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Hygiene Technologies, Water, and Health in the Hellenic World

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Abstract

The relation between human health, water, and hygiene facilities has been realized since during the Bronze Age, the explanations of illness and health problems were based on theocratic elements. However, the Greeks during the Classical and mainly the Hellenistic period clearly differentiated their thinking from all other civilizations by inventing philosophy and empirical science. Drains/sewers, baths and toilets, and other sanitary installations are reflecting high cultural and technological level, while they also are associated with observations and ideas about hygiene and medicine. The aim of this paper is to examine the knowledges about the influence of water on human health throughout antiquity. In other words, it focuses on the views that Greeks and Romans had on water quality and its impact on the human body.

Keywords: Asclepieia, Minoan era, Hippocrates, medicine, water quality

1. Introduction

People of Minoan Crete seem to have realized since the third millennium BC that various health problems could be eliminated by well-organized water supply systems and operated sanitation infrastructures. The first known Hellenic philosophical and medical writers, like Thales and Empedocles, also recognized the importance of water for the hygiene and health of people [1].

In many ancient texts, it is mentioned that water quality is considered as a major issue that affected human health. Moreover, water played a major role in the healing process, body relief, and wound care. In the *Iliad* of Homer, for example, Eurypylus asks Patroclus to wash the black blood on his wound with lukewarm water and then put on: “...ἀλλ’ ἐμὲ μὲν σὺ σώωσον ἄγων ἐπὶ νῆα μέλαιναν, μηροῦ δ’ ἔκταμ’ οἴστον, ἀπ’ αὐτοῦ δ’ αἶμα κελαινὸν/νίξ’ ὕδατι λιαρῶ, ἐπὶ δ’ ἦπια φάρμακα πάσσε ἐσθλά, τά σε προτί φασιν Ἀχιλλῆος δεδιδάχθαι, ὃν Χείρων ἐδίδαξε δικαιοτάτος Κενταύρων.” This roughly translates as follows: “...But me do thou succour, and lead me to my black ship, and cut the arrow from my thigh, and wash the black blood from it with warm water, and sprinkle thereon kindly healing herbs, whereof men say that thou hast learned from Achilles, whom Cheiron taught, the most righteous of the Centaurs...” (L, 829-831).

Until the sixth and the fifth centuries, health and healing were very much rooted in religion and magic. Furthermore, in the following centuries, till the Roman times, despite the development of philosophy and medical science, those who suffered from various illnesses and pains continued to offer sacrifices, consulted practitioners who prescribed the use of medicinal herbs, or flocked to sanctuaries dedicated to gods associated with healing and health restoring through mysterious ritual a part of which was the presence of water. Within this context the healing god Asclepius,

appeared in ancient Greece, and since the sixth century, hundreds of large and small Asclepieia were founded, with common characteristics, providing healthcare facilities. In addition to Asclepius, there have been some other health-related deities, derived from the same family, which were also worshiped at all over the Greek area as well as in Asia Minor, Egypt, or even Rome. According to the Hellenic myth and the Thessalian tradition, Chiron, the wise old centaur, was the fatherly tutor of Asclepius. Chiron's healing activity is certified both by Homer and Pindar. Indeed, due to his knowledge in the medical arts, he is added into the Thessalian healing pantheon. He seems to have possessed healing powers before Asclepius; in fact, he is known as the founder of a family of physicians, who handed down from father to son secrets of the herbs of Pelion and who healed people without payment [2].

Asclepius's skills as a doctor became so advanced, which eventually came to be worshipped as a god of health and disease and was considered to have powers, even to raise the dead, prompting the jealousy of the Olympian gods and the rage of Zeus, who struck him with a lightning bolt. Both his sons, Machaon and Podalirios, and his daughters, Hygeia, Panacea, and Iaso, were also associated with human health. Specifically, Hygeia was the goddess of public health, Panacea was the goddess of therapy, and Iaso was the goddess of cures, remedies, and modes of healing. It is noted that the word hygiene comes from Hygeia the Hellenic goddess of health. Apart from the ca. fourth BC votive relief from Kynouria, where the whole Asclepius' family welcomes a group of supplicants, a unique group of Asclepiads has been found in the complex of Great Baths of Dion. These are six sculptures at least two thirds of the natural size, representing Asclepius and his family, dating back to the early ca. third century AD [3]. There is no doubt that neither the presence of this group of statues nor their location in a complex such Great Baths was selected at random. Their presence indicates the importance of the bath for therapeutic purposes.

