

Pavia, September, 1961: a window on muscles and nerves

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Summary

In September 1961, the First International Congress of Electromyography (EMG) was held at the University of Pavia. This event proved to be a sort of foundation stone for the further development of EMG as an organized field. Many of the most distinguished clinical neurophysiologists attended this congress and took an active part in it, delivering important lectures and scientific communications on the various aspects of EMG, including electroneurography. They included: Henri Gastaut, Fritz Buchthal, Jean Edouard Desmedt, Eric Kugelberg, Roger W. Gilliatt, John A. Simpson, Albrecht Struppler, Irena Hausmanowa-Petrusewicz, and Howard Edward Lambert. The congress was organized by Paolo Pinelli, at the time a young and brilliant clinical neurophysiologist who had learned the EMG procedure in Copenhagen under the guidance of Fritz Buchthal. Various scientific and social aspects of this important congress are outlined in this paper.

KEY WORDS: First International Congress of EMG, Pavia 1961, Pavia Committee, Paolo Pinelli

A congress as a milestone in the history of a scientific field

Generally, scientific congresses are gatherings of people wanting to remain abreast of the development of knowledge in their respective fields; they are also important channels for the dissemination of new scientific achievements, or a means of meeting important people, ideal for setting up new connections and making new contacts for professional, academic or scientific reasons; more simply, they are opportunities to visit interesting new places all over the world. All these reasons are more than sufficient to justify their occurrence. But some congresses, besides being all these things, also become, above all, pages sculptured in the history of particular sciences not only because of the traces they leave in the individual memories of their participants, but also because they become a constitutive part of a scientific field, and thus a part of "collective memory". Take, for example, the Solvay congresses of physics in 1927 and 1930, remembered for the discussions between

Niels Bohr and Albert Einstein on the nature of indeterminism in the physical world, the 1900 International Congress of Mathematicians in Paris, remembered for the formulation of "Hilbert's problems" for the new century, and the X International Congress of Medicine, held in Berlin in 1890, where the audience was riveted by Robert Koch's announcement of a new treatment for tuberculosis, which later turned to be not a new cure but rather a test to verify a previous tuberculosis immunization. Without wishing to draw a direct parallel with these major events, it can certainly be said that in clinical neurophysiology, at the time a much smaller and less prominent field, the First International Congress of Electromyography (EMG) held in the ancient University of Pavia on September 4 and 5, 1961, was something similar. Indeed, for the field of EMG, this congress became a sort of a foundation event for the further development of the discipline.

In some ways, Pavia was the right place in which to start this adventure. Pavia University is where, in 1792, Alessandro Volta, at the time a professor of experimental physics, began his scientific debate with Luigi Galvani on muscle contraction and on the specific roles played by nerves in this phenomenon (1). This is also the university where, in the eighteenth century, Antonio Scarpa, a professor of anatomy, developed fundamental studies on the clinical anatomy of muscles and nerves. Pavia, a small city on the banks of the river Ticino, is also famous as the place where Camillo Golgi identified the tendon receptors that took his name (1878-1880), and where his pupils Emilio Veratti and Aldo Perroncito conducted important research on muscles and nerves: Veratti provided a clear description of the T system whose function is linked with the sarcoplasmic reticulum proper (1902), while Perroncito did fundamental research into the regeneration of peripheral nerves (1906-1907) which was subsequently applied to clinical studies by other students of Golgi, namely the clinical professor of nervous and mental diseases Ottorino Rossi and the lecturer of neurology Guido Sala (2-4). In short, muscles and nerves are, historically, key areas of research at the University of Pavia.

At the beginning of the 1960s, the time was ripe for a full assessment of a new branch of applied neurophysiology, EMG, whose clinical usefulness had, over the previous decade and a half, become increasingly evident. In fact, in the space of just a few years, this technique had had a considerable impact, leading to important new observations on the semeiology of various diseases of the motor system. Through the recording needle of the electromyograph a new window for observation of muscle action in normal and pathological conditions had been opened.

