The dawn of algometry: Paolo Mantegazza's research on pain

Valentina Cani, Ph

University Museum System, University of Pavia, Italy

Correspondence to: Valentina Cani
E-mail: valentina.cani@unipv.it

Summary

By the 1860s, Paolo Mantegazza was a professor of general pathology at the University of Pavia, where he had graduated in medicine in 1854. There, he founded Italy's first laboratory of experimental pathology and did his first research on pain, the subject of various communications presented to the Istituto Lombardo in Milan. In 1880, Mantegazza published *Physiology of Pain*, one of the several "physiologies" (of pleasure, of love, of hatred, of woman) that he wrote during his career. In this book, a testament to his scientific versatility, experimental observations supplemented his insights into hygienism and anthropology. This research on pain also led to a dispute between Mantegazza and Cesare Lombroso, which was the start of the two scientists' estrangement.

KEY WORDS: algometry, Lombroso Cesare, Mantegazza Paolo, pain, University of Pavia.

Paolo Mantegazza, a nineteenth century medical doctor

In 1854, Paolo Mantegazza graduated in medicine from the University of Pavia, presenting a thesis entitled *Physiology of Pleasure* (Mantegazza, 1854; Landucci, 1987; Barsanti and Barbagli, 2010; Govoni, 2013). During his time as a university student he had met, and befriended, the slightly younger Cesare Lombroso (Lombroso, 1921; Bulferetti, 1975; Frigessi 2003; Mazzarello 2005). It is likely that Lombroso had felt drawn to this brilliant companion, who excelled in his studies and seemed — and indeed believed himself to be — destined for a future full of academic success. That Mantegazza held himself in very high regard is shown by several passages of the long diary (running to over 60 volumes) that the scientist kept throughout his life, and which is now to be found in the city library of Monza. Among the descriptions of the places, people and episodes of his student life, in 1851 he wrote «I was born to be a professor» and in 1852 «at the age of 19 I gave public chemistry classes that were applauded. By the age of 20 I had written a work capable of making my name known beyond the Alps. Measuring myself against my contemporaries, I could not find anyone to surpass me. Thinking of the great men, I felt I could measure up to them, considering my age» (Berzero and Garbarino, 2011; Garbarino, 2017) (Figure 1).

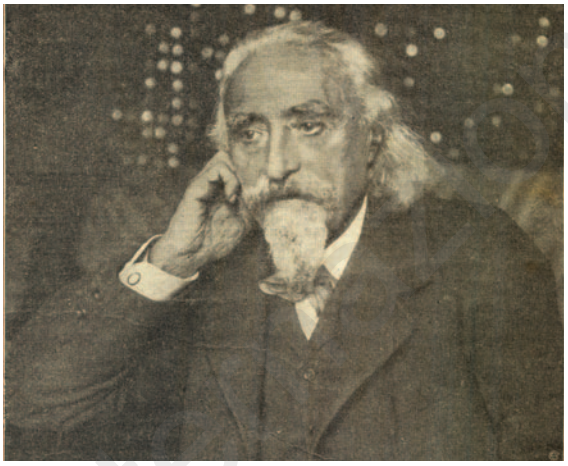

Figure 1 - Portrait of Paolo Mantegazza (La domenica del Corriere, 4-11 settembre 1910).

Lombroso held Mantegazza in high esteem, but the feeling was probably not entirely mutual. Mantegazza described his young friend as a bizarre sort of person, belonging to the class of «odd brains» and «pathological wits» (Garbarino, 2017). The paths of these two friends' lives soon diverged. Immediately after graduation Mantegazza embarked on a long journey to France, Germany, England, Argentina, Paraguay, Bolivia, Brazil and the Canary Islands in search of new experiences and fortune. His stay in South America inspired several writings, full of botanical, medical and ethnological observations. Among these, we recall one of his studies on the effects of the consumption of coca leaves, which, in 1859, he presented to the Istituto Lombardo Accademia di Scienze e Lettere in Milan, a prestigious academy founded by Napoleon Bonaparte (Mantegazza, 1859). This research had already been quoted by Sigmund Freud, who stated that he found so many exact observations in Mantegazza that he felt he must give credit also to those statements that he could not verify (Freud, 1885).

