

Constantine the African: the revival of neurology in medieval Europe

Á. L. Guerrero-Peral¹, V. de Frutos González²

¹Department of Neurology. Hospital Clínico Universitario de Valladolid.

²G. I. R. Speculum medicinae research group. Universidad de Valladolid.

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ABSTRACT

Introduction. This article offers an analysis of the life and works of Constantine the African. We will place special emphasis on the *Liber Pantegni* and its interesting remarks on the nature and treatment of neurological diseases.

Methods. After reviewing the history of the different channels contributing to medieval Galenism and the birth of the Schola Medica Salernitana, we provide an analysis of Constantine the African and his works. Following that, we present a descriptive review of the Latin edition of the *Liber Pantegni* printed by Henricus Petrus, an adaptation of one of the most famous texts in Arab medicine.

Results. Constantine the African's translations of Arabic texts marked the revival of Galenism in Western medicine and a major step forward for the medical school in Salerno.

Conclusions. The writings of Constantine the African had a tremendous influence on Western medicine in the Middle Ages. Descriptions in the *Liber Pantegni* of neurological diseases and available means of treating them illustrate the knowledge possessed by the doctors and professors of Salerno.

KEYWORDS

Constantine the African, Schola Medica Salernitana, Haly Abbas, *Liber Pantegni*.

Introduction

From Hippocrates to the Academy of Gondishapur

Hippocrates of Kos (460-377 BCE) is a key figure in the history of medicine. His time is associated with a major paradigm shift. Moving past the *mythos* of pre-scientific medicine, in which diseases were understood as divine retribution against a person who had disturbed the natural order, scholars embraced *logos*, the idea of illness as an alteration of the natural state. Hippocrates was no longer a priest of the Asclepeion of Kos (Figure 1), but rather a physician who employed his knowledge, powers of observation, and experience in the search for a disease's cause and natural history. Based on his findings, he would perhaps be able to propose a remedy.^{1,2} Hippocrates' works, the *Corpus hippocraticum*, are considered to be the keystone of classical Greek medicine. They contain many references to what we now know as neurological diseases.



Figure 1. The Asclepeion of Kos

Hippocrates' students developed the great Alexandrian School in which the study of neuroanatomy would take shape.³ Several scholars, including Asclepiades of

Corresponding author: Ángel Luis Guerrero Peral.
Servicio de Neurología Hospital Clínico Universitario de Valladolid
Avda Ramón y Cajal 3
47005 Valladolid, Spain.

E-mail: gueneurol@gmail.com

Bithynia (124-40 BCE),⁴ Cornelius Celsus (25-50 CE)⁵ and Aretaeus of Cappadocia,⁶ introduced Greek medicine to the Roman Empire, as did one of the greatest figures in the history of medicine: Galen.

Galen (129-199 CE) was trained in both his hometown of Pergamon (Figure 2) and Alexandria, where he gained valuable experience as a physician at the school of gladiators. He attained fame in his lifetime as a physician to the Roman elite.⁷ Galen understood the brain to be the central core of the human body, responsible for coordinating sensation and movement. He believed that perfect health was impossible, as the body was permanently prone to illness caused by imbalances of the four humours: blood, phlegm, yellow bile, and black bile.^{1,7} Galen's writings are noteworthy in that they compile all the medical knowledge of his time in a single doctrinal series of texts which had a considerable impact on medieval medicine.

After the fall of the Roman Empire, Greco-Roman medical knowledge, which we will hereafter call medieval Galenism, splintered into three initially different currents: Western European, Byzantine, and Arab medicine.

