Mathematics is the most beautiful
and most powerful creation of the human spirit.
Stefan Banach (Polish mathematician)

Maria Gaetana Agnesi – Italian mathematician

Series: Woman Professors – Super Heroines
Chapter/Part no: 20

In 220 anniversary of death of the Heroine!

Suggested/Cited Book:

Rachel Swaby: HEADSTRONG: 52 woman who changed science and the world, Polish translation: "Upór i przekora, 52 kobiety, które odmieniły naukę I świat" Wydawnictwo Agora, Warszawa, 2017, pages: 223-226.

The Chapter is prepared based on notes delivered by Professors Tullia Norando & Paola Magnaghi-Delfino:

This the 20th part of the series and the second one written in English. The text was inspired by the paper presented during the Conference "APLIMAT'2019" held yearly in Bratislava, Slovakia. The Heroine is Italian mathematician from XVIII century which fact is unusual and extremely interesting itself.

The above mentioned book encloses the short biographies of women in science – in our case, related to current Heroine, just 4 pages. The presented text (of the series) was also created based on the data found in some papers (listed underneath) which could be downloaded via the useful scientific text browser 'scholargoogle.com'.

Maria Gaetana Agnesi[1] was born in Milan in 1718. Her family was wealthy and literate. Her father Pietro Agnesi, a wealthy silk merchant, wanted to elevate his

[1] https://pl.wikipedia.org/wiki/Maria_Gaetana_Agnesi;
https://pl.wikipedia.org/wiki/Lok_Agnesi;
http://users.metu.edu.tr/e128415/project/maria.htm;
https://www.famousscientists.org/maria-gaetana-agnesi/;

family into the Milanese nobility upper class. In order to achieve his goal, he had married Anna Fortunato Brivio in 1717.

Unfortunately, Her mother's death provided her the excuse to retire from public life. She took over management of the household. She was one of 21 children. Maria was recognized early on as a child prodigy; it seems unbelievable (!!) but she could speak both Italian and French at five years of age. By her eleventh birthday, she had also learned Greek, Hebrew, Spanish, German, and Latin, and was referred to as the "Seven-Tongued Orator". So, it is strongly underlined in every part of the SERIES – that the knowledge of several foreign languages is a proof of extraordinary capabilities of the brain (but also - of being well-organized and hard-working person). On the other hand, knowledge of these languages helps learning of other things due to constant training of your mind and memory as well as due to personal eagerness to learn as a purpose and sense of human life.

When she was fifteen, her father began to regularly gather in his house a circle of the most learned men in Bologna, before whom she read and maintained a series of theses on the most abstruse philosophical questions. Records of these meetings are given in Charles de Brosses' *Lettres sur l'Italie* and in the *Propositiones Philosophicae*, which her father had published in 1738 as an account of her final performance, where she defended 190 theses.

After having read in 1739 the *Traité analitique des sections coniques* written by marquis Guillaume François Antoine de l'Hôpital[2], she was fully introduced into the field in 1740 by Ramiro Rampinelli, an Olivetan monk who was one of the most notable Italian mathematicians of that time. During that time, Maria studied with him both differential and integral calculus. Simultaneously, Her family was recognized as one of the wealthiest in Milan.

She is "considered to be the first woman in the Western world to have achieved a reputation in mathematics." The most valuable result of her labours was the *Instituzioni analitiche ad uso della gioventù italiana*, (Analytical Institutions for the Use of Italian Youth) which was published in Milan in 1748 and "was regarded as the best introduction extant to the works of Euler." The goal of this work was, according to Agnesi herself, to give a systematic illustration of the different results and theorems of infinitesimal calculus. The model for her treatise was *Le calcul différentiel et intégral dans l'Analyse* by Charles René Reyneau. In this treatise, she worked on integrating mathematical analysis with algebra. The first volume treats of the analysis of finite quantities and the second of the analysis of infinitesimals.

