



Science Works: Teacher Resource Book, Book 3, , , Geoff Watson, Pb Watson, Oxford University Press, 1997, 0195506952, 9780195506952, . "A junior science series designed to support the principles and goals of science education as outlined in the CSF 2000 and National Science Profile, and focuses on the relevance of science and technology to society." -- Back cover..

The Heinemann Science Scheme: Book 2, Book 2 Book 2, Ian Bradley, Mark Winterbottom, 2001, Science, 160 pages. The "Heinemann Science Scheme" offers an approach to the QCA's Scheme of Work. Teacher's resource packs provide support with lesson planning, with each chapter matching the

Australia , Victoria Parker, Jan 1, 2005, Juvenile Nonfiction, 32 pages. Describes the geography and culture of Australia, with particular emphasis on daily life for Australian children..

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The Road Less Traveled, 25th Anniversary Edition A New Psychology of Love, Traditional Values, and Spiritual Growth, M. Scott Peck, Oct 1, 2002, Psychology, 320 pages. Perhaps no book has had a more profound impact on intellectual and spiritual lives than "The Road Less Traveled." In his new Introduction, Dr. Peck recalls how this book

Aelius Galenus or Claudius Galenus (AD 129–c.200/c.216), better known as Galen of Pergamon (modern-day Bergama, Turkey), was a prominent Roman (of Greek ethnicity) physician, surgeon and philosopher.[1][2][3] Arguably the most accomplished of all medical researchers of antiquity, Galen contributed greatly to the understanding of numerous scientific disciplines, including anatomy,[4] physiology, pathology,[5] pharmacology,[6] and neurology, as well as philosophy[7] and logic.

The son of Aelius Nicon, a wealthy architect with scholarly interests, Galen received a comprehensive education that prepared him for a successful career as a physician and philosopher. He traveled extensively, exposing himself to a wide variety of medical theories and discoveries before settling in Rome, where he served prominent members of Roman society and eventually was given the position of personal physician to several emperors.

Galen's understanding of anatomy and medicine was principally influenced by the then-current theory of humorism, as advanced by many ancient Greek physicians such as Hippocrates. His theories dominated and influenced Western medical science for more than 1,300 years. His anatomical reports, based mainly on dissection of monkeys, especially the Barbary Macaque, and pigs, remained uncontested until 1543, when printed descriptions and illustrations of human dissections were published in the seminal work *De humani corporis fabrica* by Andreas Vesalius[8][9] where Galen's physiological theory was accommodated to these new observations.[10] Galen's theory of the physiology of the circulatory system endured until 1628, when William Harvey published his treatise entitled *De motu cordis*, in which he established that blood circulates, with the heart acting as a pump.[11][12] Medical students continued to study Galen's writings until well into the 19th century. Galen conducted many nerve ligation experiments that supported the theory, which is still accepted today, that the brain controls all the motions of the muscles by means of the cranial and peripheral nervous systems.[13]

Galen saw himself as both a physician and a philosopher, as he wrote in his treatise entitled *That the Best Physician is also a Philosopher*. [14][15][16] Galen was very interested in the debate between the rationalist and empiricist medical sects,[17] and his use of direct observation, dissection and vivisection represents a complex middle ground between the extremes of those two viewpoints.[18] Many of his works have been preserved and/or translated from the original Greek, although many were destroyed and some credited to him are believed to be spurious. Although there is some debate over the date of his death, he was no younger than seventy when he died.

Galen describes his early life in *On the affections of the mind*. He was born in September 129 AD; [3] his father, Aelius Nicon, was a wealthy patrician, an architect and builder, with eclectic interests including philosophy, mathematics, logic, astronomy, agriculture and literature. Galen describes his father as a "highly amiable, just, good and benevolent man". At that time Pergamon was a major cultural and intellectual centre, noted for its library (Eumenes II), second only to that in Alexandria,[5][20] and attracted both Stoic and Platonic philosophers, to whom Galen was exposed at age 14. His studies also took in each of the principal philosophical systems of the time, including Aristotelian and Epicurean. His father had planned a traditional career for Galen in philosophy or politics and took care to expose him to literary and philosophical influences. However, Galen states that in around 145 AD his father had a dream in which the god Asclepius (Aesculapius) appeared and commanded Nicon to send his son to study medicine. Again, no expense was spared, and following his earlier liberal education, at 16 he began studies at the prestigious local sanctuary or Asclepieum dedicated to Asclepius, god of medicine, as a ἰατρίτης (therapeutes, or attendant) for four years. There he came under the influence of men like Aeschrius of Pergamon, Stratoniceus and Satyrus. Asclepieia functioned as spas or sanatoria to which the sick would come to seek the ministrations of the priesthood. The temple at Pergamon was eagerly sought by Romans in search of a cure. It was also the haunt of notable people such as Claudius Charax the historian, Aelius Aristides the orator, Polemo the sophist, and Cuspius Rufinus the Consul.[3]

