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The Dawn of Control Science in Italy From Intuitive Engineering to Modern Control Theory and Automation Technology

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This paper presents a survey of the early development of automation technology and control science in Italy. The main focus is on the crucial period from 1950 through 1970. Some attention, though, has been paid also to more ancient significant events, from the Middle Ages to the first half of the XXth century. Equally included are some hints to events that occurred in the decades following 1970. However, these more recent scientific achievements are better understood within the frame of the main international stream rather than in any local perspective. As such, they have been somewhat overlooked in the present survey.

Keywords: Automation, control, history, Italy

1. Introduction

The primary purpose of this survey is to briefly outline the early days of control science and technology in Italy; namely, in a European country that, after the golden era of the Renaissance, was comparatively late in witnessing major technological developments and in participating in the industrial revolution. At the end of the 1940s, agriculture still had a major role in the Italian economy. The poverty enhanced by the war and the primary need of removing the ruins it left made basic research and advanced technological competition not to be felt as compelling priorities. The reaction, though, also fostered by a new flow of ideas across the boundaries, a favorable international climate leading to the step-by-step formation of the European Community, let alone the solid support of the US, was surprisingly rapid and strongly effective. The subsequent decade witnessed what was called the "economic boom." In a very short time, millions of people moved from farms to factories and also from the southern to the northern part of the country, raising new problems mixed with new unusual opportunities. The creation of new factories and the need to renovate the old ones made the involved people alert to the achievements and promises of modern technology. The scientific institutions began to be felt as important factors in promoting the economic welfare of the country. The purpose of the present paper is then two-fold. It aims at providing a brief account of the way control technology developed in Italy particularly in the XXth century by attempting to outline how the Italian control community got more and more strongly connected with the international one. Thus, any new scientific achievement was readily received and treasured in the country, where a research community in control science and technology could form and grow by visibly contributing to the advancement of the field.

In writing this paper, the author has taken as primary reference the notes on the early developments of systems and control science and engineering in Italy collected and published [14] by one of its chief actors

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(he repeatedly called them "memories," but his paper carries much more than a personal experience). Antonio ("Toni") Lepschy suddenly died on June 30, 2005, at the age of 74. He and the present author were planning to collect in a book the material prepared for a series of lectures they had given in April at the University of Pavia on the subtle and mostly hidden ways systems and control concepts enter, or should enter, a variety of aspects of modern general culture. The audience, made of about 80 Ph.D.s with a wide range of liberal as well as technical specializations, and Toni's friendly advice made the preparation of those lectures an unforgettable experience. Keeping full responsibility for the mistakes and the possibly questionable views expressed in what follows, this survey is dedicated to the memory of Antonio Lepschy.

In view of the afore mentioned background, essentially rooted in events of the XXth century, the present paper is organized in three parts as follows: i) before the 50s, ii) the 50s, and iii) the 60s and beyond. The last section finally presents some concluding remarks.

2. Before the 50s: A Wide Land Spangled with Rare Gems

In the now relatively rich literature on the history of control (see e.g. [1–3,6,15] and the references therein), little is said about Italian contributions to this slowly emerging branch of science and technology. As for the ancient times, from Middle Ages to Renaissance, the majority of those contributions deal with the design and construction of clock escapements. Dante Alighieri himself seems to have been enchanted by the motions of a clock mechanism when in his major poem (Paradise, XXIV, 13–15) he notes how the first wheel appears to be quiet to the observer while the last one "flies." The clock Dante's attention was captured by was most probably a "monastic waker" (Fig. 1) rather than a much more common tower clock. The history of tower clocks in Italy until the middle of the XVII century is fascinating. According to a chronicle by Galvano Fiamma, an invisible iron clock that told the time just by tolling a bell was mounted in 1309 inside the church of S. Eustorgio in Milan. Clocks built by Giovanni degli Organi were installed in the cathedral of Modena (1343) and the Torre di S. Lorenzo in Genoa (1354). In 1344, a somewhat special clock designed by Jacopo Dondi was installed in the Torre del Capitanato in Padua. Jacopo Dondi was not just a skilful craftsman; he was a learned university teacher and an inventor of sophisticated mechanisms such as to produce wonder, delight, and pleased approval among experts and fellow citizens

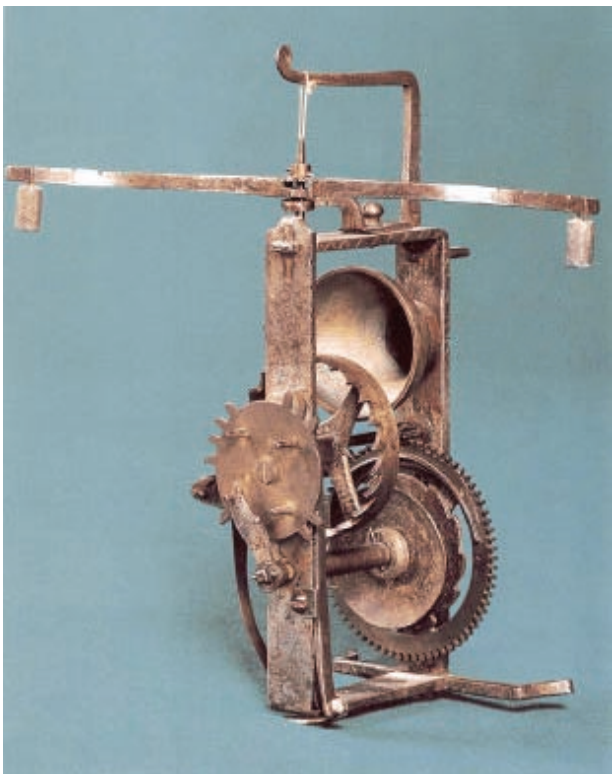

Fig. 1. Italian "monastic waker" of the XIV century.

