

Vito Volterra and the Making of Research Institutions in Italy and Abroad*

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ABSTRACT

The great mathematician Vito Volterra was a notable figure who had a significant public profile in the early years of the twentieth century.¹ He made an important contribution to political debate and, in particular, to what would become defined as science policy. Volterra's scientific interests were not limited only to mathematics and mathematical physics, but also gave impetus to research in the spheres of oceanography and meteorology. Volterra's career path, characterised by the prominence of the mathematician in the international scientific community, finally reconstituted itself into the position that he assumed toward the fascist regime in Italy. It was the very international acknowledgement of Volterra that caused resentment in Mussolini, toward whose regime Volterra maintained a strenuous opposition – resulting in the ostracism he was subjected to in his own country until his death.

Vito Volterra is generally considered one of the greatest mathematicians of his time: «His most important contributions» according to the *Dictionary of Scientific Biography* «were in higher analysis, mathematical physics, celestial mechanics, the mathematical theory of elasticity and mathematical biometrics. His major works in these fields included the foundation of the theory of functionals and the solution of the type of integral equations with variable limits that now bear his name, methods of integrating hyperbolic partial differential equations, the study of hereditary phenomena, optics of biriffringent media,

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¹ Goodstein (2007).

the motion of the earth's poles and, in his last years, placing the laws of biological fluctuations on mathematical bases and establishing principles of a demographic dynamics that present analogies to the dynamics of material systems». He was born in Ancona in 1860, and began his academic career as early as 1883, becoming full professor of Mechanics in the University of Pisa when he was only 23. He had been a pupil of Enrico Betti, whom he succeeded upon his death in 1892 on the chair of Mathematical Physics in Pisa, as well as in the direction of the *Nuovo Cimento*, the professional journal of Italian physicists. In 1893 he moved to a chair in the University of Turin; while he taught in Turin, in 1894 was elected a member of the Società Italiana delle Scienze, detta dei XL, in 1895 member of the Accademia delle Scienze di Torino, in 1899 member of the most influential body of Italian academy, the Accademia Nazionale dei Lincei.

In 1900 he moved again, this time to Rome, the topmost University of unified Italy, where he was to become for a number of years (1907-1919) the dean of the Faculty of Mathematical, Physical and Natural Sciences. As soon as he arrived in Rome, he was invited to give the inaugural lecture for the new academic year (a distinguished honor): his lecture “Sui tentativi di applicazione delle matematiche alle scienze biologiche e sociali” (On the attempts to apply mathematics to the biological and social sciences) demonstrated his great interest for the applications of mathematics to the biological sciences and to the social and economic research; this lecture circulated widely, in Italy and abroad, was translated in French in 1906, and both the Italian original and the translation were repeatedly reprinted. Later on, in the Twenties, bi-mathematics was to become one of his research fields. Before moving to Rome, Volterra had been involved in traditional academic activities: committees, academic elections, professional journals, professional societies; in 1897 he had successfully promoted, with Riccardo Felici and Angelo Battelli, the creation of the Società Italiana di Fisica.

Very keen in international relations, he was in touch with the Swedish mathematician Gustav Mittag-Leffler from 1887, and was involved from the beginning in the organization of the International Congresses of Mathematicians. Volterra established an extensive network of prestigious international correspondents, which included most of the important mathematicians of his time. With some of his French colleagues, and with Mittag-Leffler, he exchanged hundreds of letters. Starting in 1888, he visited many countries in Europe; anyway, his most frequent destination was Paris, where he was regular-

ly invited to lecture. In later years he also travelled to North and South America.

After 1900 his growing interest (both scientific and practical) for the relationship between scientific research and economic and social development, put him in touch with the new technocratic milieu emerging in Rome, under the political leadership of Giovanni Giolitti and Francesco Saverio Nitti. In 1903 Volterra was one of the three members of the commission appointed by Giolitti to study the establishment of a Polytechnic in Turin; in 1905 he became Senator, which represented a consecration of his new role as policy maker in the field of scientific research; in 1906 he promoted the creation of the *Società Italiana per il Progresso delle Scienze* (Italian Association for the Advancement of Science), soon to become the most influential organization of the Italian scientific community in the first three decades of the 20th century; in 1912 he became president of the newly established *Comitato Talassografico Italiano*, a national (and soon internationalized) endeavor for marine research in the Mediterranean Sea, which he considered both from the point of view of his biomathematical interests and from that of the Italian fishing industry. In this position, Volterra was also involved in the establishment of the national network for meteorology, in the promotion of studies of the upper atmosphere led by Gaetano Arturo Crocco, and in the early stages of the Italian aeronautics. In these initiatives he could rely on the support of Bonaldo Stringher, economist and member of the *Accademia dei Lincei*, general director of the *Banca d'Italia*, a prominent personality of the technocratic milieu, with whom he developed a close relationship.