In the Western part of the Roman Empire, especially after a number of devastating barbarian invasions, preserving this knowledge was extremely difficult. It was guarded in monasteries, such as Santa Maria de Ripoll in Catalonia. However, empiricism was gradually abandoned; the practice of medicine was invaded by notions of Christian mystical charity and benevolence, and treatments were over-simplified.^{9,10}

One noteworthy contribution by the Byzantine Empire was its compilation of literature, which was particularly brilliant during the Early Byzantine period. In these eastern reaches of the former Roman Empire, the relationship between medicine and the Christian religion was also delicate. Nevertheless, Byzantine medicine, enriched by folk treatments, was clearly care-based and successfully delivered Galenism to patients' bedsides.¹¹⁻¹³ The different currents of medieval Galenism first came together in a historical event that is now steeped in legend. A copy of *Materia Médica* by Dioscorides was sent from Constantinople to the court of Caliph Abd-al-Rahman III in Córdoba in the 10th century, which led to major advances in the medicine of Al-Andalus.¹⁴ At a later date, also in Spain, the work undertaken by the Toledo School of Translators provided new opportunities for Western European scholars to read Arabic medical texts.¹⁵

A brief overview of history is needed before we introduce the third current in medicine. The First Council of Ephesus, held in 431 CE, resolved one of the greatest controversies of the early Christian church. Followers of Nestorius held that Jesus Christ contained separate human and divine natures, but they were defeated, proclaimed to be heretics, and forced to emigrate. They travelled eastward and found shelter within the Persian Empire. Here they would come to translate their Greek medical texts into Syriac and strengthen the Academy of Gondishapur.^{16,17} One very important figure was Hunayn Ibn Ishaq, better known by his Latin name Johannitius (807-877 CE), a Nestorian Christian who translated Greek and Syriac texts by Galen and by Byzantine authors into Arabic. Johannitius delivered the teachings of Galen to Arab physicians, thereby contributing to the golden age of classical Arab medicine, which boasted such names as Rhazes (864-935 CE) and Avicenna (980-1037 CE).¹⁸



Figure 2. Theatre at the Asclepeion, Pergamon

1. The emergence of the Schola Medica Salernitana

The founding of the Schola Medica Salernitana was a key moment in the rebirth of medicine in Western Europe. Salerno is located in the south of the Italian peninsula in an enclave in which different groups, first the Lombards and then the Normans, had already been in contact with Arab and Byzantine cultures for centuries. Under the auspices of the Benedictine abbey of Monte Cassino, if the legend is true, Salernus the Roman, Pontus the Greek, Adela the Arab, and Helinus the Jew came together to found a completely secular school devoted exclusively to medicine, the Collegium Hippocraticum.¹⁹⁻²² From its earliest beginnings, the school adopted the empirical method and devel-

oped a preventive approach that would forge Salerno's reputation as a healthy city, (*Hippocratica civitas*) and its physicians' reputations as great professionals.²³

Students in Salerno were guided by a strict curriculum with exams on the works of the great authors and required to complete a final year of supervised practical experience. They were also instructed in how to behave with patients and their carers (mostly women), and how to inform family members. Professors mentioned the possibility of using placebos to make patients feel better.¹⁹ Interestingly enough, women were present both as professors and as students.^{23,24}

Instruction in Salerno was initially based on oral tradition, but the need for written texts soon became clear. The school obtained Byzantine texts written in Greek and Latin without Arab influence. Other authors within the school, such as Alfanus and Gariopontus, author of *Passionarius*, penned important texts in the 11th century.²² At that pivotal moment, a brilliant and adventurous physician –one of the most compelling figures in medical history– would change the face of Western medicine.

2. The life and works of Constantine the African

Constantine the African (1010-1098) was born in Carthage; whether he was Muslim or Christian is unclear. Although the first of his biographies was written by Peter the Deacon of Monte Cassino less than a century after Constantine's death, many of the events they recount were mythicised. After studying medicine in Baghdad, Constantine travelled to remote locations that included Syria, Egypt, Ethiopia, and India, adding to his knowledge and collecting medical texts in Arabic.^{25,26} Just before journeying home, he visited Salerno, which was already an influential city. He worked as a physician in Carthage for three years, but was forced to leave after being accused of witchcraft. At this time (after having briefly served the Byzantine emperor Constantine Monomachus, according to some), the physician sought refuge in Salerno. This may have been the product of his close relationship with Robert Guiscard, a Norman duke who had taken the region from the Saracens not long before. He began his journey with a large store of books, and legend has it that some were lost in a fierce storm. In any case, both Constantine and the remaining books were well-received in Salerno, where he arrived between 1065 and 1077. He began teaching at the medical school and his fame spread quickly. Some years later, he became a Benedictine monk

