



## Review Article

# The Egyptian theory of *wxdw* and the ancient greek medicineX'

Ana María Rosso\*

Department of Ancient History, University of Buenos Aires, Buenos Aires, Argentina.

\*Corresponding Author's Email: [rossoanamaria@gmail.com](mailto:rossoanamaria@gmail.com)

Received date: November 05, 2021; Accepted date: November 19, 2021; Published date: November 26, 2021

## ABSTRACT

Ancient Egyptian medical knowledge influenced on later civilizations, including different spheres of pre-Hippocratic medicine. Both employed the same scientific and rational systems for the patient's diagnosis, treatment and therapeutic procedures based on accurate observation. Egyptians transferred the knowledge and use of same drugs and remedies, a similar conception about the causes of sickness, Greek literary works repeated Egyptian sources about pregnancy tests or dream interpretations. In addition, the Hippocratic tradition adopted the incubation practices of the Egyptian temples.

But the most outstanding transfer was the etiological theory of gastrointestinal toxins or *wxdw* ('ukhedu'), relating to unhealthy food that marked the kick-off of the evolution of the Greek thought inside medical schools. This bright Egyptian hypothesis on the role of putrefaction, arrived to develop, step by step, through various trials in Greek medicine, as the well-known Hippocratic humoral doctrine of the Cos school.

**Keywords:** Egyptian theory, gastrointestinal toxins, putrefaction, hippocratic humoral doctrine.

## INTRODUCTION

The use of reason to explain natural phenomena has been called the 'Greek miracle', but this is a partial vision of the real facts in the roots of Western civilization. It was currently considered that Greeks were the first to formulate many of the western world's fundamental concepts in artistic styles, religious doctrines, philosophic systems, education, literature, science, politics and medicine. However it is unquestionable that Ancient Greeks were strongly influenced, from the beginning, by Egyptian, Assyro-Babylonian, Mesopotamian, Phoenician, Hittite and Minoan improvements. Nevertheless Ancient Egypt offered the highest cultural peak for those times and medical therapy was so advanced that many of their observations, policies, and commonplace procedures would not be surpassed in the west for centuries after the fall of Rome and their practice would inform both Greek and Roman medicine (Lawrence, 1964). The considerable chronological gap is not in itself a major obstacle to a comparison, since the Egyptian medicine as reflected in the surviving papyri extends over a long period from the 1800 BC until the ptolemaic age, a post Hippocratic era (Mark, 2017). All Egyptian physicians had to well know their art (David, 1999) and exemplary

punishments were imposed to safeguard professional competence against the risks of any violation of codified therapy or prescriptions. This obligation of Egyptian doctors to conform to the law had been mentioned by Aristotle (4th century BC) in his Politics: "In Egypt, doctors have the right to alter their prescription only after four days; and if one of them alters it earlier, he does so at his own risk" (Rackham et al., 1932). The impact of its prestige, authority and the elaboration of very important new ideas expanded towards other countries and affected almost every aspect of the Greek life, especially in medicine.

Ancient Egyptians, whom even Homer (Homer et al., 1946) recognized as the greatest healers in the world, were skilled in medicine more than any other art. This superiority is immediately justified in the Homeric passage by the genealogy of Egyptian doctors who descend from Paeon, being the doctor of the gods. Thus, their superior knowledge comes from their divine origin (Jouanna et al., 2012). Their prestige is more obvious in the classical period in Herodotus who declares: "It is all full of doctors" (Herodotus et al., 1972) and he reveals a peculiarity of Egyptian medicine: the specialisation of doctors. Their science evolved through the years even if Greeks, due to their divine legacy, honoured many of the early Egyptian priest-physicians, although all

these healers practiced a combination of what one today would consider practical medicine and magic. Since disease came from supernatural sources, for them it was reasonable to conclude that supernatural treatment was the best resource. Egyptian therapists, highly respected, were definitely very advanced in their knowledge of herbal medicines, surgical procedures in repairing damages of physical injuries employing new methods and techniques, and they transferred theoretical concepts and paradigms beyond their borders. Various treatments and pharmacological procedures were developed and recorded in the ancient Egyptian medical papyri and many of them have survived (Sallam, 2010). For example, the Ebers papyrus (Joachim, 1980), the largest (110 pages and 20 meters long) and one of the oldest preserved medical document dating from 1552 BC, describes many diseases concerning the heart and vessels. It also contains chapters on contraception, diagnosis of pregnancy and other gynecological matters, intestinal disease and parasites, eye and skin problems, dentistry and the surgical treatment of abscesses and tumors, bone-setting and burns. Mental disorders such as depression and dementia are also covered. However, for most of these illnesses, in addition to prescriptions, the papyrus describes some 700 magical formulas and remedies and contains many incantations meant to turn away disease-causing demons.

#### **IDENTITIES, IMPACT AND APPROACHES BETWEEN EGYPTIAN AND GREEK MEDICINE**

Hippocrates, considered the father of rational medical science, is connected with the first creative period of scientific medicine, while in Ancient times, medical practice and religion were closely associated, prevailing superstitions and beliefs in magical religion. But scholars largely ignore that Ancient Egyptian medicine developed technical knowledge, scientific and modern methods in their therapy and description of cases, according to Edwin Smith, Papyrus (Breasted, 1930), written ca. 1600 BC (possibly a fragmentary copy of an earlier text from 2500 BC). To assess the patient conditions, establish a correct and definitive diagnosis and an early treatment, a complete and careful clinical examination should be carried out following the training validation method: control of pulse pressure, palpation of affected zone, accurate description of different symptoms and local clinical signs related, establishing patients' syndrome levels and focusing on the history of damages. Such as a contemporary physician who applies the empirical scientific method (Lloyd, 1979), the diagnostic appreciations in Egypt were based on the observation through the senses of the clinical phenomena and on the emergence of secondary complications. After evaluating prognosis and related factors in the disease clinical course, a correct, specific and reasonable therapy could be applied, and Hippocratic physicians later followed step by step of this systematic and rigorous rational technique. For Jacques Jouanna, the similarities found in the technique of detailing

diseases between Egyptian medicine and the Hippocratic nosologic treatises derived from the Cnidian Sentences (Jouanna, 1974). Nevertheless, magico-religious practices undoubtedly continued throughout the millennia; and, in the absence of an effective rational remedy, Egyptians could also resort to magic and incantations (David, 2008). They established too an implicit theory of disease as a process and the therapy central aim was managing very important pathological interrelations while in ancient Greek medicine illness was initially regarded as a divine punishment.