In 148, when he was 19, his father died, leaving him independently wealthy. He then followed the advice he found in Hippocrates' teaching[21] and travelled and studied widely including such destinations as Smyrna (now Izmir), Corinth, Crete, Cilicia (now ukurova), Cyprus, and finally the

great medical school of Alexandria, exposing himself to the various schools of thought in medicine. In 157, aged 28, he returned to Pergamon as physician to the gladiators of the High Priest of Asia, one of the most influential and wealthiest men in Asia. Galen claims that the High Priest chose him over other physicians after he eviscerated an ape and challenged other physicians to repair the damage. When they refused, Galen performed the surgery himself and in so doing won the favor of the High Priest of Asia. Over his four years there he learnt the importance of diet, fitness, hygiene and preventive measures, as well as living anatomy, and the treatment of fractures and severe trauma, referring to their wounds as "windows into the body". Only five deaths among the gladiators occurred while he held the post, compared to sixty in his predecessor's time, a result which is generally ascribed to the attention he paid to their wounds. At the same time he pursued studies in theoretical medicine and philosophy.[3][22][23][24]

Galen went to Rome in 162 AD and made his mark as a practicing physician. His impatience brought him into conflict with other doctors and he felt menaced by them. His demonstrations there antagonized the less able and original physicians in the city. They plotted against him and he feared he might be driven away or poisoned so he left the city.[25]

Rome then engaged in the foreign wars in 161 AD. Marcus Aurelius and his colleague Lucius Verus were in the north fighting the Marcomanni.[26] During the autumn of 169 AD when Roman troops were returning to Aquileia, the great plague broke out and the emperor summoned Galen back to Rome. He was ordered to accompany Marcus and Verus to Germany as the court physician. In the following spring Marcus was persuaded to release Galen after receiving a report that Asclepius was against the project.[27] He was left behind to act as physician to the imperial heir Commodus. It was here in court that Galen wrote extensively on medical subjects. Ironically, Lucius Verus died in 169, and Marcus Aurelius himself died in 180, both victims of the plague.

Galen was the physician to Commodus for much of the emperor's life and treated his common illnesses. According to Dio Cassius 72.14.3-4, in about 189 AD, under Commodus's reign, a pestilence occurred, the largest of which he had knowledge, in which 2,000 people died in Rome each day. It is most likely that this was the same plague that struck Rome during Marcus Aurelius's reign.[27]

The Antonine Plague was named after Marcus Aurelius's family name of Antoninus. It was also known as the Plague of Galen and holds an important place in medicinal history because of its association with Galen. Galen had first hand knowledge of the disease. He was in Rome when it struck in 166 AD, and was also present in the winter of 168-69 during an outbreak among troops stationed at Aquileia. He had experience with the epidemic, referring to it as very long lasting, and describes its symptoms and his treatment of it. Unfortunately, his references to the plague are scattered and brief. Galen was not trying to present a description of the disease so that it could be recognized in future generations; he was more interested in the treatment and physical effects of the disease. For example, in his writings about a young man afflicted with the plague, he concentrated on the treatment of internal and external ulcerations.[27] According to Niebuhr "this pestilence must have raged with incredible fury; it carried off innumerable victims. The ancient world never recovered from the blow inflicted upon it by the plague which visited it in the reign of M. Aurelius." The mortality rate of the plague was 7-10 percent; the outbreak in 165-6-168 would have caused approximately 3.5 to 5 million deaths. Otto Seeke believes that over half the population of the empire perished. J. F. Gilliam believes that the Antonine plague probably caused more deaths than any other epidemic during the empire before the mid-3rd century.[27] It is believed that the Antonine Plague was smallpox, because though his description is incomplete, Galen gave enough information to enable a firm identification of the disease.