On returning to Italy, Mantegazza took up the chair of general pathology at the University of Pavia, and was assigned a room at the San Matteo Hospital where his students could do clinical practice. He also set up a small experimental pathology laboratory and, with the help of an assistant and several students, began conducting experimental research — work that reflected his multi-faceted interests. In this laboratory, two important scientists "came of age": Giulio Bizzozero and Camillo Golgi (Mazzarello, 2006, 2010, 2011, 2017). Transplants are one example of Mantegazza's many different interests. He collected the results of hundreds of experiments on different animal species, convinced that his re-

search would provide physiologists and histologists with valuable information and help further the development of new surgical techniques. He wrote: «if any animal close to us could give man its cornea, its skin or its teeth, I surely would accept […] these animal gifts» (Mantegazza, 1865). This work even led to exchanges with Charles Darwin, whose theories he strongly supported (Garbarino and Mazzarello, 2013).

At the laboratory, Mantegazza conducted his first experiments on pain.

He presented some communications on this topic to the Istituto Lombardo and then, in 1880, published *Physiology of Pain*, which added to the rich collection of "physiologies" (of pleasure, of love, of hatred, of woman) that had started with his graduation thesis. From a young age, Mantegazza had always manifested a curiosity and a multiplicity of interests that inevitably led him to become involved with different disciplines and disparate subjects. However, as he himself wrote, the unifying element of his work and output lay in his interest in man: «the most beautiful, richest, most complex and even unhappiest creature» (Mantegazza, 1909).

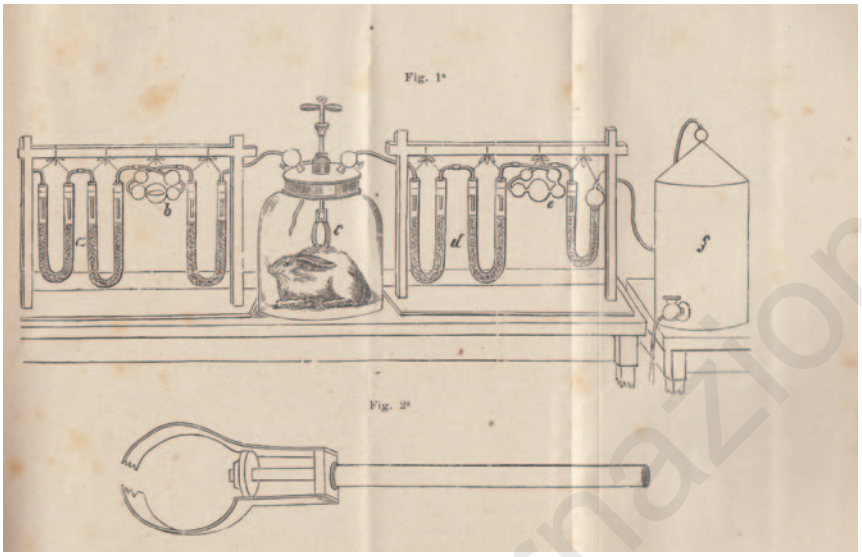

Figure 2 - The "algometer" made by Paolo Mantegazza (Mantegazza, 1880).

The dawn of "algometry"

In 1846, the first surgery performed using ether as an anaesthetic opened a new chapter in the history of medicine (Rey, 1993; Bourke, 2014). In the nineteenth century, neurophysiologists tried to study the mechanisms of transmission and perception of pain. In general, physicians were determined to impart objectivity to this complex phenomenon, which could apparently be measured only on the basis of the patient's individual reactions. The topic, being related to human behaviour, attracted the attention of Mantegazza and Lombroso. In the mid-nineteenth century Mantegazza presented several communications to the Istituto Lombardo on heterodox topics such as the study of human sperm, experiments on tissue regeneration, physical anthropology and ethnology, facial expressions of pain, and histological alterations produced by cutting nerves (Mazzarello, 2008). In 1866 he considered the effects of pain on animals, with a view to finding a way to mitigate or cure it (Mantegazza, 1866).

He tested its effects on heart rhythm, body temperature and respiration (Mantegazza, 1866, 1867). To conduct this work, he invented a device for analysing breathing changes in animals. The apparatus consisted of a glass jar sealed with an airtight lid that could hold a small rabbit or a guinea pig. There were openings in the lid to allow the passage of air and the action of a gripper mechanism, a «tormentor», by which the effects of pain on breathing were tested (Figure 2).