On the other hand, the Hippocratic gynecological writings (On the Diseases of Women, On the Nature of the women, On Sterile Women and Aphorisms=Aph.) (Littre et al., 1846-1851) exhibit often literally references of Egyptian Papyri related to women's complaints (Wreszinski, 1909; Griffith, 1893; Stevens, 1975; Iversen, 1939), including a pregnancy test measuring urine hormonal effects on germination (Garnot, 1940) (I, 6-x+3). Breast tenderness and dilated veins show in both medicines the early stages of pregnancy. "Thus, we have here one of the tangible examples of a direct influence of Egyptian medicine on Greek medical literature, in a period as ancient as Hippocrates" (Iversen, 1939).

Hippocratic book, On dreams, also follows the Egyptian dream interpretations (Gardiner, 1935) is, in fact, the first known 'dream dictionary' created by Egyptians (Rosso, 2004), to explain their meanings and to reveal ancient predictions catalogued as good or bad omens. In addition, Hippocratic medicine also adopted the incubation practices of Egyptian sleep-healing temples, a therapeutic medical method of hypnotic suggestion used at least from the reigns of Amenhotep II and Tutmosis IV onwards. Patients spent the night in a sleeping room and, while dreaming, gods suggested the better treatment for the disease or foretold his future (Philips, 1986). For P. Lang, there are important differences between a Greek abaton and an Egyptian sanctuary (Holmes, 2013) but, leaving aside the consequent evolution, the method would be the same.

Even the use of drugs and treatments astonished similar and resulted in the export of many substances from Egypt to Greece (Von Staden et al., 1989). The pharmacopeia of Hippocratic medicine expressly mentions products from Egypt, testimony at least to commercial exchanges, if not to an influence of one medicine on the other. This scientific information spread over a broad area, arriving to Rome, impacting Celsus, Pliny the Elder and Galen's writings and improving Theophrastus (Amigues, 2006) and Dioscorides' books (Marganne, 1992; Marganne, 1998). In addition, the studies focused on the widely use of the Egyptian perfumes, cosmetics, skincare, beauty products and venoms were added to a growing literature on the subject, such as the texts of Apollodorus of Alexandria, Nicander of Colophon (Jacques, 2002) (2nd century BC) and Andreas of Carystus (late 3rd century BC), as well as in those of the Roman context, Sixtus Niger, and Scribonius Largus, among others.

A variety of cultural attitudes are shared between both of these civilizations as the typical supernatural causes of internal illness, product of a divine punishment for transgressions, a demonic possession or a dead vengeance. However, in Greece, an alternative approach attributed these disorders to some moral faults or hereditary stigma, transmitted to subsequent generations, being a potential source of contamination (miasmas). On the other hand, given the belief in supernatural causes of insanity and mental problems as external demonic forces, they had their roots in a moral fault. Preventive measures for mysterious illnesses included as the most suitable treatment prayers, appropriate spells and various kinds of magic, in both Egypt and Greece, and also there complicated purification rituals as the Hippocratic source, on the sacred disease proves, despite the intent to reject superstition.

Unfortunately, the intuitions of the closed intellectual circle and first correct fruits, such as the Croton school, were soon forgotten. In consequence, the Alcmaeon's pioneering investigations, placing intelligence and sensations in the brain, were rejected by Aristotle in the 4th century BC. Coming back to the Ancient Egyptian theories, he saw the heart as the seat of mind, thinking, motion, feelings and will. It was, indeed, the source of all the nerves, and, like his predecessors, he occasionally mixed nerves, tendons and ligaments together, without connecting the vessels with the brain, and also the center of vital activities, the sensorium commune. His knowledge of the nervous system, however, was extremely vague and incorrect (Moir, 1831). He concluded that the brain is a combination of earth and water and that it is not essential for animal physiology. In his treatise, *On the Parts of Animals* (Peck et al., 1937), he hypothesized that the brain is cold and almost unsupplied by blood and that it has no relationship with the sensory organs because when touched, it does not evoke any feelings. According to Aristotle, the brain is a place where blood, warmed in the heart, is cooled. He assumed that part of the head is empty, although he probably mentioned only the ventricles. Later, Galen was highly critical of the Aristotle's research and practical activities. He proved that his numerous mistakes were largely due, among other factors, to the inability to observe the human structure through dissections, as well as by his careless animal dismemberments. He nevertheless acknowledged him as an outstanding biologist and zoologist (Souques, 1935).

In addition, mummification was practiced throughout most of the early Egyptian history (Rosso, 2004), a process that required some knowledge of the internal viscera, while in Greece the dead bodies were buried or specially cremated since 1000 BC; Greek taboo forbade them to touch corpses associated with the extremely putrid body odours and also to avoid contamination from foul smelling waste (Moulinier, 1952). Their religious ethic basis prevented them to study human anatomy and it was only allowed to dissect animals. Inevitable errors in human medical descriptions were thus made. Both medical traditions were established later, in the

3rd century BC, at the Mouseion of Alexandria and scientific anatomy was eventually developed in the Egyptian soil. The Herophilus' and Erasistratus' revolutionary discoveries, the most famous physicians of the old Alexandria Medical School together with Soranus of Ephesus (Acar et al., 2005), who practised dissections and vivisections over the criminals' bodies, allowed them to understand the differences between nerves, veins, arteries, muscles and vessels. Herophilus, through his anatomical studies on the nervous systems, proved that the brain and not the heart was the seat of intelligence (El-Abbadi, 1990). These great physicians brought with them the medical knowledge of the Greek world and supplemented it with many ancient Egyptian medical practices (Ghalioungui, 1973; Marganne et al., 1997), but the real contribution of the old Alexandria school of medicine was to re-evaluate (critically appraise) the old medical knowledge, keeping only what conformed to the ideas of Aristotle and common sense and purify it from non-logical theories and executions (Saunders, 1963; Kudlien, 1964; Longrigg, 1992). The advanced in medicine and understanding of human anatomy of the medical masters as well as the movements of the tendons, attracted frequently Greek artists to Alexandria. In order to improve their artworks and adequately portray human expression of emotions, they adopted these principles in their representations that seemed to be more realistic and natural and at the same time more dramatic and pathetic (Rosso, 2005). Alexandria, a place of inspiration, soon became world-renowned as a great centre of medical studies.