Technological and theoretical advances underpinned the development of clinical EMG. The foundation stones of this new discipline were laid through the introduction of the concept of the motor unit, by Charles Sherrington in 1925 (5), followed by the use of a concentric co-axial needle electrode by Edgar Douglas Adrian and Detlev Wulf Bronk (6), by means of which a motor unit potential

could be recorded. The 1930s brought the first applications of EMG to neuromuscular pathology, which became more and more detailed and precise over the following two decades (7). Meanwhile, EMG began to feature at international congresses: in September 1949, Professor Fritz Buchthal from Copenhagen delivered a lecture on *Electromyography in the diagnosis of central and peripheral lesions of the nervous system* at the Fourth International Congress of Neurology, held in Paris. This was followed, a few years later, by a symposium on EMG at the International Congress of Neurological Sciences in Brussels (1957), under the direction of Alfred Fessard. Then, in 1960, a "Réunion Européenne d'Électromyographie" was held in Strasbourg, with the presentation of 40 communications. In view of the new emerging problems discussed at this meeting, it was suggested that a new symposium wholly dedicated to EMG should be included in the programme of the Seventh International Congress of Neurology of Rome, held jointly with the Fifth International Congress of Electroencephalography and Clinical Neurophysiology and scheduled for September 7-15, 1961. However the organizer of this important event, Prof. Mario Gozzano, decided that clinical EMG was only a "collateral" examination tool and that it might adequately be discussed during the presentation and description of the different clinical case studies in which EMG was applied. Others, instead, felt that the technique merited a specific congress and since Rome was no longer an option, another venue had to be found. The place chosen was Pavia.

Paolo Pinelli and the Pavia Congress

The man responsible for this choice was the celebrated clinical neurophysiologist Henri Gastaut, together with the pioneer of EMG, Fritz Buchthal. In addition to the historical reasons for choosing this location, another strong incentive for holding this founding congress in Pavia was the fact that this would allow it to be organized by Paolo Pinelli, one of the brilliant neurophysiologists of the time. During a series of personal meetings at the Hotel Gallia in Milan, Pinelli had little trouble convincing Gastaut that the time had come to give EMG a measure of independence from the other branches of neurophysiology, first of all through a high-profile congress devoted to the technique. With the blessing of Gastaut, one of the greatest electroencephalographers of all time, this adventure began under the best auspices.



Fig. 1 - Paolo Pinelli with Paolo Mazzarello in 2001

Born in Mantua in 1921, Pinelli was a student at the University of Pavia as a fellow of the Ghislieri College. As a student, he worked at the Institute of Comparative Anatomy under Maffo Vialli, the scientist who, in 1937, had, together with his post-doc collaborator Vittorio Erspamer, identified serotonin (at the time called enteramin). After this first step in the research field, Pinelli became a resident at the "C. Mondino Institute", the Pavia-based Clinic for Nervous and Mental Diseases that, set apart from the city's general hospital, had two neurological and two psychiatric wards with a total capacity of 100-150 beds. The director of this neuropsychiatric hospital was Prof. Carlo Berlucchi who had gained international recognition as a psychiatrist and clinical neurologist. The scientific charisma of Berlucchi was such that a number of brilliant students were drawn to conduct research under him. Besides Pinelli, another pupil of Berlucchi at that time, the Ghislieri student Ennio De Renzi, went on to become an important scientist and the pioneer of modern neuropsychology in Italy.



Fig. 2 - Carlo Berlucchi (courtesy of Giovanni Berlucchi)

Thanks to a fellowship from the Ghislieri College, Pinelli was introduced to EMG at the "Mecca" of this research field, the Institute of Neurophysiology of Copenhagen directed by Fritz Buchthal, one of the protagonists of the exploration of the electrical activity of muscle in normal and pathological conditions (8-11). With the support of the Ghislieri grant, Pinelli spent 1949 and 1950 in Copenhagen; after this, supported by a fellowship from the Danish foundation Rask-Ørsted, he continued to work at the Institute of Neurophysiology for some years, albeit with interruptions. Buchthal, together with his collaborators Christian Guld and Poul Rosenfalck, had set down a technical protocol for performing a standardized clinical EMG examination and, with Pinelli, he conducted a rigorous analysis of action potentials in normal (12) and in various pathological conditions (13). In particular, Buchthal and Pinelli studied muscular atrophy of neurogenic origin (14), polymyositis (15), experimental peripheral nerve paresis (16), myopathies, specifically progressive muscular disorders (17) and, with a grant from the Danish Association for Infantile Paralysis and the Michaelsen Foundation, they were also able to investigate the epidemics of poliomyelitis, at that time a widespread disease, by analyzing 48 patients, many followed from the acute stage through to one year after the onset of the paresis; in so doing, they discovered the collateral nerve regeneration that occurs in this disease