In parallel, since the Classical times, the fact that medicine and health practices became more scientific, endeavors provoked a gradual advancement in the design of sanitary and sewerage engineering. Thus, there are many samples of advanced design and construction of lavatories, baths, sewage and drainage systems of those eras, as well as other hygienic structures obviously due to improved understanding of hydraulic and sanitary principles. Later on, Hellenistic period (ca. fourth to first century BC) should be considered as the most progressive time in the design of sanitary and sewerage engineering during antiquity [4]. There is no doubt that many ancient Greek cities in addition with aqueducts and distribution networks were also equipped with advanced drainage systems under their urban grids. That means that the ancients knew that sewerage infrastructures were of equal importance to their cities' water supply systems.

The purpose of this paper is to examine the perceptions of both the people in ancient Greece and Romans about the role and effectiveness of water in healing and generally in human health. In parallel, within the same context and always having in mind the theocratic perceptions of the ancient Greeks, which persist even after the development of medical science in the Classical era, the study traces the role of the gods in relieving human pain and their power to cure ill people through processes in which the element of water had crucial role. In other words, this paper aims to examine the bidirectional connection between the healing powered gods and goddesses and the water springs which they largely determined the location and form of sanctuaries and sanatoriums throughout antiquity.

2. Methodology

Philosophy and all the ideas and theories that ancient Greeks elaborated on the role of the water in human health have been the real basis for the development of hygiene technology from antiquity till nowadays.

Extensive drainage and sewerage systems and elaborate sanitary infrastructures, such as baths and flushing toilets, were in use since prehistoric in cases where settlements had urban organization and central authority, like those of Minoan Crete and other Aegean islands. Influenced by the progress of philosophy of Classical and Hellenistic periods on public health and especially in the provision of saving drinking water and adequate sewage disposal, Greeks advanced sanitary engineering through antiquity by constructing sanitary infrastructures and hygiene facilities or creating new ones. Romans having in mind the past technology and hygienic practices of the Greeks, they advanced the known sanitary techniques by implementing extensive systems for public and private hygiene, which formed the basis of modern sanitary technology.

In order to review the role of water in sanitation and preservation of the public health, antiquity texts from ancient Greek and Roman literature have been gathered, related to philosophy, medicine, architecture, and poetry. In parallel, many archeological evidences from all over Greece have been gathered and recorded for the same purpose.

As it was impossible to quote all the texts related to this issue, the most characteristics of them have been chosen and cited that means the ones that express and prove better the conditions and practices through which ancient Greeks and Romans are conducive to maintaining health, prevention, or healing diseases through cleanliness.

3. Prehistory

The first Minoan settlements were established in dry- and water-scarce sites, where the Minoans developed an advanced, comfortable, and hygienic lifestyle, as manifested by water supply systems, flushing lavatories, public and private baths, and very effective sewers and drains. All Minoan palaces have been found to have high-quality hygienic facilities, water dispensers with running water, and an underground drainage system. Besides, Minoan religion required believers to be always clean. Sacred fountains, lustral basins for ritual bathing, and other purgatory facilities were found in several palaces, cities, and other Minoan settlements next to domestic rooms or near the entrances [4].

The presence of such sophisticated hygiene and body care infrastructures must be very much connected with high-level medicine and very well-evolved healing methods. However, despite the fact that grooming and physical hygiene are depicted in many wall paintings, there are no frescoes at all that give any information about medicine and physician processes. Similarly, none of the numerous Linear B clay tablets provide any such information, although the word doctors are mentioned in their text.

4. Archaic till Hellenistic times

4.1 Water quality and human health

The effectiveness of water on the human body was particularly concerned within the ancient world. Numerous ancient written sources, concerning water and hygiene, confirmed that water had beneficial or harmful effects on human health and played a crucial role in the body or mental healing, depending on its quality; in other words it defined in many ways the art of medicine. What is even more interesting is the connection of water presence with theocratic concepts, superstitions, and processes in sacred complexes dedicated to gods with healing powers. Plutarch

(Αιτίαι Φυσικαί), Vitruvius (*De Architectura*), Pliny (*Naturalis Historiae*), and Aristotle (*Problems*) express similar views on the effect of water quality on human health [5, 6]. Alcmaeon of Croton, in the first half of the fifth century, was the first who mentioned that the health of people are very much connected to the quality of water (Aetius, V, 30, 1), which, according to Vitruvius (*De Architectura* I, 4, 9, 10), was examined by the senses, taste, smell, appearance, and temperature. Tasteless, cool, odorless, and colorless water was considered as the best, in contrary to stagnant and marshy waters that are inappropriate resulting in various diseases.