A French translation of the second volume by P. T. d'Antelmy, with additions by Charles Bossut (1730–1814), was published in Paris in 1775; and *Analytical Institutions*, an English translation of the whole work by John Colson (1680–1760), the Lucasian Professor of Mathematics at Cambridge, was published in 1801.

[2] https://fr.wikipedia.org/wiki/Guillaume_Fran%C3%A7ois_Antoine,_marquis_de_L%27H%C3%B4pital;

The work was dedicated to Empress Maria Theresa, who thanked Agnesi with the gift of a diamond ring, a personal letter, and a diamond and crystal case. Many others praised her work, including Pope Benedict XIV, who wrote her a complimentary letter and sent her a gold wreath and a gold medal.

In writing this work, Agnesi was advised and helped by two distinguished mathematicians: her former teacher Ramiro Rampinelli and Jacopo Riccati.


INSTITUZIONI
ANALITICHE
AD USO
DELLA GIOVENTU' ITALIANA
DI D^NA MARIA GAETANA
AGNESI
MILANESE
Dell'Accademia delle Scienze di Bologna.
TOMO I.
IN MILANO, MDCCXLVIII.
NELLA REGIA-DUCAL CORTE.
CON LICENZA DE' SUPERIORI.

After the death of her father in 1752, she carried out a long-cherished purpose by giving herself to the study of theology, and especially of the Fathers and devoted herself to the poor, homeless, and sick, giving away the gifts she had received and begging for money to continue her work with the poor. In 1783, she founded and became the director of the Retirement Home of Pio Trivulzio[3], a home for Milan's elderly, where she lived as the nuns which served in this institution. On 9 January 1799, Maria Agnesi died poor and was buried in a mass grave for the poor with fifteen other bodies.

[3] https://en.wikipedia.org/wiki/Pio_Albergo_Trivulzio;

Additional Books and Papers

[1] Eli Maor: Trigonometric Delights, 2013, ISBN 9780691158204, 256 pages.

[2] C. Truesdell: Corrections and additions for "Maria Gaetana Agnesi", Archive for History and Exact Science, December 1992, Volume 43, Issue 4, pp. 385-386.

[3] Massimo Mazzotti: The World of Maria Gaetana Agnesi, Mathematician of God, JHU Press, 2007, 240 pages.

[4] Mazzotti, Massimo. "Maria Gaetana Agnesi: Mathematics and the making of the catholic enlightenment." *Isis* 92.4 (2001): pp.657-683.[4]

[5] Coolidge, Ju[lian L. "Six female mathematicians." (1951), pp. 20-31[5].

[6] Mulcrone, Thomas F. "The names of the curve of Agnesi." The American Mathematical Monthly 64.5 (1957): pp. 359-361.

[7] Kennedy, Hubert C. "The witch of Agnesi-exorcised." The Mathematics Teacher 62.6 (1969): pp. 480-482.

[8] Kennedy, Hubert. "Maria Gaetana Agnesi (1718-1799)." Women of mathematics: a biobibliographic sourcebook (1987): pp. 5-16.

[9] Johnson, William. "Some women in the history of mathematics, physics, astronomy and engineering." Journal of Materials Processing Technology 40.1-2 (1994): 33-71.