who changed in fact for him and his descendants his family name into Dondi dell'Orologio. Not less famous was his son Giovanni, he too professor at the University of Padua and designer of the *Astrario*, a clock-like mechanism endowed with seven dial-plates indicating the quite complex motions of as many planets according to the Ptolemaic theory. The original copy of this amazing machine was destroyed by fire in the hermitage of San Yuste, Spain, where the Emperor Charles the Fifth had brought it along at the beginning of the XVI century. But the designer had left a precise and detailed description of his *Astrario*. Thus, several reconstructions are currently available: at the Museo della Scienza e della Tecnica in Milan, the Musée International de l'Horlogerie in Chaux-de-Fonds (Switzerland), the Smithsonian Institution in Washington, the Science Museum in London, the Time Museum in Rockford. Probably, the last reconstruction has been carried out by Emmanuel Poulle in 1998, under the direction of the Paris Observatory. Among the families of Italian craftsmen, the clock-making art was earnestly cultivated by, in the subsequent centuries, one may recall, the Della Volpaia's in Florence, the Raineri's in Parma and Reggio Emilia (authors in 1496 of the famous Moorish clock, still visible in Venice from the S. Marco square), the Griffi's in Pesaro, and in Urbino and

many others. Even Galileo Galilei who discovered in 1583 the isochronism of the small oscillations in a pendulum had probably a part in the application of this tool in the design of better clock mechanisms. Using a pendulum as clock pacemaker is in fact an important breakthrough generally credited to Christian Huygens, whose father, Constantin, had known about Galileo's discovery from the Dutch Admiral L. Real, informed by Galileo himself on June 6, 1637. With the worsening of the Italian welfare, in the XVIIth century, the primacy in this admirable technology passed to other European countries. Apparently, most of its early development took place step by step, thanks to intuitive cleverness and inventive ingenuity. In retrospect, in keeping with a modern view of the clock-making art [11,12], it is important to remember what D. S. Bernstein summarizes in a sentence: "At the heart of every mechanical clock lies a regulator."

Even from a more general viewpoint, by looking at the advancement of technology in a variety of different fields, particularly from the end of the XVIII through the first half of the XXth century, one is led to consider in how many different ways technological innovation permeates an open society. Beside major breakthroughs, produced by new ideas and concepts due to specific individuals of exceptional level, there is a multitude of relatively small, poorly recognized or intentionally covered contributions that slowly spread through the community of craftsmen, technicians, and engineers involved in technically oriented activities so as to eventually become standard practice. In many cases, this silent ferment acts as enabling factor even for major jumps forward, when times are mature and a critical threshold is inadvertently crossed. As Italian samples of those poorly known inventions either left totally undocumented, or casually come out from long uncharted archives rather than from the shelves of some Patent Office or institutional libraries, let's briefly consider two cases concerned with automatic control.

The first case is one of (intuitive) feedback pressure controls. In 1873, the engineer Enrico Riva had patented an original type of steam-powered velocipede; namely a three-wheels car more similar to a coach than to anything else. As is well known, car technology soon followed a different stream but, among the papers he left on his death, an automatic apparatus is described meant "to balance the pressure in the slide valve of steam-engines." The document is in French and the novel apparatus is qualified as "type Riva-Zara" (Fig. 2). The patent object is described as follows: It "consists of a new and special device by which the pressure above the slide valve of railway or stationary or marine steam-engines is kept between given limits whatever the pressure in the steam generator may be. The device is based on the elasticity of the thin sheet-metal wall which is such as to avoid the need of preventing steam leakages by gaskets, stuffing boxes, wedges or elastic joints." Despite some research, the Riva's partner Zara remains totally unknown to the author of this note.

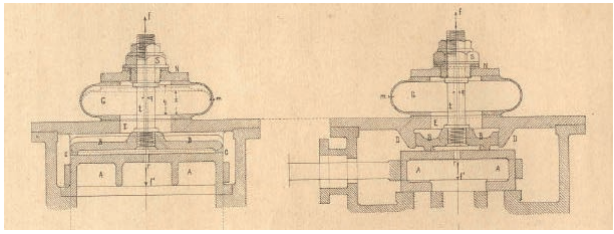

Fig. 2. The Riva-Zara automatic pressure regulator.

The second example is an early case of stand-off armament to be used in the arming of airships in World War I. In order to hit the then Austrian city of Pula, a naval stronghold very well protected by anti-aircraft defence, Gaetano Arturo Crocco, and Alessandro Guidoni invented a sort of telebomb, similar to a small airplane, equipped with a nontrivial feedback control apparatus. After parting from the airship and flying a short vertical run to reach the appropriate speed, the bomb was set in gliding flight by a distance-measuring fan and was able to fly in that mode over a distance of up to 20 kilometers. At a suitable time, it was set back into vertical flight to hit the target. In order to keep the desired direction, during the gliding flight, a gyroscope controlled the rudder. The bomb, mounted on a F6 airship, was successfully tested on the Furbara military field, in front of the Latium coast, at the end of 1917. The war ended before the Italian army could decide to face the remarkable production costs of the new armament. Guidoni and Crocco were not ordinary men. Alessandro Guidoni had obtained a degree in Industrial Engineering from the Politecnico di Torino in 1903 and a second degree in Mechanical and Naval Engineering from the University of Genoa in 1905. In 1910, he had designed an automatically stabilized airplane focusing then, in the subsequent decade, on the design of various hydroplanes. Attaché as army officer at the Italian Embassy in London from 1920 through 1923, he obtained from the Royal Aeronautical Society the title of Honorary Fellow. Guidoni died in 1928 while personally testing a new kind of parachute in Montecelio, a place with a significant role in the history of Italian Air Force since then renamed Guidonia in his honor. Born in Naples in 1877, Gaetano Arturo Crocco had studied Mathematics and Physics for two years at the University of Palermo; after graduating at the Scuola d'Applicazione di

Artiglieria e Genio di Torino (Turin School of Artillery and Engineering Application), he specialized in Electrical Engineering at the Montefiore School of Liège (Belgium). In 1906, together with Ottavio Ricaldoni, he had designed and built the first semi-rigid airship named "the one"; it was endowed with an automatic rudder and with course indicators of novel conception. In 1908, thanks to the substantial help of Vito Volterra, he had founded the Istituto Centrale Aeronautico (Aeronautic Central School) where the first Italian teaching and research activities in Aeronautics were promoted. In 1926, Crocco had given a course on Airship Theory and Construction at the University of Rome where one year later, in view of his "exceptional merits," he became full professor and engineer "ad honorem." Member of several national and international Academies, in 1951 he was the founder of the Società Italiana dei Razzi (Italian Rocket Society) and went on to become one of Italy's leading space scientists. Dead in Rome in 1968, he is the only Italian scientist whose name appears in the Space Hall of Fame of Alamogordo (New Mexico).

Giuseppe (or Joseph) Massimo Pestarini is mentioned by S. Bennet in his History of Control Engineering [1,2] together with very few other Italian names. Pestarini was born in Athens of an Italian father and a Greek mother. Grown up with an international education (Athens, Paris, and Munich), he worked in industry until 1937, when he moved to university, first at the Politecnico di Torino, then in Rome, and finally, after World War II, in the US. He is the inventor of a family of electrical machines (the metadynes) particularly suited for control applications, thanks to their high "dynamic gain" (namely the ratio between power gain and response time). The family included the world-wide known amplidyne, whose fatherhood became the object of a long and unfortunate judicial controversy with General Electric.

