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Physiology at the University of Turin from the unification of Italy to the end of the twentieth Century

G. Losano & O. Pinotti

Summary

In spite of its contribution to the unification of Italy, last century the Italian ruling class was rather conservative not only in politics but also in culture. Positivism which was already popular in France had a few followers in Italy. Thus, at the University of Turin, medical and biological sciences were in need of a strong revewal. The renewal came when, in 1861, the Ministre of Education Francesco De Sanctis invited the Dutch physiologist Jackop Moleschott to teach in Turin. Moleschott was the one who introduced experimental physiology in Turin and in Italy. Since he was also a materialistic philosopher, his way of thinking was based not only on the results of experiments, but also on general iideas which formed a sort panteistic system. If this way of thinking was a limitation to his scientific reserach, his pupil Angelo Mosso, who succeeded him on the chair of Physiology in 1879 distinguished between materialistic methodology and materialistic philosphy, thus contributing to take experimental research out of any prejudice. Mosso, who had an international education, renewed the research methodology in Italy by introducing the use of the chimograph which allowed the recording of the time-dependent vital phenomena.

Résumé

Malgré son apport à l'unification de l'Italie, la classe dirigeante italienne cultivait plutôt un esprit conservateur, tant du point de vue politique que culturel. Le positivisme, déjà populaire en France, ne comptait que peu d'adeptes en Italie. Ainsi les sciences médicales et biologiques avaient un grand besoin de renouveau. Celui-ci fit son apparition lorsqu'en 1861 le ministre de l'éduction, Francesco De Sanctis invita le physiologiste Jackop Moleschott à venir enseigner à Turin. Moleschott est celui qui introduisit la physiologie expérimentale à Turin et en Italie. Etant donné qu'il était aussi un philosophe matérialiste, sa façon de penser était non seulement basée sur les résultats expérimentaux mais également sur des idées générales qui constituaient une sorte de système panthéiste. Si cette façon de penser constituait un frein à sa recherche scientifique, son élève Angelo Mosso, qui lui succéda à la chaire de physiologie en 1879, fit la distinction entre la méthodologie matérialiste et la philosophie matérialiste, évitant ainsi de provoquer le moindre préjudice à la recherche expérimentale. Mosso, qui avait eu une éducation internationale, renouvela la méthologie de recherche en Italie en introduisant l'usage du chimographe qui permettait d'enregistrer les phénomènes vitaux dépendant du temps.

Until 1861 Turin was the capital of the Kingdom of Sardinia, around which Italy was built. The unification of Italy was mainly due to a number of military initiatives organized by the government underthe pressure of some liberal and democratic ideals emerging from the intellectual community after the French Revolution and the subsequent Restoration. Due to the rather peculiar situation of a liberal process undertaken by a Government which in any case was heir of the Restoration, it is not surprising that the ruling class responsible for the unification, though progressive with respect to the spirit of the Anciene Regime, was conservative with respect to the class which in France emerged with the proclamation of the Third Republic.

Gianni Lasano & Oreste Pinotti
Dipartimento di Neuroscienze, Sezione di Fisiologia, Corso Raffaello 30, 10125 Torino, Italy

The characteristics of the ruling class were in a way the characteristics of culture in Torino : progressive enough to press the Government towards liberal reforms, the world of culture had not yet absorbed the new scientific spirit which in France, in England and later in Germany had its roots in positivistic philosophy.

Positivistic philosophy, however, was not unknown in italy. Here it had its main representative in Roberto Ardigo (1828-1920), a former priest, who devoted himself to the scientific renewal of psychology. Italian positivism had quite different characteristics compared with French positivism: in France it was popular amongst the scientific community and the ruling class, whereas in Italy it was a minority trend. In Torino, just a few years before the unification of Italy, a new wind blew with the arrival from Naples of some Hegelian «egg-heads» who, in their opposition to the Bourbonic regime had elaborated innovative political and cultural ways ofthinking. BertrandoSpaventa, Salvatore Tommasi and Francesco De Sanctis contributed to the updating of culture and, indirectly, of science in the rather conservative, educated upper classes of Torino. In particular De Sanctis, who became Minister of Education after the unification of Italy, was the man who invited the Dutch scientist Jakop Moleschott from Zurich to teach Physiology at the University of Torino. The arrival of Moleschott in Torino represented a real turning point in the field of physiological research in this university.

The different political, cultural and philosophical background of France and Italy involved a difference also in the advancement of biological sciences. In France, research in Physiology was stimulated by positivism, in spite of some curious extremist aspects of this philosophical trend, such as the religion of Humanity of Auguste Comte. In Italy it was still in a sort of pre-scientific stage.