On the other hand, Rufus of Ephesus, a Greek doctor from the 1st century (thus pre-dating Galen), notes in his work *On the Names of the Parts of the Human Body*, that sutures in the skull did not have ancient names in Greek, but they were named by Egyptian-speaking doctors who wrote in Greek: coronal (στεφανιαία), the suture of the bregma; lambdoid (λαμβδοειδής), that of the occipital bone; the sagittal (ἐπιζευγνύουσα), down the middle of the skull; finally, the scale-like (λεπιδοειδής), sutures of the temporal bone and also certain parts of the skull bones. Their precise knowledge of cranial anatomy led them to create Greek technical words, a clear example of an original contribution of Egyptian-speaking doctors to Greek rational medicine. Whilst speaking Greek badly, they contributed to the enrichment of Greek medical technical vocabulary.

Regarding to ethics in medicine, the tomb of Nenk-Sekhmet, chief of Physicians during the 5th Dynasty, shows that the Ancient Egyptian doctors adopted an ethical code, centuries before the Hippocratic oath with one such inscription that stating 'Never did I do evil towards any person', but really it could be demonstrating personal and professional integrity. About Greek humoral and pneumatic physiology, it seems to be a simple re-elaboration of the Egyptians' precedent theories, with some analogies, as we will demonstrate later.

The strong Egyptian influence on Greek culture was possible, thanks to the trade relations between Egypt and Greece and the increasing Ionian colonization of the Egyptian Delta with the arrival of Greek mercenaries (Rosso, 2016). At this time Ionian philosophy was founded and medical sciences emerged. Egyptian teachings provided Greek science foundations, even in mathematics, and Thales de Miletus, the first Greek mathematician, and Pythagoras of Samos travelled to Egypt and Babylon where they studied astronomy and geometry. The Saite Dynasty played a central role in the renovation of cultural and artistic ideas and probably in this period ancient papyri were copied again and medical treatises were reviewed. A direct influence of Egyptian art was also shown on Archaic Greece, especially in sculpture, including the reformed Saite canon of art, which divided the human figure by twenty-one horizontal grids. Early Archaic Greek sculptors are thought by the Greeks to have been influenced by Egyptian artistic style. Diodorus also relates the story of Theodorus and Telekles, the sons of Rhoikos and 'most renowned of the ancient sculptors', who are said to have spent time in Egypt. This evidence for an Egyptian influence establishes a significant precedent for further cultural and artistic transmission between Egypt and Greece of the early Archaic Period that did not end solely with sculpture, because medical works of the Hippocratic collection were written in Ionic dialect-although Cos and Cnidus were Dorian settlements. It became a literary language in all areas, not only for expounding a system of philosophy, medicine and science in general, but also, initially, for the world history (Longrigg, 1989), even in Dorian places. Thales, the father of Greek philosophy and the first individual in western civilization known to have entertained and engaged in scientific philosophy, wrote a book of medicine and other philosophers were similarly versatile, as Diogenes, Philolaus and Democritus (Macfie, 1907). At that time, cultural exchanges were intensified as well as medical development. The most important influence was the theory of digestion and gastrointestinal residues or *wxdw*, a treatise found in the Papyrus Ebers (§ 856a col. CIII, 1-2) and Berlin Medical Papyrus 3038 (dated to the following 19th Dynasty) that contain a 'Book for Driving out Corruption (*wxdw*) from All the Limbs of a Man' (§163a col. XV, 1-5), said to have been "found under the two feet of Anubis in Letopolis and brought to the Majesty of the King of Upper and Lower Egypt Den" (Deines et al., 1958) of the 1st Dynasty, some 1500 years earlier, though a proper understanding actually requires complementary sources.

#### **The Egyptian theory of *wxdw* and the practice of mummification**

This etiological theory shows the focus of health internal problems and the link between pathological disorders and clinical manifestations, an approach to the process of indigestible food and digestive tract disturbances (Ritner, 2000). The medical term *wxdw* was first translated by scientists and historians in a pathological perspective as leprosy, smallpox, syphilis or even a purulent disease. Later,

it was evaluated in a scientific approach related to internal diseases, as an etiological agent or symptom, responsible for the disturbances, pain or inflammation (Yoyotte, 1968) that required a rational therapy. In 1959, Steuer and Saunders analysed the evolution of these noxious agents in certain Greek theories, establishing a discussion that had a wide acceptance with a few exceptions, for example, Bardinet's adverse commentary by lack of support (Bardinet, 1995). P. Lang, in turn, recognizing that digestion and expulsion of food was a significant feature of Egyptian pathology, considers that the term *wxdw* refers to a harmful transformation of excrements and it is not correctly used to mean faeces, called in Egyptian *Hs* (Lang). In reality, Egyptians believed that all diseases were caused by the stool putrefaction and the toxins established in the intestinal tract, the direct responsible for poisonous products relating to unhealthy food, produced a bowel autointoxication, eliminated by frequent colon cleansing.

Following these Egyptian theoretical definitions and their intrinsic motivation, not until 1880's an appreciation of the toxins produced by the microbes in the gut was developed, leading Charles Bouchard to propose his autointoxication theory in 1884. During the early 20th century the colon was viewed as the central road to a limitless array of illnesses. The terms autointoxication, intestinal stasis and intestinal toxemia were often used interchangeably to describe a process whereby intestinally-derived toxins could influence systemic health. Thus, medical concepts about disease entities, their etiology and pathophysiology underwent historical changes (Baron et al., 2002). According to Steuer and Saunders, this Egyptian idea of an intestinal toxemia was then transmitted directly to the earliest Greek physicians, such as Euryphron, Herodicus of Cnidus and Alcamenes of Abydos, as we see in the Papyrus Anonymus Londinensis, thanks to their close contacts with the Saite Dynasty.