This research led to a dispute with Lombroso, who, in the same years, published a paper on the measurement of pain induced by electrical stimulation in the healthy and the «alienated» man (Lombroso, 1867), enrolling, among the volunteers, his assistant, Camillo Golgi (Mazzarello, 2010).

Lombroso's explanation of the data he collected conflicted with that provided by Mantegazza: according to Lombroso, pain itself caused an increased heart rate, while Mantegazza argued that this increase was simply an effect of the muscular movements that generally accompany pain. Lombroso seems to have been the first to formally use the term «algometria» (algometry) (Lombroso, 1867), although Mantegazza stated that Lombroso got the idea and the use of the word from him (Mantegazza, 1868). In actual fact, Italian dictionaries do not link the word to Mantegazza at all. They date the first use of the terms «algometria» and «algometro» (algometer) to 1911 and 1913, respectively (Garollo, 1913 -1930; Devoto and Oli, 2017), while the Italian Encyclopaedic Dictionary links the term algometry with the name of Lombroso (Dizionario Enciclopedico Italiano, 1955-961) (Figure 3).

Mantegazza also disapproved Lombroso's use of an electrical instrument because it generated pain sensations very different from those usually afflicting man (Mantegazza, 1868). Lombroso replied to this critique defending his methods, which in his opinion were less cruel than those used by Mantegazza and capable of providing more objective measures (Lombroso, 1868). The disagreement between the two scientists persisted, reference to this still being made in Mantegazza's final publication on pain, *Physiology of Pain* (1880).

From 1870s, Mantegazza also showed an interest in the «expression of pain» (Mantegazza, 1874, 1876a, 1878) and he used photography in an innovative way to show the facial expressions of individuals subjected to painful stimuli.

The results of this research were presented in the book *Atlas of the Expression of Pain* (Mantegazza, 1876b; Piccardi et al., 1998).

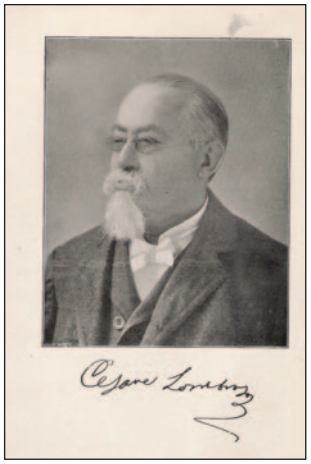

Figure 3 - Portrait of Cesare Lombroso.

The physiology of pain

Mantegazza summarised all his work on pain, conducted in previous years, in his volume *Physiology of Pain*. He wrote: «As impalpable as air, as infinite as space, as importunate as boredom, pain enters into all the facts of life, frightens the vile and awakens the strong to supreme struggles; an unresolved problem for the physiologist, a tormenting question for the philosopher; a source of speculation for the crafty, and an encourager of mercy in the generous; a torment to everyone [...] everyone fears or fights it».[1] He returned to the question of algometry and reiterated his opposition to the experiments with an electrical algometer conducted by Lombroso, his «adversary and friend». He declared that he felt compelled to abandon the algometer he had invented, and algometry in general, because the «expression of pain» and tolerance of pain were too variable, making its scientific measurement «impossible» (Mantegazza, 1880).

Mantegazza distinguished «physical pains» from «moral» ones. The first part of *Physiology of Pain* retraced the studies he had done on the influence of pain on animal hearts, on the motions of the heart, and on respiration, digestion and nutrition.

Mantegazza also dealt with the impact of pain on the muscles and the nervous system. He pointed out that prolonged physical pain could also weaken the brain, but, in the strongest individuals, also be a source of inspiration. He noted, for example, that the «gloomy melancholy» that afflicted Chopin had nevertheless allowed him to write some of his most moving compositions, and that some of the most «sublime pages» of *The Sorrows of Young Werther* sprang from Goethe's «outbursts of painful hysteria».