Aristotle, who mentions the difference between drinking water and that which was used for all other daily needs in his *Politics* (1330b), believed in the importance of water in the human body and underlined that water causes more diseases than food, since food contains water (*Problems* I, 13, 14, 861a) ([1], p. 51). Hippocrates and Vitruvius make extensive reports to diseases which were caused by poor-quality water. The contribution of water to the physical and mental development of humans, in addition to clean air, is also underlined by Diodorus of Sicily, who claims that water “...πρός υγείαν σωμάτων και ρώμην συμβάλλεται...” (“water...also contribute to the health and vigour of their bodies...”). Many ancient writers pointed the fact that the Athenians were affable and had a loud voice and great memory due to the excellent quality of water that flowed in their town from Hymettus, Penteli, and Parnitha. Diodorus of Sicily also emphasizes the contribution of water in physical and mental health along with fresh air (...πρός υγείαν σωμάτων και ρώμην συμβάλλεται...).

According to the ancient people of the Greek area, the quality of water depended on the geological profile of the spot from which it flowed. Moreover, the orientation of springs and their position in relation to the direction of the winds are also largely related to the water quality of an area which affects public health. Athenaeus, for example, referring to Hippocrates, records the primacy of the waters that are eastbound and are exposed to the eastern winds. He believes that those waters are “λαμπρά, εὐώδη και κοῦφα” (“...One should, however, drink water which is light and transparent in appearance, light, too, in actual weight and free from solid matter...”). The most harmful waters of the human body were marshes. The ancients knew that swamps, marshlands, and, generally, naturally occurring collections of stagnant water could cause dangerous or even mortal diseases, such as malaria. Marshes at the edge of Loudias lake/river next to the capital city of Macedonia, Pella, affected badly the public health so much that people there both had “...a spleen twice as large as (their) belly...” (“τῆς κοιλίας τόν σπλῆν’ ἔχοντα διπλάσιον,” Athenaeus, *Deipnosophistai* A, 348e-f) and their “...faces pale...” (“ἐτύχανον ... χλωροί ὄντες,” Athenaeus, *Deipnosophistai* A, 352a) which both of them are malaria symptoms. Moreover, the inhabitants of Troizina, which were drinking inappropriate water, had also health problems especially on their feet. Athenaeus also dealt extensively with the quality of water in various parts of the world and many times repeats information written years ago. Among others, he mentioned that the Nile water was very fertilizing and fresh. Hence, it loosens the bowels and aids digestion, since it contains a soda ingredient (*Deipnosophistai* B, 41). On the other hand, he attributed the death of many Egyptians to the Nile water, when sometimes droughts had occurred in the Nile valley and the flow of water became poisonous for humans.

Hippocrates since the end of the fifth century BC developed a medical approach, which was based on observation of clinical signs and rational conclusions and not to the religions or magical beliefs, or to the displeasure of the gods, or other supernatural causes [6, 7]. Specifically, for the first time, he supported the rationality of the etiology of disease and separated real medicine from religious superstitions. He applied logic so as to understand various diseases and find ways to cure them. In his texts he often mentions the effect of drinking water on the human body. He

attributes the appearance of some diseases or even the weakness of some people to the bad water quality, of high salinity, that means salty, bitter, nitrite, sulfate, ferrous, acidic waters, or even rain waters which are perishable and can damage human cells or irritate the skin. Hippocrates pointed out that the quality of rainwater is rapidly getting worse with strange smell and unpleasant taste. Drinking it without pre-boiling or pre-filtering it, can provoke damages in human cells by causing stomach aches, poisoning, and vomiting. In addition, especially the water, which falls after a long period of drought, is similarly dangerous for human health, since it is essentially derived from a dirty atmosphere (*Περί Αέρων, Υδάτων, Τόπων, and Περί Χυμών*). Thus, other waters affect human health negatively or cause even death, even though they are appropriate in other cases. Hippocrates mentions that seawater is certainly not drinkable; however, a sea bath could be beneficial in healing skin irritation or wounds (*Περί υγρών χρήσιος*).

Contamination of water that used to run through lead supply pipes was a very serious issue of the Roman era concerning public health. Vitruvius theorized about the impact of lead erosion on water quality, which affects badly the human health, and recommended the use of clay pipelines where the water preserves its good taste; therefore, it is appropriate for drinking: “...*etiamque multo salubrior est ex tubules aqua quam per fistulas quod plumbum videtur esse ideo vitiosum, quod ex eo cerussa nascitur. Haec autem dicitur esse nocens corporibus humanis. Ita quod ex eo procreatur, ‘si’ id est vitiosum, non est dubium, quin ipsum quoque non sit salubre. Exemplar autem ab artificibus plumbariis possumus accipere, quod palloribus occupatos habent corporis colores. Namque cum fundendo plumbum flatur, vapor ex eo insidens corporis artus et in diem exurens eripit ex membris eorum sanguinis virtutes. Itaque minime fistulis plumbeis aqua duci videtur, si volumus eam habere salubrem.*” This roughly translates as follows: “...Water conducted through earthen pipes is more wholesome than that through lead; indeed that conveyed in lead must be injurious, because from it white lead is obtained, and this is said to be injurious to the human system. Hence, if what is generated from it is pernicious, there can be no doubt that itself cannot be a wholesome body. This may be verified by observing the workers in lead, who are of a pallid colour; for in casting lead, the fumes from it fixing on the different members, and daily burning them, destroy the vigour of the blood; water should therefore on no account be conducted in leaden pipes if we are desirous that it should be wholesome. That the flavour of that conveyed in earthen pipes is better, is shewn at our daily meals, for all those whose tables are furnished with silver vessels, nevertheless use those made of earth, from the purity of the flavour being preserved in them...” (De Architectura 8, 6, 10-11).

