History of Mechanism and Machine Science 38

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Distinguished Figures in Mechanism and Machine Science

Their Contributions and Legacies, Part 4

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History of Mechanism and Machine Science

Volume 38

Series Editor

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Preface

This is the fourth volume of a series of edited books whose aim is to collect contributed papers on distinguished figures in MMS (Mechanism and Machine Science). This is a continuation of the first volume that was published in 2007 (ISBN 978-1-402-06365-7), the second one in 2010 (ISBN 978-9-048-12345-2), and the third one in 2014 (ISBN 978-9-401-78946-2), all combining ancient and recent scholars in order to give not only an encyclopaedic character to this project but also to emphasize the significance of MMS over time.

This book-series project has the characteristic that the papers recognize persons and their scientific work with relevant technical developments in the historical evolution of the fields that today are identified in MMS. Emphasis is also given to biographical notes describing efforts and experiences of the persons who have contributed to technical achievements with their individual life history. But a technical survey is the core of each contributed paper yet.

This fourth volume of the series project has been possible thanks to the invited authors, who have enthusiastically shared this initiative and have spent time and effort in preparing the chapters in due time.

The stand-alone chapters cover the wide field of the History of Mechanical Engineering with a specific focus on MMS by specific discussions of the distinguished figures and their specific activities they have carried out during their life with impacts also in the next developments with also today fame. In this book, special attention is addressed to modern figures who had recent contributions in the fields of MMS that may not yet well known in the international community, also with the aim to show that the science and technology evolution and particularly the History of Mechanical Engineering is built day by day even with a very recent contributions that need to be recognized as soon as possible not only for the historical credits but for tracking the future and more works and attentions to those topics.

We believe that readers will take advantage of each of the chapters in this book and future ones by getting further satisfaction and motivation for her or his work (historical or not).

We are grateful to the authors of the papers for their valuable contributions and for preparing their manuscripts on time, as well as the reviewers for giving useful comments for chapter improvements. Also acknowledged is the professional assistance by the staff of Springer and especially by Ms. Anneke Pot and Ms. Nathalie Jacobs, who at the beginning of the book project have enthusiastically supported this project with their help and advice, and Mr. Pierpaolo Riva in the final preparation also of this fourth book.

We are grateful to our families and our friends and colleagues for their patience and understanding, which have made possible for us to work on this book and the book-series project of distinguished figures on MMS.

Rome, Italy — Marco Ceccarelli
Beijing, China — Yibing Fang
August 2019

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1 Biographical Notes

Giovanni Bianchi, Fig. 1, was born in Como, Italy, on 11 March 1924 and died in Milan on 13 November 2003.

He got the degree of mechanical engineer at Politecnico di Milano on 1950, and he received the master degree in Mechanics at Cornell University, USA, in 1953.

He started research activity at CNR (Italian National Council for Research) from November 11, 1953 to October 31, 1954. From November 1, 1954 to January 31, 1955, he got a position of teaching assistant and then he was appointed assistant professor from February 1, 1958 to October 31, 1970.

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Fig. 1 Portrait of Giovanni Bianchi (1924–2003) in 2000

Has been appointed as an extraordinary professor of mechanics applied to machines from 1.11.1970, and then full professor from 1.11.1973 until the retirement on 31.10.1992, whereas he continued to be active until November 11, 1996 after award to professor emeritus in 1994.

He was a professor also for other disciplines and specifically:

– Machines (until 31.10.1966)
– Dynamics and vibration of machines (from 1.11.1968 to 31.10.1980).

He was elected Director of the Institute of Mechanics and Construction of Machines at Politecnico di Milano.

Since 1968 he was member of the Executive Council of CISM, International Center of Mechanical Sciences where he also served as Secretary General from 1977 to 2000.

In 1965 he was among the founders of AIMETA (Italian Society of Theoretical and Applied Mechanics) for which he served as chief editor of the society journal Mecanica and Secretary General until 1982 and then in 1982–85 as President [1]. In 1969 he was also among the founders of IFToMM (International Federation for Theory of Machines and Mechanisms) for which he served as member of the Executive Council in 1971–79 and then as President in 1984–91 [2].