(18). During these investigations into the epidemics of poliomyelitis, Pinelli was also in contact, between 1949 and 1950, with the Institute of Theoretical Physics of Copenhagen (for the elaboration of the statistics of the experimental data). There he met Niels Bohr, a gentle man and friend of Buchthal (P. Pinelli, personal communication).

Pinelli had the good fortune to be in Copenhagen with another brilliant post-doc from Pavia, the biologist Cesare Casella, a close friend in spite of belonging to the rival Borromeo College. Casella was an extraordinarily able researcher whose investigation into sarcolemma function elicited an enthusiastic response from Buchthal. Buchthal then asked Casella, in perfect Latin, to tackle some even more difficult topics; Casella, serious, replied: "Paganini does not repeat". Then he smiled quietly and performed the new studies required by his boss.

EMG was not, however, the only kind of research that Pinelli performed at the institute directed by Buchthal. There, he met the pediatrician Margaret A. Lennox with whom he began to study electroencephalography (EEG) in children, a field that was to become an important part of his scientific activity in the subsequent years.

Back in Italy, Pinelli introduced what he had learned in Scandinavia into the Mondino Institute in Pavia and the Milanese clinics. Through Casella and the technician Gerolamo Barni, the first EMG instrument was soon built, thanks also to support received through the post-war USA Marshall Plan, which provided the electrical amplifiers, invented by Franklin Offner, necessary to make the electric signals from the muscles perceptible. Barni then built two instruments for Milanese hospitals: one for the Carlo Besta Neurological Institute and the other for the Paolo Pini Orthopedic Institute. Pinelli instructed the medical doctors working in these centers in the use of the new neurophysiological tool.

Alongside EMG, other neurophysiological techniques were cultivated at the institute directed by Berlucchi, e.g. electronystagmography, by Gildo Gastaldi, and psychogalvanic reactions by Ennio De Renzi, while EEG had been actively used since 1948. Among the many important studies performed in this period at the Mondino Institute it is worth mentioning the first demonstrations by Berlucchi and Pinelli, using EEG recordings, of dissociated sleep (i.e. dreams intruding into wakefulness) in post-encephalitic parkinsonism and, by extension, in other cases of Parkinson's disease (19). With Pinelli a driving force in his role as general secretary of the event, the University of Pavia prepared to host the First International Congress on EMG. The event was scheduled for September 4-5, 1961, just before the joint meetings of Rome.

The chairmen of the congress were Henri Gastaut, Luigi De Caro, Carlo Berlucchi and, in spite of his initial opposition to the very idea of a meeting devoted specifically to EMG, the powerful neurologist Mario Gozzano. The various scientific sessions were led by Fritz Buchthal from Copenhagen, Cesare Casella from Pavia, Bedrich Drechsler from Prague, Irena Hausmanowa-Petrusewicz from Warsaw, Howard Edward Lambert from Rochester, Wladimir T. Liberson from Chicago and Hines (Illinois), and François Thiebaut from Strasbourg.

The Pavia Congress

On Monday, September 4, 1961, the Volta Theater – the "sacred" site where, at the beginning of the nineteenth century, Alessandro Volta had unveiled his breathtaking invention, the battery – was crowded with people. Down at the chair, the rector of the University, physiologist Luigi De Caro, delivered, in French, his address to the audience, briefly summarizing the recent development of EMG. His opening remarks were followed by an introduction given by Carlo Berlucchi who, again in French, made references to Pavia's neurology tradition which began with Camillo Golgi and was continued by his pupils Ottorino Rossi, famous for his investigation into the regenerative capacity of the peripheral nervous system, and Giuseppe Carlo Riquier, whose studies on the experimental pathology of beriberi had deepened knowledge of a disease-model useful for EMG research. After expressing special thanks to his assistant Pinelli, Berlucchi expressed his satisfaction to see, gathered together, so many illustrious "adeptes de cette nouvelle science" (20).