Opinions on this issue conflict. For example, Hodge [8] excludes the possibility of poisoning or even of the bad impact on the health of Roman citizens, in the long run, from the lead water pipes [9] because, on the one hand, the continuous flow of water into them does not allow the taking of harmful substances at least to such an extent as to affect public health, and solidified calcium deposits on the inner walls of the pipes after a period of continuous use were acted insulating, preventing any contact of the water with the lead. On the contrary, Kobert, accepting the remarks of Vitruvius, made the firm declaration that the ancients had to suffer from poisoning from lead water pipes [9]. Other scholars, professing themselves, note that lead poisoning was commonplace and sometimes it was taking epidemic proportions [10, 11].

Given these, ancient physician's tried to find ways to improve the quality of water that should be swallowed so as to protect the population from waterborne diseases [1]. Both the ancient Greeks and Romans were aware of various ways to control and upgrade water quality so as to avoid many illnesses that were caused

by drinking contaminated water. Many different water purifying methods are mentioned in ancient texts written by Vitruvius, Hippocrates, Athenaeus, or Galen, which include the boiling of water over the fire, heating of water under the sun, dipping of heated iron into the water, and filtrating through gravel and sand. Hippocrates discovered many of the healing powers of water. He invented the practice of sieving water and obtained a bag-type filter, known as “Hippocratic sleeve,” the main purpose of which was to trap sediments that caused bad tastes or odors. Boiling water must be the most common treatment of water cleaning. Athenaeus copied an information from Herodotus’ *Histories* who had mentioned that the king of Persia always took with him a drinking water, which comes from Choaspes springs, from Susa. This was the only water he used to drink. This water had been boiled and then was transferred to silver jars in four-wheeled wagons, following the king. Ctesias of Cnidus certified that the water was boiled and then placed in the cans for use and added that it was very light and enjoyable. Athenians, on the other hand, since the fifth century BC used to mix a part of wine with nine parts of water. Chemical compounds that are produced in the mixture have the power to destroy the germs that cause diseases such as typhoid, dysentery, salmonella, or even cholera [12].

4.2 Water in medicine and its role in healing process

The roots of modern medicine could be traced in the late Archaic and Classical Greece [6]. Even though medical history goes back to Homeric times, illnesses were regarded as a punishment and healing as a gift from the gods. Classical and Hellenistic eras are also very important as far as the evolution in sanitation and hygiene technology in the Hellenic world matters. That is undoubtedly related to the scientific approach to the illnesses and the study of medicine, which never completely disconnected from various religious approaches or from sanctuaries related to health and cure, such as the Asclepieia, which were transformed somehow to medical schools and hospitals. During this period there were two different approaches in Hellenic medicine: (a) the religious medicine of god Asclepius and (b) the philosophical medicine of Hippocrates, Herophilus, Erasistratus, and Asclepiades.

Quite early ancient Greeks transferred medical powers from Mount Olympus down to earth. Thus, appeared Asclepius. Galen, who believed in the myths, remarks that before Asclepius medicine was based on experience and people were healed using only plants, while he made it an empirical science, by introducing new and different methods of healing. Accordingly, to the Hellenic mythology, Asclepius was the son of Coronis and Apollo, who carried him to the centaur Chiron. He raised Asclepius and instructed him in the art of medicine. Besides, according to an etymological approach, the compound name Ασκληπιός (Asclepius) consists of the Hellenic words ασκείν (practicing) and ήπιος (mild), meaning the one that gently removes pain and illness. Another etymological analysis the Hellenic word Asclepius derives from the Hellenic verb σκελλώ (do something hard) which, along with the privative phoneme A and the word ήπιος (mild), implies the one who prevents drying and necrosis of the body gently, with medicine [13, 14].

Specifically, Asclepius was a popular and influential healing figure throughout the Mediterranean [15]. He also became so popular across Greece for his extraordinary healing skills that he was worshipped everywhere in the ancient Hellenic world and its colonies. The healer and comforting god was much loved in the entire Greece. In the south his cult was officially swept at least since the end of sixth century BC, even though his activities and contribution to the art of medicine were widely known since Homer, which is ca. eighth century BC [13, 16–18]. In the north

the first established archeological evidences for the worship of Asclepius go back at least the first half of the ca. fourth century BC, which are mainly coming from the colonies, for example, from Amphipolis, Olynthus, and Potidaea [19].