Egyptians realized that intestine (*KAb*), as reservoir of digestive waste, was the starting point of corpse decomposition and putrefaction, both giving up a foul odour. After the burial pits the corpse was placed in properly furnished tombs and decay was hastened because the body no longer came in contact with the hot sand. To solve the problem, they created mummification and embalming (the latter, called *sdwx*, treat, embalm, word used also to refer to treatment in general) (Steuer et al., 1959), an art and science to preserve human remains.

Egyptians were convinced that regeneration is the meaning of life. Existence was transformed in a continuous improvement and a dynamic renovation while an eternal life emerged from death and rejuvenate. "You sleep in order to wake you up; you died in order to live" (Faulkner, 1969). The challenge of living existence was characterized by crisis and uncertainty stages and they discard the great danger of extinction through body preservation and mummification and all its essential rituals. Death (*m(w)t*), synonym of

decomposition or disappearance, reached also to gods, animals and insects (Faulkner et al., 1990) but in a constant renewal their existence was far from the unchanging infinity of Apopis, snake of chaos (Hornung, 1997). They believed in the resurrection of the body and life everlasting. But reborn will not consist of the return to everyday life but awake from their sleep in the afterlife of the world of dreams and visions (Szpakowska, 2003).

“Most internal organs are devoid of microbes when we are alive” (Costandi, 2015). But far from being dead, however, a rotting corpse is teeming with life. It is the cornerstone of a vast and complex ecosystem which emerges, flourishes and evolves as decomposition advances.

The human microbiome comprises bacteria, archaea, viruses and eukaryotes which reside within and outside our bodies, all living members that comprise in the microbiota. The human Gastrointestinal (GI) tract harbours a complex and dynamic population of microorganisms-bacteria, viruses, fungi and other life forms, the gut microbiota, by far the largest of the communities living inside every person, which exert a marked influence on the host during homeostasis and disease. Intestinal bacteria play a crucial role in maintaining immune and metabolic homeostasis and protecting against pathogens. Forensic scientist Gulnaz Javan and colleagues of Alabama State University of Montgomery published in 2016, the very first study of what they have called the ‘thanatomicrobiome’ (from the Greek Thanatos=death), describing human postmortem microbial communities (Javan et al., 2016).

The field of microbiome research, originated in microbiology, has evolved rapidly over the past few decades and has become a topic of great scientific and public interest, considering the latest technological developments and findings. Discovery of DNA, the development of sequencing technologies, PCR, and cloning techniques enabled the investigation of microbial communities using cultivation-independent, DNA and RNA-based approaches. There is also no clear consensus as to whether extracellular DNA derived from dead cells (so-called ‘relic DNA’) belongs to the microbiome. However all mobile genetic elements, such as phages, viruses, and ‘relic’ and extracellular DNA, should be included in this term. Therefore, all these investigations show the importance of the Egyptian proposal and demonstrate that gut bacteria play essential role in human health and diseases, as Egyptians had thought two thousand years ago.

Microbe communities change rapidly after death, in part because the immune system has shut down and is not regulating their spread. Microbes in the gut, which were helping the body digest food, now digest the body. Fluids rich in nutrients are released from body orifices. From the forensic point of view, microorganisms are important for their role in the activity of cadaveric decomposition (Adserias-Garriga et al., 2017) that begins several minutes after death with a process called autolysis or self-digestion.

This usually begins in the gut, at the junction between the small and large intestine. Eventually, though, all other tissues begin to break down in this way. Damage blood cells spill out of broken vessels and, aided by gravity, settled in the capillaries and small veins discolouring the skin. Body temperature also begins to drop, until it has acclimatised to its surrounding. Then rigor mortis-the stiffness of death-sets in, starting in the eyelid, jaw and neck muscles, before working its way into the trunk and then the limbs. In life, muscle cells contract and relax due to the actions of two filamentous proteins, called actin and myosin, but after dead the cells are depleted of their energy source, and the protein filaments became locked in place. This causes the muscles to become rigid, and lock the joints.

The disruption of the immune system and the deterioration of the physical barriers that occur after death allow microbes to proliferate throughout the body (Gunn et al., 2012), because there is an increase in carbon and nutrients, which facilitates its proliferation. The swelling phase, a consequence of oxygen depletion, produce the accumulation of gases such as carbon dioxide, methane or sulfuric acid, and the predominant aerobic organisms in the fresh state are replaced by anaerobic organisms. The advanced decomposition stage is characterized by the presence of microorganisms that may enter during the agonal period, for example, and subsequently be useful for diagnosis of the cause of death (Uchiyama et al., 2012). Different bacterial communities are observable in fresh, bloated, active and progressive decay, and also in the dry remains (Payne, 1965). Degree of decomposition varies not only from individual to individual but also differs in various body organs. Spleen, intestine, and the surrounding tissues, stomach, liver, enriched in enzymes and pregnant uterus are earlier to decay, digested by the gut bacteria, but on the other hand kidney, heart and brain, which has high water content, and bones are later in the process.

When a decomposing body starts to purge, it becomes fully exposed to its surroundings. At this stage, the cadaveric ecosystem really comes into its own: a ‘hub’ for microbes, insects and scavengers. Two species prevail, blowflies and flesh flies (and their larvae), attracted by a foul, sickly-sweet odour, that detect using specialised receptors on their antennae, then land on the cadaver and lay their eggs in orifices and open wounds. Each fly deposits around 250 eggs that hatch within 24 hours, giving rise to small first-stage maggots. These feed on the rotting flesh and then moult into larger maggots, which feed for several hours before moulting again. Their presence attracts predators that are far more diverse than had previously been imagined.