Until the end of the 40s, the teaching and research activity in Automatic Control was almost inexistent in the Italian Schools of Engineering. Only some basic concepts were occasionally included in advanced courses of Mechanical or Electrical Engineering. Not to hide part of the truth, it has also to be pointed out that conceptual slips, let alone plain mistakes, were not always avoided in these brief and somewhat marginal accounts. On the positive side, though, Lepschy [14] refers to a book on Advanced Applied Mechanics by Ottorino Sesini, professor at the Politecnico di Milano. One might also recall Ercole Bottani for his early, deeply motivated, and greatly influential support of the systems approach in dealing with engineering problems [5]. A significant exception in that sort of early academic inattentiveness is the

Fig. 3. Prof. Giuseppe Evangelisti.

publication in 1947 of an important book [9] by Giuseppe Evangelisti (Fig. 3), professor of Hydraulic Constructions at the University of Bologna. When he wrote the book, Evangelisti had already gained a solid international reputation for his studies in fluid dynamics, particularly the so called "water hammer" and the way it has to impact the design of hydraulic power plants (in Italy, he had been one of the very few engineers admitted in the prestigious Accademia dei Lincei). Though never translated in foreign languages, the book increased the author's international visibility as one of the not so many real experts of automatic control in Europe. He was in fact the single Italian scientist included, in 1956, in the small group of outstanding personalities IFAC got started by.

At the end of the 40s, applied research teams began to be formed in some major companies active in Italy. The need of taking full advantage of the progress already recorded in some foreign countries, chiefly UK and USA, particularly in the fields of energy conversion (including nuclear energy), chemical plants, or steel and paper factories, exerted a considerable push. In many respects, those teams acted as a sort of yeast in supporting the rapid growth of interest for the potential impact on a wide range of industries, services, and administrations of what we now call Information Technology; in many cases, Control and Automation Science and Engineering were to play the not yet sufficiently recognized role of catalysts in that new and highly pervasive process.

Just to mention some of the most significant facts, we may recall that in November 1946, a few major companies (Cogne, Edison, FIAT, soon joined with SADE and Montecatini) had established in Milan a study and research center, called Centro Informazioni Studi ed Esperienze (CISE), substantially meant to start investigations on the pacific use of nuclear energy: a field temporarily forbidden to Italy by the

armistice regulations. Despite the limited funding, an advanced electronic lab was set up and constantly expanded at CISE under the direction of Emilio Gatti. As early as in 1933, Carlo Calosi, Professor of Electrical Engineering at the University of Genoa, had persuaded the executive team of SETEMER, a Genoese private industrial group, to set up a study center focusing on new communication and signaling systems to be used in road and railway networks. At the beginning of World War II, he had invented an "intelligent" magnetic torpedo cap successfully adopted by the Italian as well as by the German Navy. After the armistice of 1943, Calosi was taken to the US, where he began to cooperate in the development of new submarine arming systems. In 1946, after a brief stay in Italy, he went back to the US to work at Raytheon, where he later became Research Director and finally Vice-President. In Genoa, Calosi left Massimo Merega, a close friend and partner of his with whom he was to keep on playing a significant role in the development of the electronic industry in Italy. In particular, they were chief actors in promoting the creation of Microlambda in Naples. From the merging of Microlambda with SINDEL, in 1960, Selenia came about, a company Calosi was to subsequently become a Managing Director and President of. As we shall see, these events played a sort of enabling role for the first steps of Control and Automation Engineering in Italy.

3. The 50s: A Spring of Solid Promises and Seminal Initiatives

Splitting any facet of history into phases or stages or periods is always questionable and, at least to a certain extent, arbitrary. History is a continuum and boundaries between periods obviously do not exist. Yet, the decade began in 1950 has played, for several reasons, a worldwide special role in the history of control. Italy is no exception. Most of the momentum beside the increased demand of research in Control and Automation Engineering came then from industry. All facets of Electronics involved in the automation of industrial products or processes were looked at as expedient in leading up to innovation. The demand of expertise in those fields began to widely exceed the offer and that created a climate of excitement and expectation. To set things even, it has also to be pointed out the good deal of imagination and adventurous future forecasting that wide burst of interest was affected by. Electronic technology saw the transition from the vacuum tube to the semiconductor era. Computer, control, and telecommunications were not perceived as different disciplines but just as advanced facets of Electronics, namely information-oriented Electrical Engineering. Their potential impact on traditional engineering appeared to be impressive, but the limits of that "invasion" were difficult to foresee. The first digital computer in Italy, a gift of the US within the European Recovery Program, was a vacuum-tube CRC 102A. It was set in operation at the Politecnico di Milano in 1954, primarily as a new tool in engineering-oriented numerical analysis and a sophisticated test-bench for studies in computer programming and applied digital electronics. Able to execute an average of about 70 basic (arithmetic, logic, or auxiliary) instructions per second, in very few years it allowed the solution of many significant, otherwise unsolvable, problems of industrial interest. But the current frontiers of Computer Science and Technology were still quite far away. Most of the activity needed to enable the first steps of digital computation at the Politecnico di Milano was performed by three pupils of Ercole Bottani; chief actor was Luigi Dadda, with Emanuele Biondi and Lorenzo Lunelli serving then in a backing role. In 1955, a Ferranti Finac was set in operation at the University of Rome, while in 1956 a Bendix D12 was installed in the Sala Calcoli (Computation Room) of the University of Bologna directed by Giuseppe Evangelisti, who had established it since 1951 on the basis of a Philbrick analog computer. Beginning in 1957, the Sala Calcoli should have developed into the Centro Calcoli e Servomeccanismi (Computation and Servomechanisms Center) that in the 60s became the cradle of the Bolognan research in automatica.

Between 1952 and 1954, the project of a national nuclear reactor took form and moved the first steps. At CISE, Emilio Gatti (Professor of Applied Physics at the Politecnico di Milano since 1951) engaged the Laboratory of Electronics in the design and realization of the servomechanisms needed to operate the reactor. Among the engineers working in Gatti's lab was Sergio Barabaschi, fresh author under his supervision of a brilliant thesis on the control of impulse trains. At CISE, he faced several control problems relevant to the reactor operation; he also designed, under Gatti's guide, a fairly unusual special purpose analog dynamic simulator based on the use of magnetic amplifiers. When the project of a national nuclear reactor passed to the newly established Nuclear Research Center of Ispra (1957), Barabaschi moved to that Center to work on the development of the Ispra Laboratory of Servomechanism and Control. In that Laboratory, was also active Renzo Tasselli, co-author with Barabaschi of a textbook on Elements of Servomechanism and Control, published

in 1965 [10]. The book has long been used to teach Basic Control Engineering in many technical high schools and in some undergraduate university programs. In 1963, the Laboratory of Servomechanism and Control moved from the Nuclear Research Center (NRC) of Ispra to the more recently established NRC of Casaccia, near Rome. In 1975, Barabaschi began to cooperate with Ansaldo, a big Genoese company, in the design of nuclear reactors. At Ansaldo, where he definitely moved in 1980, he kept on working on nuclear engineering related control and automation issues. After 1994, he began to take on important responsibilities in governmental and European Union organizations (Under-Secretary at the Ministry of University and Research, President of the European Industrial Research and Management Association, President of the European Science and Technology Assembly, and Vice-President of the European Council of Applied Science and Engineering) tied in a wide sense only to control related activities.