Indeed, seated in that historic venue were many individuals who went on to become protagonists of EMG investigation and clinical neurophysiology over the next twenty years, personages such as (in addition to Buchthal,



Fig. 3 - Volta Theater. Henri Gastaut is at the chair.

Casella, Drechsler, Hausmanowa-Petrusewicz, Lambert, Liberson and Thiebaut, the leaders of the scientific sessions) Henri Gastaut from Marseille, Poul Rosenfalck and Werner Trojaborg from Copenhagen, Jean Edouard Desmedt from Brussels, Eric Kugelberg from Stockholm, Roger W. Gilliatt and Giuseppe Pampiglione from London, John A. Simpson from Edinburgh, Albrecht Struppler from Munich, François Isch from Strasbourg, Heini Kaeser from Basel, Geoffrey Rushworth from Oxford, Jean Louis Lericque and Jacques Lefebvre from Paris, R. G. Willison from London, Kurt Pateisky from Vienna, and Hans Hufschmidt from Würzburg. Also in attendance were a great many Italian medical doctors who would go on to become important neurologists and clinical neurophysiologists, like Ludovico Bergamini, Carlo Loeb, Gildo Gastaldi, Faustino Savoldi, Giorgio M. Kauchtschischwili, Giovanni Lanzi, Vittorio Cusi, Giandomenico Sacco, Antonio Arrigo, and Vittorio Tronconi. In all, the various sessions were attended by more than a hundred delegates. The congress witnessed many advances in the standardization of a technique that, at the time, was still evolving; furthermore, with the inclusion of the bioelectri-

cal clinical parameters of electroneurography and nerve conduction in different anatomical situations, in physiology and in pathology, it also marked a broadening of the scope of EMG examination. In this respect, it is worth recalling a lecture delivered by Roger W. Gilliatt on the first recording of sensory nerve action potentials in man (21). Other important reports dealt with: the analysis of neuromuscular transmission tested by repetitive electrical nerve stimulation (a communication by Jean Desmedt, a master of studies of this kind, 22), the electromyography of responses elicited by electrical nerve stimulation (a wonderful lecture by Howard Edward Lambert on the *Diagnostic value of electrical stimulation of motor nerves*, 23), studies of monosynaptic and polysynaptic reflexes elicited by electrical or mechanical stimulation (communications by Wladimir T. Liberson, Eric Kugelberg and Geoffrey Rushworth, 24-26), the electromyography of muscle fibers (a clinical communication by Poul Rosenfalck and Fritz Buchthal and an experimental investigation by Cesare Casella and Giovanni Rapuzzi, 27,28), and the electromyography of the motor unit in neuropathies, myopathies and oculomotor muscles.

Many Italian researchers, particularly from Pavia, presented the results of their EMG investigations. Headed by Pinelli there were presentations by Antonio Arrigo, Giovanni Lanzi, Faustino Savoldi, Giorgio M. Kauchtschischwili, Vittorio Cosi and Piero Rovetta, among others.

A final part of the congress was devoted to the standardization of reporting and terminology in EMG. This part of the congress was a significant founding stone for the further development of the discipline. The re-

aim of defining the major issues related to EMG (i.e. terminology and technology). The Pavia Committee was established without formal rules of procedure and with the sole purpose of providing the EMG community with ideas and advice. Its members were: Fritz Buchthal, Jean Desmedt, Bedrich Drechsler, Roger W. Gilliatt, Irena Hausmanowa-Petrusewicz, François Isch, Eric Kugelberg, Howard Edward Lambert, Jacques Lefebvre, Wladimir Liberson, Paolo Pinelli, John A. Simpson, Albrecht Struppeler, and Toshihiko Tokizane (the latter, who was a professor at the Brain Research Institute of Tokyo University, was not present at the meeting but was included soon after the end of the Congress).

