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UNIVERSITIES AND MATHEMATICIANS IN ITALY (1861-1914)

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1 The rough data

In 1861 for the first time in its history Italy was unified. From 1861 Italy changed a few times its boundaries (but not by much) and its political system. But the main revolution was in 1861: there was a State, a School (controlled by the State) and Universities. The State employed people and in particular university professors and school teachers. The school had an official curriculum and of course the universities had to teach to future schoolteachers something which could allow them to teach the official curriculum. Schooling; according to the official data ([NN], pp. 149-171) the percentage of analphabetics in Italy was 74.7% in 1861, 68.8 in 1871, 48.7% in 1901, 37.9% in 1921, 27.3% in 1921 (but 21.6% inside the 1871 boundaries), 20.9% in 1931 (but 21.6 inside the 1871 boundaries) and 12.9 in 1951; here the percentage is from people 6 years old or older and analphabetics for the statistics were usually considered people "who cannot read although perhaps they learnt approximatively to make their signature". There was a huge difference in the percentage on analphabetics in the various regions, while the difference at a higher level of schooling was very small. From 1861 to 1991 the schools were divided into 3 parts: 5 years for elementary school, then "medie" and then the University. There were 3 different types of "medie": classics (the only one which allowed to go to the Universities except for a few exceptions) and lasted 8 years, the technical (who allowed to go to a small number of graduate courses) and lasted 7 years and the "magistrali" (who prepared only teachers for elementary schools and allow to go to one graduate course who prepared teachers for "medie") and lasted 6 years. The University courses lasted 4 years except Medicine (6 years), Engineering and Architecture (5 years); Chemistry lasted 4 years before 1951 and then 5 years. In 1911 there were Universities (sometimes with a very small number of Faculties) in the following towns; inside curly brackets the ones not in 1861: Torino, {Milano}, Pavia, Padova (then in Austria), {Venezia (then in Austria)}, Genova, Bologna, Ferrara, Modena, Parma, {Firenze}, Pisa, Siena, {Vallombrosa}, Perugia, Camerino, Macerata, Urbino, {Roma (then in the State of the Pope)}, {Aquila}, {Bari}, {Catanzaro}, Napoli, Catania, Messina, Palermo, Cagliari, Sassari. University professors (counting both the full time tenured ones and the ones with only a part time teaching job without tenure) were 605 in 1861, 1434 in 1911 and 4333 in 1955. In 1861 (resp. 1911, resp. 1951) there were 4830 (resp. 9714, resp. 27548) students for Law, 1224 (resp. 1762, resp. 18368) for Literature, History and Philosophy, 5685 (resp. 7615, 34680) for Medicine and Pharmacy, 2.373 (resp. 5860, resp. 20639) for Mathematics, Engineering and Architecture, 1488 (resp. 632, resp. 9977) for Physics and Chemistry, 35 (resp. 532, resp. 2.286) for Agriculture; furthermore in 1911 other 4497 students were enrolled in other graduate courses while in 1951 19023 students were enrolled in Economy or Political Sciences and 10201 in other courses. Before 1960 the first two years of Mathematics, Physics and Engineering were the same and usually taught simultaneously. There were 15635 University students in 1861, 30612 in 1911 and 142722 in 1951. The percentage of female University students was 16,2% in 1911 and 27.727% in 1951. As a comparison, in 1956 (resp. 1992) 20.379 (resp. 46.110) students obtained their degree from the Italian Universities.