In 1954, the San Giorgio, a company of Finmeccanica producing mercury vapor rectifiers in Sestri (Genoa) since 1930, became the Nuova San Giorgio. One of the tasks the new company had to fulfil was the automation for the Italian Navy of the gun control system by first introducing a radical switch from purely mechanical to electronic control technology. The responsibility of forming what came later to be referred to as the "Genoa Group" was taken by Carlo Calosi. The group consisted of people from Nuova San Giorgio (among them Luigi Carlo Rossi, the future head in 1962 of the Servosystems and Electronics Division, to become ELSAG in 1969) as well as from other companies of Finmeccanica; among them were Giorgio Quazza and Emilio Ferrari, who had to partly share with Calosi the responsibility of leading the group. Thanks to an extraordinary collective effort, made of individual talents and strong team spirit, the problem was successfully solved in due time, namely in just 18 months.

Giorgio Quazza has been the most outstanding Italian personality in the field of Control Engineering and beyond. Born in Mosso S. Maria near Biella (Piedmont) in 1924, he entered at seventeen the Politecnico di Torino. Very soon, he decided to engage in the Resistance while first continuing his studies of Industrial Electrical Engineering then joining the partisan army in the Alps. On December 4, 1944, he got captured and carried away to a prison camp in Bolzano and then to Mauthausen. After an attempt to escape from the concentration camp, he accused himself in order to avoid a mass shooting; but, surprisingly indeed, he was spared. Back home in May 1945, he declined a proposal of silver medal for partisan merits and, after a short pause to partly recover from the inflicted pains, he faced a period of extremely intense study. Thus, in December 1946 he could graduate full marks with a thesis on static and dynamic stability in large power networks. He then got an employment at the Officine Savigliano, Turin, where he could gain a better knowledge of several unsolved problems concerning the dynamics and control of electrical machines. From 1950 through 1953, he went first to MIT in Boston, then to the Brooklyn Polytechnic Institute in New York to specialize in the theory and design of servomechanisms. The title of his Ph.D. thesis was: "Synchros as error-measuring devices in servomechanisms." Back from the US, he began to work in Finmeccanica (Ansaldo, San Giorgio, Microlambda, and finally, as already recalled, Nuova San Giorgio). In 1956, he and his team moved to a new company of the Edison Group named CEA – Costruzioni Elettroniche ed Automatismi (Electronic Constructions and Automatic Systems) – to be later merged with a company mostly active in the telephone market to create the CEA-Perego. In the new company, Quazza was responsible for the Research and Systems division, where he promoted a number of advanced control-related industrial research projects. He did personally carry out insightful studies on the regulation of induction motors and the application of multivariable control theory to interconnected electric power networks. Since 1957, the team included Fabio Saccomanno, just graduated in Genoa under the supervision of Paolo Marsilii; in a few years, he should have become one of Quazza's closest partners.

In the academic year 1955/56, Paolo Marsilii had given at the University of Genoa a course on *Industrial Electronics*. The course included the subject of servomechanisms and naturally developed in one of the first courses in Automatic Control offered by Italian Universities. In the subsequent academic year, a course on *Industrial Electronics and Servomechanisms* was given for the first time at the Politecnico di Milano by Carlo Costadoni. Costadoni was leading the control group he had set up in CGE (Compagnia Generale di Elettricità), a company then jointly controlled by General Electric and FIAT. The notes of his course [8], finally published in 1962, had a long and thoughtful preface in which, among many other things, he wholeheartedly advocated the use of the term "automatica," introduced in France in 1956. This book got unfortunately overlooked in a recent catalog of historic control treatises [10]. One of its chapters had been written by Emanuele Biondi who in the 60s would have relieved Costadoni in his teaching activity

at the Politecnico di Milano. At the University of Padua, a first course on servomechanisms was given in 1959 by Giuseppe Francini, Professor of Applied Electronics and, formerly a researcher of the Fondazione Ugo Bordoni.

The Fondazione Ugo Bordoni was active in Rome since 1954 in the Istituto Superiore delle Poste e Comunicazioni (Institute for Advanced Postal and Communication Services). In the Laboratory of Sevomechanisms of the Foundation was working since the very beginning Antonio Ruberti, freshly graduated from the University of Naples. Ruberti was joined in 1955 by Antonio Lepschy, graduated at the University of Padua under the supervision of Giovanni Someda. They had a chance to briefly cooperate with Giuseppe Pestarini who was a consultant of the Fondazione Ugo Bordoni. However, their academic reference was Algeri Marino, full professor of Comunicazioni Elettriche (Electrical Communications) at the University of Rome, in whose view the servomechanisms could be considered as an important part of telecommunication systems. Interested then in automation, Marino supported the creation within the Consiglio Nazionale delle Ricerche (National Research Council), or CNR for short, of a Commissione per l'Automazione (Automation Committee), the technical secretaries of which were A. Lepschy and A. Ruberti. In addition, he strongly supported an international meeting, sixth in a yearly series organized by CNR under the heading of Giornate della scienza (Science Days), devoted to the automation problems. A very large Organizing Committee and a much smaller Executive Committee were readily set up. President of the latter was Algeri Marino while Lepschy and Ruberti were two of the ten members. They were also appointed General Secretaries of the Conference.

