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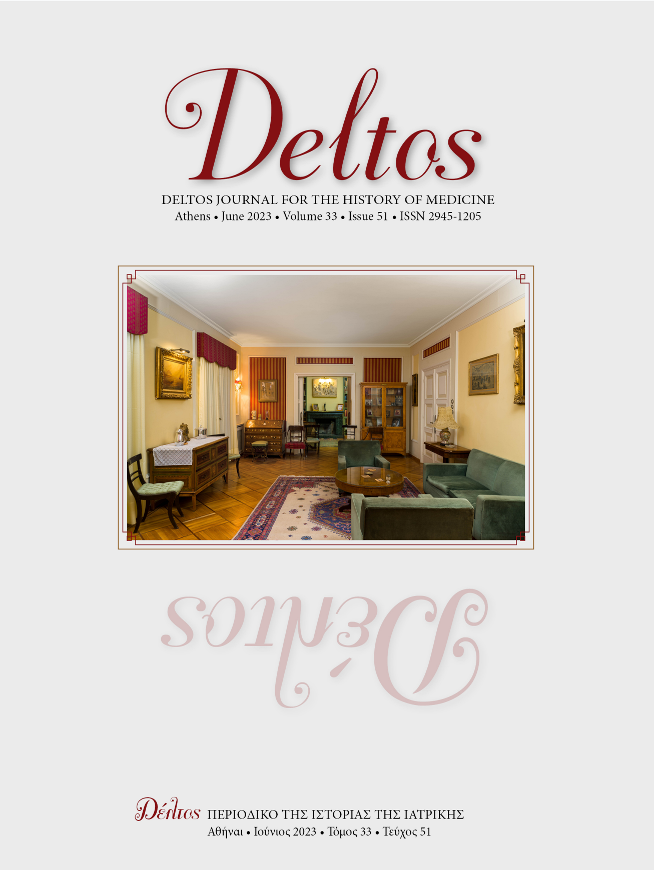

Giorgio Armeno Baglivi - Reappraisal of a seventeenth century physician scientist

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Abstract

The seventeenth century was an exciting transformative period of creativity in the generation of new medical knowledge. It was then that the scholasticism of the past was formally replaced by the new spirit of inquiry, experimentation, quantification, and validation that had originated in the Scientific Revolution of the previous century. It was then that within the prevailing notions of iatromechanics that anatomical observations at postmortem were linked to clinical symptoms of diseases and launched the discipline of pathological anatomy, and when the introduction of anatomical experimentation and quantification that was reasonably analyzed launched the discipline of physiology. It was also then that iatrochemistry transformed the alchemy of the past into chemistry and launched the quest for the elements that constitute matter. It is in this creative environment that Giorgio Armeno Baglivi (1668-1707), a disciple of Marcello Malpighi (1628-1694), was born, matured, trained and became a distinguished physician of the period. Reputed as a strict iatromechanist, careful scrutiny of the writings of Baglivi reveal a pioneering physician scientist with broader and more insightful views of the body in health and disease. He was a strong promoter of correlating postmortem findings to antemortem clinical symptoms of patients that would lead to the emergence of pathology and the nosography of disease. In dealing with the circulation, he was limited in addressing the composition of blood, but considered the maintenance of fluid equilibrium essential to normal bodily functions. He attributed acute diseases to changes in fluid composition and equilibrium, and their progression to chronicity to the solidification of those changes in affected organs observed at autopsy. It would take three centuries of investigation and technological developments to resolve these problems of homeostasis as we understand them now. The difficulties Baglivi faced in dealing with them is a classic example of the intellectual hardships that pioneers in the scientification of medicine had to toil with in the seventeenth century to bring medicine to its present stage of a scientific discipline rather than just another professional occupation.

The seventeenth century was a transformative period when the concepts and methods of the Scientific Revolution that were developed in the previous two centuries were tested, verified, validated, enriched, and by the close of the century set the stage for the Enlightenment that followed. It was a time when new medical knowledge was made, exchanged, and spread. It was then that scholasticism was formally replaced by inquiry and forums for their consideration and evaluation created under the patronage of local authorities such as the Accademia dei Lincei in Rome in 1603, the Accademia del Cimento in Florence in 1657, the Royal Society of Medicine in London in 1662, and the Académie des Sciences in Paris in 1666. It was a time that fostered the exchange of ideas by the distribution of relatively short, published tracts and by correspondence between its primaries, which by the end of the century evolved into the self-proclaimed "Republic of Letters" of the intellectual community that would blossom into the Enlightenment which followed. It was the time when the 1543 "Fabrica" (structure) of Vesalius (1514-1564) evolved and was incorporated into the "anatome", "anatomia", and "anatomica" in the title of the books and tracts published then (Fig. 1).[1-3]