In 1909 he sailed for his first journey to the United States. He had been invited (with Ernest Rutherford, Robert William Wood and Carl Barus) by Arthur Gordon Webster to lecture in the celebrations of the 20th anniversary of Clark University, near Boston. A few months before leaving Italy he had met the American astronomer George E. Hale, first in Brussels, then in Rome, where Hale had been invited to lecture on his recent research on sun spots. During this first visit in the United States, which was arranged before they met in Europe, Volterra could not manage to reach the Mount Wilson Observatory and reciprocate Hale's visit to Rome, but it was immediately clear that the two gentlemen liked each other. Actually, they were both dealing with a similar set of institutional problems, aimed at establishing a cooperative institutional environment between the scientific community, the government, and industry. There was a big difference, of course, between a country where the corporate

industrial system was already strong and far-reaching (US) and a country (Italy) which was at the time a latecomer of industrial development. In histories of Italian economy the years from 1896 to 1914, the so-called “Giolitti period”, are usually defined as the years of the “industrial take-off”. The need to develop a science-based industry had been stressed by Volterra as early as his inaugural lecture of 1900; as a member of the Turin Polytechnic Commission he had thoroughly studied the German model of university-industry relationship, and had praised it as a model to be pursued in the establishment of the new school. But he was clearly more attracted by the ongoing developments of a different model in the US in the first two decades of 20th century:

Close cooperation between the industrial interests and the educational institutions of the country, which in Germany was made so effective by the domination of both by the State, can in America be brought about only by a voluntary personal relationship between the executives of the companies and the instructing staff of the institutions. (Noble 1977, 143, n. 80)

Between 1907 and 1920 Hale was a leader in the American scientific community to this aim: he was involved in the origins of Caltech, in the renewal and strengthening of the National Academy of Sciences, and during World War I in the establishment of the National Research Council.

In 1910 a young, brilliant student from Harvard University, Griffith C. Evans (a pupil of William F. Osgood and Maxime Bôcher), obtained a Sheldon Travelling Fellowship, and decided to use it to travel to Europe from 1910 to 1912, where he spent most of his time in Rome, studying with Volterra. The Italian mathematician and his family made a warm welcome to the young American, and Virginia and Angelica (the wife and the mother of Vito) grew very fond of him: with Virginia they were to keep in touch for many years, even after Vito’s death, until the beginning of the Sixties; we know from Evans that he spent many Sundays lunching at the Volterra’s, in Rome, Via in Lucina, or in Ariccia (a small town near Rome where Volterra had his country house), and that in the afternoon he would talk with Vito not only on mathematical subjects, but also on topics related to university, science policy and politics in general in the United States. In the following years Evans was for Volterra a continuing source of useful information on those topics. In 1912 Edgar O. Lovett (with whom he corresponded since 1903) invited Volterra to lecture in the ceremony for the formal opening of the Rice Institute (other invited speakers were, for science, Hugo de Vries, Emile Borel, Henri Poincaré, William Ramsay, Wilhelm Ostwald, Carl Størmer, and for the humanities, Henry Jones and

Benedetto Croce). This time, Volterra had a full schedule to comply with: first he had to go to San Francisco, to lecture at Berkeley, then he reached Pasadena, where he could visit the Observatory and talk at length with Hale, then he went to Houston, to lecture at Rice. Evans had returned to the United States a few months before. He was still in Rome, when he received offers from Yale, and from the University of California at Berkeley (according to one of his biographers he also turned down an offer from MIT). He discussed these offers with Volterra, as he found them unsatisfactory, both from the point of view of the salary, and of the kind of job he was being offered. Volterra had mentioned Evans to Lovett already when they met in Paris, in January 1912. At the end, Evans accepted an offer from the Rice Institute, as he felt that Rice offered him the greatest opportunities. In his letters he thanks Volterra, saying that he got the job at Rice (where he remained until 1934, when he accepted to go to Berkeley) because of his support. At the Rice celebration Volterra's attendance was given an outstanding acknowledgement: he talked twice in the official addresses, and twice as invited lecturer, as he gave not only the lectures he was supposed to give, but was also asked to commemorate Henri Poincaré, who had been invited to the Rice inauguration and unexpectedly died shortly before.