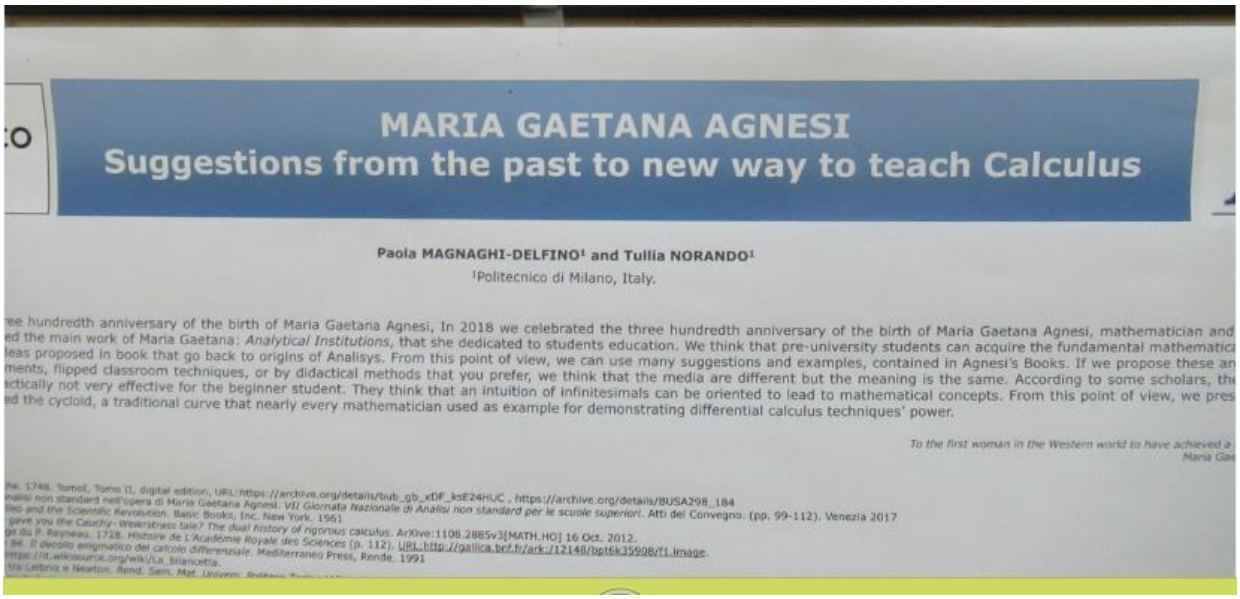
[10] Stefano Zen: Maria Gaetana Agnesi between newtonianism, mathematics and Catholicism in enlightenment Italy, in Frammenti di filosofia contemporanea, vol. XXIII, edited by Ivan Pozzoni (Villasanta [MB]: Limina Mentis, 2018), 1-13[6].

[4] https://ore.exeter.ac.uk/repository/bitstream/handle/10036/28899/paper03.pdf?sequence=1;

[5] https://scholar.google.pl/scholar?hl=pl&as_sdt=0%2C5&q=Agnesi+mathematician&btnG=;

[6] https://www.academia.edu/34827669/Maria_Gaetana_Agnesi_Between_Newtonianism_Mathematics_and_Catholicism_in_Enlightenment_Italy_in_Frammenti_di_filosofia_contemporanea_vol._XXIII_edited_by_Ivan_Pozzoni_Villasanta_MB_Limina_Mentis_2018_1-13;

Photos from APLIMAT Conference and Bratislava
(by Stan Zawiślak)



MARIA GAETANA AGNESI
Suggestions from the past to new way to teach Calculus

Paola MAGNAGHI-DELFINO[1] and Tullia NORANDO[1]
[1]Politecnico di Milano, Italy.

ee hundredth anniversary of the birth of Maria Gaetana Agnesi, In 2018 we celebrated the three hundredth anniversary of the birth of Maria Gaetana Agnesi, mathematician and
ed the main work of Maria Gaetana: *Analytical Institutions*, that she dedicated to students education. We think that pre-university students can acquire the fundamental mathematica
leas proposed in book that go back to origins of Analisys. From this point of view, we can use many suggestions and examples, contained in Agnesi's Books. If we propose these ar
ments, flipped classroom techniques, or by didactical methods that you prefer, we think that the media are different but the meaning is the same. According to some scholars, th
ictically not very effective for the beginner student. They think that an intuition of infinitesimals can be oriented to lead to mathematical concepts. From this point of view, we pres
ed the cycloid, a traditional curve that nearly every mathematician used as example for demonstrating differential calculus techniques' power.