The Convegno Internazionale sui Problemi dell'-Automatismo (International Conference on Automation Problems) was held in Milan, 8–13 April 1956. The scope of the conference included all facets of automation in the broadest possible sense. The program was organized in three main sections: 1) Scientific and technical foundations, 2) Technical and economic prospects, and 3) Socioeconomic effects of automation. In particular, the topics covered in Section 1 were ranging from control theoretical or terminological issues to general purpose analog and digital computation, and from pneumo-hydraulic or pneumo-electric components to problems connected with the design of speaking or translating machines. In Section 3, a certain attention had also been focused on educational problems. The main opening address was given by the President of CNR, Gustavo Colonnetti, followed by four speakers including Gino Cassinis, Deputy Mayor of the City and Rector of the Politecnico di Milano, Algeri Marino, and Renato Teani (President of CEA). In the list of authors one could find Mark A. Aizerman, George R. Boulanger, Herman H. Goldstine, Adolf Leonhard, Marc Pélegrin, Vladimir V. Solodovnikov, Yakov Z. Tzypkin, and John C. West. Among the Italian authors: Sergio Barabaschi, Roberto Busa, Silvio Ceccato, Carlo Costadoni, Emilio Gatti, Antonio Lepschy, Luigi Piglione, Giorgio Quazza (with several papers), Antonio Ruberti, Antonio Tescari, and Ezio Volta. The closing session was attended by the President of the Republic together with members of the Government and the Houses of Parliament, Civic Authorities, and a large audience. To celebrate the fiftieth anniversary of that event, a 2nd International Conference on Automation Problems has been organized by Sergio Bittanti in Milan on September 2006 [4].

Significantly enough, the topic chosen by AEI – Associazione Elettrotecnica Italiana (Italian Association of Electrical Engineering) – for its Annual Meeting held in Trieste, September 1956, was Regolazione automatica e servomeccanismi (Automatic Regulation and Servomechanisms). Again in 1956, a specific association called Associazione Nazionale Italiana per l'Automazione (ANIPLA) was created and Automazione e Strumentazione became its official journal. Presidents of the association from the foundation until the mid 70s have been: Carlo Rossi, Ottorino Sesini, Antonio Todisco, Renato Teani, Giorgio Quazza, Emanuele Biondi, Umberto Pellegrini, and Giorgio Camatini. Current President is Leone D'Alessandro. Among the first activities of ANIPLA was the organization of continuing education courses on subjects of interest to automation technicians and professionals. The notes of a course given by Giorgio Quazza, published in 1962, became one of the first textbooks on Control Theory produced in Italy [16].

At the end of September 1956, during a meeting held in Heidelberg under the heading of Automatic Control Congress, a group of scientists and engineers from different countries decided to take appropriate actions in order to set up what had to become the International Federation of Automatic Control (IFAC). A preliminary draft of the Constitution was prepared at the Constitutive Assembly of IFAC held in Paris in 1957. Italian member of the founding group was Giuseppe Evangelisti who, thanks to the support of Algeri Marino, obtained the creation, in 1958, of a CNR Commission for IFAC. As President of the Commission, the Secretaries of which were Lepschy and Ruberti, he invited on behalf of the CNR the

leading committees of IFAC to meet in Rome in order to follow up with the preparation of the first IFAC General Assembly. The 4th Information Bulletin of IFAC, dated May 1959, summarizes part of the Rome meeting as follows.

"On invitation of the Italian National Research Council, the Executive Council and the Advisory Committee of IFAC had a meeting in Rome from March 2 to 6, 1959."

"The Constitution which has been adopted at the Constitutive Assembly of IFAC September 1957 in Paris had found some criticisms among several National Member Organizations. A special committee under the chairmanship of Prof. G. Evangelisti (Italy) had collected and coordinated all proposals for amendments of the Constitution and has taken these comments as a basis for a new draft which thoroughly was discussed by the Executive Council. The new draft including some more modifications will be submitted to all National Member Organizations before long in order to vote on it on the General Assembly to be held in Chicago in September 1959."

The Italian delegation to the Chicago Meeting, held at the Sheraton Hotel September 14–18 1959, consisted of Giuseppe Evangelisti – member of the consulting Committee of IFAC – Antonio Lepschy and Antonio Ruberti. On the occasion, Algeri Marino had prepared a lecture on the problems of university education in the field of automatic control and automation. The lecture was presented by Lepschy and discussed in a September 14 session of the consulting Committee. As is well known, the first IFAC World Congress was held in Moscow, from June 27 to July 1, 1960. Between the first (Moscow, 1960) and the second (Basle, 1963) world congresses, the first symposium organized under the aegis of IFAC was held in Rome, April 26–28, 1962.

At the end of the 50s, the times were mature for a renewed organization of the Italian Schools of Engineering. Thus, by a law that came into force in 1960, a new degree in Electronic Engineering was introduced in the university regulations. At that time, the boundaries of Electronics included not only the design of electronic devices, components, circuits, and systems, but also all facets of Computer, Communication, and Control Engineering. The names of existing courses in Industrial Electronics and Servomechanisms were changed into Automatic Control. New courses on control related subjects were started in almost every School of Engineering offering a degree in Electronics or in Electrical Engineering. The teachers were some of the already mentioned pioneers but also some professors of different disciplines (mostly of Electrical Engineering) fostering a special interest in automation and control. A possibly incomplete list may refer to Luigi Piglione and Giovanni Fiorio at the Politecnico di Torino, Carlo Costadoni and Emanuele Biondi at the Politecnico di Milano, Antonio Lepschy in Trieste, Luigi Mariani (and Antonio Lepschy) in Padua, Paolo Marsilii and Ezio Volta in Genoa, Giuseppe Evangelisti in Bologna, and Antonio Ruberti in Naples and in Rome. A textbook co-authored by A. Lepschy and A. Ruberti [13] came to strengthen in 1963 the availability of serious Italian treatises on Automatic Control. With the establishment of so many courses, the stage was set to give an increasing number of young graduates a chance of engaging in control-related university research.

4. The 60s and Beyond: A New Research-Driven Season

As a result of a national competition, in 1961 there were the first *liberi docenti* in Automatic Control. They were: Antonio Lepschy, Giorgio Quazza, and Antonio Ruberti. In the immediately subsequent years that title was obtained by Francesco Brioschi (Politecnico di Milano), Doriano Ciscato, Giovanni Marchesini, and Luigi Mariani (University of Padua), Giovanni Marro and Eugenio Sarti (University of Bologna), Mario Murgo and Massimiliano Petternella (University of Rome), and Mario Policastro (University of Trieste); from industry: Vincenzo Gervasio, Fabio Saccomanno, and others. The last competition to become *libero docente* in Automatic Control was held in 1971 when about 20 candidates obtained the title.

One of the most effective initiatives taken in the 60s in order to promote the research of an increasing number of graduates eager to specialize in system and control science at a university level was a series of summer schools held in Bressanone (1963, 1964, and 1965) and Cagliari (1966) under the aegis of CNR. Bressanone (or Brixen, in German) is a small historic town near the Austrian border, immersed in an alpine landscape and pleasantly marked by an ancient atmosphere. The University of Padua has an auxiliary seat in Bressanone, thanks to which the meetings could be held at a moderate cost, in particular for those who couldn't count yet on a regular income. At the first meeting (1963), the lectures addressed three main research topics of System and Control Theory plus a somewhat elementary introduction to Graph Theory given by Rigo Righi, a learned manager of the Italian Railways; in addition, G. Evangelisti gave a thoughtful talk on human aspects of automation. As for the main topics, the lecturers were (Fig. 4):

Fig. 4. Bressanone, September 1963. From left to right: Antonio Ruberti, Emanuele Biondi, Giorgio Quazza, and Antonio Lepschy.