The newly formed Pavia Committee immediately prompted the development of a Special Commission on Electromyography, which was set up by the General Assembly of the International Federation of Clinical Neurophysiology, meeting a few days later in Rome at the Fifth International Congress of Electroencephalography and Clinical Neurophysiology. The Pavia Committee became a consultative commission of experts able to give advice and guidance to major neurophysiological institutions on problems related to EMG. It also influenced the development of the International Society of EMG which soon became an important coordination platform for clinical neurophysiologists. The next milestone, resulting from these organizational efforts, was the Second International Congress of EMG in Copenhagen (32), held in 1963 under the joint auspices of the International Federation of Clinical Neurophysiology and the World Federation of Neurology.

An emotional moment, at the First International Congress of EMG in Pavia, was the visit to the Institute of General Pathology, Golgi's institute, where Emilio Veratti had also worked and where the Golgi complex, the sarcoplasmic reticulum and the Negri bodies of rabies were discovered.

The congress also provided lighter moments, for example a dinner organized by Carlo Berlucchi at the Mondino Institute, and a party for selected guests at Pinelli's house, organized by his wife Maria Luisa. The congress also included a cultural high point, a concert of ancient music organized by Raffaello Monterosso, then director of the Pavia School of Musical Paleography, held in the magnificent Fresco Room of the Collegio Borromeo.

In 1962, a special issue of *Electroencephalography and Clinical Neurophysiology* (Supplement No. 22), edited by Paolo Pinelli, Fritz Buchthal and François Thibaut and entitled *Progress in Electromyography*, which collected the proceedings of the Pavia Congress, was published. As Alberto Salama of the Massachusetts General Hospital (Boston) remarked a few years later in a review of this volume: "This book is a must in every electromyographer's library. It will appeal also to the neurologist and even to the general practitioner; they will find in it an explanation of the meaning and limitations of these techniques as diagnostic aids" (33).

The Pavia Committee continued to be active for some years, albeit in an unofficial capacity. In 1970, a report published in *Electroencephalography and Clinical Neurophysiology* by Howard Edward Lambert acknowledged the activity of this commission, which was chaired at the time by John A. Simpson and included, besides the individuals already mentioned, Heini Kaeser and Kurt Pateisky (34). However, the coordination activities of the Pavia Committee were progressively absorbed by



Fig. 4 - The participants at the First International Congress of EMG in a courtyard of the main building of the University of Pavia

port by Wladimir Liberson was extremely important in this respect as it looked at the significance of the terminology used by electromyographers, whom he had previously questioned in this regard (29). Liberson also usefully listed a number of definitions of terms currently employed in EMG. This critical issue was also taken up by Paolo Pinelli who, in his lecture, highlighted the need to organize commissions of experts in order to establish common ground on terminology and methods (30).

Accordingly, a committee, soon known as the "Pavia Committee" (31), was set up at the congress with the

the International Federation of Clinical Neurophysiology and thus, in the early 1970s, it ceased to function.

Pavia, December 2, 2011, fifty years on

The C. Mondino National Institute of Neurology, IRCCS, recently organized a commemorative event to mark the fiftieth anniversary of the historic First International Congress of EMG. On December 2, 2011, in the Berlucchi conference room at the institute's new site on the outskirts of Pavia, Paolo Pinelli related his personal recollections of the event. After his intervention, rich in lively anecdotes perfectly preserved in his mind for so many decades, it was the turn of some of his pupils to celebrate their master. The first to speak was Giuseppe Nappi, former Chair of Neurology, University of Pavia and Sapienza University of Rome and present scientific director of the Mondino Institute, who organized the meeting with the assistance of Silvia Molinari. He was followed by Pietro Tonali, Pinelli's successor to the Chair of Neurology at the Catholic University in Rome, Vittorio Cusi, who delivered some scientific communications at the First Congress, Arrigo Moglia and Giorgio Sandrini who have both worked as clinical neurophysiologists along the lines traced by their master. Paolo Mazzarello, another of Pinelli's pupils and now professor of history of medicine at the University of Pavia, concluded the session with some historical remarks. After this emotional commemorative event, the library of the Mondino Institute hosted a buffet to toast the rich history of EMG, a field in which Paolo Pinelli continues to be a protagonist.



Fig. 5 - Pavia, December 2, 2011, The Berlucchi conference room, C. Mondino National Institute of Neurology, Pavia. From left to right: Pietro Tonali, Paolo Pinelli, Vittorio Cusi, Giuseppe Nappi.

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