There were sanctuaries located in remote but beautiful areas, well-known as Asclepieia or Asclepieions, dedicated to the healer god, which functioned as centers of medical advice, prognosis, and healing. More than 300 *Asclepieia* existed across the ancient Hellenic world. They swept over Greece during ca. fifth century BC. Since then, the cult of the healer god has become increasingly popular. That means that almost every Hellenic city had an *Asclepieion*, which means a sanctuary dedicated to the health of citizens through the worship of the healer god [13, 16–18].

The geomorphology and the natural environment were playing an important role in the choice of the location of Asclepius' sanctuaries, as they were facilitating the development of worship. In each case, rich aquifers and natural springs were a major factor for the operation of these sanctuaries. In addition, the presence of rivers or constantly flowing torrents was composing an ideal environment for sacred centers dedicated to Asclepius. Apart from this environment profile, every sanctuary had three basic characteristics connected to water, fountains, hygiene facilities, and baths. After all there was a close relationship between thermal springs, Asclepius, and medicine [16, 18, 20].

They were not the only areas of worship but also medical care centers. Thousands of people used to visit them to be healed from various problems and physical or mental health illnesses. They were combining experimental therapeutic methods with various religions and magical elements and the healing power of water. These included sacrifices, prayers, proper nutrition, taking of medicinal plants, hearing theatrical and musical performances, and finally hypnotherapy. Special procedures, such as catharsis, exercises, massage, and fasting, were taking place there in order to obtain physical and mental recreation and healing. For those buildings such as theaters, gymnasia, hippodromes, and sanitation installations were constructed next to the central temple or to the main buildings of every sanctuary, where physicians were practicing medicine. Finally, the crucial role of water in the procedures or sacred rituals and ceremonies in every Asclepieion is associated with the existence of fountains, springs, and baths. Fountains were perhaps the most basic element of Asclepius' sanctuaries, as the supply of running water was essential not only for ritual ceremonies but also for all of the healing practices which were carried out there. Usually, the required water for purifications and other religious and therapeutic procedures was drawn from tanks, fountains, or sources that were embedded in the sanctuary. It is worth mentioning that a water source constituted an indispensable feature in the sanctuaries of Asclepius [13, 17, 18]. In the temple of Asclepieion of Corinth, the necessary water for the cult and hygiene was drawn from Lerna spring. It was located in the southern site of Lerna court beneath the avaton and was praised as "...the sweetest..." ("...ἡδίστου...") (Athenaeus, *Deipnosophistai* D, 156). The Asclepieion was a place where people were coming to be healed of their diseases. The complex included dining rooms, bathing facilities, dormitories, and other structures.

In Athens the fountain was built above the spring. It was incorporated in the avaton of Asclepius temple and had a circular form, just like the natural carving on the rock of the Acropolis' hill from where the water was outflowing [21]. A fountain has been also found in the Asclepieion of Kos [20], while the natural water source in the sanctuary of Asclepius at Levina in Crete has been also molded in fountain [22, 23]. Furthermore, an inscription of ca. second century BC from Veroia informs the existence of a big, complicated fountain with many spouts in the Asclepieion of the city [24].

The worship of Asclepius was often inserted to already existing sanctuaries of deities who were related to his origin and life, like his father Apollo, or were having similar curative powers [13, 25]. The coexistence of Asclepius, Apollo, Hygeia, and occasionally goddesses Artemis and Demeter was also equally common [13, 17, 26].

In Afytos of Chalkidiki, the cult of Asclepius coexisted with the sanctuary of Zeus Ammon. The relation of Zeus with water and healing is not disputed so as the appropriateness of the area which was of great natural beauty and had rich vegetation, plus water abundance. The baths, built in ca. second century BC nearby, were undoubtedly associated with the healer god, as various findings indicate the practice of medical art in some of the rooms [27]. Often Asclepius was worshiped in areas which were also dedicated to the cult of Nymphs [17, 20], probably due to the common natural environment that these deities were required. Along with the cult of Asclepius in Lebena existed the worship of Hermes, Nymphs, and river Acheloos [22].

