their scientific achievements.

- Women Nobel Prize Laureates
  A list of all the women who have won the Nobel Prize, with links to other sources and organizations about women in science.