These stages take place simultaneously depending largely of temperature. With dry heat a corpse tends to mummify rather than fully decomposed, a matter that ancient Egyptian knew well.

### The noxious agents *wxdw* and living people

In addition, in living people, these noxious agents *wxdw*, produced in faeces and in the lower intestine (pHwy), spread upwards to the body through the blood vessels (mtw=vessels) and the vascular system. They could cause physical harm and a great variety of suppurative and other diseases, such as fever and changes in the pulse, the first concept similar to the Hippocratic fetid fluxion (congestion or 'ρεύματα'), later applied to phlegm and bile. This putrefaction formed in the bowels under abnormal conditions, moving through the blood stream, could cause myocardial infarction, cerebral oedema, venous thrombosis, anus injuries and ulcerations, pustules (kAkAwT), abscesses (bnwt), swellings (Sfwt=shefwt) and tumefactions. A pustule or gland (Gardiner Aa 1) at the end of the words, is the determinative hieroglyphic used for a variety of diseases and injuries, the same that characterized the unpleasant, disliked, bad, (nHA) terrible and painful things such as viscera (Ais), bile (bnf), feces (Hs), infected injuries (ASyt), tumours (anwt), fat (DdA), urine (wsSt), foul odour. Really, anything that had a very unpleasant smell was painful, despicable and abominable and, therefore, gave rise to a sacred horror.

Herodotus already established a link between digestion and disease and ends by saying that Egyptians believed ingested food could be the cause of all diseases. He also affirms that for 3 consecutive days each month they purged themselves, looking after health by means of emetics and drenches composed by colocynth, castor oil plant and possibly aloes. They refreshed the heart and anus and expelled fever (Steuer, 1948). This enteroclyster or enema was learned from the ibis-headed god Thoth, who cleans the inside of his body bowel by introducing water with its long beak (Pliny et al., 1938-1962). Another prophylactic treatment was pulling back down with gentle massages these pathogenic substances or residues (materia peccans), result of an abnormal fermentation after digestion, and later expelling them by the rectum.

If *wxdw* were absorbed, they could cause various additional problems: coagulation, thickness and destruction of blood (snf=blood), possible vascular duct (mtw) obstruction or blockage (Sna=shena) only removed applying venesection or phlebotomy, method proposed first by Egyptian physicians (Rapson, 1982), abscesses or pus (ryt), adhered to the faeces, an extremely prevalent infection in Egypt.

"The early Greek physicians believed, however, that the decomposing of the blood, phlegm and bile, was responsible for the formation of pus, whereas the Egyptians held that pus was a modification of *wxdw*". Disorders could also involve stone formations blocking physiological functions, bile and phlegm corruption (arwt and stt respectively) as shown in Figure 1, (Ebell, 1937) all of them causing physical destruction and pathogenic decay that even survived in the modern use of Greek word sepsis.

	wxdw		Ais
	Hs		bnf
	Kob		Hs
	sdwx		ASyt
	m(wjt)		anwt
	pHwy		DdA
	mtw=vessels		wsSt
	kAkAwT		snf=blood
	bnwt		Sna=shena
	Sfwt=shefwt		ryt
	nHA		stt

Figure 1: Translation of medical terms in ancient Egyptian language.

The assimilation of food, in the Aristotelian school of biology, depended of the heat quantity, as Hippocrates also holds (De morbis IV, 59) (Potter, 1988): heat facilitates the digestive process and generates putrefaction, although being insufficient, perittōma or excrements develop. The colon separates assimilable food from solid waste to be evacuated. But if residual remain in the bowels an alternative elimination to clean the gastro-intestinal tract, as did the Egyptians, could be by means of clyster (emetics, purges and enemas).

The digestive process, similar to boiling, has 2 stages: the concoction or 'pepsis', in the upper digestive tract or upper belly (κοιλία); and 'sepsis', terminal stage with perittōma as result in the lower tract of bowels, a reservoir of residues classified in 2 types by Egyptians and Aristotle, related to the quantity of heat required: faeces (Hs ó kopros) and excrements. Kopros were a normal waste matter to be evacuated later, with putrefaction as a useful agent, and their counterpart, excrements (*wxdw* or perittōma) an abnormal condition with pathogenic putrefaction.

The Aristotelian perittōma, related with putrefaction or 'sepsis' (σήψις) (Lee et al., 1952) and corruption phthora (φθορά), always pathogenic "because everything rots except fire", is crucial to understand the subsequent evolution between excretions and fluxions. Perittōma (περίττωμα) or residues combines 4 components to be eliminated: sperme (σπέρμα) that arises as the result of useful food, while faeces (κόπρος), bile (χολή) and phlegm (φλέγμα), occur as a result of useless food (Peck et al., 1942). Aristotle also regarded black bile (as well as yellow bile) as a 'residues' (perittōma) that had no positive role in the body and that was not present in every human being. Bile and phlegm, in an unorthodox view, were excretions of putrefied (septic) perittōma, recognized as a genuine pathological entity called also sepedon (σήπεδών) for Hippocrates.

The pneumatic theory, correlated in this case to smells and pestilences of decomposing bodies or miasmas, derived from the Egyptian theory of *wxdw*. According to

P. Berlin (XIII, 3-7) undigested food residues decompose and generate intestinal and pathological gases or physai 'breaths' (φύσαι) that causes several illnesses, described also in modern experimental biology. However, Greeks soon rejected this idea contrary to the principle of the inalterable air, impossible to putrefy as the only gas in existence. In the Aristotelian corpus, respired pneuma is the cool, atmospheric air that is good while connate pneuma (σύμφυτον πνεῦμα), the warm mobile 'air' or inner pneuma, is a sort of residue (perittōma) related to blood, the material vehicle by which sensations are transmitted from the sense organs to the common sense located in the heart, where the blood is first produced (Gregoric, 2007; Freudenthal, 1995). As its qualifier indicates, connate is pneuma that animals generate internally, resembling to some extent atmospheric or respired pneuma. The three vital activities in animals that involve connate pneuma are sense perception, particularly the senses of hearing and smelling, animal motion and animal generation. Regarding this point, it figures specifically in the constitution and expulsion of the male seed during copulation and perhaps in the drawing of this seed into the uterus of females, that in the sperm transmits the capacity for locomotion and certain sensations to the offspring, according to Book 10 in History of Animals (Balme, 1965).