Besides Asclepius who was widely known as a healer god, in Macedonia similar properties seem to attribute to *Darron* (in Hellenic Δάρρων). According to Hesychius, *Darron* was a *Macedonian demon to whom they pray for the healing of sick people* (Μακεδονικὸς δαίμων, ᾧ ὑπὲρ τῶν νοσοῦντων εὔχονται). According to another opinion, the name Δάρρων (*Darron*) is another form of the name Θάρρων ἢ Θάρσων, which means courage, which is accompanying the first name of a healer god, Apollo or Asclepius, meaning that he gives courage to patients and helps in their health recovery [28]. Recently a sanctuary has been found in Pella, which is related with an inscription to the worship of demon *Darron*. Several findings plus architectural remains, such as a purification of a cistern, a well, a fountain, a sink near the entrance, are similar to those found in places dedicated to Asclepius. Possibly *Darron* was a local, demonic being with therapeutic attributes, perhaps attendant of Asclepius, like Telesphoros, worshiped by the Macedonians probably together with Asclepius or Health [29].

Both Pliny and Vitruvius tried to mention all the benefits from therapeutic baths and the use of water, which were also pointed out by Homer, ages ago: “...ἡ δὲ τετάρτη ὕδωρ ἐφόρει καὶ πῦρ ἀνέκαιε πολλὸν ὑπὸ τρίποδι μεγάλῳ· ἰαίνετο δ’ ὕδωρ. αὐτὰρ ἐπεὶ δὴ ζέσσειεν ὕδωρ ἐνὶ ἥνοπι χαλκῷ, ἔξ ῥ’ ἀσάμινθον ἔσασα λό’ ἐκ τρίποδος μέγαλοιο, θυμῆρες κεράσασα, κατὰ κρατὸς τε καὶ ὤμων, ὄφρα μοι ἐκ κάματος θυμοφθόρον εἴλετο γυίων...” (κ360). This roughly translates as follows: “... But when the water boiled in the bright bronze, she set me in a bath, and bathed me with water from out the great cauldron, mixing it to my liking, and pouring it over my head and shoulders, till she took from my limbs soul-consuming weariness...” It was well-known that hydrotherapy is beneficial for muscle aches, daily stress, illnesses, or injuries. The heated water relaxes, improves body circulation, and reduces inflammation.

As for Hippocrates, the therapeutic bath is a medical procedure and should be taken under detailed instructions (diet and regimen in acute diseases 65): “...The bath is useful in many diseases, in some of them when used steadily, and in others when not so. ... And if the patient be not bathed properly, he may be thereby hurt in no inconsiderable degree, for there is required a place to cover him that is free of smoke, abundance of water, materials for frequent baths, but not very large, unless this should be required. It is better that no friction should be applied, but if so, a hot soap (smegma) must be used in greater abundance than is common, and an affusion of a considerable quantity of water is to be made at the same time and afterwards repeated... But the person who takes the bath should be orderly and reserved in his manner, should do nothing for himself, but others should pour the water upon him and rub him, and plenty of water, of various temperatures, should be in readiness for the douche, and the affusions quickly made; and sponges should be used instead of the strigil, and the body should be

anointed when not quite dry. ... and a man should not be washed immediately after gruel or drink; ... In general, it (bath) suits better with cases of pneumonia than in ardent fevers; for the bath soothes the pain in the side, chest, and back; concocts the sputa, promotes expectoration, improves the respiration, and allays lassitude; for it soothes the joints and outer skin, and is diuretic, removes heaviness of the head, and moistens the nose. Such are the benefits to be derived from the bath, if all the proper requisites be present; but if one or more of these be wanting, the bath, instead of doing good, may rather prove injurious ... it is by no means a suitable thing in these diseases to persons whose bowels are too loose, or when they are unusually confined, and there has been no previous evacuation; neither must we bathe those who are debilitated, nor such as have nausea or vomiting, or bilious eructations; nor such as have hemorrhage from the nose, unless it is less than required at that stage of the disease (with those stages you are acquainted), but if the discharge be less than proper, one should use the bath, whether in order to benefit the whole body or the head alone. If then the proper requisites are at hand, and the patient is well disposed to the bath, it may be administered once every day, or if the patient is fond of the bath there will be no harm, though he should take it twice in the day...”