Key Words: *Giorgio Baglivi, Marcello Malpighi, iatromechanics, iatrochemistry, anatomy, physiology*

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Introduction of experimental quantification

It was a century dominated by scientist investigators known as "natural philosophers" as the appellation of "scientist" did not exist until the 19th century when science was being incorporated into the medical curriculum and the term was coined by the English polymath William Whewell (1794-1866) in 1834. It was the century when the Newtonian dictum of "numero, pondero, et mesura" formally introduced quantification in medicine rooted in the work of Santorio Santori (1561-1636), whose life-long metabolic balance studies were published in 1614 as "Ars de Statica Medicina" (Fig. 1), an introductory text that introduced quantification in the quest of medical knowledge.[2,4,5]

It was the period that saw the dawn of physician scientists who dismantled much of the erroneous Galenic physiology that had dominated medical thought theretofore, led by the publication in 1628 of "De motu cordis" of William Harvey (1578-1657), a milestone in the understanding of the cardiovascular circulation that introduced experimental quantitative methodology into the study of physiology.[1-3] It was also then that the correlation of structure to function began to be studied in earnest notably by Marcello Malpighi (1628-1694) who authored his milestone "De viscerum structura exercitatio anatomica" in 1666.[1,6] These two texts were the leading landmarks that framed the iatromechanical school of thought which came to dominate much of the medicine of the 17th century (Fig. 1). The studies of Harvey presented the heart as a mechanical pump that energized the flow of blood through the hydraulic pipes of the vasculature. While the studies of Malpighi formulated the kidney as a secretory gland within the iatromechanical concept of glands as sieves that mechanically strained solids from liquids whose glandular secretions were in essence the product of mechanical sieving.[3,6,7] This classification of the kidneys branding them as secretory glands would prevail well into the first half of 20th century, even after the glomerular filtration and tubular reabsorptive and secretory functions of the kidneys were well established.[8]

The founding blocks of iatromechanics actually came from outside medicine. Instrumental in introducing its computational basis was René Descartes (1596-1650), a mathematician with aspirations to be a physician, who actually adopted Harvey's discovery of the circulation to formalize the philosophy of iatromechanics that would shape medical thought through much of the 17th century.[9,10] Where Descartes was instrumental in the introduction of mathematics into medical investigation, the astronomer Galileo Galilei (1564-1642) was instrumental in introducing physics into iatromechanics (Figs. 1 and 2).[10-12]

Where iatromechanics ruled Southern Europe, in its North medical thought was dominated by the parallel evolution of iatrochemistry from the Latin "chymia" of old to the "chymie" of France and "chymistry" of England. Originally, the etymology derives from the Greek word "hymos" hence Hippocrates' humoral theory. Its principal proponent was Robert Boyle