Nevertheless, Aristotle and later Galen (Jouanna, 2000) reintroduced the concept of miasmas, causing epidemic fevers through putrefactive particles in the air, an idea supported by Egyptians (Eb. 750-756) long before. They thought that goddess Sekhmet every year introduced pathogenic elements or demons into the air and, in consequence, pestilences broke out.

## DISCUSSION

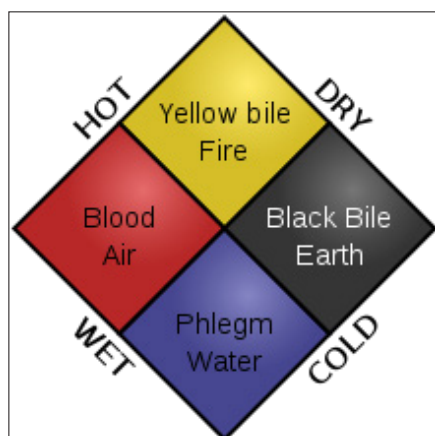
### About Cnidian school and the evolution of *wxdw* theory

The aforementioned treatise of *wxdw* was progressively reinterpreted by different Greek medical schools and within Cnidian School the concept of perittōma suffered a continuous evolution. First of all, according to Alcamenes of Abydos (Jones, 2011) toxic agents, going up and down, damage the body as *wxdw*, while Dexippus the Coan; sharing Cnidus' aetiological concepts of diseases, confirms the putrid origin of phlegm and bile composed of waste indigestible material residues. This time could be perceived as a transition period to the Hippocratic theory of humoralism because sour, bitter, phlegm and bile, were closely related to the concept of sepsis.

On the other hand, Euryphron of Cnidus, like the Egyptians, held that excrements remaining in the human body become perittōma and can rise to the head producing disease, introducing Herodicus of Cnidus an important variant in this sense. A pathogenic fluid derivate hygrotēs (ύγρότης), also putrid, could be sour (όξεία) or bitter (πικρά) and rises to the head instead of perittōma, using the term crisis in reference to a variability of putrid excretions blending, that can explain a great number of diseases.

Timotheus of Metapontum called this putrid moisture hygron, instead of hygrotēs, coming to the head and remains there; transformed into a salty and pungent watery fluid, similar to the Hippocratic fluxions, flows down causing illness. However, hygrotēs, a pathogenic counterpart of the elemental body fluid, differs from the Hippocratic rheumata, a fetid fluxion that remains in the body not readily evacuated, neither so putrid nor rising to the head. Health problems, according to Phasilas of Tenedos, were often the result of fetid excretions or the faecal excrements themselves, and an alternative cause, also for Aristotle, was the emanations of excessive moisture arisen from an unsuitable place. For Plato liquefaction or decomposition of tissues, it is due to interruption or changes of the blood supplies, once becoming bitter, acidic and salty, it caused ichor, phlegm and bile, all factors of corruption.

Although Hippocrates work was based on observation of clinical signs and rational conclusions, many of his theories were not based on logic, particularly his theory on 'humoralism' (Thivel, 2001), an extension of the Pythagorean theory on nature. The concept of "humors" (chemical systems regulating human behaviour) became more prominent from the writing of medical theorist Alcmaeon of Croton. His list of humors was longer and included fundamental elements described by Empedocles, such as water, air, earth, fire, etc. However The Nature of Man has remained the most famous Hippocratic work in Western medicine, since it discusses the humoral theory of the four humours, but it was considered not being authentic. The author denounces here a monist conception of human nature and affirms that man is formed of four humours (Figure 2) which are mixed when man is in good health and separated when man is sick. He believed that illness was the result of an imbalance in the body (dyskrasia, meaning 'bad mixture') of the four humours: blood (Greek: αίμα, haima), black bile (Greek: μέλαινα χολή, melaina chole), yellow bile (Greek: ξανθη χολή, xanthe chole) and phlegm (Greek: φλέγμα, phlegma) (Doufas et al., 2010). The properties of each of these correspond to each of the four seasons, each humour predominating in the season which shares the same nature: blood, hot and wet, predominates in spring; yellow bile, hot and dry, in summer; black bile, cold and dry, in autumn; and phlegm, cold and wet, in winter. In this book the theory is not connected to the four elements of the universe (fire, air, water, earth), and there is no trace of its development into a theory of the four temperaments or of their corresponding character types. The patient would then become sick and remain that way until the balance was somehow restored. Hippocratic therapy was directed towards restoring this balance and to avoid this imbalance, the doctor recommends modifying one's regimen according to the seasons. For instance, using citrus was thought to be beneficial when phlegm was over abundant.



**Figure 2:** Translation of medical terms in ancient Egyptian language.

## CONCLUSION

The aetiology of bowel disease supported by the brilliant Egyptian hypothesis about the role of putrefaction and fermentation of ingested food helped provide a coherent and scientific therapy and marked a turning point in the evolution of Greek thought, as Saunders emphasised in 1959, considering the origin of the pathological theories of Cnidian medicine. This medical school borrowed the essential basis of the doctrine and progressively, through different stages led to the Hippocratic humoral theory: the imbalance among 4 bodily humours, blood, phlegm, and yellow and black bile was a harbinger of disease. During Galen's lifetime in the 2nd century, the Hippocratic question, i.e. the problem of attributing treatises to Hippocrates, was already openly disputed. Galen saw *The Nature of Man* as a composite treatise, whose main part was, however, written by Hippocrates. At the time of the Roman doctor, other theories were in force in an environment of intellectual stimulation and the Hippocratic theory 'competed' so to speak, with Cnidian and Egyptian principles, from which it had derived. It is not certain whether the humoral theory had become canonical but only this had a future (Schöner, 1964). Galen himself did not make much use of it, since the basis of his system is the theory of the four elementary qualities hot, cold, dry and wet. It is possible that the Hippocratic humoral theory, re-interpreted and systematised by Galen, was re-elaborated in an Alexandrian context, particularly by the development of a systematic theory of the four temperaments. However the Hippocratic tradition and the humoral theory at the end was acknowledged and lasted until the 17th century in the West but progressively lost influence and surprisingly was forgotten and rejected as an obstacle to medical practice in the mid-19th century with the rise of controlled empirical science. What even remain today are the Egyptian main ideas of harmful and toxic intestinal residues, producing putrefaction or incipient decay related with the words septicaemia, pyemia or sapremia (a constitutional disorder due to chemical poisoning by bacteria products, resulting from putrefactive processes in a wound infection).

