More Tales of Our Forefathers

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1. I am not a historian and I've no faith that all that I'm telling you is true. None of the stories was made up, at least by me.
2. I regret that this is mainly about forefathers and not foremothers also, although there will be one female mathematician among 22 mathematicians.

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4. Mostly we remember mathematicians by applying their names to theorems and to mathematical objects. In this regard, I quote **The Arnold Principle.** "If a notion bears a personal name, then this name is not the name of the discoverer."

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In the modern era, there is enough infrastructure that for the past 50 years, many great mathematicians quickly found important positions and lived rather dull lives (although there can be political upheavals that change that). But the lack of many university positions and limited contact between groups means that this is less true of the greats of 150-250 years ago.

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- He spent his career employed by the Academies of Science, first in St. Petersburg (1727-41), then Berlin (1741-66) and then St. Petersburg (1766-83) again.
- A remarkable thing about that is that he was totally blind from 1766 but continued to produce many papers until his death!

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In 1801, he published his masterpiece, *Disquisitiones Arithmeticae* on number theory and also in that year gained great fame for the following:

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He spent his career as the observatory directory and, in addition to his "pure mathematics", developed techniques in magnetism, geodesy, and potential theory. Indeed, his work on Gaussian curvature and Gauss' law (on div and integrals) had roots in this applied work.

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6. In 1827, Abel and Jacobi revolutionized the theory of elliptic integrals by understanding that their inverse functions were doubly periodic (what we now call elliptic functions). But in his notebooks starting about 1796, Gauss had this basic idea, at least for a special case called the Lemniscate integral.

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But somehow that hasn't been enough and there have been persistent stories that his attitude is connected to the reception that his masterpiece *Disquisitiones Arithmeticae* got from the French Academy. W.W. Rouse Ball (1850-1925) claimed in a history of mathematics that Gauss submitted the manuscript in 1800 to the French Academy and they rejected it with a snide description of the work.

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In this regard there is a poignant side to Legendre's career.

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So much for the impact of not publishing!

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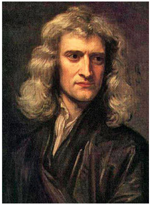

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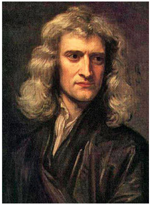

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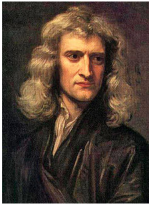

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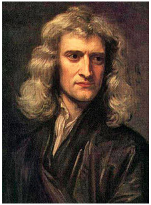

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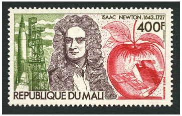

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Hilbert's early work involved aspects of algebra – particularly, invariant theory (Hilbert basis theory) and algebraic number theory.

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Picking only three mathematicians isn't easy but the deepest ones, at least from the first half of the last century, are clearly Riesz, Szegő and von Neumann. Of course, there were Riesz brothers so I get to discuss four and up the total number to 22. Remarkably, F. Riesz was a student with Lipót Fejér (1880–1959) but the other three – M. Riesz, Szegő and von Neumann – were all students of Fejér.

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Riesz and his brother as well as Haar, Kőnig and Fejér never married and he told his student Kalmar that he shouldn't marry but instead devote his life to science. As one of Riesz' students reports: "*However, Kalmar did get married. This made Riesz lose his temper to some extent. For a while he was nervous and impatient to Kalmar.*

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This would lead to disconcerting results for the collaborator, who was perpetually out of step. An example was told me by Tibor Rado, his ex-assistant. During the academic year, Riesz would lecture on measure theory and functional analysis. Rado would take copious notes.

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10. Definition of Hardy spaces (H^p) and Riesz factorization

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27 HL Maximal Inequality $\Rightarrow$ Lebesgue Differentiation

28 Riesz Convolution Rearrangement Inequality

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Marcel Riesz (1886–1969) was a Jewish–Hungarian mathematician whose students included Cramér, Hille, Frostman, Thorin, Gårding, and Hörmander. He was Frigyes' younger brother and did his studies in Budapest under Fejér.

The year after getting his PhD., he was invited to visit by Mittag-Leffler and spent the rest of his career in Sweden – in Stockholm from 1908 until moving to Lund in 1926 where he stayed until his retirement in 1952.

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I want to end my discussion of von Neumann with some fascinating history behind the von Neumann and Birkhoff ergodic theorems. In early 1931, Bernard Osgood Koopman (1900–81) published a short note that explained that measure-preserving dynamics induced unitary operators on $L^2(\Omega, d\mu)$ and suggested that the newly discovered (by Stone and von Neumann) spectral resolution and eigenvectors/eigenvalues might be significant, but he didn't do anything further with this.