2 The top places for Mathematics

It is fair to say that from around 1890 to the First World War Italy was the third mathematical power in the world (after France and Germany). Italy's strong research topics were Geometry (in particular the famous algebraic geometry school and differential geometry) and Analysis with good researchers in Mathematical Physics. Algebra had hard times; it was not in the undergraduate curriculum for students enrolled in Mathematics as a separate topic until the reform of 1960 (Algebra instead of Chemistry in the first year) and hence there were no chairs labelled Algebra; for a discussion of this problem on the life of certain mathematicians, see [BS] and [Gh]; for the teaching and the introduction of Galois theory in Italy, see [Ma]; matrix calculus had Capelli; vector calculus and later (after differential geometry and mechanics) tensor calculus was a favorite topic. In the reunification of Italy (the so-called Risorgimento) young mathematicians had an important role (even in the battlefields) and several of them (while still being active mathematicians) had political power (e.g. ministers and senators) (see [A], [B] and [Sa]). L. Cremona (1830–1903), the founder of the famous Italian Algebraic Geometry school, the first Italian Professor of Geometria Superiore (Bologna 1860) was minister and an influential life senator. From 1861 to the First World War the Italian mathematics established itself as a discipline, both from the point of view of teaching (at all levels) and for research. It was in a much stronger position in Italy than any other scientific discipline and this was reflected in its share of the chairs in the Universities. Following [N], p. 832, here is a list of the Chairs in the Faculty of Science in various years: 1881 (Astronomy 6, Physics 15, Chemistry 14, Biology 30, Geology 18, Mathematics 69, Drawings (partially perspective and geometry for Engineerings and Architectures) 11), 1891 (Astronomy 3, Physics 17, Chemistry 14, Biology 42, Geology 22, Mathematics 69, Drawings 11), 1900 (Astronomy 7, Physics 18, Chemistry 18, Biology 41, Geology 26, Mathematics 73, Drawings 10), 1910 (Astronomy 7, Physics 17, Chemistry 27, Biology 43, Geology 32, Mathematics 69, Drawings 11), 1922 (Astronomy 5, Physics 17, Chemistry 17, Biology 29, Geology 26, Mathematics 61, Drawings 11), 1930 (Astronomy 7, Physics 15, Chemistry 23, Biology 37, Geology 26, Mathematics 66, Drawings 7), 1940 (Astronomy 6, Physics 24, Chemistry 27, Biology 40, Geology 31, Mathematics 59, Drawings 3).

A key place to educate very good students was Scuola Normale Superiore di Pisa, essentially containing a Faculty of Letters (Ancient Greek, Latin, Italian, History, Philosophy) and a Faculty of Science (Mathematics, Physics, Chemistry and Natural Sciences). For its history, see [TS] and [Ca]. Inside the Faculty of Sciences of Scuola Normale Superiore Mathematics had a prominent position. Mathematicians were quite often Directors of Scuola Normale Superiore di Pisa (U. Betti (1865-1874 and 1876-1892), U. Dini (1874-1876 and 1900-1918), L. Bianchi (1918-1928). For a list of the 72 Mathematicians who graduated from Scuola Normale Superiore from 1851 to 1933, see [N], pp. 883-884; among the most famous ones: U. Dini (1864), G. Ascoli (1867), E. Bertini (1868), C. Arzelà (1870), S. Pincherle (1874), G. Ricci-Curbastro (1876), L. Bianchi (1877), C. Somigliana (1881), V. Volterra (1882), M. Pieri (1884), F. Enriques (1891), G. Lauricella (1894), G. Scorza (1898), G. Fubini (1900), G. Vitali (1901), E. E. Levi (1904), R. Torelli (1904), M. Picone (1907), A. Signorini (1909), G. Sansone (1910), G. Albanese (1913), L. Fantappié (1922), L. Cesari (1933). For many biographical notices (even unconventional ones) on mathematical students of Scuola Normale Superiore di Pisa and on their careers, see [S]. This booklet gives a good picture of the academic life and jobs in Italy in that period. For a more official view of the Scuola Normale Superiore and more data, see [Ag] and [Ca].

3 Michele de Franchis

Michele de Franchis was born in Palermo (Sicily) on April 6th 1875 and graduated there in Mathematics in 1896 (advisor G. Guccia). Then for ten years he was an untenured assistant professor, teaching sometimes at high schools both there and in Messina. From 1906 he was Full Professor first at the University of Parma (1907), then at Catania (1908) (back in Sicily) and then at Palermo until his death (February 19th 1946). From 1914 he was Director of the prestigious but slowly decaying Rendiconti del Circolo Matematico di Palermo, after the death of its founder, Guccia ([BM]). In 1909 he and G. Bagnera (1865-1927; see [Bg] and [Se1] for his life and his mathematical works) won the Prize Bordin of the Académie des Sciences (Paris) for their joint work on hyperelliptic surfaces. In 1907 F. Enriques and F. Severi won the same prize for a related work (see section 4). Now de Franchis' name is associated to the following theorem of him.