## REFERENCES

- Lawrence JS (1964). Logan clendening lectures on the history and philosophy of medicine: Tenth Series-The Transitions from Ancient Egyptian to Greek Medicine. *California Medicine*. 100: 317.
- Mark J (2017). *Egyptian Medicine*. World History Encyclopedia.
- David AR (1999). *Handbook to life in ancient Egypt*. Oxford University Press. 336.
- Aristotle, Rackham H (1932). *Politics*. Harvard University Press. 12-14.
- Homer, Rieu E (1946). *The Odyssey*. London. 4:229-232.
- Jouanna JB, Van der Eijk P (2012). *Greek medicine from Hippocrates to Galen: Selected papers*. Brill. 9.
- Herodotus, Selincourt AD (1972). *The Histories*. Harmondsworth Publisher. 2nd Edition. 84.
- Sallam HN (2010). Aristotle, Godfather of evidence-based medicine. *Facts, views & vision in ObGyn*. 2: 11.
- Joachim H (1890). *Papyrus Ebers: Das älteste buch über heilkunde*.
- Papyrus E, Ebbell B (1937). *The Papyrus Ebers: The Greatest Egyptian Medical Document*. Copenhagen; Oxford University Press.
- Cunha FI (1949). The Ebers Papyrus. *Am J Surg*. 77: 134-136.
- Breasted JH (1930). *The Edwin Smith Surgical Papyrus*. Chicago, Ill. University of Chicago Press.
- Lloyd G (1979). *Magic, Reason and Experience: Studies in the origin and development of Greek science*. Cambridge University Press. 347-348.
- Jouanna J (1974). Hippocrate: Pour une archéologie de l'école de Cnide. *Belles lettres*. 508.
- David R (2008). The art of healing in ancient Egypt: A scientific reappraisal. *The Lancet*. 372: 1802-1803.
- Littré E (1846-1851). *Oeuvres complètes d'Hippocrate*. Paris: J.B. Baillière.
- Wreszinski W (1909). *Die Medizin der alter Agypter: Der grosse medizinische Papyrus des Berliner Museums (Pap. Berl. 3038)*. Leipzig: J.C. Hinrichs'sche Buchhandlung. 1-142.
- Griffith F (1893). *The Petrie Papyri: Hieratic papyri from Kahun and Gurob*.
- Stevens JM (1975). *Gynaecology from ancient Egypt: The papyrus Kahun a translation of the oldest treatise on gynaecology that has survived from the ancient world*. *Med J Aust*. 2: 949-952.
- Iversen E (1939). *Papyrus Carlsberg no. VIII: With some remarks on the Egyptian origin of some popular birth prognoses*. Munksgaard. 1-31.
- Garnot JS (1940). *Kopenhagener Texte zum demotischen Weisheitsbuch (Pap. Carlsberg II, III Verso, IV Verso und V) 1-224*.
- Iversen E (1939). *Papyrus Carlsberg No. VIII, with remarks on the Egyptian origin of some popular birth prognoses*. Munksgaard. 26: 21-22.