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At the beginning of October 1931, von Neumann, then in Princeton, went to New York where Koopman was on the Columbia faculty and told Koopman of his result to confirm that Koopman had not found it independently.

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Still later in October, Koopman and George David Birkhoff (1884-1944) came to Princeton for the opening of (old) Fine Hall. There, Koopman and von Neumann told Birkhoff of von Neumann's result, knowing of Birkhoff's long interest in the quasi-ergodic hypothesis.

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The issue is that while Birkhoff was clearly motivated by von Neumann, who was first, Birkhoff was more senior, a member of the National Academy, and a good friend of the managing editor of the PNAS (who held the post for almost fifty years!), Harvard chemist, E. B. Wilson.

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Two years earlier, as a graduate student, he had published fundamental work on eigenvalue perturbation recovering and extending earlier work of Rellich. He was only a graduate student at age 32 because he had spent much of the War years in the countryside under bad conditions that caused him to contract tuberculosis.

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Introduction

Riemann, Euler, Gauss

Newton, Hilbert, Poincaré

Riesz^2, Szegő, von Neumann

Kato, Loewner, Verblunsky

Blumenthal, Pick, Tauber

Landau, Kőnig, Marcinkiewicz

Krein, Noether, Thomson

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Loewner's remarkable theorem on matrix monotone functions has gotten a growing fan club. For example, I am writing a monograph on the subject which I describe as a love poem to Loewner's Theorem.

Loewner

I conclude the discussion of Loewner with a wonderful quote from his student Lipman Bers: "*Loewner was a man whom everybody liked, perhaps because he was a man at peace with himself.*

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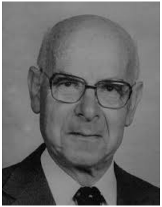

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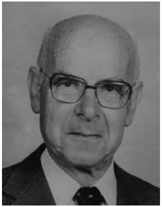

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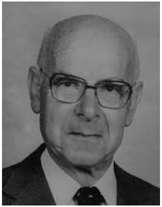

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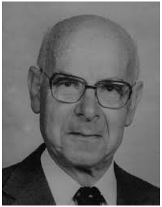

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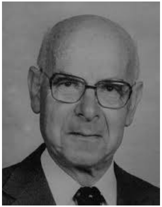

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Since then there are more than 110 MathSciNet references to Verblunsky's Theorem or Coefficients. So I guess not only is Verblunsky a personal favorite of mine, I must be personal favorite of his.

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Pick is best known for solving the problem $f(z_j) = w_j$ for Herglotz functions from which we get Pick functions, Pick's Theorem, Pick matrix and Pick interpolation.

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Returning to Germany at the end of 1928 was not such a wise move. Hitler came to power on Jan. 30, 1933 and by April 7, there was a law in place allowing the removal of Jewish teachers from Universities. On Nov. 2, 1933, Landau tried to give his first lecture of the fall quarter. Teichmüller objected to the teaching of Jewish calculus rather than Aryan calculus and organized student members of the SA who prevented any students from entering the lecture hall.

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Among the other German Jewish mathematicians fired from their jobs and unable to find suitable jobs outside Germany (although both emigrated to Palestine) were Schur and Toeplitz.

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Friedrich Hartogs (1874-1943), a founding father of the theory of several complex variables and Felix Hausdorff (1868-1942), the founder of point set topology and Hausdorff dimension also committed suicide rather than get shipped off to camps (both by overdoes of barbiturates).

Marcinkiewicz

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He got his degree in 1929 and in the 1930's, he ran a world center of functional analysis out of the University of Odessa collaborating often with his friend Naum Akhiezer (1901-1980) who was based in Kharkiv.

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Krein worked in a wide array of specialties: convex sets in Banach spaces, orthogonal polynomials, moment problems, Banach algebras and representation theory, prediction theory, operator algebras, self–adjoint extension theory, trace class scattering theory, Toeplitz operators, J contractive functions and trace ideals.

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Noether

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Emmy Noether (1882–1935) was a German Jewish mathematician. Her great–grandfather, Elias Samuel, was forced to change his name by a Napoleonic edict and her grandfather's name changed from Hertz Samuel to Hermann Nöther. Later her father, Max, changed the spelling to Noether. Her father (1844-1921) was a mathematician of the school of Albert Clebsch (1833-1872) which included Paul Gordan (1837-1912) who will play a role shortly (they are of course remembered for the Clebsch–Gordan coefficients). Gordan's approach was very computational – as Weyl wrote of him: "*There exist papers of his where twenty pages of formulas are not interrupted by a single text word; it is told that in all his papers he himself wrote the formulas only, the text being added by his friends.*"

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She continued to write papers in Erlangen with no official connection to the University until 1916 when she was invited to Göttingen.