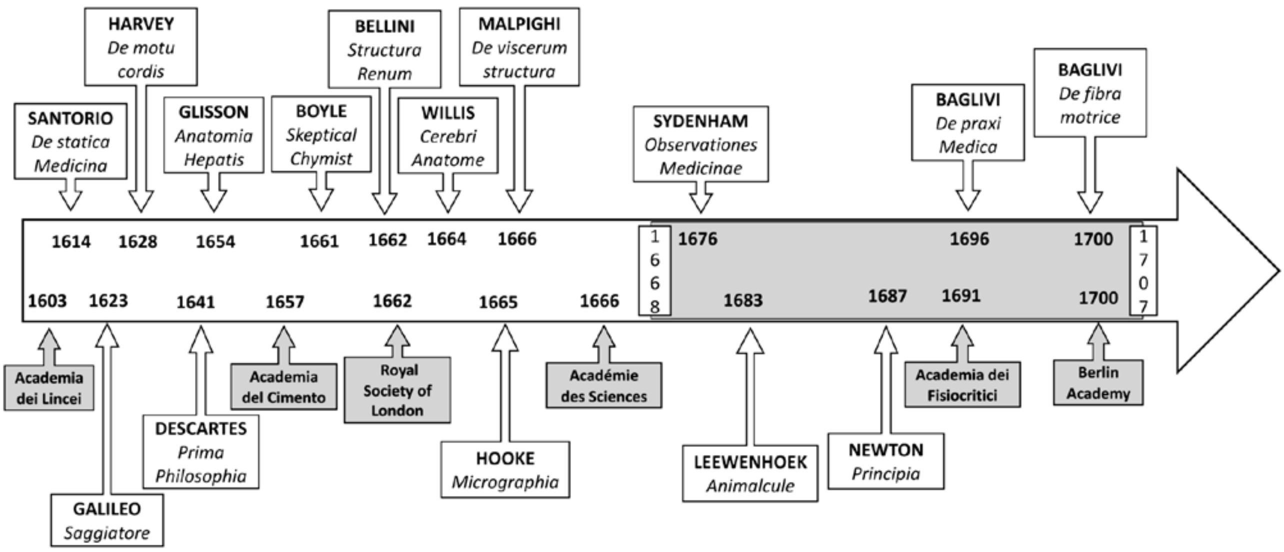

Figure 1. Timeline of medical progress in the 17th century. The life span of Giorgio Armeno Baglivi (1668-1707) is highlighted in light grey in the central arrow. The grey boxes below the arrow represent the principal academies that were established. The white boxes below the arrow represent relevant non-medical texts of the period. The boxes above the arrow represent the medical texts of the period. The name of the authors is shown in bold capital letters, the Latin name of the text is shown in italics under the name of each author.

(1627-1691) whose 1661 landmark "The Sceptical Chymist" is credited for launching the transformation of alchemy to the chemistry of the new era of medical thought.[10,13]

Giorgio Armeno Baglivi

It is in this exciting age of creativity that Duro (Giorgio in Italian, Gevorg in Armenian) was born on September 8, 1668, in Dubrovnik, then a trading outpost of Venice, to an Armenian migrant merchant father, hence his given baptismal name of Giorgio Armeno.[14] When his parents died in 1670, he was raised by Jesuit priests until 1683 when at the age of 15 he was adopted by an Italian physician in Lecce, across the Adriatic from Dubrovnik, named Pietro Angelo Baglivi, hence his adopted name of Giorgio Baglivi, with which he grew up and studied medicine in Naples, Salerno, Padua, Pisa, and Bologna.[15] His life and works have been detailed in several excellent reviews and will not be detailed here.[14-17] His intellectual heritage is shown in Figure 2. Like other intellectuals of his time, Baglivi maintained an active correspondence with most of his mentors, colleagues as well as other distinguished physician scientists of his time. A lot of over 100 of his original letters was obtained by William Osler (1849-1919) in 1908 and then edited and published in 1974.[18] As a disciple and assistant of Marcello Malpighi, Baglivi applied microscopy to the study of structure wherein he developed the notion of the "fibre" as the fundamental functional unit of the human body exposed in his "De Fibra Motrice et Morbosa" published in 1700.[19,20] A declared iatromechanist, Baglivi is reputed as a radical physician who overemphasized the application Descartes' "bête machine" to the human body as a mechanical automaton. However, a critical examination of his work reveals a pioneering physician scientist with broader and insightful views of the functions of the body in health and disease well beyond that of a mere mechanical automaton. It is this latter facet of Giogio Armeno Baglivi that is considered in this article which focuses on two of his principal contributions to the progress of medical knowledge. First is his contribution to refining the role of post-mortem examination to medical knowledge, and second is his concept of the importance of the equilibrium of bodily fluids in health and disease. In order to maintain focus of these issues it was necessary to omit mention of many notable contributors of the period to these and other pertinent medical subjects.

Contribution to pathological anatomy

As a disciple and colleague of Malpighi, Baglivi accompanied him to Rome when Malpighi was summoned there in 1692. When Malpighi died in 1694, it was Baglivi who performed his autopsy. Accompanying him in the procedure were Antonio Maria Valsalva (1666-1723) and Giovanni Maria Lancisi (1654-1720). Baglivi included the case history and autopsy findings of Malpighi as the final chapter of his "De Praxi