Theorem 3.1 *([dF1] and [dF4]). Let X be a smooth complex compact Riemann Surface of genus $g \geq 2$. Call Hol(X) the set of all non-constant holomorphic maps $f : X \longrightarrow C$, where C is a smooth Riemann Surface of genus ≥ 2. Then Hol(X) is finite.*

The key point in the statement of Thorem 3.1 is that the target, C, is not specified: $\mathrm{Hol}(X)$ counts all non-constant holomorphic maps with as target a curve of genus at least two. It is important that we assume that C has genus at least two for the following reasons. First take C of genus 0, i.e. $C \cong \mathbf{CP}^1$; for every compact Riemann Surface Y there are infinitely many surjective holomorphic maps $f : Y \longrightarrow \mathbf{CP}^1$; any such map is associated to a pair (L, V), where L is a holomorphic line bundle on Y and V is a vector subspace of the space $H^0(Y, L)$ of global holomorphic sections of L with $\dim(V) = 2$ and V spanning L; viceversa, every such pair (L, V) gives a holomorphic map $f : Y \longrightarrow \mathbf{CP}^1$; here $\deg(f) = \deg(L)$. If C has genus 1, i.e. if C is an elliptic curve, then for most Riemann Surfaces there is no non-constant holomorphic map $f : X \longrightarrow C$; however if there is one such holomorphic map f, there are infinitely many such maps and even maps with arbitrarily large degree for the following reason; C is a complex abelian Lie group; hence not only $\mathrm{Aut}(C)$ is infinite but for any integer $x \geq 1$ there is a surjective holomorphic map $t(x) : C \longrightarrow C$ with $\deg(t(x)) = x^2$ given by the multiplication by x; just compose any f with the maps $t(x)$, $x \geq 1$. In recent times Theorem 3.1 was reproved and improved several times. In 1983 Howard and Sommese gave a bound on $\#(\mathrm{Hol}(X))$ depending only on the genus, g, of X. For a better bound, see [K]. In that paper E. Kani proved that there is no polynomial bound of $\#(\mathrm{Hol}(X))$ as a function of the genus, g. In [AP] the authors proved an exponential bound, say $\#(\mathrm{Hol}(X)) \leq \exp\{(4/3)\log(3)(g^2 - 1) + [\log_2(g)]\log(84g) + \log(12)(2)^{1/2}\}$. The assumption "$X$ of genus $g \geq 2$" means that X is hyperbolic in the sense of complex geometry (see [L]). From this point of view and with a look at arithmetic problem, de Franchis theorem is a very active research topic even in higher dimensions (see [L], [M], [ML] and [KO]). Section 8 of [M] contains a discussion of de Franchis theorem. A. N. Parshin used it to show that the Shafarevich conjecture for curves defined over a number field implies Mordell conjecture ([Pa]); both conjectures were proved by G. Faltings ([Fa]) and he got a very deserved Fields Medal for this work. M. de Franchis obtained his theorem studying correspondences between curves and his approach was found useful even in [AP]. Another important contribution of de Franchis is the following theorem concerning irregular complex projective surfaces ([dF2]).

Theorem 3.2 *Let X be a smooth complex projective surface such that there are two holomorphic 1-forms ω_1 and ω_2 on X with $\omega_1 \wedge \omega_2 = 0$. Then there exists a holomorphic map $f : X \longrightarrow C$ with C smooth curve of genus at least two and regular holomorphic 1-forms a_1 and a_2 on C with $\omega_i \cong f^*(a_i)$, $i = 1, 2$.*

This theorem is a basic result in the theory of algebraic surfaces. Later, he gave an extension of Theorem 3.2 to higher dimensional complex projective manifolds ([dF3]). For far reaching higher dimensional generalizations, see [Ra], [Ct], [GL1], [GL2], [Bi] and the references quoted in [Bi]. In summary, I was fascinated by the evergreen influence of some papers by a very good mathematician who however was considered "a minor" in the big Italian Algebraic Geometry school and had comparatively little students and younger collaborators (G. Albanese went to Brazil, while the young R. Torelli was killed in action during the First World War).