To the first woman in the Western world to have achieved a
Maria Ga

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analisi non standard nell'opera di Maria Gaetana Agnesi. VII Giornata Nazionale di Analisi non standard per le scuole superiori. Atti del Convegno. (pp. 99-112). Venezia 2017
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https://it.wikisource.org/wiki/La_bilancetta.
tra Leibniz e Newton. *Rend. Sem. Mat. Univers.*

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Poster presented at the Conference APLIMAT'2019 in Bratislava

Shop – Old Town in Bratislava

Curriculum Vitae

of two Italian mathematicians who wrote some papers about Maria Gaetana Agnesi

i.e.

Tullia Norando

&

Paola Magnaghi-Delfino

Professor Tullia Norando

Tullia Norando was Researcher and then Associate Professor of Mathematical Analysis at Politecnico di Milano until her retirement. She received her undergraduate degree in Classical Studies and her master degree in Mathematics from the Università degli Studi of Milan in 1972. She taught in high school, then in many courses to develop and enhance high school teacher's contents knowledge and instructional strategies aligned with the engineering, architecture and design studies.

In 2000 Tullia Norando was co-founder of the laboratory **FDS** (**F**ormation, **S**cience Communication, **D**idactics and **E**xperimental Teaching) of the Department of Mathematics. Its mission includes the improvement of teaching techniques, research and services consistent with the broader missions of the Department of Mathematics and the mathematical achievement of high school students. It also supports e-learning courses to enable students to study specific areas of mathematics appropriate to their need, and projects for students to want to learn how to apply advanced mathematics. In this context, FDS promotes large-scale initiatives for the dissemination and the "demystification" of the difficulties of mathematics as awards, games, television programs, conferences. Science communication activities are devoted to public awareness of science with the promotion and / or organization of seminars, conferences, doctoral courses and other initiatives, some of them in relation to other activities that take place both in Italy and abroad.

Tullia Norando was the supervisor of the projects of **Experimental Teaching of FDS**. These projects are based on the idea of reconciling the various talents of creative processes. Projects arise as the result of a synergy between different scientific experiences or from the dialogue with the artistic world, like graphic art, music and theatre. Tullia Norando is scientific advisor of the plays of **TeatroInMatematica** and attend to *in Action with Math*, short course to support the kids in mathematics learning.
From 2010 she collaborates with Paola Magnaghi-Delfino in interdisciplinary research, in particular in projects that combine scientific data and artistic insights. With Paola Magnaghi-Delfino, Tullia Norando was curator of the exhibits "**Lezione di Galileo Galilei sulla struttura dell'Inferno**", in Politecnico di Milano (Mai 2013), in Ravenna Dante's September and in BergamoScienza Festival in October 2013.

In 2016-17-18 they announced the **Math&Art contest** for students of the High School. The participants are requested to realize artworks with mathematical subjects. At the end of the competition, Tullia Norando e Paola Magnaghi organized the exhibits of the select artworks in Politecnico di Milano. In 2018, they were promoters of the initiative in honour of the 300th anniversary of the birth of Maria Gaetana Agnesi, and collaborated on events included in the calendar of the City of Milan. They participated in the creation and execution of the performance *Conversations*, and were organizers and speakers at the conference *Maria Gaetana Agnesi: woman, mathematics, and benefactress*. In August, they were members of the Organizing Board della 18th Conference on Geometry and Graphics.
In 2019, they were promoters, in Milan, of the congress Faces of Geometry. From Agnesi to Mirzhakani, which is inserted in the world celebrations of Miryam Mirzhakani birthday.