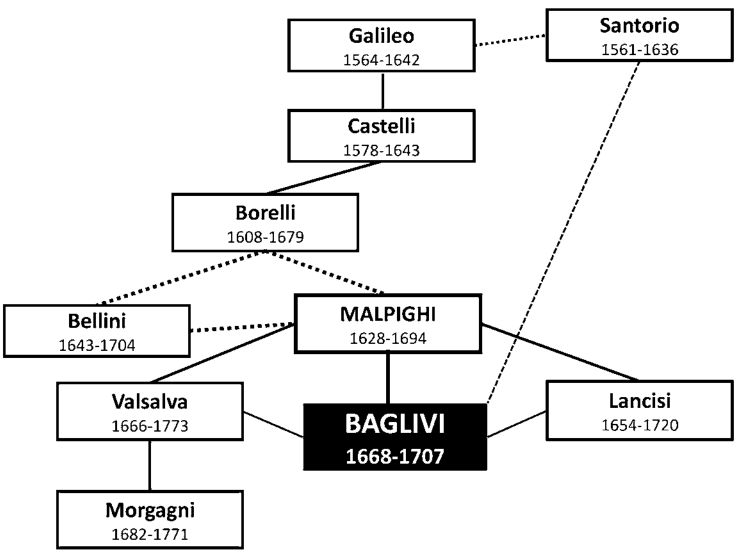

Figure 2. The intellectual heritage of Giorgio Armeno Baglivi. The last name of each related investigator is shown in bold capital letters and their life span below their names. Solid connecting lines indicate direct relationship or sponsorship of the individuals; dotted lines indicate communication in exchanged texts or letters; dashed line indicate familiarity with the contributions of the senior individual.

Medica", as seems to have been customary then. He shared his findings at autopsy with consultants and communicated them to the Royal Society of London. The following extract is from the second edition of the English translation of his book, "The Practice of Medicine", published in London in 1723.[21]

Case report: "Marcellus Malpighi had been subject for many years to Vomitings, bilious stools, Palpitations of the Heart, Stones in the Kidneys and the Bladder, a pissing of blood, and some light touches of the Gout. Upon his coming to Rome, all these Disorders were inflamed, especially the Palpitations of the Heart, the Stone in the kidneys, and the very sharp biting night sweats. Such was the condition of Malpighi on July 25, 1694, at which time he was seized with an Apoplexy… attended with a Palsy of the whole right side, and a distortion of the mouth and right Eye … After struggling for days with a long Train of grievous symptoms … he was seized on November 29 with a fresh fit of Apoplexy, … and he died."

Dissection of the corps: "The heart was larger than ordinary, especially the Walls of the Left Ventricle, which were as thick as the breadth of Two Fingers. The Left kidney was in natural state; but the Right was half as big again as the left, and the basin of it was so much dilated that one might easily thrust Two Fingers into it. In the Bladder we found a little Stone. The rest of the natural Viscera were well conditioned. When I opened his Head, I found in the cavity of the Right Ventricle of the Brain, an extravasation of about two pints of black clotted blood, which was the cause of his Apoplexy and his death."

A concise but precise classic case report of hypertension and chronic kidney disease culminating in an intracranial hemorrhage in a 66-year-old man with gout. Unfortunately, this was before the blood pressure could be measured, its detrimental consequences were recognized, the clinical features of uremia were identified, and fatal cerebrovascular accidents linked to hypertension and chronic renal failure. However, it is the accuracy of Baglivi's description of the clinical symptoms and their correlation to the meticulously observed morbid changes that laid the foundation of the pivotal role of post mortem examination to the understanding of diseases in the following years. While this is the only pot-mortem autopsy reported by Baglivi, in his "Specimen de fibra mortice et morbosa", he clearly declares, "I have totally dedicated myself to observing the symptoms of diseases and the opening of the corpses of those people … nobody will ever learn the function and structure of a viscus unless … once the symptoms of the disease have been described, the corpse is opened, and the viscera carefully examined".[22]

The role of post mortem studies in understanding disease processes was highlighted as early as in 1507 by the Florentine Antonio Benivieni (1443-1502), was glorified by the Netherlandish painters of the period such as the 1632 rendering of "The Anatomy Lesson of Dr. Tulp" by Rembrandt (1606-1669), and actively pursued by the disciples of Malpighi. These included Antonio Valsalva who trained Giovanni Battista Morgagni (1682-1771) and was considered a founding father of anatomical pathology (Fig. 2). He in turn authored the biography of his mentor Valsalva in 1740, twenty years before the publication of his milestone five volume, "De sedibus et causis morborum per anatomen indigatis" in 1761.[23,24] It was this undertaking of the scientific correlation of clinical symptoms and diseases to morbid lesions that would launch the nosology of the so-called "English Hippocrates", Thomas Sydenham (1624-1689) considered central to the progress of clinical medicine.[25,26]