4 Comments on the references

In several places we made a few comments on the references. For several papers on the general history of Mathematics in Italy, see [G], [DGN] and [MG]. Almost all sources are in Italian; the only exceptions are letters to or from foreigner mathematicians (French and German); most of the correspondents were French or German mathematicians and these letters (as well as the reports concerning the studies of young top researcher usually in German in the second half of XIX century) are very important; they show more than from the quotations in the original papers the diffusion of ideas, techniques and problems and the mutual influences. The last part of [AA] contains several such letters to F. Enriques. We recommend the introduction of [AA] to understand the mathematical, political and social background of research and teaching in Italy in that period and the mutual friendship or competition among mathematicians. For the relations with German and French mathematicians and in particular with E. Picard, see [AA], pp. XVII-XVIII; for chairs, jobs and so on, see [AA], pp. XIX. We recommend all the papers in [DGN], but they focus on the period 1918-1945. For the the description of a big project of publication of the correspondence to or from mathematicians, see [GN1]; several volumes appeared ([Cr], [G], [Pi]). For other letters, see [Ba] and [GN2]. The paper [Tr] is very opinionated. Every University published some celebrative booklets with names and careers of their Professors. Usually, however, this is just propaganda. From a methodological point of view, much better is [FP] which, however, consider a small University. Much more important for Mathematics was Pisa. For the start of the mathematical school of Pisa, see U. Bottazzini : "Enrico Betti e la formazione della scuola matematica pisana", in: [MG], pp. 229-276. There are printed Collected Papers or, at least, Selected Papers of all major Italian mathematicians of this period. Each of these publications contains a vita and a mathematical appreciation of the mathematician, but usually of the elogiative type. For all active Italian mathematicians of that period there are printed nechrologia; however these nechrologia are scattered and often not easy to find, unless they were reprinted in the Collected Papers of the dead mathematician. The collected papers of G. Bagnera and of M. de Franchis were published only recently ([Bg] and [dF5]) and these volumes contain very good introductions. It is easy from old books in Italian libraries to know the content of the courses of Mathematics at the University level; some of the classics were reprinted several times for, say, twenty years to be used in the courses. Some of the ones written by top mathematicians were reprinted ([E] and [EC], the latter being however much more than lecture notes for two or three courses). Old textbooks for the teaching of Mathematics in Italy from 1861 are available in the Italian libraries. Many of them were written by either old University professors or by young non-tenured assistant professors and often signed by a pair (Professor,Assistant), The book [V] contains a very detailed discussion of the different mathematical programs in the secondary schools from 1861 to 1984 (roughly students from 11 to 18 years hold) and the various reforms (the name are of the minister of education): Casati (1859), Coppino (1887) and Gentile (1923) and several modification of programs and number of teaching hours. Roughly speaking, after 1890 the role of Classic studies (Ancient Greek, Latin and so on) increased while the role of Mathematics and even more of

Physics and Natural Sciences was reduced. The book [V] contains also a discussion of the failed attempt of reforms and of the role of mathematicians in that attempt. The private correspondence of mathematicians now in print gives a new light on this subject showing also the role of the single mathematician in the distribution of chairs, assistantships, post-doctoral grants, prizes and the publication of the Italian research mathematical journals. It is very instructive to compare the letters by F. Enriques on this subject, the non-partizans comments in the introductions of [AA] and of [dF5] (by C. Ciliberto and E. Sernesi) and the appreciation of the work of Bagnera and de Franchis made by F. Severi in the nechrologia [Se1] and [Se2] and by O. Chisini (a faithful student of F. Enriques) in the nechrologium [Ch]. In the latter nechrologium F. Chisini even downplayed Theorem 3.1 and the role of de Franchis in its proof). For the relation of Theorem 3.2 to work of F. Enriques, see the letters by Enriques to Castelnuovo (n. 644 and n. 646 of [AA]). For essentially the period 1900-1960 it is amusing to read the autobiography of A. Terracini ([T]) who after the Second World War and his return from South America was a President of Unione Matematica Italiana.

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