In 1914–1915 Volterra was very active in the political debate on Italy's position in the European War. He was against the neutrality proclaimed at the outburst of the War, and in favour of an alliance with the French-British Entente against the Central Empires. When Italy broke its neutrality in 1915, May 24th, Volterra entered the Army as a volunteer in the Air Force, and was immediately involved in scientific and technical inter-allied cooperation: in this position he met again with friends, the French Borel and Picard, the British Schuster, and the Americans Hale and Evans. The former was leading the newly created National Research Council, the latter was liaison officer in Paris and Rome. Volterra in 1917 became the director of the *Ufficio Invenzioni e Ricerche*, from which the Italian National Research Council was to develop after the War, and in 1918–1919 he worked with Hale, Schuster and the Belgian Georges Lecointe in the foundation (led by Hale) of the International Research Council (nowadays the International Council of Scientific Unions) of which he was to become vice-president. In 1920 he was elected president of the *Società Italiana delle Scienze detta dei XL*, and in 1923 president of the *Accademia Nazionale dei Lincei*. In the same year he succeeded in obtaining from the government the creation of the National Research Council, and he was appointed president of the new body. It has to be borne in mind that since the previous

years he had remained a member of the boards of both the SIPS and the Comitato Talassografico, and immediately after the War he had been appointed president of the Bureau International de Poids et Mesures (of which he would remain president until his death), with Charles Guillaume as Secretary General: under their guidance the Bureau built its new location at Pavillon de Sèvres in 1931 and established the new measurement standards for electricity and photometry.

In November 1919 Volterra sailed again to the United States, this time to lecture in Berkeley. On the way back he visited again Pasadena and Houston, to meet Hale and Evans, and to participate in some social events organized by Evans and Lovett. Before leaving to Europe he also found time to give a talk at Cornell University, which invited him when they learned he was in the States. This was Volterra's last visit to the USA; archival research shows that he was planning at least three further visits, in 1923, 1926 and 1937, but that he failed to leave for different reasons. The interest for the United States shown by these plans let us understand that what he said in one official address at the Rice inauguration was not just said for mere courtesy:

Allow me to express the feeling of admiration that I experience in visiting this great new country, an admiration that has changed only to increase since my last coming to America. Your high civilization and enterprising spirit have been able to conquer an entire continent, to create as if by enchantment marvelous cities like this which we are visiting now [Houston]. These grow up in a few years. They provide themselves not only with all the modern comforts which make existence easy and agreeable, but also reach a high place in life that is intellectual and moral. [...] You have created institutions from the beginning and at once, universities in which you can accommodate everything to the demands of the present, without the embarrassment of a single relic from the past.²

He kept being interested in science policy and in general politics in the US, as is shown in his correspondence with Evans, who sent him comments on Hoover, and on Roosevelt: one of Evans' pupils, C.F. Ross, had become chief economist of the NRA. From 1924 Volterra was also involved in the important Rockefeller Scholarship Program: he met Wickliffe Rose in his travel to Europe, then met and corresponded with Augustus Trowbridge, a Princeton physicist «in charge of the Board's work in this field in European countries».³

² Rice Digital Scholarship Archive. http://scholarship.rice.edu/bitstream/handle/1911/8864/article_RI034231.pdf?sequence=4, consulted on December 30th, 2010.

³ Rose to Volterra, 1925.

When the IEB funded the creation of the Institut Henri Poincaré in Paris, Volterra was involved, and was invited to lecture for the inauguration of the Institute.