- Gardiner A (1935). Hieratic Papyri in the British Museum Third series. Chester Beatty Gift. Cambridge University Press. 10: 369-371.
- Rosso AM (2004). From sleep to dreams: Theories and beliefs in Antiquity. The 39th International Congress of the History of Medicine, Alfredo Musajo-Somma ed. 475-482.
- Philips AK (1986). Observation on the alleged new kingdom sanatorium at Deir el-Bahari. *Göttinger Miszellen*. 89: 77-83.
- Holmes B (2013). Philippa Lang: Medicine and Society in Ptolemaic Egypt. Cambridge University Press. 57: 596-597.
- Von Staden H, Chalcedonius H (1989). Herophilus: The art of medicine in early Alexandria: edition, translation and essays. Cambridge University Press. 15.
- Amigues S (2006). Theophraste: Recherches sur les plantes. *Les belles lettres*. 5.
- Marganne MH (1992). Les références à l'Égypte dans la Matière médicale de Dioscoride. *Serta Leodiensia Secunda*. Mélanges publiés par les Classiques de Liège à l'occasion du 175e anniversaire de l'Université. 309-322.
- Marganne MH (1998). Thérapies et médecins d'origine (égyptienne) dans le *De medicina* de Celse. In *Maladie et maladies dans les textes latins antiques et médiévaux*. Actes du Ve Colloque International (Textes médicaux latins de l'Antiquité et du Haut Moyen Âge). 137-150.
- Jacques JM (2002). Nicandre, Les thériaques.
- Moir DM (1831). *Outlines of the Ancient History of Medicine: Being a view of the progress of the healing art among the Egyptians, Greeks, Romans, and Arabians*. William Blackwood. 81-83.
- Peck AL, Forster ES (1937). *Parts of animals; Movement of animals; Progression of animals/De partibus animalium*. Harvard University Press.
- Souques A (1935). *Connaissances neurologiques d'Hérophile et d'Erasistrate*. *Revue neurologique*. 63: 145-176.
- Rosso AM (2014). Mummification in the Ancient and New World. *Acta medico-historica Adriatica: AMHA*. 12: 329-370.
- Moulinier L (1952). Le pur et l'Impur dans la pensée des Grecs d'Homère à Aristote. 211: 99-104.
- Acar F, Naderi S, Guvencer M, Türe U, Arda MN (2005). Herophilus of Chalcedon: A pioneer in neuroscience. *Neurosurgery*. 56: 861-867.
- El-Abadi M (1990). The life and fate of the ancient library of Alexandria. *Unesco*. 118-119.
- Ghalioungui P (1973). The House of Life, Per Ankh, Magic and Medical Science in Ancient Egypt. *Amsterdam*. 9: 198.
- Marganne MH, John F Nunn (1997). *Ancient Egyptian medicine*. London, British Museum Press. *Medical History*. 41: 410-411.
- Saunders JJ (1963). The debate on the Fall of Rome. *History*. 48: 1-7.
- Kudlien F (1964). Herophilus and the beginning of medical skepticism. *Gesnerus*. 21: 1-3.
- Longrigg J (1992). *Greek rational medicine: philosophy and medicine from Alcmaeon to the Alexandrians*. Routledge. 1-220.
- Rosso AM (2005). Galien entre l'Anatolie et l'Égypte face au défi de la tradition anatomique. *Proceedings of the 38th. International Congress of the History of Medicine*. 105-106.
- Rosso AM (2016). *Medicine in Antiquity, its development in Egypt and Greece: Identities and Influences*. *Congress ISHM*. 6-28.
- Longrigg J (1989). Presocratic philosophy and Hippocratic medicine. *History of Science*. 27: 1-39.
- Macfie RC (1907). *The romance of medicine*. Cassell, limited. 15.
- Deines H, Grapow H, Westendorf W (1958). *Grundriss der Medizin der alten Ägypter*. Akad.-Verlag Publisher. 5: 11-12.
- Ritner RK (2000). Innovations and adaptations in ancient Egyptian medicine. *J Near East Stud* 59: 107-117.
- Yoyotte J (1968). Une théorie étiologique des médecins égyptiens. *Geunthner*. 79-84.
- Bardinet T (1995). Les papyrus médicaux de l'Égypte pharaonique. 128-130.
- Lang, *Medicine and society*, 116.
- Baron JH, Sonnenberg A (2002). The wax and wane of intestinal autointoxication and visceroptosis--historical trends of real versus apparent new digestive diseases. *Am J Gastroenterol*. 97: 2695-2699.
- Steuer R, Saunders J (1959). *Ancient Egyptian and Cnidian Medicine. The relationship of their Aetiological concepts of disease*. *J Hist Med Allied. Sci* 4.
- Faulkner RO (1969). *The ancient Egyptian pyramid texts*. Aris & Phillips.
- Faulkner RO, Andrews C (1990). *The ancient Egyptian book of the dead*. University of Texas Press.
- Hornung E (1997). *Les Dieux de l'Égypte: l'un et le multiple*. Flammarion. 141-153.
- Szpakowska K (2003). *Behind closed eyes: Dreams and nightmares in ancient Egypt*. The Classical Press of Wales. 22-25.
- Costandi M (2015). Life after death: The science of human decomposition. *The Guardian*. *Neurophilosophy, UK News*.
- Javan GT, Finley SJ, Abidin Z, Mulle JG (2016). The thanatomicrobiome: A missing piece of the microbial puzzle of death. *Front Microbiol*. 7: 225.
- Adserias-Garriga J, Hernández M, Quijada NM, Lázaro DR, Steadman D, Garcia-Gil J (2017). Daily thanatomicrobiome changes in soil as an approach of postmortem interval estimation: An ecological perspective. *Forensic Sci Int*. 278: 388-395.
- Can I, Javan GT, Pozhitkov AE, Noble PA (2014). Distinctive thanatomicrobiome signatures found in the blood and internal organs of humans. *J Microbiol Methods*. 106: 1-7.
- Gunn A, Pitt SJ (2012). Microbes as forensic indicators. *Trop Biomed*. 29: 311-330.

- Uchiyama T, Kakizaki E, Kozawa S, Nishida S, Imamura N, Yukawa N (2012). A new molecular approach to help conclude drowning as a cause of death: Simultaneous detection of eight bacterioplankton species using real-time PCR assays with TaqMan probes. *Forensic Sci Int.* 222: 11-26.
- Payne JA (1965). A summer carrion study of the baby pig *Sus scrofa* Linnaeus. *Ecol Appl.* 46: 592-602.
- Steuer RO (1948). *Wxdw*: Aetiology Principle of Pyaemia in Ancient Egyptian Medicine. *Bull Hist Med.* 10: 1-36.
- Pliny, H. Rackham (1938-1962). *Natural History*. London : William Heinemann. 10.
- Rapson H (1982). *A circulation of blood: A history*. London : F. Muller. 1-132.
- Ebell B (1937). *The Papyrus Ebers*. Ejnar Munksgaard Copenhagen. 1-129.
- Potter P (1988). *Hippocrates, Affections. Diseases 1. Diseases 2*. Harvard University Press, Cambridge. 5: 1-297.
- Aristotle, Lee SH (1952). *Aristotle Meteorologica*. London; Harvard University Press: Cambridge, Mass. 7: 1-480.
- Aristotle, Peck A (1942). *Generation of Animals*. Cambridge Harvard University Press.
- Gregoric P (2007). *Aristotle on the common sense*. Oxford University Press. 1-268.
- Freudenthal G (1995). *Aristotle's theory of material substance: Heat and pneuma, form and soul*. Oxford University Press.
- Balme D (1965). *Aristotle, History of Animals*. London; Harvard University Press: Cambridge, Mass. 3.
- Jouanna J (2000). *Miasme, maladie et semence de la maladie. Galien lecteur d'Hippocrate. Studi su Galeno. Scienza, Filosofia, Retorica e Filologia.* 39-72.
- Jones WH (2011). *The medical writings of Anonymus Londinensis*. Cambridge University Press.
- Thivel A (2001). *La doctrine d'Hippocrate dans l'Anonyme de Londres. Collection de l'Institut des Sciences et Techniques de l'Antiquité.* 790: 197-210.
- Doufas AG, Saidman LJ (2010). *The Hippocratic paradigm in medicine: Origins of the clinical encounter.* 110: 4-6.
- Schöner E (1964). *Das Viererschema in der antiken Humoralpathologie*. F. Steiner.