and took up residence at the abbey at Monte Cassino. Here, Abbott Desiderius, who also had some medical knowledge, and Alfanus I, Archbishop of Salerno, urged him to complete his translations.^{23,27}

Throughout his journeys, he acquired numerous Arabic-language medical texts by authors including Ibn Al-Gazzar (*Viaticum*), Johannitius (*Isagoge*), Hippocrates (*Aphorisma, Prognostica*), Galen (*Tegni, Megategni*), Philaretus (*De Pulsibus*), Rhazes (*Liber divisionum, Liber experimentorum*), and Isaac of Toledo (*Liber dietorum, Liber urinarium, Liber februm*).^{20,28} He spent his years in Monte Cassino producing translations (or adaptations, according to most authors) of those texts. Although Constantine's versions respect the doctrinal conception and general structures of the original works, he tended to insert his own observations which are often hard to distinguish from the original text. In addition, he suppressed references to the original authors and presented the texts as his own.^{25,29,30} The debate over Constantine's alleged plagiarism in all of his translations began in the 12th century and continues to this day. In the African physician's favour, it must be said that he provided Latin translations of medical concepts previously unknown in that language, and contributed original ideas to all of his writings. However, it must also be noted that with the exception of Isaac of Toledo, he did not cite any of the authors whose original works he used.²⁵

3. A fundamental manuscript: the *Liber Pantegni*

Constantine the African's first translation was a text by the Persian physician 'Ali ibn al-'Abbas al-Majusi (Haly Abbas in Latin), titled *Kamil as-sina'a at-tibbiya* (Perfect Book of the Art of Medicine) or else *Kitab al-Maliki* (the Royal Book). Later known as the *Liber Pantegni*, it would come to be one of Constantine's key works.³¹ We know little of Haly Abbas (930-994 C.E.) except that he was born in Ahwaz, near Gondishapur, to a Zoroastrian family in modern-day Iran. We also know that he dedicated his Royal Book to a prince named 'Adud al-Daula Fana Khusraw, which probably indicates that the prince was a patron.^{28,32-35} He wrote this book, which soon became widely-consulted, in Baghdad where he served as physician to the Buyid dynasty.³⁵

Constantine the African completed his translation in 1087 without mentioning Haly Abbas. Another Latin translation of the text was also completed by Stephen of Antioch in 1127, under the title *Liber Regius*.^{35,36}

We present a descriptive review of the Latin edition of the *Liber Pantegni*³⁷ printed by Henricus Petrus in 1539. The text consists of 10 books, each of which is divided into chapters.

Book 1: Fundamentals of medicine. This book addresses the different areas of medicine, the elements making up the human body, and the qualities of the human body and each of its members.

Book 2: Description of "simple organs" (bones, nerves, blood vessels, cartilage, ligaments, hair, nails).

Book 3: Description of "compound organs". Members composed of various simple organs according to medieval Galenism.

Book 4: Functions of the sensory organs.

Book 5: Galen's *sex res non naturales* (six non-natural causes of sickness or health). These factors, grouped as dualities, regulate health and prevent illness: air; food and drink; exercise and rest; sleeping and waking; repletion and excretion; and emotional well-being.³⁸

Book 6: Illnesses of the sensory organs.

Book 7: Illnesses of the circulation, digestion, and urine.

Book 8: Skin diseases.

Book 9: Treatise on *a capite ad calcem* therapy, beginning with illnesses affecting the head and moving gradually lower until reaching the feet.

Book 10: Natural history of selected diseases.