Among others, they recognized various types of hot and medicinal springs whose sulfurous waters refresh the human body. Pliny in *Naturalis Historia* tried to refer the powerful properties of water for humans, which are so numerous that no one could ever describe: “... *quapropter ante omnia ipsarum potentiae exempla ponemus. cunctas enim enumerare quis mortalium queat?*” (*Naturalis Historia* 31, 1-8). This roughly translates as follows: “...*It will be only proper, therefore, in the first place to set forth some instances of the powerful properties displayed by this element; for as to the whole of them, what living mortal could describe them?...*” He mentioned the presence of different kinds of waters springing forth from specific spots, cold or hot or even tepid with positive influence on human health, in fact curative for specific diseases: “...*alibi tepidae, egelidae, atque auxilia morborum profitentes et e cunctis animalibus hominum tantum causa erumpentes augent numerum deorum nominibus variis urbesque condunt...*” This roughly translates as follows: “... Then, again, there are others that are tepid only, or lukewarm, announcing thereby the resources they afford for the treatment of diseases, and bursting forth, for the benefit of man alone, out of so many animated beings...,” “...*vaporant et in mari fuere, mediosque inter fluctus existit aliquid valetudini salutare...*” This roughly translates as follows: “...*There are others, too, which send forth their vapours in the sea even, thus providing resources for the health of man in the very midst of the waves...*”, “...*Iam generatim nervis prosunt pedibusve aut coxendicibus, aliae luxatis fractisve, inaniunt alvos, sanant vulnera, capiti, auribus privatim medentur, oculis vero Ciceronianae...*” This roughly translates as follows: “...*According to their respective kinds, these waters are beneficial for diseases of the sinews, feet, or hips, for sprains or for fractures; they act, also, as purgatives upon the bowels, heal wounds, and are singularly useful for affections of the head and ears: indeed, the waters of Cicero are good for the eyes...*”, “...*In Campania, too, are the waters of Sinuessa, remedial, it is said, for sterility in females, and curative of insanity in men...*”, “... *in Aenaria insula calculosis mederi..... idem contingit in Velino lacu potantibus...*” This roughly translates as follows: “*The waters of the island of Aenaria are curative of urinary calculi,¹ it is said..... Patients suffering from these complaints may be cured also by drinking the waters of Lake Velia...*”, “...*iuxta Romam Albulae aquae vulneribus medentur, egelidae hae, sed Cutiliae in Sabinis...prope morsus videri possit, aptissimae stomacho, nervis, universo corpori...*” This roughly translates as follows: “... *The tepid waters of Albula,¹ near Rome, have a healing effect upon wounds. Those of Cutilia, in the Sabine territory...seem to be the best situation for stomach ailment, on the whole body...*”

5. Roman era

Along with the Greeks, the Etruscans, the people who lived in the area south of the Arno River, had linked individual hygiene and public health with the presence of clean water but with the immediate removal of dirt and excess water from very early. That's why they had developed the hydraulic art and had built plumbing facilities from very early, sophisticated, so that they were used as models by the Romans. Even Cloaca maxima in Rome was built by Etruscan engineers around 600 BC, while the first aqueduct in Rome in 312 BC is also attributed to them [30]. Also, the thermal baths of Etruria (Chianciano, Del Sasso), as well as the famous centers of Etruscan medicine, have been of a magical religious character.

Roman medicine, very much like Greek medicine, in parallel with its scientific base, was very strongly connected with religious influences and superstitions [6]. However, apart from a large number of doctors and physicians who developed the science and practice of medicine, the Romans' real contributions to healthcare are the hygiene and sanitation technologies, water sophisticated supply, and sewage systems. Hygiene in Roman era included baths and toilets in private and public buildings. The Romans developed the art of baths, which in every case had as an essential condition to the adequate supply of water and the presence of an efficient drainage system. Many of the baths were grandiose bands that operated until sunset and were open for the sick up to 2 hours and in the afternoon for the rest of the guests.

In addition to the baths, the Romans greatly promoted the use of natural hot springs scattered throughout the Empire [31]. Most of them had healing properties and could relieve various body or even insane sufferings. The fact that therapeutic bathing in medicinal and thermal springs provide relief for many complaints was very well-known since the Hellenistic period; nevertheless the Romans were the ones who developed systematically [32]. High-temperature springs were treated as a special kind of waters ages before the Roman era. In fact, some of them were considered to be sacred, with supernatural powers and special healing properties. In ancient Greek and Latin literature numerous well known thermal springs were reported. Many of them seemed to have components which give them different properties, and make them suitable for the treatment of different diseases.

The Romans built splendid baths on the sites of hot springs in all over the empire, where many people flocked in order to find healing or relief for their illness. This practice of them was certainly not free from their theocratic perceptions. Besides, Vitruvius recommended spots with natural water springs as the best choice for shrines dedicated to every god or goddess, especially to those connected to healing: *"...naturalis autem decor sic erit, si inum omnibus templis saluberrimae regiones aquarumque fontes in iis locis idonei eligentur in quibus fana constituentur, deinde maxime Aesculapio Saluti, quorum deorum plurimi medicinis aegri curari videntur. cum enim ex pestilenti in salubrem locum corpora aegra translata fuerint et e fontibus salubribus aquarum usus subministrabuntur, celerius convalescent..."* (De Architectura, 1, 2, 7). This roughly translates as follows: *".....Natural consistency arises from the choice of such situations for temples as possess the advantages of salubrious air and water; more especially in the case of temples erected to Æsculapius, to the Goddess of Health, and such other divinities as possessing the power of curing diseases. For thus the sick, changing the unwholesome air and water to which they have been accustomed to those that are healthy, sooner convalesce; and a reliance upon the divinity will be therefore increased by proper choice of situation..."*

Ages later, Caelius Aurelianus, a Roman citizen who lived in the fifth century AD in the town Sicca in the African province Numidia, supported the therapeutic use of sea bathing as a very relieving and curative body treatment. He suggested people to

lay in a bathtub full of hot ocean water the high temperature of which may maintain by dipping in flaming iron bars.