Three main concerns are remarkable in Volterra's institutional activity: 1) his attention to the relationship between scientific community, politics, and economic development; 2) the desire of overcoming the limits of hyperspecialization and promote the crossing over of disciplinary boundaries; 3) his being involved in the institutional development of disciplinary fields outside mathematics, and especially in three of them, where an important renewal of methods was on the go, i.e. economy, biology, and physics. It is striking that Volterra, long before being himself directly involved in bio-mathematical research in the Twenties, had a leading role in creating the Comitato Talassografico, and through it a whole network of laboratories for the biological, physical and chemical study of the Mediterranean Sea, including meteorology studies, aeronautical research and studies of the upper atmosphere. Even more striking the fact that Volterra had a key role in the organization of the Italian physicists, far beyond the role he played in the organization of Italian mathematicians. As mentioned above, in 1897 he was the main promoter of the the Società Italiana di Fisica, and he did so as a response to the founding, in 1896, of the Associazione Elettrotecnica Italiana (the society of electrical engineers promoted by Galileo Ferraris), as he feared that the AEI might become the only professional association available for the Italian physicists.

In Rome, Volterra taught at the School of Mathematics, in those years closely connected to the School of Engineering in San Pietro in Vincoli, but in 1902 he affiliated to the Institute of Physics, directed by Pietro Blaserna. Blaserna and Volterra wanted to promote in this Institute new research patterns, based on what was called, at that time, the "new physics": in order to strengthen this scientific approach they obtained the creation of a chair of "fisica complementare" on which they called the young and brilliant Alfonso Sella, whose untimely and sudden death in 1907 was at the origin of the coming in the physical institute of Rome of Orso Mario Corbino in 1908. Volterra sponsored the publication of important works of young Tullio Levi Civita in the *Nuovo Cimento*, prevailing on unwilling colleagues. As for the IEB, at the request of Trowbridge Volterra sponsored the scholarships of André Weil (proposed by Vessiot; Weil had just spent one year in Rome with Volterra on a scholarship from the Ecole Polytechnique), Robert Mazet (proposed by Vessiot; Mazet was to come to Rome to work with Levi Civita); at the request of Guido Castelnuo-

vo he sponsored Bruno De Finetti. But the scholarships he himself proposed to the Rockefeller, with the exception of Szolem Mandelbrojt (to come to Rome to study with Volterra himself) were aimed at the development of studies in nuclear and theoretical physics: Enrico Fermi, Enrico Persico, and Franco Rasetti (who was, thanks to Volterra, exceptionally granted two scholarships, in 1928 and 1930).

Volterra had never liked Mussolini's government. In a letter of 1922 to Charles Guillaume he expressed his "concern" for the political situation in Italy, but, like many other members of the liberal establishment, he did not question, at first, the legitimacy of a government appointed by the King. He simply continued the activities connected with his important institutional position, and kept willingly to cooperate, when necessary, with governmental bodies. Things began to change in 1924, when the "Matteotti affair" demonstrated the true nature of Fascism and precipitated the gradual transformation of Mussolini's government in a dictatorship. Under these circumstances Volterra, who had been in 1923 an open opponent of the Educational Reform promoted by Giovanni Gentile, in October 1924 joined the *Unione delle forze liberali e democratiche* led by Giovanni Amendola, in 1925 signed the "Manifesto degli intellettuali antifascisti" proposed by Benedetto Croce, and soon after joined the group of anti-fascist Senators, the only legal group of opponents that Mussolini was forced to tolerate since he could not dissolve the Senate (composed of life-lasting members appointed by the King) as he had done with the Chamber of Deputies. At the beginning of 1926 the government started a, firstly non declared but gradually open, war against Volterra's influence on the scientific community: in June 1926 it prevented his re-election as president of the Lincei, then dramatically stopped funding the NRC until a new president (Marconi) was appointed in 1927, and in 1928, at the meeting of the International Research Council, the Italian delegates, at the general astonishment, declared that they would no longer recognize Volterra as vice-president.

In 1931 the university professors were ordered an oath of fidelity to the fascist government: by refusing it Volterra lost his academic position, and was forced to retire (it must be stressed that only 12 university professors on roughly 1.200 refused the oath); the story repeated in 1934, with a similar oath being imposed on the members of academies and science institutions: at this time, Volterra ceased to be a member of the Lincei. In 1938, being Jew, he was victim with his family of the racial laws, though, as a Senator, he was partially safeguarded against the worst aspects of anti-Semitic legislation. Volterra

reacted with exceptional vitality to this situation: he kept going on with his scientific activity and kept alive his extraordinary network of relations, in Italy and abroad.⁴ He died in 1940, at the age of 80, a few months after Italy had entered World War II.

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⁴ Israel (2005).