Bianchi's human sensibility is also reinforced by his deep sense of family, his love for wife Barbara and his affection for all his children. Barbara has always been close to every important, silent, positive moment, entrusted with a profound culture of intense humanity. This total kindness was an element that made the collaboration with

Giovanni exciting. His scientific work has also been performed in many important areas in mechanics. His formality in dealing with relationships was also expressed with a close focus on research papers, with an absolute precision of each evaluation.

Many signs left by Giovanni Bianchi with his daily activities both in Italy and abroad still remain at the Milan Polytechnic and at CISM, AIMETA, and IFToMM. He was well reputed as scientist and leader in the national and international community not only in the areas of mechanical engineering.

2 Main Activities

In the political and social evolution that in the years 1960–2000 changed the economic structure of the world by creating new structures and eradicating acquired structures, science and technology began to have a global impact and to involve human and cultural aspects to straightening the relationships among peoples, nations, persons.

Giovanni Bianchi has lived as a man and as a university professor, as a person, as a father, as a researcher in the strong reality of the past years of that challenging period and has been an exemplary actor that has been recognized throughout the scientific world, Figs. 2 and 3.

Bianchi began his activity in the world of university teaching in the fields of machine mechanics and theory, at the Politecnico di Milano, at the Institute of Mechanics and Machine Construction in the 1960s. He begins a career that covers the difficult and often impossible research role and connections between the actors and the interpreters of the research, for that disposition to shared knowledge

Fig. 2 Giovanni Bianchi chairing a meeting at CISM with prof Duditza and prof Manna

Fig. 3 Giovanni Bianchi on a concert as expert musician

that Aristotle first, in 343 BC, teaches as a basic element for deep knowledge in Categories, 8.9.

Bianchi immediately begins as the coordinator of the AIMETA Italian Association of the theoretical and applied mechanics, the action and the heavy work of the person who helps people to integrate into new cultural and scientific environments and cooperates with foreign institutions. There are even distant Nations with which to cooperate, which are also of different scientific, racial, and political situations. Immediately begins the construction of a cultural canvas that will take to the heights of theoretical and applied mechanics in the world, with the opening already in 1969 of IFToMM, International Federation of the Theory of machines and mechanisms, which today plays a key role in mechanics and robotics.

Giovanni Bianchi acted on several parallel fronts, and in recent years there are scientific research developments and the organization of a world-wide network of international, unrestricted and barrier-free experiences that create a major selection for the affirmation of mechanics and related disciplines, in universities and in practical and industrial applications.

Bianchi, as philosopher Augustine also considers in the text “Beauty”, chooses the path of sharing to the aspects not yet well-known of science, and as a setting he sometimes can choose from different positions, an intermediate position that assumes its own willingly, though it is not his personal conviction. We would point him as a savior in many phases of mechanical development because he has bent the competitive edge by affirming his logical abilities in every situation. Recognizing that his approach has always been to build an institutional future with the defense of the most valuable and most significant institutions beyond political risk. The opening on the institutional future led to a lot of writing and participation in the creation of AIMETA, and then of IFToMM and also of CISM, International Center

of Mechanical Sciences, jewelry of knowledge and communication culture that are always constantly growing and today are beautiful gems in modern mechanics.

The possibilities of national and international co-operation have been mainly built by Prof. Bianchi not only on individual characters but also on institutions.

2.1 At Politecnico Di Milano

We recall prof Giovanni Bianchi as a young professor, who wrote by his hand with the thin and clear calligraphy, which for many students served as a useful reference especially for the learning from the course. He gave mechanical and machines courses, even in cooperation with colleagues from other departments giving a synthetic impression, which then led to the mechanics of the systems. Bianchi becomes a highly experienced teacher, and his pathway has developed horizontally, not commonly in university teaching. He has also fundamentally taught the dynamics and vibration of machines with high-level theoretical developments which is a basic reference of mechanical engineering. His exam-related teaching was very intense and focused closely on the character of the student who was generally very satisfied with the evaluations. Bianchi also spent much for student care in their graduation thesis, which had to be precise, thorough, exhaustive. In Milan Polytechnic Bianchi developed a lot of care in up-to-date teaching, even reinforced by his parallel experience of international teaching.

His didactic activity has been complete and has also brought prestigious results to the enlargement of mechanical courses in the university, up to the arrival of intelligent robotics. His international activity has followed a trajectory that has begun in Italy and followed throughout the world.