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It must be emphasized that this idea has been a touchstone of modern theoretical physics. Once quantum mechanics was discovered and Poisson brackets were replaced by commutators, the theorem shone even brighter and symmetry became a basic building block of new discoveries in particle physics. As one physicist put it: *"Noether's theorem to me is as important a theorem in our understanding of the world as the Pythagorean theorem."*

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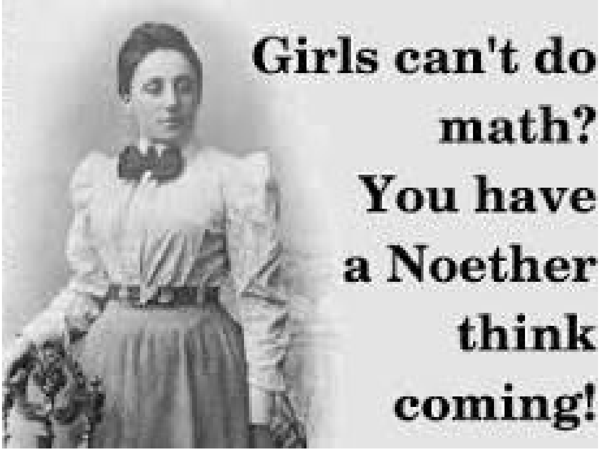
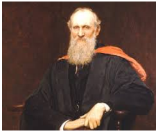


Thomson



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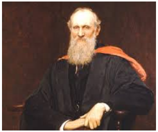

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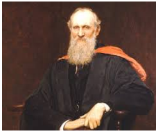

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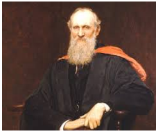

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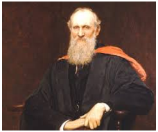

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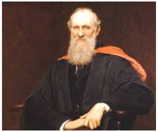

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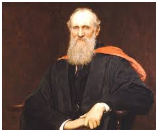

Scottish mathematician William Thomson (1824–1907) is our last bonus. He was a the son of a math professor at the University of Glascow. A bit of a prodigy, he published his first papers while an undergraduate at Cambridge at age 17. In 1846, the chair of natural philosophy at Glascow opened up and Thompson's father used his influence to get his 22 year old son appointed, a position he occupied for over 50 years.

He has two notable mathematical contributions. One is that together with Gauss and Green, he was key participant in an understanding in the higher dimensional analogs of the fundamental theorem of calculus. He was impacted by Green's work and found what is now usually called Stokes' Theorem. So why does it have Stokes' name?

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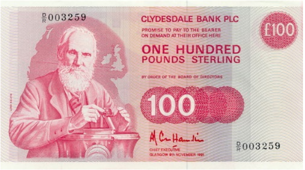

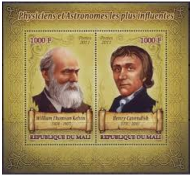

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Final Thoughts

I hope you've learned that our forefathers are fascinating as people and that you'll consider using Mr. Google and Ms. Wikipedia to look up the names you find on theorems.

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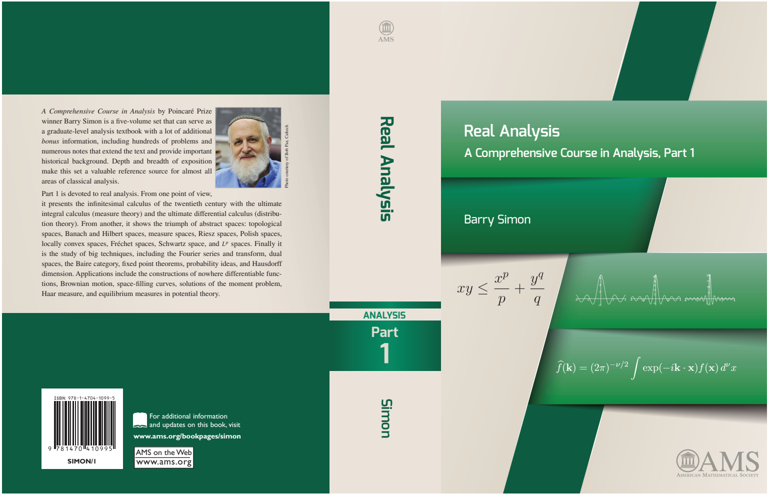