Galen notes that the exanthema covered the victim's entire body and was usually black. The exanthem became rough and scabby where there was no ulceration. He states that those who were going to survive developed a black exanthem. According to Galen, it was black because of a remnant of blood putrefied in a fever blister that was pustular. His writings state that raised blisters were present in the Antonine plague, usually in the form of a blistery rash. Galen states that the skin rash was close to the one Thucydides described.[27] Galen describes symptoms of the alimentary

tract via a patient's diarrhea and stools. If the stool was very black, the patient died. He says that the amount of black stools varied. It depended on the severity of the intestinal lesions. He observes that in cases where the stool was not black, the black exanthema appeared.[27] Galen describes the symptoms of fever, vomiting, fetid breath, catarrh, cough and ulceration of the larynx and trachea.[27]

When Peripatetic philosopher Eudemus became ill with Quartan fever, Galen felt obliged to treat him "since he was my teacher and I happened to live nearby." [28] Galen wrote: "I return to the case of Eudemus. He was thoroughly attacked by the three attacks of quartan ague, and the doctors had given him up, as it was now mid-winter." [29] Some Roman physicians criticized Galen for his use of the prognosis in his treatment of Eudemus. This practice conflicted with the then-current standard of care, which relied upon divination and mysticism. Galen retaliated against his detractors by defending his own methods. Garcia-Ballester quotes Galen as saying: "In order to diagnose, one must observe and reason. This was the basis of his criticism of the doctors who proceeded alogos and askeptos." [30] However, Eudemus warned Galen that engaging in conflict with these physicians could lead to his assassination. "Eudemus said this, and more to the same effect; he added that if they were not able to harm me by unscrupulous conduct they would proceed to attempts at poisoning. Among other things he told me that, some ten years before, a young man had come to the city and had given, like me practical demonstrations of the resources of our art; this young man was put to death by poison, together with two servants who accompanied him." [31]

Garcia-Ballester says the following of Galen's use of prognosis: "In modern medicine, we are used to distinguishing between the diagnostic judgment (the scientific knowledge of what a patient has) and the prognostic judgment (the conjecture about what will happen to him.) Galen, like the Hippocratics, was not. For him, to understand a clinical case technically, "to diagnose", was among other things, to know with greater or lesser certainty the outcome for the patient, "to prognosticate". Prognosis, then, is one of the essential problems and most important objectives of Galenic diagnosis. Galen was concerned to distinguish it from divination or prophecy, both to improve diagnosis technically and to enhance the physician's reputation." [32]

The 11th-century Suda lexicon states that Galen died at the age of 70, which would place his death in about the year 199. However, there is a reference in Galen's treatise "On Theriac to Piso" (which may, however, be spurious) to events of 204. There are also statements in Arabic sources that he died at age 87, after 17 years studying medicine and 70 practicing it, which would mean he died about A.D. 217. Nutton [33] believes that "On Theriac to Piso" is genuine, the Arabic sources are correct and that the Suda has erroneously interpreted the 70 years of Galen's career in the Arabic tradition as referring to his whole lifespan. Boudon-Millot [34] more or less concurs and favours a date of 216.

Galen contributed a substantial amount to the Hippocratic understanding of pathology. Under Hippocrates' bodily humors theory, differences in human moods come as a consequence of imbalances in one of the four bodily fluids: blood, yellow bile, black bile, and phlegm. Galen promoted this theory and the typology of human temperaments. An imbalance of each humor corresponded with a particular human temperament (blood "sanguine, black bile "melancholic, yellow bile "choleric, and phlegm "phlegmatic). Individuals with sanguine temperaments are extroverted and social. Choleric people have energy, passion and charisma. Melancholics are creative, kind and considerate. Phlegmatic temperaments are characterized by dependability, kindness, and affection. [35]

Galen's principal interest was in human anatomy, but Roman law had prohibited the dissection of human cadavers since about 150 BC. [36] Because of this restriction, Galen performed anatomical dissections on living (vivisection) and dead animals, mostly focusing on pigs and primates. [5] This work was useful because the anatomical structures of these animals usually closely mirror those of humans. Galen clarified the anatomy of the trachea, and was the first to demonstrate that the larynx generates the voice. [37][38] In one experiment Galen used bellows to inflate the lungs of a dead animal. [39][40]

Among Galen's major contributions to medicine was his work on the circulatory system. He was the first to recognize that there were distinct differences between venous (dark) and arterial (bright) blood. Although his anatomical experiments on animal models led him to a more complete understanding of the circulatory system, nervous system, respiratory system and other structures, his work contained scientific errors.[7] Galen believed that the circulatory system consisted of two separate one-way systems of distribution, rather than a single unified system of circulation. He believed that venous blood was generated in the liver, from where it was distributed and consumed by all organs of the body. He posited that arterial blood originated in the heart, from where it was distributed and consumed by all organs of the body. The blood was then regenerated in either the liver or the heart, completing the cycle.[35] Galen also believed in the existence of a group of blood vessels he called the rete mirabile, in the carotid sinus.[35] Both of these theories of the circulation of blood were later shown to be incorrect by Ibn al-Nafis.[12]