E. Biondi (The Lyapunov Direct Method), A. Lepschy and A. Ruberti (Identification Methods for Linear Time-Invariant Systems), and G. Quazza (Multivariable Control Systems). In the second meeting (1964), several researchers of the second generation were given the chance of lecturing in that witty atmosphere. The topics addressed in the second meeting were organized in five sections of unequal size. 1) Elements of Modern System Theory (A. Ruberti), 2) Identification Problems (lectures by G. Fantauzzi and M. Petternella, organized by A. Ruberti), 3) Variational Methods and Maximum Principle (lectures by G. Basile, G. Fiorio, A. Lepschy, G. Marro, G. Pesamosca, L. Piglione, and M. Policastro, organized by A. Lepschy), 4) Dynamic Programming (lectures by E. Biondi, F. Brioschi, A. Debenedetti, L. Divieti, G. Guardabassi, F. Luccio, S. Rinaldi, and P. Rozzoni, organized by E. Biondi), 5) Optimum Seeking Methods (lectures by S. De Julio, E. Ferrara, G. Pesamosca, and R. Rossi, organized by A. Ruberti). In 1966, the meeting was held at the University of Cagliari, chief town of Sardinia. The subject of the Cagliari school was Stochastic Methods in System Theory. Lecturers were: F. Donati, R. Genesio, G. Koch, V. Tagliasco, and E. Volta. This series of summer schools ended in Palermo, Sicily, after a 11-year pause. In Palermo (1977), the general topic was the same as in 1966 and several lecturers were already researchers of third generation: S. Bittanti, E. Canuto, G. Finzi, G. Fronza, R. Genesio, R. Guidorzi, G. Menga, M. Milanese, E. Mosca, G. Picci, N. Sorrentino, A. Spirito, A. Tiano, and G. Zappa. The Lecture Notes of the five summer schools initiated in Bressanone have been published by CNR in a series of four volumes (the second volume consists of lectures given in 1964 and in 1965) called Collana di Automatica [7]. A few more lectures for which no written notes were subsequently produced, whereby left somewhat undocumented, have not been mentioned in the above short account.

The first Italian chair of Automatic Control was established in 1963 by the University of Rome. Examiners of the pertinent competition were F. Barozzi, Professor of Electrical Engineering, G. Evangelisti, G. Francini, A. Marino, and F. Neri, Professor of Electrical Measurements. The competition ended in 1964 with three winners, as was then the rule: Enzo Belardinelli, Antonio Lepschy, and Antonio Ruberti. Ruberti was immediately called in Rome, Lepschy in Bari and Belardinelli in Bologna. In 1966, Lepschy could move to Trieste, wherefrom he eventually moved to Padua (1970). The result of the competition, in the memories of many people (including some of the winners), was not consistent with the ranking of the candidates, among which was Giorgio Quazza who quietly resented that issue for years. In retrospective, the least one can say is that the Italian University missed, in that occasion, a unique opportunity to enroll a great man and also to give the younger scholars a remarkable example. Meanwhile, Emanuele Biondi and Luigi Piglione, winners of a competition for a chair of Electrical Engineering, had been called by the Politecnico di Milano and by the Politecnico di Torino, respectively, where they kept on fostering their interest in Systems Science and Engineering.

In 1964, Quazza and part of the group he had set up in CEA-Perego moved to ENEL (National Electric Power Agency) to constitute in Milan the Centro Ricerche di Automatica (CRA – Automatica Research Center). Under his leadership, the CRA grew up to more than 70 graduates engaged in problems of automation, optimization, digital signal processing, telecommunication, numerical analysis, complex systems modelling, and simulation. He personally developed innovative studies on the modelling and direct digital control of steam generators, the optimal dispatching of electrical power, and the control by on-line computers of multiarea power networks. The Center readily achieved a prestigious international visibility. The rest of the group grown up in CEA-Perego went to enrich the expertise spread in the industrial tissue: Carlo Delgrosso set up in Florence the ECS (Electronic Control Systems), Paolo Dufour moved to INNSE, and others to IME, PRAXIS, and to Olivetti.

In order to cover the position left by Lepschy on his move to Trieste, a new competition to a chair of Automatic Control was initiated in 1967 by the University of Bari. The winners were: Giorgio Quazza, Giovanni Marro, and Massimiliano Petternella.

Immediately after having been called by the University of Bari, Quazza resigned from the chair to resume his leading position at ENEL-CRA. Marro was called in Bologna and Petternella in Rome. Following a slightly different path, in the early 70s, a chair in Automatic Control was obtained by Mario Murgo in Rome, Mario Policastro in Trieste, and Eugenio Sarti in Bologna. By the same path, Francesco Donati obtained a chair in Electromechanical Applications at the Politecnico di Torino and Giuseppe Basile in Applied Electronics in Genoa. A new competition to 21 chairs in Automatica did not take place before 1974. In that occasion, the winners were: Gianni Bertoni, Claudio Bonivento, Carlo Bruni, Alessandro De Carli, Sergio De Julio, Roberto Genesio, Guido Guardabassi, Alberto Isidori, Arturo Locatelli, Giovanni Marchesini, Luigi Mariani, Angelo Marzollo, Sergio Milo, Edoardo Mosca, Fernando Nicolò, Salvatore Nicosia, Tommaso Raimondi, Sergio Rinaldi, Fabio Saccomanno, and Roberto Schmid. At the same time, Doriano Ciscato won a chair in Industrial Electronics.

Since 1969, all persons active in Italian Universities or Research Centers or in smaller research bodies involved with automatic control had constituted a group called Gruppo Ricercatori di Automatica (GRA) including 120 members under the chairmanship of Antonio Ruberti. The group has changed names and forms several times through the decades without loosing its basic cohesion in dealing with a changing institutional environment. Today, the group is constituted as Società Italiana dei Docenti e Ricercatori di Automatica (SIDRA), and its current Chairman is Antonio Vicino.

Beginning with the early 70s, a strong support to the university research in systems and control science came from CNR through a number of specialized Laboratories and Study Centers. Mentioning them gives an opportunity to provide a sketchy, certainly incomplete, yet hopefully significant picture of the status of research in the 70s in a few major universities and public institutions.