Attention should be paid to the links of the Politecnico di Milano with other universities, and on this thought and attitude the Politecnico has opened segments detached in many cities of Lombardy. From an educational point of view, Bianchi developed that figure of interdisciplinary professor who is available and interested to the evolution of science and international dynamic relationships. We must consider that his professional contribution within university institutions was very positive and effective because he allowed to understand how the university didactic structure can be well distributed and shared with scientific, technical, educational and even psychological developments. Bianchi was a symbol of the ability to represent well documented technical culture as a flexible, useful, easy tool accessible by young students and senior specialists. It must have a formal logical structure that is perfect in the face of learning. This was the main didactic contribution of Giovanni Bianchi, still valuable todays.

2.2 At AIMETA—Italian Association of Theoretical Mechanics and Application

An important starting point of the influent activity of Giovanni Bianchi was the Journal "MECANICA" of AIMETA, by coordinating the articles in the Italian Journal of applied theoretical mechanics and evaluating the values, checking the sources, reviewing the generation, contacting authors and pointing to new authoritative collaborators. It was his first international official experience, to whom he collaborated willingly because the team was simple, well-tempered, articulated. The results of his chairmanship of the journal consolidated the AIMETA association in Italian cultural policy with meetings, seminars, and international activities that still make it an absolute reference. Secretariat and editorial staff were well connected although they belonged to different institutions so that the results were always positive and without any criticism. Magazine numbers, high-level in English, and the editorial quality of the product's graphics have also made it a remarkable breathtaking structure today. It should be considered that it is not easy to make a scientific argument, such as theoretical and applied mechanics, productive. Prof. Bianchi has been one of the protagonists in such expertise and its dissemination. He co-organized the first AIMETA conference in Udine in 1971.

We need to understand all the contributions that come from different disciplines, especially the energy and space, the critical one of quantum mechanics and make the subject usable. Often you need to talk to the author to technically clarify the unknown aspects and to feel together with the great group of mechanics scholars.

Bianchi could build an Italian group of aggregators. This has even built new symbiotic scientists and research aggregations, including with the Italian Mechanical Committee, focusing on the Politecnico di Milano in an international nature. From this great appreciation that has made Politecnico di Milano a cultural, scientific, technical and industrial wealth of Italy of the 20th century, it is also owed to Prof. Giovanni Bianchi, projected also towards the 21st century

2.3 At CISM International Center for Mechanical Science

To understand the origin of the communication and development capabilities of Giovanni Bianchi in world rames it is necessary to consider his initial activity leading the CISM Center, the International Center of Mechanical Sciences, in Udine, Italy. The need to provide real life data and experience makes unique and inseparable from human contexts and social backgrounds the Bianchi's cultural growth inside of the international scientific community. Let us therefore look at the center of Udine as a physical sacrifice for the long continuous journeys between Milan, his residence, and Udine, away from the family so loved with his children to whom he dedicated soul and body in his life. Bianchi has managed to build a perfect secretarial, resource management facility in Udine. The great commitment with evaluations on Friuli

territory of Udine, with intense connections throughout the world, beyond any geographic political reality, with a mental openness that has made the center of Udine an absolute reference even today after so many years since its Foundation. Bianchi was the strong advocate of the approach of Prof. Luigi Sobrero who first, with an unbelievable illuminated vision for those times, wanted to create in the center of Europe a free, independent, economically strong and ethically valid institution in the face of any propulsion, discussion, political attitude.

Giovanni immediately set the center with a dynamic intent, with highly specialized courses, inviting experts from all over the world with a quality request.

He worked with a culture management that was dynamic, open, and very courageous as they also address issues at the limits of human knowledge such as quantum mechanics applied to industrial mechanics. The Bianchi's approach to knowledge can be emphasized referring to early days of robotics that first became Udine in Italy's didactic institutional theme. In 1972 he contributed to start a congress, called Romansy, that today being a series is still a scientific reference of primary interest for robotics form all around the world. It is to note what was the political climate of those 70s, when the Cold War created a barrier between the Soviet Union and the Western countries, and few visionaries among whom Bianchi was a leader has attempted such an initiative.

The CISM Center in Udine was an example of mental openness to culture and free information, an open discussion center and, above all, of professional fairness. Giovanni Bianchi ws Secretary General for several years with his new way of cooperating as paramount, because there is no mechanical scientist who did not go to Udine in the period of his leadership in CISM. Virtually, in the respect of the official culture of scientists from other countries, Giovanni Bianchi has carried on a worldwide discourse that everyone is grateful for.