Galen was a skilled surgeon, operating on human patients. Many of his procedures and techniques would not be used again for centuries, such as the procedures he performed on brains and eyes.[7] To correct cataracts in patients, Galen performed an operation similar to a modern one. Using a needle-shaped instrument, Galen attempted to remove the cataract-affected lens of the eye.[41] His surgical experiments included ligating the arteries of living animals.[42]

At first reluctantly, but then with increasing vigour, Galen promoted Hippocratic teaching, including venesection and bloodletting, then unknown in Rome. This was sharply criticised by the Erasistrateans, who predicted dire outcomes, believing that it was not blood but pneuma that flowed in the veins. Galen, however, staunchly defended venesection in his three books on the subject,[43] and in his demonstrations and public disputations.

Although the main focus of his work was on medicine, anatomy, and physiology, Galen also wrote about logic and philosophy. His writings were influenced by earlier Greek and Roman thinkers, including Plato, Aristotle, and the Stoics. Galen was concerned to combine philosophical thought with medical practice, as in his brief work *That the Best Physician is also a Philosopher*. He took aspects from each group and combined them with his original thought. He regarded medicine as an interdisciplinary field that was best practiced by utilizing theory, observation, and experimentation in conjunction.

Several schools of thought existed within the medical field during Galen's lifetime, the main two being the Empiricists and Rationalists (also called Dogmatists or Philosophers), with the Methodists being a smaller group. The Empiricists emphasized the importance of physical practice and experimentation, or "active learning" in the medical discipline. In direct opposition to the Empiricists were the Rationalists, who valued the study of established teachings in order to create new theories in the name of medical advancements. The Methodists formed somewhat of a middle ground, as they were not as experimental as the Empiricists, nor as theoretical as the Rationalists. The Methodists mainly utilized pure observation, showing greater interest in studying the natural course of ailments than making efforts to find remedies. Galen's education had exposed him to the four major schools of thought (Platonists, Peripatetics, Stoics, Epicureans), with teachers from the Rationalist sect and from the Empiricist sect.

As a Vitalist, Galen believed that the world was living and in a constant state of evolution. He used the pneuma, which in his time was considered to be a breath drawn in and distributed throughout the body. Instead, he reframed the definition and studied the pneuma according to three "vital principles of life". There were three kinds of pneuma. There was the natural pneuma, which controlled day-to-day functions; the survival instincts of any living thing, and both plants and animals had it. There was the vital pneuma, which had to do with the functions of the body and pertained to the arterial system. These were the functions of internal regulation such as body temperature and digestion, both animals and humans had this pneuma. Lastly, there was the psychic pneuma, which was found in the brain, and was capable of higher cognitive functioning. This would have only been found in humans, a higher functioning creature. This, in turn, was quite similar to Plato and Aristotle's models of the tripartite soul.

Galen may have produced more work than any author in antiquity, rivaling the quantity of work issued from Augustine of Hippo.[44] So profuse was Galen's output that the surviving texts represent nearly half of all the extant literature from ancient Greece.[22][44] It has been reported that Galen employed twenty scribes to write down his words.[citation needed] Galen may have written as many as 600 treatises, amounting to some 10 million words.[citation needed] Although his surviving works amount to some 3 million words, this is thought to represent less than a third of his complete writings. In AD 191, a fire in the Temple of Peace destroyed many of his works, particularly treatises on philosophy.[citation needed]

Because Galen's works were not translated into Latin in the ancient period, and because of the collapse of the Roman Empire in the West, the study of Galen, along with the Greek medical tradition as a whole, went into decline in Western Europe during the Early Middle Ages, when very few Latin scholars could read Greek. However, Galen and the ancient Greek medical tradition generally continued to be studied and followed in the Eastern Roman Empire, commonly known as the Byzantine Empire. All of the extant Greek manuscripts of Galen were copied by Byzantine scholars. In the Abbasid period (after 750 AD) Arab Muslims began to be interested in Greek scientific and medical texts for the first time, and had some of Galen's texts translated into Arabic, often by Syrian Christian scholars (see below). As a result some texts of Galen exist only in Arabic translation,[45] while others exist only in medieval Latin translations of the Arabic. In some cases scholars have even attempted to translate from the Latin or Arabic back into Greek where the original is lost.[44][46][47] For some of the ancient sources, such as Herophilus, Galen's account of their work is all that survives.