The *Kitab* contained the *Theorica*, corresponding to the 10 books of the *Liber Pantegni* listed above, plus the *Practica* which Constantine the African never finished translating.

4. Neurology in the *Liber Pantegni*

The *Pantegni* contains many references that can be matched to our concept of neurology. Here we will present the most remarkable passages in this sense. Chapters and pages are cited from the 1539 edition printed by Henricus Petrus.³³

Nerves and the brain

Based on the distinction made in medieval anatomy between 'simple organs' (those with an apparently homogenous composition) and 'compound organs'

(those composed of several simple organs), Constantine described nerves as simple, cold organs, and stated that they enabled the body to move and feel (Book I, Chapter VII, p. 10). Nerves, along with other simple organs such as ligaments, form specific compound organs such as tendons and muscles, which in turn form the 'universal compound organs' (Book III, Chapter I, p. 48).^{22,38}

The *Liber Pantegni* distinguishes between animal, spiritual, and natural members. Animal members imitate animal actions and were created by a divine power in all animal life to enable sensation and voluntary movement. The main animal member in humans is the brain, which is the seat of memory, reason, and intelligence and the origin of a person's ability to feel and move other members voluntarily. The brain is aided in its tasks by the eyes, ears, nose, tendons, and nerves. For instance, nerves carry the ability to feel from the brain to the body (Book II, Chapter I, p. 25-27).

The brain is the seat of human virtues, which are imagination, memory, and intellect. The latter is the main trait distinguishing humans from animals, and the source of the other two virtues. A person's imagination transmits imagined information to the intellect. The intellect acts as a judge able to distinguish between information received from the imagination and information from the memory. It shapes that information and keeps it until rendering it into deliberate action (Book IV, Chapter IX, p. 91).

All nerves originate from the brain or neck. Those originating in the brain are softer, while nerves arising from the neck are harder. Among the nerves originating from the brain, those coming from the anterior part of the brain are the softest since they provide sensation to the rest of the body. In contrast, nerves originating in the posterior part of the brain are harder since they are mobile. If they were soft, abrupt movements would quickly cause them to break (Book I, Chapter VIII, p. 10). The book maintains the distinction between cranial nerves (emerging from the brain) and spinal nerves (emerging from the neck). This distinction was established by Galen and supported in the Arab school by Rhazes.³⁹ The book describes seven pairs of cranial nerves; the first pair reaches the eyes so that they can see and move, and it also extends to the tongue to enable its sense of taste. The second pair reaches the face to facilitate movements needed in eating and also reaches the lips and tip of the nose. The third pair extends to the gums and teeth to provide them with sensation, while the fourth

one reaches the palate, providing the sense of taste. The fifth pair extends to the ears to enable hearing and reaches as far as the tendons at the level of the chest to facilitate movement. The sixth pair reaches both the entrails and the tendons of the throat. In both cases, these nerves facilitate movement. The seventh and last pair extends to the tendons of the mouth and throat to provide mobility. Spinal nerves (31 nerve pairs plus a single nerve) all reach structures below the neck and provide those structures with both sensation and spontaneous movement (Book I, Chapter X, p. 34-37).

General nervous diseases

The book lists several general nervous diseases. For instance, poor and slow pronunciation is cited as a sign of nerve and language dysfunction (Book I, Chapter XXIV, p. 20). 'Fissure' is the term used to describe the condition caused by separation of the nerves (Book VI, Chapter IV, p. 145). We also read that one of the causes of illnesses involving disfigured members is nerve rupture due to spasms, pressure, or relaxation (Book VI, Chapter VII, p. 149).

When Constantine lists advantages and disadvantages of a number of foods and drinks, he states that cold water is not beneficial to nerves (Book V, Chapter XXVIII, p. 132). Neither is any type of wine, since wine is injurious to both the nerves and the brain. He also quotes Hippocrates as stating that wine is harmful to the head (Book V, Chapter XXVIII, p. 135). Nevertheless, delicate white wines are beneficial to members formed by nerves (Book V, Chapter XXVIII, p. 134).