Chosen Publications

1. A.Angelini, P.Magnaghi-Delfino, T.Norando *Galileo Galilei's Location, Shape and Size of Dante's Inferno: an Artistic and Educational Project* Aplimat Journal of Applied Mathematics 2014 pp.143-165.
2. P.Magnaghi-Delfino, T.Norando *Luca Pacioli's Alphabeto Dignissimo Antiquo: a geometrical reconstruction* Aplimat Journal of Applied Mathematics 2015 pp. 555-577
3. P.Magnaghi-Delfino, T.Norando *The Size and Shape of Dante's Mount Purgatory* Journal of Astronomical History and Heritage 2015 vol.18 (2) pp 123-134
4. P. Magnaghi-Delfino, T.Norando *Alessandro Mazzucotelli: an artistic and educational project* Aplimat Journal of Applied Mathematics 2016 pp.771-791
5. P. Magnaghi-Delfino, T.Norando *FDS Interdisciplinary Research Initiatives* INTE 2016 (in printing)
6. P.Magnaghi-Delfino, T.Norando *Luca Pacioli's Alphabeto Dignissimo Antiquo: a geometrical reconstruction* Aplimat Journal of Applied Mathematics 2015 pp. 555-577
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10. P. Magnaghi-Delfino, T. Norando *Luca Pacioli: Letters from Venice* ImageMath6. Springer 2018 pp 100-108
11. P. Magnaghi-Delfino, T. Norando *Geometrical analysis of a design artwork coffee table designed by the architect Augusto Magnaghi-Delfino* Aplimat 2018 pp 686-697
12. P. Magnaghi-Delfino, T. Norando *Luca Pacioli: a Leonardo's friend* XVIII International Conference on Geometry and Graphics 2018 pp 492
13. P. Magnaghi-Delfino, T. Norando *Tug of war: maths & sports project* IV International Conference on Higher Education Advances 2018 pp 167-175
14. P. Magnaghi-Delfino, T. Norando *Maria Gaetana Agnesi. New way to teach maths is in the past?* Atti del convegno *INTE* 2018, Parigi
15. P. Magnaghi-Delfino, T. Norando *Maria Gaetana Agnesi. There is no innovation whithout memory* Atti del convegno *INTE* 2018, Parigi
16. P. Magnaghi-Delfino, T. Norando *Maria Gaetana Agnesi: suggestions from the past to new way to teach calculus* to Aplimat 2019, pp. 761-771
17. P. Magnaghi-Delfino, T. Norando *Teaching calculus with Maria Gaetana Agnesi.* G. Slovensky casopis pre geometriu a grafiku - vol. 15 (30) pp.18-34.

Professor Paola Magnaghi-Delfino

Paola Magnaghi-Delfino is currently Aggregate Professor of Mathematical Analysis at Politecnico di Milano. Paola Magnaghi belongs to the laboratory **FDS** (**F**ormation, **S**cience Communication, **D**idactics and **E**xperimental Teaching). Its mission includes the improvement of teaching techniques, research and services consistent with the broader missions of the Department of Mathematics and the mathematical achievement of high school students. It also supports e-learning courses and projects for students interested on advanced mathematics' applications. In this context, FDS promotes large-scale initiatives for the dissemination and the "demystification" of the difficulties of mathematics as awards, games, television programs, conferences. Science communication activities are devoted to public awareness of science with the promotion and organization of seminars, conferences, doctoral courses. In particular, FDS organizes the cycles of seminars called Mathematics and Culture and FDS Seminars. The need to represent the reality with a model as universal as possible, which occurs in sciences and arts, is inspired by principles very similar to those that govern the mathematical world.

Paola Magnaghi is the supervisor of the projects of **Experimental Teaching of FDS**. These projects are based on the idea of reconciling the various talents of creative processes. Projects arise as the result of a synergy between different scientific experiences or from the dialogue with the artistic world, like graphic art, music and theatre. Paola Magnaghi is scientific advisor of the plays of **TeatroInMatematica** and attend to *in **Action with Math***, short course to support the kids in mathematics learning. From 2010, she collaborates with Tullia Norando in interdisciplinary researches, in particular in projects that combine scientific data and artistic insights. With Tullia Norando, she was curator of the exhibits "**Lezione di Galileo Galilei sulla struttura dell'Inferno**", in Politecnico di Milano (Mai 2013), in Ravenna Dante's September and in BergamoScienza Festival in October 2013.
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