In Rome, senior researchers and teachers in the systems and control area under the leadership of Antonio Ruberti (who also led the Computer Science group) were: C. Bruni, A. De Carli, S. De Julio, G. Di Pillo, A. Isidori, G. Koch, M. Lucertini, M. Murgo, F. Nicolò, M. Petternella, and S. Nicosia. Petternella, Murgo, and De Carli were specializing in advanced industrial instrumentation and motion control, and Bruni and Koch in stochastic processes and system identification. Giorgio Koch soon came into the inheritance of the chair of Bruno de Finetti at the University of Rome. De Julio, Di Pillo, and Lucertini got a chair in Operations Research, thus contributing to the renewal of the Italian studies in that area. Nicolò, Nicosia, and Isidori, together with Ruberti himself, insisted on basic systems and control theory, especially nonlinear (bilinear) and multivariable systems analysis and control. Pretty soon, Nicosia and Nicolò focused on robotics and industrial automation, while Alberto Isidori gained a prestigious international reputation as the champion of that Roman school in nonlinear system theory he substantially contributed to set up. Lorenzo Sciavicco, educated in Rome, moved to Naples in 1968 where he gave birth to a school in robotics, the most brilliant representative of which was to become Bruno Siciliano. In 1970, the CNR established at the University of Rome the Centro di Studio dei Sistemi di Controllo e Calcolo Automatici (Study Center on Automatic Computing and Control Systems). Its Director was Antonio Ruberti until the end of 1980, when the Center developed into the Istituto di Analisi dei Sistemi e Informatica (Institute of System Analysis and Computer Science), no longer included in the university structure but still strongly tied with it (Ruberti was the Chairman of its first Scientific Council). Antonio Ruberti has been indeed, during the 60s and thereafter the major enlivener and the strongest motive power in Italy of scientific research in automatic control. Dean of the School of Engineering (1973–1976) and Rector (1976–1987) of the University of Rome, Ruberti's horizon blew up in the 70s far beyond the boundaries of control science. From 1987 through 1992, he has been a member of the Italian Government; first as Minister without Portfolio for the Coordination of Scientific Research (1987–1989), and then as Minister of both the University Education and the Scientific and Technological Research (1989–1992). Elected in the Italian Parliament in 1992, he resigned that commitment two years later to become a member of the European Commission, in charge of scientific research, development and education affairs. In April 1996, he was elected again at the national Parliament, where he chaired the Commission for the Politics of the European Union. Ruberti died in the year 2000, at 73. The University of Rome entitled to his name the Department of Systems, Computer and Control Engineering he had founded (with a different name) in 1969; so did the CNR with the Istituto di Analisi dei Sistemi e Informatica (IASI).

In Bologna, Giuseppe Evangelisti kept on teaching a course in Automatic Control until 1965, when Enzo Belardinelli relieved him. In the second half of the 60s, the responsibility of leading the research in systems and control science smoothly passed to a younger generation of teachers and scholars. In

particular, a few papers by Giuseppe Basile (educated in Bologna but active in Genoa since 1963) and Giovanni Marro had set the foundations of the Geometric Approach to Linear System Theory later on independently developed by Murray Wonham and Stephen Morse. Belardinelli's research interests began to move on to bioengineering studies while the activities of the Centro di Calcoli e Servomeccanismi, founded by Evangelisti in 1957, eventually merged in the Department of Electronics, Computers and Systems. As already mentioned, Eugenio Sarti got a chair in Control in 1970; Gianni Bertoni and Claudio Bonivento in 1975. Evangelisti died in 1981 at 78. His pioneering activity had been recognized in various ways both at a national (Accademia dei Lincei, Accademia delle Scienze dell'Istituto di Bologna, Istituto Lombardo Accademia di Scienze e Lettere) and at an international level (Académie des Sciences de Toulouse, Institute Belge de Régulation et d'Automation, Association Suisse pour l'Automation). He also received a "laurea honoris causa" from the München Technische Universität.

Senior researchers and young professors in Padua under the soft leadership of Antonio Lepschy were in the 60s, Doriano Ciscato, Giovanni Marchesini, and Luigi Mariani. Ciscato's research interests focused on process control, electrical drives, and power electronics. Giovanni Marchesini began his activity in the School of Natural, Physical, and Mathematical Sciences contributing to establish the Center of Applied Mathematics, the special focus of which was on optimization; back in the School of Engineering, he worked for a while with Giorgio Picci on bilinear systems; in 1972, he began with Ettore Fornasini his research on 2D systems; Dean of the School of Engineering from 1993 through 1996, he has been Rector of the University of Padua from 1996 through 2002. Luigi Mariani worked first on topics of industrial electronics focusing then on a special class of digital control systems with a time-varying underneath sampling frequency; from 1984 through 1993 he has been the Dean of the School of Engineering in the University of Padua. In the 60s, Lepschy had also followed the scientific growth in Trieste of Mario Policastro, Sergio Milo, and Angelo Marzollo, promoter in Udine since the early 70s of lively initiatives within the Centro Internazionale di Scienze Meccaniche (International Center of Mechanical Sciences). In 1968, the CNR established in Padua the Laboratorio di Elettronica Biomedica under the direction of Giuseppe Francini, and in 1970 the Laboratorio di Elettronica Industriale (Laboratory of Industrial Electronics) under the direction of Antonio Lepschy, who in that year had finally been called in Padua to cover a chair of Automatic Control. In 1973, the two labs merged with the new name of Laboratorio per Ricerche di Dinamica dei Sistemi e di Elettronica Biomedica (Research Laboratory for System Dynamics and Biomedical Electronics). First Director of the new lab was Antonio Lepschy relieved in 1975 by Luigi Mariani. In the subsequent decades, Lepschy kept his role of wise mentor for the Padua group of control until his retirement in 2003. At the University and in other scientific institutions, he went to cover important positions occasionally involving delicate responsibilities. He invariantly did it with his unique manner marked by gentleness, knowledge, and wisdom. Distinguished member of several Academies (Accademia Nazionale delle Scienze detta dei XL, Istituto Veneto di Scienze, Lettere ed Arti, Accademia dei Concordi di Rovigo, Accademia Galileiana di Scienze, Lettere ed Arti), he had a special taste for humanities; his personal library consisted of more than 15,000 volumes covering all facets of human knowledge and telling a lot on the complex and deep variety of his cultural interests and intellectual curiosities.