For a better understanding of the «birth» of modem physiology in Europe a number of factors must be considered. While the term «physiology» was at first a name given to any attemps to explain vital and behavioural processes in a materialistic way, such attempts soon showed the strict dependence of the new science on anatomy. Anatomy, however, could not supply enough information to explain the phenomena occurring in living organisms. The *Elementa physiologiae corporis humani,* published by Albrecht von Haller between 1757 and 1766 was an example of the limits of the dependence of physiology on anatomy. It was clear that physiology had to look for its roots elsewhere. Thusthe attention of physiologists turned to chemistry and physics. The separation of physiology from anatomy, i.e. of function from structure, played a remarkable role in the success of what became known as vitalism. A good exemple of vitalism is to be found in a book published by Xavier Bichat in 1800 with the meaningful title of *Recherches physiologiques sur la vie et la mort.* However vitalism was not always an impediment to research if it encouraged the activity and the achievements of men like Bichat and Francois Magendie, who was at the same time both vitalist and upholder of the necessity of experimental investigations. In opposition to vitalism, which asserted the existence of a vital force at the origin of all vital processes, mechanicalism considered these processes as the result of two components only : matter and movement. In France mechanicalism in science was obviously strictly combined with positivism in philosophy.

In Germany the situation was rather different, because of the heritage of the movement of *Naturphilosophie.* This movement, though producing interesting results in different fields of culture and literature, was the source of some prejudice which caused a delay in the revival of science. In opposition to *Naturphilosophie,* the new ideas raised by positivism developed into a real philosophical materialism in the thinking of scientist such as Karl Vogt, Ludwig Buchner and Jakop Moleschott. It is important to remember, however, that in Germany vitalism was also a stimulus for a number of scientists: the names and the results of Johannes Muller and Justus Liebig are remarkable examples of how, in the presence

of debate, «conservative» ideas could also be a spur for important scientific investigations...

During thefirst half of the XIXcentury in the small states which were later unified as the Kingdom of Italy, there was nothing comparable with the scientific debate occurring in France and in Germany. If some achievements were obtained in physics and in natural sciences by individualssuch as Alessandro Volta or Lazzaro Spallanzani, they were dated back to the XVIII century and had little, if anything, to do with medical science. Thus when in 1861 Francesco De Sanctis, Ministre of Education of the new unified state, invited Jakop Moleschott to teach physiology in Turin, at that time the capital city, fresh air blew through the Medical Faculty of the University. The actual process of unification was a powerful stimulus for the advancement of culture and science in Turin, where it brought brilliant intellectuals from the south of Italy with new ideas for the improvement of the higher learning.

A brief biography of Moleschott gives a good account of the change (Losano 1994). Jakop Molescott was born in Bois-le-Duc (Holland) in 1922. He attended the University of Heidelberg (Baden) where he received his medical degree in 1845. After his graduation he returned to Holland where he worked as a general practioner for a couple of years. Then he left Holland again when he was appointed *«privat dozent»* in physiology at Heidelberg. A *privat dozent* was an expert authorized to teach in a university without salary, paid only by the students who choose to attend his lectures instead of those of the official professor of the same subject. The official professor was the *«professor publicus ordinarius»,* i.e. the professor who really represented the university. At the end of the courses the students were examined by an external board, so there was a competition between the *professor publicus ordinarius* and the *privat dozent.*

During his stay in Heidelberg, Moleschott published the two most important works of his career, *die Nahringlebe fur den Volk(The* theory of nutrition for the people) in 1850 and *Kreislauf des Leben. Physiologische Antworten aufLiebigs chemische Briefe* (The circulation of life, a physiological answer to the chemical letters of Liebig) in 1852.

In spite of its simple title, the former work contained the basic scientific and philosophical theories which were developed in the latter. According to these theories a living organism was built up by the substance of the inorganic world introduced with the food. Furthermore, physical and mental attitude and behaviour were the consequence of the particular composition of the body accordingly to the type of nutrition. It can be easily understood how the scientific thinking of Moleschott could involve a social involvment in a period when the nutritional conditions of the lower classes were far from satisfactory.

The preface to *die Nahringlebe fur den Volk* was written by the German materialistic philosopher Ludwing Feuerback. Although his materialism was different from that of the Dutch scientist, which he classified as « vulgar materialism », in the preface we find the famous sentence which says that «an individual is what he eats». I report this sentence, because the Italian translation offered the opportunity to some naive secondary school philosophyteacherstoengageasort of controversy against whatthey believed to be the root of Marxian materialism. The Italian translation, in fact, omits the pronoun «he» and actually says that an individual is simply a thing which eats. On the basis of this misinterpretation, these teachers said that Feuerback considered man as an animal which has to satisfy material needs only, without any spiritual or ethical concern. In the fifties of the present century somebody transferred the conceptfromFeuerbacktoMarxto refute communism as the basis of an intrinsic moral degradation !

