Indian J Physiol Pharmacol 2009; 53(2) : 109–112

Guest Editorial

ANGELO MOSSO (1846–1910)

Angelo Mosso died in 1910 at the age of 64. The fabric of our civilization in the meantime has transformed significantly. To understand this change it is not merely important to know what the science is doing now. It is also essential to be aware of how it came to be, what it is, how it has responded in the past to the successive forms of the society and how it has served to mould them. If we wish to gain perspective for tomorrow, we need to look to the past and to the work of men like Angelo Mosso who give us courage and inspiration to change the future.

The story of Angelo Mosso dates back to 19th Century Europe when she was witnessing a huge political and social turmoil. It left indelible imprint on his life and his scientific journey. That was the post- renaissance era in which change from being a means of reconciliation with nature to one of controlling the nature through application of knowledge of science was brought about. Emergence of bourgeois culture and capitalistic mode of economy along with the debacle of feudalism in the 19th century had influenced science toward its emergence. The birth of Angelo Mosso in 1846 at Turin, Italy coincided with a new era of experimental culture and objectivity. A new concept of experimental physiology bloomed and led to investigations on the machinery of the body by applying basic principle of mechanical and electrical engineering.

By virtue of being a carpenter's son, Angelo Mosso had a passion for designing instruments since childhood. The impoverished and deprived childhood had a lasting effect on his psyche which helped him evolve as a social reformer in his later life. His interest in the natural sciences overcame his modest background and he could get admission into a medical school at the University of Turin from where he graduated on July 25, 1870. His experimental thesis on the growth of bones brought him due acknowledgement. He was lucky enough to work with Moritz Schiff at Florence and later Friedrich Wilhelm Ludwig at Leipzig, Germany. Ludwig suggested him to study graphical records of respiration and tracings of limb volume variation on a kymograph. He had a privilege to also meet Du-Boi Reymond, Claude Bernard, Charles Brown Sherrington and Louise Antonie Ranvier. He was fascinated by the beauty of physiological recording system, graphical methods and the photographic techniques. He himself constructed various physiological devices which included the ergograph, plethysmograph, sphygmomanometer and cystometer among others.

On his return to Turin, Angelo Mosso was appointed the Professor of Pharmacology (1875) and Physiology (1879). Turin flourished as an active center for research in experimental Physiology during his term. His tenure in the department was a witness to many students including Warren Bombard, Charles Scott Sherrington, Harvey Cushing and John Harley. He pursued mainly two lines of research: the analysis of motor functions and analysis of relationship between physiological and psychic phenomena. His arduousness into scientific research led to development of Psychophysiology which included study of fatigue of muscles and its psychological correlates.

Mosso carried out the first systematic study of emotions within the confines of laboratory. He published his results in '*La Paura*' with an elaborate physiological mechanism for blush that rejected the previous Victorian concept that correlated phenomenon of blush with high class European morality. In his research on emotion and fear, he used a self designed instrument *plethysmograph* on subjects undergoing questioning and recorded their corresponding cardiovascular and respiratory activity. His views on integration of psychological reactions and the physiological mechanisms are incorporated in a text entitled '*La Paura*' (Fear) published in 1884. Thereafter his observations led to the formulation of concept of 'Trial by instrumentation'. He hypothesized that a subject lying on a bed mounted on a fulcrum device could be questioned and examined for deception. This setup was called *Mosso's cradle*. This cradle movement would actually reflect the change in weight distribution caused by changing blood flow. This was based on the simple fact that vasomotor phenomenon accompanying emotions actually make our heart beat to quicken or become slower causing blush or pallor.

He also constructed a *sphygmomanometer* based on the principle of volume plethysmography. Incidently, at the same time his investigation of urinary bladder function using a cystometer was the first step into urodynamics. During the same period, Angelo Mosso carried out numerous studies on blood circulation, mechanism of muscle movement including the detrusers, sports medicine and physical education. He was the first to demonstrate the phenomenon of contracture in humans which had been earlier demonstrated by Hugo Kronecker in frogs in 1870. He succeeded in developing an ergograph which would measure the mechanical work of the muscles of man. This instrument, now available in an endless array of specialized forms, has become a nearly indispensable tool for the study of muscular function in the Physiology laboratories. He found that each individual had a different fatigue profile depending on the test conditions, in other words: 'the way we get fatigued'. He described the phenomenon of contracture after muscle fatigue and compared it with a rheumatic torcicollis or cramp of the writer or of violin or piano players. In fact, his observations and interpretations on fatigue characteristics of the sea quails had intrigued him to delve into its mechanism. These quails which migrated on the shores of Southern Europe appeared to have lost all sense of judgement after covering a distance of about 300 miles. They could use their wings again after many days of lying still.