In the mid 60s, a new thrust to the Genoese research in Automatic Control came from the project of installing a process computer on the liner Esquilino to conduct, during its normal operation, a series of advanced experiments meant to identify a model of the ship, to control its power engine and other important on board apparatuses, to automatically produce the optimal course between given terminals, and so on and so forth. The project, jointly supported by the CNR, the Lloyd Triestino (owner of the ship), IBM, and the study center CETENA of Italcantieri was led by Ezio Volta. In the handful of young researchers, who then sailed the high and not always calm seas between Genoa and the Far East were Vincenzo Tagliasco, future founder of the Genoa research team in Bioengineering, and Riccardo Zoppoli joined later by Pierpaolo Puliafito. As a follow up of that project, in 1970, the CNR established in Genoa the Laboratorio di Automazione Navale (Laboratory of Ship Automation) under the direction of Ezio Volta. At the University, together with Volta was active since the early 60s Fabio Saccomanno who in 1975 obtained a chair in Automatic Control, thereby definitely leaving the ENEL-CRA. Beginning in 1963, Giuseppe Basile was charged with a course in Applied Electronics that he kept until 1973 when he obtained a chair from the University of Bologna. In Volta's wake, V. Tagliasco (before definitely switching to Bioengineering) and R. Zoppoli kept on furthering the progress of the Genoese research in Automatica and Operations Research.

At the Politecnico di Torino, the activity initiated by Luigi Piglione and fostered by Lorenzo Marenesi, a professor of Electrical Engineering with strong interests in system dynamics, was continued in the 60s by Giovanni Fiorio supported by Francesco Donati and Roberto Genesio. The former was subsequently led to engage his strong background in Automatic Control as professor of Electromechanical Applications, while the latter, winner of a chair in Automatica in 1975, joined Edoardo Mosca at the University of Florence. In the early 70s, a new generation of researchers, represented by Giuseppe Menga, Mario Milanese, and Angelo Negro, focused more and more on system identification methods associated with bounds on the modelling errors. The obtained results made way to devising new robust control system design methods while enlightening in new terms the subtle interaction between identification and control. Thus, the group primarily formed around M. Milanese could pioneer in the subsequent decades a research area come to witness a tremendous growth worldwide.

The group formed in the 60s at the Politecnico di Milano by Emanuele Biondi mainly consisted of Francesco Brioschi, Adriano De Maio, Luigi Divieti, Guido Guardabassi, Arturo Locatelli, Sergio Rinaldi, and Roberto Schmid. Biondi's primary research interests were more concerned with wide-sense Systems Engineering than with Control Theory and Technology. Thus, the features he gave to the group did not change when in 1970 he became the Director of a newly established CNR Study Center on System Theory. L. Divieti, R. Schmid, and E. Biondi himself readily moved onto biomedical engineering studies. Winner of a chair at the University of Pavia, R. Schmid formed a strong bioengineering group and subsequently developed an academic career ending as Rector of that University. Biondi with a handful of younger researchers of the Department of Electronic and Information Engineering joined a group grown in the Department of Mechanical Engineering to create under his leadership a new Bioengineering Department. F. Brioschi and A. De Maio eventually oriented their activity on subjects of Macro- and Micro-Economics. They too, together with younger scholars active around them, joined a group working on similar subjects in the Department of Mechanical Engineering to create a new Department of Management, Economics and Industrial Engineering. In the 90s, A. De Maio became the Rector of the Politecnico di Milano. Finally, G. Guardabassi, A. Locatelli, and S. Rinaldi kept on working in System and Control Theory and on gathering good pupils to involve in their research projects. The current Editor in Chief of this journal was one of those pupils. Main topics in the early 70s were sensitivity analysis (via a geometric approach), periodic systems, and optimal periodic control. Two of those early students are the present and the past Deans of one of the five branches in which in the 90s the School of Engineering has been split at the Politecnico di Milano. S. Rinaldi came readily to focus on Environmental Engineering studies and played an important role in giving birth to a new degree in that area. A. Locatelli eventually relieved E. Biondi as Director of the Study Center on System Theory while G. Guardabassi has played some role, lately, in a number of initiatives leading since 2001 to a new degree in Automation Engineering.

Beginning in 1971, Giorgio Quazza was charged by the Politecnico di Milano with a course on Process Control for which he prepared, despite his heavy leading responsibilities at ENEL-CRA, detailed notes that have been for decades a basic reference in that area. In 1976, A. Locatelli and the present author organized in Udine the first IFAC Symposium on Large-Scale Systems Theory and Applications, where Quazza gave a plenary lecture on "Large Scale Control Problems in Electric Power Networks," that readily became a basic reference in the field. As an example of the advanced research activity carried on at CRA in the 70s on that subject, we may recall that in 1973 a first attempt to connect, through Italy, the Yugoslavian to the Western European power network unexpectedly failed due to definite instability. A clever sensitivity-based theoretical analysis developed by Fabio Saccomanno made it possible for Vittorio Arcidiacono and Emilio Ferrari to successfully solve the problem. Also thanks to the advice of CRA, the same technique for a better damping of electromechanical oscillations was readily adopted in several countries all over the world.

Giorgio Quazza has been active in many professional associations (ANIPLA, AICA, FAST, etc.) where he invariantly promoted and carried out important initiatives. Since the end of the 60s, he began to take on leading responsibilities within IFAC, in the Systems Engineering Committee, the Applications Committee, and finally, the Executive Council. He died in August 1978 while crossing alone, with full consciousness of the risk, a glacier of the Alps not to miss an appointment with a close friend. The responsibility of continuing his teaching at the Politecnico di Milano was taken on by Claudio Maffezzoni. To honor G. Quazza's memory, IFAC established a medal and a monetary prize presented at each triennial World Congress to "a distinguished control engineer." He was indeed a gentleman, a wise engineer, a serious researcher, and a right man. His manners were gentle; his partnership reliable and his

friendship solid. So discreet as to seem timid, his strong character despised any arrogant tone or sense of superiority, no matter whether justified to whatever extent. In any discussion, he was able to listen carefully to others before arguing on their points; he had the rare quality of being a natural leader, unquestionable and unquestioned. His memory is to many a valuable property of silent morality; his heritage an impervious commitment.

5. Concluding Remarks

In this paper, the early days of control in Italy have been sketched out with special regard to the crucial period from 1950 to 1970 when a handful of pioneers set the basis for the subsequent impressive developments. In doing this, the attention has been primarily focused on apparently independent stories marked by the talents of exceptional personalities. The subsequent research achievements have been mostly left in the background. Those which are worth mentioning are in fact well known to the scientific community. On one hand, they developed in Italy, during the last thirty years or so, in a way which is strictly connected with the international scientific stream whereby not too different from the way things happened in other countries; on the other hand, they are perhaps too close to be already looked at as parts of a history and too deeply intertwined with personal experiences for the present author to afford putting them in a proper perspective. Notwithstanding this choice, it is quite possible that some facts or persons have not been given the attention they actually deserved and that some of the stated opinions may not be fully shared by some readers. For all of these, the author apologizes with the colleagues and with the not sufficiently recognized common masters.

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