In «Thecirculatinof life» Moleschott developed the main concepts contained in his previous book and organized a proper scientific and philosophical system. In brief Moleschott suggests that there is

a continuous passage of chemical compounds from the inorganic tot the organic world and living organisms. The book contained severe criticisms of some fundamentalist religious beliefs, which a few years later (1859) would seriously be attacked by the publication of *the Origin of the Species* of Charles Darwin. In the climate of this controversy, which included the debate between vitalism and mechanicalism, Moleschott openly said that one of the objectives of science, and of his own research, was the fight against any kind of religious belief.

The consequence of the publication of «The circulation of life» was the dismissal of Moleschott from the University of Heidelberg in 1854. Afterwards he taught a few years in Zurich, where he met the Italian Minister of Education Francesco De Sanctis, who invited him to teach physiology in Turin. De Sanctis' invitation aimed at enriching the Italian cultural horizon with the new ideas growing in the international context (Pogliano 1990). However, as said above, Turin was culturally still rather conservative. Thus it was not easy for De Sanctis to win the reluctace of the High National Council of Education and of the University Senate to open the doors to a scientist who was not only a materialistic thinker but also a sympathizer of socialism (Gravela 1994).

The arrival of Moleschott in Turin represented a real renewal of physiological research, which for the first time in Italy began to be based on solid experimental grounds, or, better, began to be a science instead of mere speculation. Worthy of note are the investigations performed by Moleschott on white and red blood cells as well as on embryos and on the effect of light on the production of carbon dioxide by animals. Moleschott attributed this effect to a stimulus directly exerted on tissue metabolism, without any intervention of vision. Although a number of Moleschott's results were later found incorrect, they clearly showed the importance of experiments in biological sciences.

The thesis upheld in «The circulation of life», became the frame of reference for all his later findings and statements. Thus what atthe beginning was presumed to be the arrival of scientific investigations, becamethe starting pointfora new deductive system, capableof explaining all natural phenomena; what could have been a fruitful methodological materialism became a rather mystic philosophical, and perhaps pantheistic, materialism.

Since the public is usually impressed more by general ideas than by specific scientific results, Moleschott's ideas became popular outside the scientific community. It is interesting that even the poet Gabriele D'Annunzio suggested the need to base poetry on physiology, independently of the fact that he probably had no idea of what physiology was.

In Turin Moleschott's experimental method was fruitful also in other areas of biology. In 1881, two years after he left Turin to teach at the University of Rome, Giulio Bizzozero, Professorof General Pathology, presented a communication about his discovery of platelets at the Royal Academy of Medicine (Bizzozero 1882). Such a discovery is an indication that in the medical faculty of Turin, Moleschott actually founded a type of school inspired to positivist philosophy or, at least, to positivist scientific methodology. Apart from Bizzozero, who was personally encouraged by Moleschott in his research on platelets, this school included personalities like Piero Giacosa, Professor of Pharmacology, Giacomini, Professor of Anatomy, Timermans, Professorof Internal Medicine Pacchiotti, Professorof Propedutics. Surgery, plus his young co-workers in physiology, Pagliani and Mosso (Dianzani 1994).

In 1879 Moleschott left Turin for the University of Rome, La Sapienza. His chair in Torino was then assigned to his former pupil Angelo Mosso (1846-1910). The term «formerpupil» is necessary, because Mosso afterobtaining his medical degree in 1870, went to Florence to do his military service. In Florence he had the opportunity to meet the German scientist Moritz Schiff, head of the Laboratory of Physiology of the Institute of Higher Studies. After military service he worked for a brief

period in that laboratory. In 1873 Mosso went to the University of Leipzig, where he attended the Laboratory of Physiology of Karl Ludwig until 1874 (Pinotti 1987; Cosmacini 1992).

Karl Ludwig was a strong supporter of mechanicalism, but, unlike Moleschott who is mainly remembered for his philosophy, he is still famous today as the inventor of the kymograph, a rotating drum used to record time-dependent physiological phenomena. The invention of the kymograph represented a milestone in the history of life sciences, because itfavoured the passage of physiological studies from morphological observations and chemical analysis to the dynamic recording of vital processes. Although morphological observations and chemical analysis were already based on solid experimental procedures, I think that modern physiology as a well defined discipline among the other biological sciences, was born with the advent of the recording systems.

Before returning to Italy, Mosso spent a short period in Paris to visit the laboratories of Jules Etienne Marey, Claude Bernard and Charles Edward Brown-Sequard. It is likely that the main reason of his visit to Paris was a desire to learn the use of the capsule of Marey, a very simple but useful device, which allowed the transfer of some movements such as the pulsation of the arteries, to the kymograph where they were recorded. Mosso in fact used the capsule of Marey as a transducer in several experimental set-ups. After his return to Italy, Mosso was first appointed *libero decente* in pharmacology. The position of *libero decente* was the equivalent of the position of *privat dozent* in Germany. He was also appointed professor-protempore of the same subject. Finally, when Moleschott went to Rome, he obtained the chair of physiology as a full professor.