Contribution to physiological anatomy

Broadly outlined, physiology as we understand it now is considered to have been formally introduced into the medical lexicon in 1542 as "physiologia" by Jean Fernel (1497-1558). As a component of the expanding studies of nature (Greek "physis"), physiology made its formal entry into the medical curriculum in 1766 in the "Elementa Physiologiae" of Albrecht von Haller (1706-1777), was institutionalized as an experimental laboratory based discipline by Francois Magendie (1783-1855). The latter's student Claude Bernard (1813-1878) formalized it in 1859 into a biological feed-back control system necessary in maintaining the constancy of the internal environment (milieu intérieur) necessary for life, which in 1926 became the homeostasis of Walter Cannon (1871-1945).[27-30]

Actually, it all began in the quest of the relation of structure to function sought by Hippocrates (ca. 460-370 BC), experimentally explored by Galen (ca. 130-200) but then literally neglected until the Scientific Revolution when the study of anatomy was formalized and the relation of structure to function began to be explored. Its crowning achievement was the pioneering work of William Harvey, whose "De motu cordis" is considered the founding cornerstone of physiology.[1] But Harvey was and considered himself an anatomist who characterized his book as an exercise in anatomy (Exertatio Anatomica). Harvey's report was exceptional for its times in its use of experimentation and calculations. Early physiological texts that followed were essentially based on conceptual deductions derived by anatomists from their anatomical observations by intellectual deductive reasoning.[1,2,31] And while some of those deductions were based on experimentation, they were mainly limited to dye injections and restricted by the magnifying power of the available microscopes, which they actually termed "glasses". It is thus that the Fabrica (structure) of Vesalius, became the "anatome", "anatomia", and "anatomica" of the title of physiological texts that followed, such as that on the brain "Cerebri Anatome" by Thomas Willis (1621-1675) in 1664, on the liver "Anatomia hepatis" by Francis Glisson (1599-1677) in 1654, and on the kidney "Exertatio anatomica de structura usu renum" by Lorenzo Bellini (1643-1704) in 1662 (Fig. 1).[28,31,32]

It is within this conceptual framework that Baglivi's contribution to the emergence of physiology with its roots in anatomy should be evaluated. It was a time that anatomy ruled, when anatomical dissection became a tool of inquiry, when the functions of the body were interpreted in iatromechanical principles within which life was defined as motion, and when iatrochemical efforts were just beginning to reduce matter to its elements. Which accounts for why Baglivi promoted the "fibre" as the smallest functional operative unit of the body, whose sensitivity and contractility provided the force of movement by which the Cartesian "homme machine" was animated.[29,33] In his "De fibra" he distinguishes two types of fibres, membranous and muscular, a herald of the tissues of Xavier Bichat (1771-1802). Although the cell was already described in 1665 it literally remained the empty shell that Robert Hooke (1635-1703) had observed in corks until the cell theory was formulated in 1839.[34]

While an iatrochemical solidist, Baglivi fully appreciated the importance of fluids in the hydraulics of Harvey's circulation but had trouble explaining its composition beyond that of the then prevalent concepts of their physical corpuscularity and chemical attractiveness. As an experimental anatomist of his times, Baglivi was also a firm proponent of the ancient Hippocratic teachings of the importance of meticulous observation and educated rational reasoning in the practice of his trade which ended leading him to attribute acute diseases primarily to changes in fluidity, whose equilibrium if not restored by treatment became fatal or progressed into chronicity when solid morbid changes developed and were observed at post-mortem examination.[5,12] Essentially, and in line with the parenchymatous concept of Erasistratus (340-250 BC), he considered his fibres as solidified fluids. In so doing, he was a pioneer in the evolution of the mechanical machines to the biological organism we recognize now.[3,5,12] A physician scientist ahead of his times Baglivi laid the grounds for Claude Bernard's declaration that, "Descriptive anatomy is to physiology what geography is to history, and just as it is not enough to know the topography of a country to understand its history, so also it is not enough to know the anatomy of organs to understand their functions." It would take over three centuries of considerable scientific investigation, technological developments, and repeated experimental studies to bring his concepts to their reality as we understand them now.