In the second century AD Galen, who linked healthcare with diet, use of water baths, and hygiene [30], did not consider at length with the benefits of bathing and spring waters. His medical references include the beneficial use of the thermomineral waters [32, 33], while he recommended the additional use of baths not by using hot waters. The water should be neither tepid nor icy, as it strengthens the whole body and makes the skin thick and tough [34].

Moreover, Pedanius Dioscorides, a Greek physician of the first century AD, suggested that a mixture of an equal measure of water and must (grape pulp) boiled over a soft fire until the water is used up has laxative effects for the human body. Talking about herbal medicine in his five-volume book *De Materia Medica* (5, 13), he also mentioned that for the same purposes, someone can mix an equal amount of sea water, rainwater, honey, and must, pour it out into another jar, and set it in the sun for 40 days.

6. Conclusions

The connection between public health, clean water, and sanitation has been explored since antiquity. Medicine in Classical and Hellenistic times became gradually more based on clinical observations and scientific investigations. Before that time advances, medicine was entirely confined to religious beliefs and rituals [35]. Since the sixth century BC, philosophy began to flourish in the Greek cities of the Aegean and the Ionian coast of Asia Minor. The environment was mature enough, and scientific medicine was enabled to be born. Physicians attempted to identify material causes for illnesses; in parallel, people never stopped flocking to sanctuaries so as to find succor for their illnesses. They usually preferred Asclepieia, which were located in areas with lush vegetation, rich, and fresh water.

Ancient authors many times commented about the influence of different kinds of water on people's health. Thus, they were all aware that waterborne infections have been among the main causes of people's deaths. The Romans believed that illnesses had a cause and that the bad health is connected to bad water and sewage. Both Greek and Romans were trying to improve the quality of water using settling tanks, filters, or boiling it, which was the most recommended of all existing methods.

Influenced by the advent and progress of philosophy in Classical and Hellenistic periods, sanitation and hygienic conditions and especially medicine became gradually more based on clinical observations and scientific investigations.

The role of water is crucial in the Hippocratic medicine. Specifically, what is shown here is that diseases are less frequent in cities with an eastern aspect, since the waters, which flow there, is considered to be healthier and more suitable for drinking.

In conclusion, although the above descriptions do not provide a complete picture of urban sanitation technologies in ancient Greece, they serve to illustrate the fact that such technologies were in use in ancient Greece since about 4000 years ago. These advanced technologies, developed originally in Minoan era, were subsequently transferred to the Mycenaean civilization and then the Archaic, Classical, and Hellenistic Greece. These sanitation and hygienic technologies were further improved during the Roman period formed, for example, a type of lavatory which survived with limited modifications for more than 1500 years. Based on historical and archeological evidences, the present-day progress in urban water technology as well as in comfortable and hygienic living is clearly not a recent development. The Greeks considered pioneers in developing the basic sanitation technologies in the

western world. They placed emphasis on providing an urban hygienic environment, with emphasis in a sustainable way since the prehistoric times.

Undoubtedly ancient Hellenic and Roman views contain excellent remarks on the role of the water and hygiene with regard to people's health. For that many of which have survived until modern times. Centuries later, in the late nineteenth century, the role of personal and public hygiene and water on people's health was really very well understood. The fact that hygiene technologies and safe drinking water are intimately tied to human health has been so perfectly conceivable that Lewis Thomas mentioned [36]: The connection between public health, clean water and sanitation has been explored since antiquity. Medicine in Classical and Hellenistic times became gradually more based on clinical observations and scientific investigations. Before that time advances, medicine was entirely confined to religious beliefs and rituals [35]. Since the sixth century BC, philosophy began to flourish in the Greek cities of the Aegean and the Ionian coast of Asia Minor. The environment was mature enough, and scientific medicine was enabled to be born. Physicians attempted to identify material causes for illnesses. In parallel, people never stopped flocking to sanctuaries so as to find succor for their illnesses. In the late Hellenistic period, the knowledge of the ancient world of hygienic matter was incorporated in legislative rules.

Ancient authors many times commented about the influence of different kinds of water on people's health. Thus, they were all aware that waterborne infections have been among the main causes of people's deaths. There is no question that our health has improved spectacularly in the past century. One thing seems certain: It did not happen because of improvements in medicine, or medical science, or even the presence of doctors, much of the credit should go to the plumbers and sanitary engineers of the western world [37].

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