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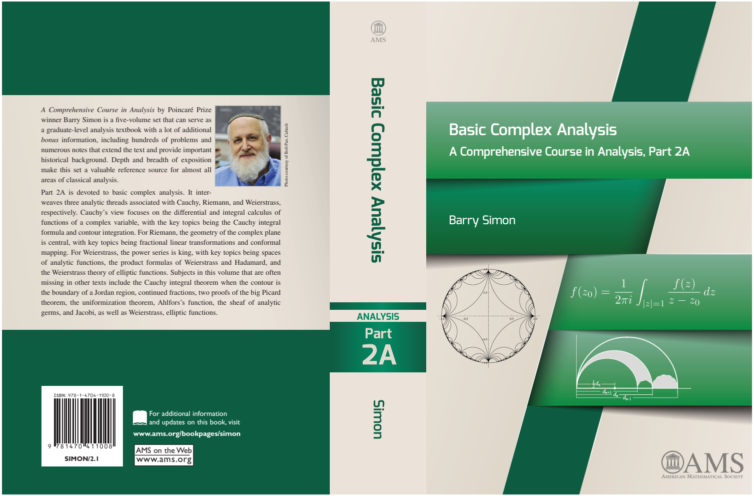

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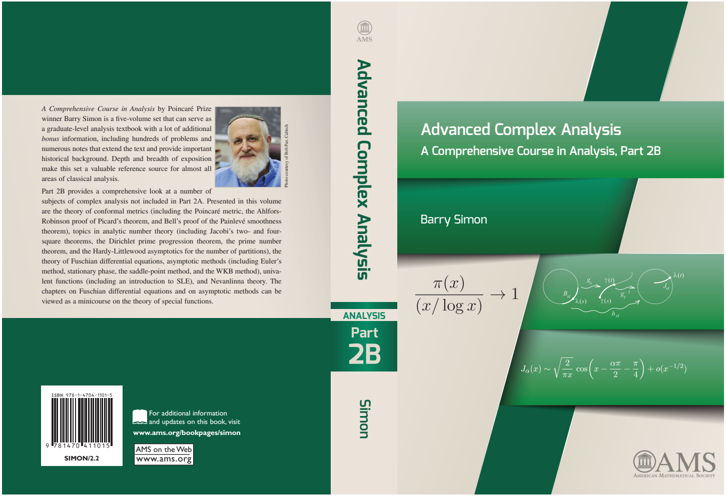

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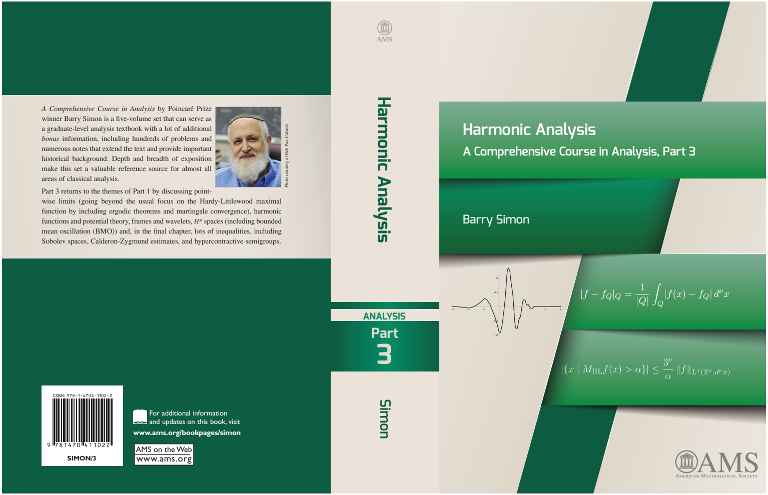

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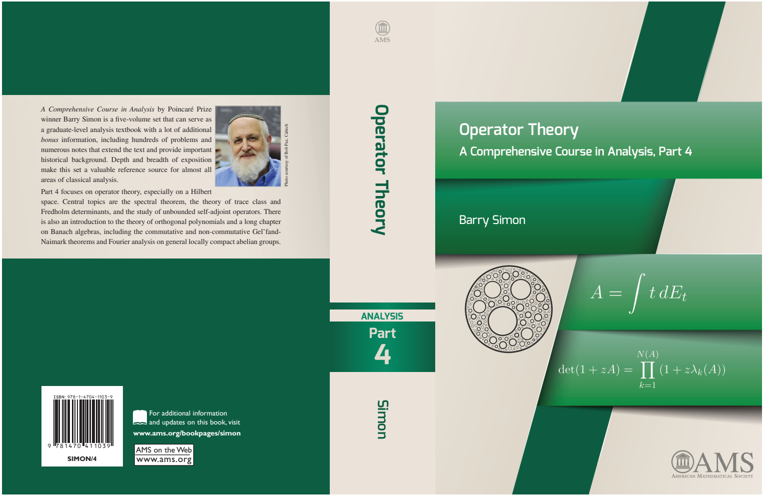

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