He became an apostle of the physical education while his stay in Turin which itself had been established as a cradle for sports movement by that time. He called for 'sports for all', especially for the children of the working class, as the best means to fight illness. He also holds the credit for delivering a speech in the Olympic Games where he said "in the muscle resistance to fatigue lies most of the future richness of our Country". He also proposed suitable activities for improving common women's strength and health. His concern for the welfare of the working class led to the publication of '*La Fatica*' (Fatigue) on May 1, 1891, which was the second anniversary of the Labor Day. He also raised his voice against child labor.

The story still continues and it would be incomplete without the mention of his remarkable contribution to the measurement of brain blood flow. Though crude, his inferences are the basis for the more refined neuroimaging techniques of fMRI and PET, essential to neuroscience research today.He believed that pulsations (normally observed in the fontanelles of young children) reflected blood flow to the brain. He reported his classic recordings on two adults who had suffered head injuries leaving them with permanent defects in the skull over the frontal lobes. One of them was a peasant named Bertino. While working with Bertino, Mosso observed a sudden increase in the magnitude of pulsations over the frontal lobes. The pulsations grew larger just when the ringing of local church bells and the chiming of a clock signaled 12 o'clock noon, the time for a required prayer 'Ave Maria'. The changes in brain pulsations occurred independently of any change in heart rate or blood pressure as measured in Bertino's forearm. Intrigued by these observations and what they might imply about the relationship between a person's mental state and blood flow in the brain, Mosso confirmed the same results after subjecting Bertino to a simple mental task. He also made the use of the lacuna in the skull and put a thermometer to measure the cerebral temperature. This inspired his student Hans Berger to repeat his experiments with a galvanometer instead of a thermometer, and Berger was able to record the EEG.

The history of mountaineering in Italy is undeniably linked to his name. He was blessed with the patronage of the Queen Margherita of Italy in this endeavour. In the capacity of the president of 5th International Congress of Physiology, Turin, he announced the establishment of a center on high altitude physiology on Monte Rosa, Italy. He was chosen a senator of the reign of Italy in 1904 and that year also coincided with the construction of laboratory at Monte Rosa which became a center for the advanced biological research along with meteorological and geophysical observations. Beside Italian authorities, many foreign institutions contributed to its construction from the Washington Academy of Science to the Royal Society of London that was guaranteed study space in the laboratory. Mosso's interest in high-altitude physiology was highlighted by the publication of *Fisiologia dell'uomo Sulle Alpi* (The Physiology of Man on the Alps) in 1897. He also proposed the treatment of '*acapnia*' (the term was coined by him to describe diminution of carbonic acid) and administered CO_2 gas mixtures to relieve hypoxic symptoms in subjects exposed to pressures as low as 250 torr (~8800 m) in a hypobaric chamber.

As his career was blooming, he was diagnosed with locomotor ataxia. That phase proved to be a turning point in his life and Mosso switched over to archaeology from physiology. He applied his previous knowledge to study anthropometric data of prehistoric skulls found at various excavations in Italy. He was recognized as an archaeologist of high esteem. His primary goal was to find out the position, his country Italy had held in primitive civilizations. He felt that the higher degree of cultural ethos found in the remains excavated in Italy were because of the fact that Italy had enjoyed higher sea power over other European empires. Italian mastery of the oceanic navigation later on gave rise to Portuguese, Dutch, British and French hegemony in the whole world and a new concept of imperialism came into light. He proclaimed that the European civilization came from Africa and not Asia. His book entitled 'Origins of Mediterranean Civilizations' is still considered a priceless contribution to the field of archaeology. Another text 'Italian Stone Age' could not be published because of his untimely death in 1910.

Angelo Mosso, indeed, embodies the true spirit of a scientist who puts in the same effort and zeal while studying human subjects or animals ranging from monkeys, frogs, pigeons, horses, fishes to marmots. The social problems which he encountered during his lifetime instigated him to work for the upliftment of the proletarian class. His concept of scientific socialism has immortalized him on the Italian scholastic firmament. A hundred year after his death, Angelo Mosso still remains as a beacon light to actualize the power of science for the emancipation of mankind.

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