Mantegazza analysed different responses to pain in men and women, attributing to the latter a greater capacity for resistance to physical pain as well as greater suffering in the field of «moral pains», those related to affections. Women suffered more than men because they were «less selfish», «less intelligent», and because men have imposed on them a state of subjection, and very often also «slavery» (Mantegazza, 1880). The second part of the book focused on the «special pains» deriving from the organs of sense, caused for example by hunger, pleasure or fear.

Mantegazza considered suffering in an anthropological sense, and explored «the expression of pain», as he had already done a few years earlier in the *Atlas*.

He drew a distinction between the sexes, between different ages, and between ethnic groups, trying to give the reader a sample of the most disparate expressions of pain, also with the aim of teaching how to distinguish its expressive signals. He remarked, for example, that it was easier to command the muscles than the vasomotor nerves that control the blanching or reddening of the skin in response to pain.

The volume was, in fact, intended for a wide audience and it made references to episodes taken from history, popular culture and art. An entire chapter is devoted to pain in art: Mantegazza also cites works reproduced in the *Atlas* in which attention was drawn to expressions of suffering.

Treating pain

Mantegazza also considered various methods of pain treatment. He defined anaesthesia as one of the most «beautiful» and «useful» inventions of the century (Mantegazza, 1880). He also described some examples of local anaesthetics, including cold and some narcotic substances, morphine and atropine.

Coca was not mentioned, even though he had noted its stimulating properties, which were also attracting the attention of Freud who, as already mentioned, in 1884 wrote an essay on the substance that aroused a great deal of interest.

One of his young colleagues, Carl Koller, tested the action of cocaine as a local anaesthetic in the ophthalmic field, verifying not only its anaesthetic properties on the patient but also its ability to suppress the corneal reflex (Rey, 1993). Thus, there began a new era for the local treatment of pain combined with advances in neuroanatomy and neurophysiology, disciplines whose first steps were taken in attempts to explain complex phenomena such as referred pain (Cani and Mazzarello, 2015).

Concluding remarks

The history of pain research is one of the most important chapters in the history of modern neuroscience. It is a field that developed in parallel with neuroanatomical, neurophysiological, neuropharmacological and psychological advances, resulting in a multidisciplinary conceptualisation that characterises, in particular, contemporary approaches to the study of this elusive but also tangible phenomenon.

Paolo Mantegazza, thanks to his scientific and, particularly, anthropological vision, was certainly a pioneer of a modern approach to the study of pain.

[1] «Impalpabile come l'aria, infinito come lo spazio, importuno come la noia, il dolore entra in tutti i fatti della vita, spaventa i vili e ridesta a lotte supreme i forti; problema inestricato al fisiologo, quesito tormentoso al filosofo; speculazione al furbo e consigliere di pietà al generoso; tormento a tutti […] tutti lo temono o lo combattono».

References

Barsanti G, Barbagli F (2010). L'uomo e gli uomini. Antologia di scritti antropologici. Polistampa, Firenze.

Berzero A, Garbarino MC (2011). La scienza in chiaroscuro. Lombroso e Mantegazza a Pavia tra Darwin e Freud. Pavia University Press, Pavia.

Bourke J (2014). The story of pain. From prayers to painkillers. Oxford University Press, Oxford.

Bulferetti L (1975). Cesare Lombroso. UTET, Torino.

Cani V, Mazzarello P (2015). Golgi and Ranvier: from the black reaction to a theory of referred pain. Funct Neurol 30: 73-77.

Devoto G, Oli GC (2017). Dizionario della lingua italiana. Le Monnier, Milano.

Dizionario Enciclopedico Italiano (1955-1961). Istituto della Enciclopedia Italiana, Roma.

Frigessi D (2003). Cesare Lombroso. Einaudi, Torino.

Freud S (1885). Über Coca. Perles, Vienna.

Garbarino C, Mazzarello P (2013). A strange horn between Paolo Mantegazza and Charles Darwin. Endeavour 37: 184-187.

Garbarino MC (2017). L'Università di Pavia nel diario di uno studente d'eccezione. Il Giornale della mia vita di Paolo Mantegazza. In: D Mantovani (Ed.), Almum Studium Papiense. Storia dell'Università di Pavia. Cisalpino, Milano, pp. 869-872.

Garollo G (1913-1930). Piccola Enciclopedia Hoepli. Hoepli, Milano.