Spinal nerve diseases

According to Constantine, these diseases are numerous and depend on the degree to which the nerve is affected. Therefore, absence of mobility is caused by obstruction of a spinal nerve, since the ability to move cannot be transferred to a member lacking both mobility and sensation. If obstruction affects all nerves, the entire body loses both sensation and movement, which then causes an epileptic attack due to nerve spasm. A patient may lose his voice due to obstruction of the nerve that reaches the throat; depending on the affected nerve, patients may also lose bladder control or vomit involuntarily (Book IX, Chapter IX, p. 250-252). Spasm is due to shortening of an affected member. When the entire body is affected, this is called tetany. Any member will suffer spasms if the

nerve connected to the tendons in that member experiences spasms (Book IX, Chapter XI, p. 252-253).

The five senses

The *Liber Pantegni* lists five senses, which are sight, hearing, taste, smell, and touch. Each of these senses corresponds to one of the four elements (earth, air, fire, and water) or to a mixture of two elements. Sight is the most subtle sense because it corresponds to fire; in turn, hearing pertains to air, smell pertains to water and earth, taste pertains to water, and touch is the least subtle because it corresponds to earth alone. (Book IV, Chapter X, p. 92). One of the most beautiful passages in the text describes the affinities of the sensory organs. It states that the eyes delight in intermediate colours, such as green and blue, but shrink from pure black and pure white. The ears appreciate sweet, low, modulated, and rhythmic sounds, like heartbeats, but are averse to harsh sounds like thunder or shrill sounds like marble or bronze being cut. The nose takes pleasure in aromatic scents and is averse to strong odours. The tongue appreciates sweet tastes because they soften its roughness, but shrinks from bitter flavours that abrade it and burn holes in its surface. Also rejecting acidic and sour tastes, the tongue seeks richness, and while it is injured by bitterness and salt, it may be soothed by sweet flavours. Fingers delight in touching surfaces resembling skin, whether cool or warm, rough or smooth. They avoid contact with objects that are sharp, too hot, or too cold (Book IV, Chapter XVI, pp. 94-5).

Constantine then expounded on illnesses affecting the senses. He stated that afflictions of the ear may be due to the brain, which provides the ability to hear, or to the nerve, which conveys this ability to the ear. The nerve may fail due to poor or absent connection between its connecting structures (Book VI, Chapter XIII, p. 155).

When the sense of touch is completely lacking, the patient experiences absence of both sensation and voluntary movement, which often affects the feet and hands. At times, sensitivity in one particular member may merely decrease, and then we say that it is asleep. (Book VI, Chapter XVI, p. 156-7).

Headaches

We feel that one of the most interesting parts of the *Liber Pantegni* is the section on headaches.

Constantine indicated general causes of headaches, including extreme cold and excess of phlegm (Book IV, Chapter IV, p. 103). Also citing Hippocrates' *Aphorisms*, he indicates that following a dry summer with a north wind and a rainy autumn with a west wind, people will suffer from winter headaches. In cold winter weather, these headaches are due to the head filling with primarily wet humours which are retained in the brain, causing headache (Book V, chapter V, p. 104).

A number of foods can also cause headaches, including onions (Book V, chapter XVII, p. 124), milk (Book V, chapter XXVI, p. 130), warm honey with nuts (Book V, chapter XXVII, p. 131), and pure wine. However, delicate white wines mitigate the pain of a headache caused by abundant humours in the stomach (Book V, Chapter XXVIII, p. 134-5).