Conclusion

Exposed to many of the greatest minds of the period (Fig. 2), Baglivi was no genius himself. However, his training, studies, concepts, and contributions were significant enough for his selection in life as Papal physician to Pope Innocent XII, professor of Anatomy at the papal university of Sapienza in Rome, and a member of the Royal Society of Medicine in London. And, by his posthumous inclusion on the list of the 100 "Great Doctors" compiled in 1933 by the eminent medical historian Henry Siegrist (1891-1957).[35]

While his own contributions to the advancement of physiology and pathology were relatively modest, he exemplifies the intellectual struggle that contributed to the evolution of medical knowledge. And, while he does not qualify as a genius of the 17th century, he definitely and unequivocally was one of its giant pioneers on whose shoulders geniuses stood to see farther and lead us to where we now are. Worth considering in this regard is his premature death before reaching the age of 40 which may have prevented the full development of his relatively innovative concepts on the importance of maintaining the equilibrium of fluids in health and disease that may well have qualified him as a genius.

ΠΕΡΙΛΗΨΗ

Giorgio Armeno Baglivi - Επανεκτίμηση ενός επιστήμονα ιατρού του 17ου αιώνα

Garabed Eknoyan

Ο δέκατος έβδομος αιώνας αποτέλεσε μια συναρπαστική περίοδο δημιουργικού μετασχηματισμού στην παραγωγή νέας ιατρικής γνώσης. Ήταν τότε που ο σχολαστικισμός του παρελθόντος αντικαταστάθηκε επίσημα από το νέο πνεύμα της έρευνας, του πειραματισμού, της ποσοτικοποίησης και της επικύρωσης των αποτελεσμάτων που είχε αναδειχθεί από την Επιστημονική Επανάσταση του προηγούμενου αιώνα. Τότε που, στο πλαίσιο των επικρατουσών εννοιών της ιατρομηχανικής, οι ανατομικές παρατηρήσεις επί πτωμάτων συνδέθηκαν με τα κλινικά συμπτώματα των ασθενειών και γέννησαν την ειδικότητα της παθολογοανατομίας και που η εισαγωγή του ανατομικού πειραματισμού και του ευλόγως αναλυθέντος ποσοτικού προσδιορισμού γέννησαν την ειδικότητα της φυσιολογίας. Ήταν επίσης τότε που μέσω της ιατροχημείας η αλχημεία έδωσε τη θέση της στη χημεία και ξεκίνησε η αναζήτηση των στοιχείων που αποτελούν την ύλη. Είναι σε αυτό το δημιουργικό περιβάλλον που γεννήθηκε, ωρίμασε, εκπαιδεύτηκε και διακρίθηκε στην ιατρική ο Giorgio Armeno Baglivi (1668-1707), μαθητής του Marcello Malpighi (1628-1694). Ενώ απέκτησε φήμη ως αυστηρός ιατρομηχανικός, η προσεκτική ανάγνωση των γραπτών του Baglivi αποκαλύπτει έναν πρωτοπόρο επιστήμονα ιατρό με ευρύτερες και διορατικές απόψεις για το σώμα σε κατάσταση υγείας και ασθένειας. Υπήρξε σθεναρός υποστηρικτής της συσχέτισης των ευρημάτων της νεκροψίας με τα προθανάτια κλινικά συμπτώματα των ασθενών που θα οδηγούσε στην εμφάνιση των ειδικοτήτων της παθολογίας και της νοσολογίας. Όσον αφορά το κυκλοφορικό, περιορίστηκε στην εξέταση της σύνθεσης του αίματος, και θεωρούσε τη διατήρηση της ισορροπίας των υγρών απαραίτητη για τις φυσιολογικές σωματικές λειτουργίες. Απέδιδε τις οξείες ασθένειες σε αλλαγές στη σύνθεση και την ισορροπία των υγρών και την εξέλιξή τους σε χρονιότητα στην εδραίωση αυτών των αλλαγών στα προσβεβλημένα όργανα ως παρετηρούντο κατά την νεκροψία. Χρειάστηκαν άλλοι τρεις αιώνες έρευνας και τεχνολογικών εξελίξεων για να καταστούν κατανοητά αυτά τα προβλήματα της ομοιόστασης. Οι δυσκολίες που αντιμετώπισε ο Baglivi κατά την εξέταση αυτών των θεμάτων αποτελούν κλασικό παράδειγμα των διανοητικών δυσκολιών που χρειάστηκε να αντιμετωπίσουν οι πρωτοπόροι στην επιστημονικοποίηση της ιατρικής τον δέκατο έβδομο αιώνα για να ανάγουν την ιατρική στο σημερινό επίπεδο μιας επιστημονικής και όχι απλώς μιας επαγγελματικής ενασχόλησης.

Λέξεις Κλειδιά: *Giorgio Baglivi, Marcello Malpighi, ιατρομηχανική, ιατροχημεία, ανατομία, φυσιολογία*

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