Especially remembering unforgettable conferences, such as on September 1978 holding at CISM by Dr. Antal Bejczy, JPL, USA, on Space Robotics. It was the first scientific presentation in Europe on the remote control from the ground to the moon of what would be the future extra-terrestrial robots. This presentation was an absolute point of reference also for Italian, European and interested researchers in spatial research. Today, one looks at space exploration with a sense of security due to Antal Bejczy's work together with Giovanni Bianchi's sensibility. The cordiality of reception at CISM, with the sensitivity of educated and affectionate teaching staff and assistance, the care on scientific products and documentation, accurately collected in archives that keep alive the memory of the present, which often technically becomes old, enabled Giovanni to let CISM be a center of highest excellence in the world. There are many things to say and in something to tell how Bianchi decided that at the end of each congregation at the lunch of greetings, a song could be heard that would be a symbol of every country and it was a magical moment still remembered, by Japanese, American, Chinese, Russian, Brazilian, Italian and all the worldwide researchers. Everyone was singing songs naturally with the words of their own language. Moments that for many of us have remained unforgettable.

2.4 At IFToMM

Since the very early days Bianchi begins the successful adventure of IFToMM, the International Federation for Machine and Mechanism Theory, then referred to as the Science of Machines and Mechanisms. It is the time of 1965, when the new mechanical science related to energy, automation, technology, electronics and point-to-point control begins to emerge. Mechanics lessons consider important to know the mechanics control systems, to calculate the possibilities of the mechanisms, to the more complex mechanical systems, and to think intelligently about the control, using the first electronic components that are on the market. The foundation of the world federation takes place at critical times and important for the development of world industrial society. The birth of IFToMM represents a significant index of sensitivity to economic, cultural and political developments. Giovanni Bianchi was present in the Foundation Team. In meetings in Poland in Zakopane in 1969 lay the foundations for articulation of the mechanics federation and in 1972 in Dubrovnik in Yugoslavia, meetings and settings grew. Bianchi was on the practical implementation of the federation, one of the most important scientists in the technical field to be present and participates with high-level scientific and dissemination work. In these days, some scientific and technical directions are indicated by the commitment of well-known thought-trained scientists, including Prof. Artobolevski, a great character indifferent to any difficulties and crises, of which a memorial plaque is present near Red Square of Moscow.

Young researchers and experienced professors adhere to the IFToMM Federation which every four years has a world Congress. Conferences are the diamond's point to participate in mechanical knowledge and advance the first results in a discipline that is emerging, at a time, as explosive: robotics.

The federation coagulates these international reference researches. Also important is the Congress in New Delhi, India, in 1983, where all European countries present their relations and it will be very important also to solicit the cooperation of the countries that were then in the third world. Is an intense, effective and positive advocate of cultural, mental, intellectual and moral openness for a beautiful, unlimited and borderless collaboration. His great capacity is to be protagonist in silence, to be a great reference without soliciting adhesions or praying. Bianchi is always present at the important moment and in the meetings, that count. Subsequent congresses confirm the quality of the activities of the World Federation. In 1995, the congress in Milan of the federation can gather honors from the Milanese authorities, Lombardia's top authorities and a large number of television networks that portrays the events developed during the congress. A first event is the first surgical operation of robotics in the world on a living human being that takes place from the congress seat to the Policlinico Hospital in Milan. A media success that launches the IFToMM Federation at the summit of Italian interests and world appreciation. Participants at the IFToMM 1995 Congress are around 1,000 from around the world. It is the first time for an official Chinese delegation. The congress closes with an unforgettable episode: the robotized cultivation of Californian daisies in Los Angeles with the help

of Prof. George Bakey at the closing of the congress on a Saturday morning, and is night in California.

Bianchi worked within IFToMM for commission creation. The commissions have a specific theme: from international relations to that of control theory, from rotor dynamics to mechanics history, and touch on all the specific issues of mechanical engineering. Each committee is made up of scientists from the nations participating in the Congress of Milan and will grow. They will always be growing because the Federation becomes pervasive. Bianchi was an effective protagonist and began development activities also towards communication. He set up collaborations for a high prestigious publisher for which virtually all books that are prepared and derived from the activity of the Mechanical Federation become practically usable. Bianchi's work was significant because it linked to a deep culture of collaboration without wishing to prefigure special sectors, without imposing unverified roads, but on the contrary offering suggestions that each researcher and teacher can do right.