Govoni P (2013). Mantegazza Paolo. In: Il contributo italiano alla storia del pensiero. Appendice VIII della Enciclopedia Italiana di Scienze, Lettere ed Arti. Istituto della Enciclopedia Italiana, Roma, pp. 392-396.

Landucci G (1987). Paolo Mantegazza e la "storia naturale" dell'uomo. In: L'occhio e la mente. Scienza e filosofia nell'Italia del secondo Ottocento. Olschki, Firenze, pp. 137-206.

Lombroso C (1867). Algometria elettrica nell'uomo sano ed alienato. Annali Universali di Medicina 64: 102-121.

Lombroso C (1868). Sull'algometria elettrica: risposta. In: Rendiconti del R. Istituto Lombardo di Scienze e Lettere. Classe di scienze matematiche e naturali 1: 388-399.

Lombroso G (1921). Cesare Lombroso. Storia della vita e delle opere. Zanichelli, Bologna.

Mantegazza P (1854). Fisiologia del piacere. Bernardoni, Milano.

Mantegazza P (1859). Sulle virtù igieniche e medicinali della coca. Annali Universali di Medicina 31: 449-519.

Mantegazza P (1865). Degli innesti animali e della produzione artificiale delle cellule. Amministrazione del Politecnico, Milano.

Mantegazza P (1866). Dell'azione del dolore sulla calorificazione e sui moti del cuore. In: Rendiconti del R. Istituto Lombardo di Scienze e Lettere. Classe di scienze matematiche e naturali 3: 127-134.

Mantegazza P (1867). Dell'azione del dolore sulla respirazione. In: Rendiconti del R. Istituto Lombardo di Scienze e Lettere. Classe di scienze matematiche e naturali 4: 254-259.

Mantegazza P (1868). Sull'algometria: nota critica. In: Rendiconti del R. Istituto Lombardo di Scienze e Lettere. Classe di scienze matematiche e naturali 1: 322-328.

Mantegazza P (1874). Dell'espressione del dolore: studi sperimentali. In: Rendiconti del R. Istituto Lombardo di Scienze e Lettere. Classe di scienze matematiche e naturali 7: 154-163.

Mantegazza P (1876a). Dell'espressione del dolore: studi sperimentali. In: Rendiconti del R. Istituto Lombardo di Scienze e Lettere. Classe di scienze matematiche e naturali 9: 405-419.

Mantegazza P (1876b). Atlante dell'espressione del dolore. Brogi, Firenze.

Mantegazza P (1878). Espressione del dolore secondo il sesso, l'età, la costituzione individuale e la razza: nota. In: Rendiconti del R. Istituto Lombardo di Scienze e Lettere. Classe di scienze matematiche e naturali 11: 315-325.

Mantegazza P (1880). Fisiologia del dolore. Paggi, Firenze.

Mantegazza P (1909). La Bibbia della speranza, STEN, Torino.

Mazzarello P (2005). Il genio e l'alienista. La strana visita di Lombroso a Tolstoj. Bollati Boringhieri, Torino.

Mazzarello P (2006). Il Nobel dimenticato. La vita e la scienza di Camillo Golgi. Bollati Boringhieri, Torino.

Mazzarello P (2008). La medicina e le discipline affini nelle pubblicazioni dell'Istituto Lombardo. In: E Gatti, A Robbiati Bianchi (Eds.), L'Istituto Lombardo Accademia di Scienze e Lettere. Storia della classe di scienze matematiche e naturali, Milano, pp. 565-670.

Mazzarello P (2010). Golgi: a biography of the founder of modern neuroscience. Oxford University Press, New York.

Mazzarello P (2011). The rise and fall of Golgi's school. Brain Res Rev 66: 54-67.

Mazzarello P (2017). Giulio Bizzozero a Pavia: la scienza come vocazione. In: D Mantovani (Ed.), Almum Studium Papiense, Storia dell'Università di Pavia. Cisalpino, Milano, pp. 1331-1334.

Piccardi M, Roselli G, Chiarelli C (1998). Il Fondo fotografico Mantegazza. Studi sul dolore. Archivio per l'Antropologia e la Etnologia 128: 87-156.

Rey R (1993). The History of Pain. Harvard University Press, Cambridge-London.