The *Liber Pantegni* dedicates a full chapter in Book IX to classifying types of headaches. With a few modifications, it repeats the major classifications which previous authors had already established.^{6,13,40-41}

The first type, *cephalea*, is defined as pain affecting the patient's entire head due to the effects of structural abnormalities, gases, or trauma. Consumption of numerous foods, including walnuts, sharp cheese, garlic, and onions may all cause this illness, along with other external causes such as the sun's heat. Pain may be relieved by applying a cold pack to the head, or cold flowers such as violets or roses near the nose. *Cephalea* may also be caused by a surfeit of wine, prolonged periods of wakefulness or sleep, dehydration, profuse bleeding, coitus, or shooting pains in another part of the body which reach the head (Book IX, Chapter III, p. 240-243).

The second type, *hemicrania*, is defined as pain which only affects half of the head. It is caused by harmful humours deposited in the meninges or by vapours rising from the stomach to the brain. This type of headache is characterised by pain in the eyes with occasional vision loss (Book IX, Chapter III, p. 243).

At this point, we should mention *galeata*, a term that substitutes *cephalea* as it is described in older classification systems.^{6,13,40-41} *Galeata* is a long-lasting, mildly intense, non-debilitating headache featuring exacerbations accompanied by photophobia and poor tolerance of movement. The patient will need to rest in a dark, quiet place, and pain may affect the eyes. Exacerbations may be triggered by noises, watching a fire, certain smells, or

drinking wine. This type of headache is difficult to treat and frequently affects epileptic subjects, especially when their diet is poor (Book IX, Chapter III, p. 243).

The last type of headache is associated with *phrenitis*, or fever with mental confusion and drowsiness. This may correspond to what we now call meningoencephalitis (Book IX, Chapter IV and p. 243-4). *Phrenitis* was described by the Byzantine author Alexander of Tralles.¹³

Apoplexy and epilepsy

Both apoplexy and epilepsy are described in the *Liber Pantegni*. Concurring with most texts of the time,^{42,43} they are considered to be similar diseases provoked by multiple factors. Causes may be vascular, resulting from a predominance of cold humours, or else ventricular or cellular due to obstruction of the ventricles (Book IX, Chapter VII, p. 246-249).

Obesity and excessive alcohol consumption favour cold humours and create susceptibility to apoplexy and epilepsy (Book V, Chapter XXVIII, p. 133). A mild winter (Book V, Chapter IV, p. 102) or too much cold air (Book V, Chapter IV, p. 103) may also cause these conditions.

Constantine described the initial symptoms of apoplexy as including acute headache, blurred vision, vertigo, and full-body tremors (Book IX, Chapter VII, p. 246-249). The patient later loses mobility, and if the apoplectic attack is strong, there is no cure (Book IX, Chapter VII, p. 246-249).

Constantine believed that epilepsy was less serious than apoplexy since patients do not lose sensitivity and mobility despite falling and suffering spasms. For this reason, epilepsy was sometimes called 'half apoplexy'. There are two types of epilepsy: one originates in the brain and the other is caused by nerve spasms. The first type of epilepsy is due to the ventricles becoming obstructed with thick, viscous phlegmatic or black bile humours; when these humours grow warm the patient falls to the ground. It is preceded by severe headache, blurred vision, and sensory alterations, especially those affecting hearing, taste, and touch. Epilepsy due to nerve spasm is considered more serious. However, its prognosis is similar to that of apoplexy. Constantine observed that both types of epilepsy tended to occur during childhood and that if the disease did not subside within the first 20 years, it would remain a lifelong condition (Book IX, Chapter VII, p. 246-249).

Conclusion

Constantine the African was an important author. Through his efforts, Greek, Hebrew, and Arabic texts reached Western medicine, renewing it and setting the stage for the birth of new universities such as Schola Medica Salernitana. His influence on medieval medical knowledge was considerable. Before Avicenna's *Canon* was translated in Spain, there were no other sources of Arab medical knowledge in Europe.⁴⁴

Apart from being one of his most well-known works, the *Liber Pantegni* contains a wealth of references to neurological diseases. Our review of this text reveals the theoretical knowledge, diagnostic methods, and treatment techniques employed by doctors from the Schola Medica Salernitana to treat medieval neurological patients.

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