The most remarkable merit of Mosso was that of bringing the recording procedure to Italy. As he fully understood the innovative importance of the new method, he invented a number of instruments for the dynamic recording of the processes occurring in a living organism. The most famous of these instruments are the ergograph for the study of muscular work and fatigue, the plethysmograph for the study of the changes in volume of the limbs in dependence on the blood flow, the pneumograph for the recording of the movements of the thoracic cage in respiration, the ponometer which allowed him to distinguish between muscular and nervous fatigue and the sphygmomanometer with which he recorded accurate curves of the arterial blood pressure. Starting from the general principale which characterized Mosso's sphygmomanometer, in 1896 Scipione Riva-Rocci, assistant professor of internal medicine invented his own sphygmomanometer which is still used today.

Thanks to the appropriate use of the above instruments Mosso's investigations were extended to a large area of physiology from circulation to respiration, neurophysiology, muscle physiology, metabolism, etc. He was also the first scientist to study the effect of high altitudes on the vital functions in man. Inparticularthisfield of research offered him the opportunity to display his ability as an organizer, with the construction of two important scientific laboratories: the Capanna Regina Marcherita (Queen Margherita Hut) at 4558 m on Punta Gniffetti of Mount Rosa in 1893 and the Laboratory at the Col d'Olen at 2995 m in 1907. After his death the latter was given the name of "Istituto Scientifico Angelo Mosso", and is now a property of the University of Turin.

As an organizer Mosso was also responsible for the relocation of the Institute of Physiology from the few rooms it occupied before to the new large building where it is now. Under his chairmanship the new Institute with its modern and well equipped laboratories soon became famous all over the world and attracted highly qualified foreign scientists to Turin.

Since positivism involved a strong confidence in science as a means to solve all problems of mankind with the knowledge of what was believed to be the definitive truth, Mosso felt an obligation to write books

for the common people. Some titles are *«Fear»* (1884), *«Fatigue»(~\894), «Physiology of man on the Alps»* (1898), and, outside the area of physiology, *«Democracyin Religion andScience»* (1901), *"Modern life of the Italians»* (1906), plus some books dealing with archeaeology. His interest in archaeology started when he was appointed Senator and began to spend part of his time in Rome. The interest grew up in the last period of his life, when he went to the Island of Crete with the hope of treating his Tabes dorsalis by the Mediterranean climate.

The work where Mosso better expressed his philosophical position was «Materialism and Mysticism», the official opening lecture delivered to the whole university atthe beginning of the academic year 1895-1896. This workshowsagreatdifference between the ideas of Mosso and those of Moleschott. Mosso's materialism was methodological and not philosophical as was the one of his predecessor. In the philosophical materialism of Moleschott, which summarized all natural phenomena in a sort of metaphysics similar to the religion he meant to fight, Mosso saw a possible a danger for freedom from prejudice in research. Although religion was outside his personal interest, in Mosso's methodological materialism we can see the admission of what Spencer called the unknowable, which could not be removed by science as asserted by Ardigo, but which could remain the properfield of methaphysics or theology.

It is possible that the philosophical ideas of Mosso were the consequences of both the new times and his research. During the activity of Mosso, the fight between vitalism and mechanicalism had lost much of its importance and began to appear as a restraint rather than a stimulus for research. Moreover, investigations based on dynamic recordings were no longer able to produce general theories as when chemical analysis allowed Moleschott to write «The circulation of life».

In spite of their differences, both Moleschott and Mosso greatly contributed to the renewal of physiology in Italy. The former brought to Turin the experimental method, the latter reinforced the method with recording techniques. A new school was then born in Italy : a school which was no longer provincial, but open to international influence. A school which was represented by towering personalities like Giulio Fano (1856-1930), who taught in Genova, Florence and Rome, Vittorio Aducco (1860-1937), who taught in Siena and Pisa, and Amedeo Herlitzka (1872-1949), who succeeded Mosso at the University of Turin.

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Biography

Gianni Losano was born in Pinerolo, Italy, in 1934. Doctor of Medicine in 1959 at the University of Turin, he became Associate Professor of Physiology in the same University in 1969, and Professor of Physiology in 1973. His field of research is Cardiovascular Physiology. He is a member of the Scientific Committee of the Scientific and Technological Archv. Of the University of Turin.

Oreste Pinotti was born in Padova, Italy, in 1912. Doctor ofMedicine in 1926 atthe University of Padova, he was Professor of Physiology and head of the Department of Physiology of the University of Turin from 1961 to 1977. His field of research was Cardiovascular Physiology. After his retirement in 1977 he lives in Padova. He is a member of the Accademia Nazionale dei Lincei.