Angelo Mosso (1846-1910)

UNIVERSITÀ DEGLI STUDI DI TORINO

Angelo Mosso (1846–1910)

Stefano Sandrone Marco Bacigaluppi Marco R Galloni Gianvito Martino

S Sandrone, M Bacigaluppi, G Martino Vita-Salute San Raffaele University, 20132 Milan, Italy

S. Sandrone (&) · M. Bacigaluppi · G. Martino Neuroimmunology Unit, Division of Neuroscience, Institute of Experimental Neurology, San Raffaele Hospital, Via Olgettina 58, 20132 Milan, Italy
e-mail: sandrone.stefano@hsr.it

M.R. Galloni
Department of Veterinary Morphophysiology and Scientific and Technologic Archives, University of Torino, 10095 Grugliasco, Turin, Italy

Angelo Mosso was born on the May 30, 1846, in Turin, Italy. His modest family was from Chieri, a town near Turin. Mosso spent a large part of his childhood in Chieri and would for the rest of his life consider himself a citizen of this small town [1]. In school, he was not always a model pupil: on one occasion, for example, his mother had to intercede in order to have him re-admitted after he had been put to work in his father's carpenter shop [1]. Though he spent his childhood and adolescence in poverty, his brilliant results in secondary school helped him to obtain grants and his diploma. Thanks to his family's savings and his earnings as an assistant-teacher in Chieri, Mosso could pay the academic fees and study medicine. In 1870, he graduated from the University of Turin magna cum laude. As a young physician in Florence, he devoted himself to research in the physiology laboratory directed by Moritz Schiff (1823–1896), where he studied the mechanics of esophageal contraction. He then moved to Leipzig, to the laboratory of Carl Ludwig (1816–1895), and subsequently to Paris, where he worked with Claude Bernard (1813–1878) and É tienne-Jules Marey (1830–1904). During his European tour, he

focused on graphical methods to investigate the dynamics of physiological phenomena. On his return to Turin, he applied the graphical method to the circulation in the human brain.

Mosso's most well-known contribution to neurology is his study of subjects with skull defects [2, 3]. The 'Mosso method' consisted of measuring changes in cerebral blood flow in these patients by recording brain pulsations—a phenomenon normally observed in the fontanelles of newborns—by means of the special plethysmograph he developed for this purpose. By converting brain pulsations into plethysmographic waves he could quantify the magnitude of the volume changes. He noted, for example, that when the experimental subjects were engaged in tasks such as mathematical calculations, the pulsations of their brains increased [3, 4]. This evidence, considered as 'the best proof of the immediate afflux of blood to the brain during mental activity' [5], led him to infer that brain activity was accompanied by an increase of blood flow [4].

In 1879, he was appointed to the chair of Physiology in Turin, previously held by Jakob Moleschott (1822–1893). The Accademia dei Lincei, the most prestigious Italian academy of science, honored him by awarding the Royal Prize for his studies on the human brain circulation; the prize motivation was written by Hermann von Helmholz (1821–1894). Three years later, he was appointed National Fellow of the same Accademia. However, recording of brain pulsations had some intrinsic limitations, such as the impossibility of recording them in healthy subjects with intact skulls. Mosso tried to overcome this problem by building the "human circulation balance" [6]. This was a "delicately balanced table that could tip downwards either at the head or the foot if the weight of either end increased" [5]. Moreover, any changes in the volume of feet and hands were co-recorded with a hydraulic plethysmograph, and breathing with a pneumatic pneumograph. By positioning subjects in equilibrium during resting conditions, with only small regular waves caused by respiration, he was able to study blood flow variations occurring during emotional or intellectual tasks. In fact, these tasks could tilt the head-end of the balance, thus indicating an increase of blood flow [6]. This incredibly simple but revolutionary balance can be regarded as the first ante litteram non-invasive "neuroimaging" technique [7]. From a conceptual point of view, the recording of brain pulsations with plethysmographic techniques as well as the "human circulation balance" can now be considered the first steps in the subsequent development of functional neuroimaging [3, 4].

Mosso's name is also attached to several other instruments he invented and refined, including the ergograph, which was used to quantify the optimum strength of muscle contraction before the appearance of muscular fatigue, and a sphygmomanometer for measuring pulse volume. At the Turin Institute of Physiology and at the mountain laboratory in Monte Rosa ("the Regina Margherita Hut", 3,000 m above sea level), Mosso followed his wide interests, ranging from the physical laws of human muscle fatigue to the analysis of behavioral reactions and the modifications of sleep architecture of monkeys at high altitude, and to remedies for mountain sickness, studies that make him a forerunner of aeronautical and space medicine [8]. His school has been considered a "physiological Mecca", since he trained some of the most important Italian researchers, among them Vittorio Aducco, Aldo Fano, Amedeo Herlitzka, and Mariano Luigi Patrizi [9]. He founded the Archives Italiennes de Biologie, wrote popular books on his research, underlined the importance of sports activities in the Italian school system and was president of the "Reale Società Ginnastica di Torino" football team, one of the oldest Italian football teams and one of the four teams that disputed the first Italian Serie A Football League.

In 1907, the same year in which he was appointed Senator, his physicians advised him to leave his laboratory and spend more time outdoors. Subsequently, Mosso spent long periods in Crete and in southern Italy, where he devoted himself to archeology; in order to apply his scientific attitude to this field of study, one that seemed to him insufficiently scientific, he started to analyze the chemical compounds of metals [1]. He died in 1910, at the age of 64. In conclusion, Mosso can be truly recognized as "the foremost Italian physiologist of his time and his generation", given the wide range of his investigations and the instruments he invented and applied [9]. His seminal scientific contributions, characterized by versatility and exceptional technical skills [9], make him one of the greatest Italian neuroscientists, even though he is now often forgotten.

Conflicts of interest: The authors declare that they have no conflicts of interest.

References

1. Foà C (1957) Angelo Mosso. Sci Med Ital 5:549–567
2. Mosso A (1880) Sulla circolazione del sangue nel cervello dell'uomo. Atti della R Acad Lincei Mem Cl Sci Fis Mat Nat III:237–358
3. Zago S, Ferrucci R, Marceglia S, Priori A (2009) The Mosso method for recording brain pulsation: the forerunner of functional neuroimaging. Neuroimage 48:652–656
4. Raichle ME (2009) A brief history of human brain mapping. Trends Neurosci 32:118–126
5. James W (1890) The principles of psychology. Henry Holt & Company, New York
6. Mosso A (1884) Applicazione della bilancia allo studio della circolazione sanguigna dell'uomo. Atti della R Acad Lincei Mem Cl Sci Fis Mat Nat XIX:531–543
7. Sandrone S, Bacigaluppi M (2012) Learning from default mode network: the predictive value of resting state in traumatic brain injury. J Neurosci 32:1915–1917
8. Various Authors (1912) Angelo Mosso, la sua vita e le sue opere. In memoriam. Fratelli Treves Editori, Milan
9. Anonymus (1946) Prof. Angelo Mosso (1846–1910) Nature 157–689