Even in his own time, forgeries and unscrupulous editions of his work were a problem, prompting him to write *On his Own Books*. Forgeries in Latin, Arabic or Greek continued until the Renaissance. Some of Galen's treatises have appeared under many different titles over the years. Sources are often in obscure and difficult to access journals or repositories. Although written in Greek, by convention the works are referred to by Latin titles, and often by merely abbreviations of those. No single authoritative collection of his work exists, and controversy remains as to the authenticity of a number of works attributed to Galen. Consequently research on Galen's work is fraught with hazard.[20][44]

In his time, Galen's reputation as both physician and philosopher was legendary,[49] the Emperor Marcus Aurelius describing him as "Primum sane medicorum esse, philosophorum autem solum" (first among doctors and unique among philosophers *Praen* 14: 660). Other contemporary authors in the Greek world confirm this including Theodotus the Shoemaker, Athenaeus and Alexander of Aphrodisias. The 7th-century poet George of Pisida went so far as to refer to Christ as a second and neglected Galen.[50] Galen continued to exert an important influence over the theory and practice of medicine until the mid-17th century in the Byzantine and Arabic worlds and Europe. Hippocrates and Galen form important landmarks of 600 years of Greek medicine. A. J. Brock describes them as representing the foundation and apex respectively.[5] A few centuries after Galen, Palladius *latrosophista* stated, in his commentary on Hippocrates, that Hippocrates sowed and Galen reaped.

Thus Galen summarised and synthesised the work of his predecessors, and it is in Galen's words (Galenism) that Greek medicine was handed down to subsequent generations, such that Galenism became the means by which Greek medicine was known to the world. Frequently this was in the form of restating and reinterpreting, such as in Magnus of Nisibis' 4th-century work on urine, which was in turn translated into Arabic.[51] Yet the full importance of his contributions was not appreciated till long after his death.[5] Galen's rhetoric and prolificity were so powerful as to convey the impression that there was little left to learn. The term Galenism has subsequently taken on both a positive and pejorative meaning as one that transformed medicine in late antiquity yet so dominated subsequent thinking as to stifle further progress.[51]

After the collapse of the Western Empire the study of Galen and other Greek works almost disappeared in the Latin West. In contrast, in the predominantly Greek-speaking eastern half of the Roman empire (Byzantium), many commentators of the subsequent centuries, such as Oribasius, physician to the emperor Julian who compiled a *Synopsis* in the 4th century, preserved and

disseminated Galen's works, making Galenism more accessible. Nutton refers to these authors as the "medical refrigerators of antiquity".[5][51] In late antiquity medical writing veered increasingly in the direction of the theoretical at the expense of the practical, with many authors merely debating Galenism. Magnus of Nisibis was a pure theorist, as were John of Alexandria and Agnellus of Ravenna with their lectures on Galen's De Sectis.[52] So strong was Galenism that other authors such as Hippocrates began to be seen through a Galenic lens, while his opponents became marginalised and other medical sects such as Asclepiadism slowly disappeared.[51] Greek medicine was part of Greek culture, and Syrian Eastern Christians came in contact with it while the Eastern Roman Empire (Byzantium) ruled Syria and Western Mesopotamia, regions that were conquered from Byzantium in the 7th century by Arab Muslims. After 750 AD, Muslims had these Syrian Christians make the first translations of Galen into Arabic. From then on Galen and the Greek medical tradition in general became assimilated into the medieval and early modern Islamic Middle East.[5]

The first major translator of Galen into Arabic was the Syrian Christian Hunayn ibn Ishaq. Hunayn translated (c. 830–870) 129 works of "Jalinos"[53] into Arabic. One of the Arabic translations, "Kitab ila Aglooqan fi Shifa al Amraz"™, which is extant in the Library of Ibn Sina Academy of Medieval Medicine & Sciences, is regarded as a masterpiece of Galen's literary works. A part of the Alexandrian compendium of Galen's work, this 10th-century manuscript comprises two parts that include details regarding various types of fevers (Humyat) and different inflammatory conditions of the body. More importantly, it includes details of more than 150 single and compound formulations of both herbal and animal origin. The book provides an insight into understanding the traditions and methods of treatment in the Greek (Unani) and Roman eras. In addition, this book provides a direct source for the study of more than 150 single and compound drugs used during the Greco-Roman period.

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