Today, much of the Federation's current activity involves the scientific world of engineering, mechanics, information technology and communication. We must therefore consider that the seeds casted by Bianchi in his life were also generated by his profound culture.

His consistent management in the IFToMM federation always allowed individual personalities to be expressed without unnecessary favoritism, without unnecessary unjustified priorities, but by emphasizing the efforts of the Commissions as it is possible to achieve new high-level achievements that further enrich the Commissions strength. Bianchi never wanted to appear as the sole manager, but on the contrary, he learned as a coordinator, knowledge and testimonies, keeping alive the relationship with the students, always informed with great courtesy and correctness. Also for these reasons, the IFToMM Federation has also become the home of friendly and lasting relationships, which have enabled it to receive ever more membership and development support, with a pleasant memory. It was in meetings in Italy at a seaside resort in Camogli, with Giovanni Bianchi for a "focaccia" (pizza bred), a nice meeting before a difficult meeting in Genoa.

3 Main Scientific Contributions

Giovanni Bianchi produced a vast and profound scientific activity, in publications, books, interventions at congresses and at universities.

This is a list of examples of publications of Prof. Giovanni Bianchi:

- La propagazione di onde d'urto in regime plastico (1957)
- I moti traslatori di un'asta pesante, I. Risposta ad una eccitazione a gradino II. Analisi della soluzione con riguardo alle applicazioni nei problemi di misura, III Applicazione allo studio di particolari dispositivi dinamometrici e accelerometrici (1960)

- Il comportamento elasto-viscoso dei metalli sollecitati dinamicamente al di sopra del limite di elasticità (1960)
- Il progetto di una attrezzatura per prove d'urto (1960)
- Sul calcolo del volano e dell'irregolarità periodica in macchine azionate da motore asincrono (1960)
- Some experimental and theoretical studies on the propagation of longitudinal plastic waves in a strain-rate dependent material (1963)
- Un metodo di calcolo per la dinamica del sistema veicolo—barriera di sicurezza (1965)
- Dinamica del sistema veicolo—barriera di sicurezza: schemi elementari e approssimazioni successive (1966)
- Verifiche sperimentali nello studio del sistema veicolo—barriera di sicurezza (1966)
- Sull'analisi del quadrilatero articolato con procedimento di calcolo automatico (1968)
- Sintesi di sistemi articolati per moti alternativi (1969)
- Progettazione cinematica di un meccanismo tendifilo articolato (1970)
- Synthesis of quick—return mechanisms with optimum transmission angle characteristis (1971) (with N. Bachschmid)
- Constitutive equation and continuity in the propagation of plastic waves (1974)
- Proprietà della propagazione di onde in regime plastico in relazione alla forma dell'equazione costitutiva (1975)
- Research on Mechanisms (1979)
- On the grasping process for objects of irregular shape (1980) (with A. Rovetta).

Relevant is also his production or co-editorship of books from CISM courses, like for examples:

- G. Bianchi, Constitutive Equations and Continuity in Propagation of Plastic Waves, in "Topics in Contemporary Mechanics", CISM Courses and Lectures 2010, Springer Verlag, Wien—New York, 1974
- G. Bianchi Editor, Noise Generation and Control in Mechanical Engineering, CISM Courses and Lectures n. 276, Springer Verlag Wien—New York 1982
- G. Bianchi, K. V. Frolov and A. Oledzki Eds Intl. CISM-IFToMM-WHO Symposium, "Man Under Vibration: Suffering and Protection", Elsevier Amsterdam 1981;
- G. Bianchi and W.O. Schielen Editors,Intl. IUTAM-CISM Symposium on "Dynamics of Multibody Systems", Udine, June 1983, Springer Verlag, Berlin 1986;
- And several proceedings of the CISM-IFToMM Symposium Romansy.

Among significant contribution that are considered in the history of mechanical engineering we can considered the pioneering works of Giovanni Bianchi on vibrations analysis, design of mechanical systems and early works on robot design.

One of the most fascinating work is the study of human hand grip and the next robotic hand he designed as reported in the paper 'Design and Control of Mechanical Hands for Robots' co-authored with Alberto Rovetta. The human grip was studied