

## **Prolegomena**

### **Water and Wastewater Technologies in Ancient Civilizations**

The rapid technological progress in the twentieth century created a delusion of almightiness and a disdain for the past. Past technologies and management practices were regarded to be far behind the modern ones. In water resources science, technology and management, the twentieth century signified major advances. At the same time, it gathered a great deal of unresolved problems, related to the adequacy of water supply and irrigation water and the protection from floods and droughts. In some areas, owing to the explosive population growth, such problems were intensified in an unprecedented degree. Moreover, new problems have arisen such as the contamination of surface and ground water. Naturally, intensification of unresolved problems led societies to revisit the past and to investigate well-tried and successful past solutions. To their surprise, those who attempted this retrospect, based on archaeological and historical evidence, were impressed by two things: the similarity of problems with modern ones and the advanced level of solutions, technological and management.

Thus, it is now well documented that most of the technological solutions related to water are not achievements of present day engineers but date back to two to four thousand years ago. These achievements include massive hydraulic constructions (dams, polders and levees), and urban systems for water conveyance (aqueducts) and removal (sewer and drainage systems). These hydraulic works reflect also advanced scientific knowledge, which for instance allowed the construction of tunnels from two openings (geometry, geodesy) and the transportation of water both by open channels and closed conduits under pressure (hydraulics). Related to this is the departing from the mythological and hyperphysical views of the world and the development of scientific theories and ideas, for instance for the hydrological cycle; this occurred for first time in history in ancient Greece by Ionian philosophers. Certainly, technological developments were driven by the necessities to make efficient use of natural resources, to make civilizations more resistant to destructive natural elements, and to improve the standards of life, both at the private and public level. With respect to the latter, certain civilizations developed an advanced, comfortable and hygienic lifestyle, as manifested from public and private bathrooms and flushing toilets, which can only be compared to the modern one, re-established in Europe and North America a century and a half ago. Technological developments were combined to advanced management practices that included water legislation and institutions both for the operation and maintenance of existing systems as well as for the construction of new works.

Apparent characteristics of technologies and management practices in many ancient civilizations are the durability and sustainability. For instance, there exist several ancient hydraulic works that have been operated for millennia, or are still in operation up to now. Also, there have been integrated management practices, combining both large scale and small scale constructions and measures, that have allowed cities to sustain for millennia. The notion of long-term durability is missed in present day engineering designs and constructions, whereas the notion of sustainability was re-considered only in the last couple of decades, yet its meaning being unclear and further explored to date.

With the increasing worldwide awareness of the importance of water resources management in the ancient civilizations, the responsibility for organizing 1<sup>st</sup> International Symposium on Water and Wastewater in Ancient Civilizations was undertaken by the International Water Association (IWA) Head Quarters a few years ago. The Symposium was organized by IWA, in collaboration with the Hellenic National Agricultural Research Foundation, the Hellenic Municipalities Association and

other national and international agencies, in Iraklio, Greece, from 28 to 31 October 2006. The aims of the Symposium were:

- (a) To reveal the cultural heritage in several regions of the world and to make visible the archaeological remnants of technologies which have contributed to the development of the existing technologies in water and wastewater management.
- (b) To describe and evaluate the old technologies, which on a long term may contribute to water and wastewater management systems and to the development of integrated methodologies.
- (c) To develop small systems based on old technologies using new equipment, which may be of great significance for water, wastewater and environmental management in the future, particularly in developing countries.

The main sessions of the Symposium were: (a) From mythology to water science; (b) Water resources management in the ancient world; (c) Ancient water resources technologies: aqueducts, cisterns, dams, and qanats; (d) Ancient stormwater and sanitary technologies; (e) Water uses, supply and irrigation; and (f) Old influences in modern water technologies.

The Symposium aimed at bringing together a wide body of knowledge from the newly emerged and expanding field of water and wastewater management technologies in ancient civilizations. Over 100 papers were submitted, out of which 93 (84 full and 9 short papers) were selected and included in a proceedings volume. This number of papers was impressive, particularly because most of the contributions do not originate from formal and funded research projects. Many authors were motivated by personal interest or even by hobby and made their contributions in parallel to their many duties and under the stress of their heavy workload. Apart from the number of papers and the quantity of information gathered and processed, several other things were impressive. The composition of the group of participants was a real interdisciplinary one, comprising more than 20 formal disciplines, with dominance of Engineering and Archeology but also including Life Sciences, Environmental Sciences, Health Sciences, Physics, Geosciences, Economics, and even Industry. The geographical coverage was wide beyond expectations, including all five continents with the prominence of Mediterranean and particularly the Ancient Greek and Roman worlds. The time frame of the conference themes extended from prehistorical to medieval and contemporary times; a few papers examined modern themes trying to trace old influences. Some papers had more philosophical and scientific, rather than technological, content, examining the birth and historical evolution of water sciences. The 30 papers included in this special issue are selected from the papers presented in the Symposium.

The following general conclusions were drawn in the final session of the symposium, in attempt to summarize the state of the art in the field and the symposium contribution:

1. The history of water science and technology is currently not widely known. Furthermore, it contains biased, inaccurate or inconsistent bits of information and has a lot of gaps. However, it is important to learn it better and several of its chapters should be revisited and better analysed.
2. There is interest on revisiting past water technologies and management practices, which is justified by the understanding of the diachronic similarity of problems and of the deadlocks and intensification of problems in the current situation. It is generally recognized that history is the best teacher for the future (the past is the key to the future) and that ancient civilizations developed advanced knowledge, wisdom and sustainable practices, which is useful to know.
3. History teaches that water management is important for the sustaining of civilizations and that sightless or insufficient management may result in civilization collapses. Particularly, civilization collapses have been resulted from inability to deal with climate changes (which seem to have been occurred several times in the past); persistent multiyear droughts;

destructive and recurrent floods or earthquakes that destroyed hydraulic infrastructures; and negative human impacts on the environment (deforestation, erosion, desertification).

4. History also teaches that many civilizations all over the world have developed magnificent technologies and management practices characterized by sustainability and durability (operation for millennia, as opposed to today's design horizons of 20-50 years); safety and security (as opposed to today's many insecure structures); and wise combinations of different scales projects and measures (as opposed to today's dominance of large- or mega-scale projects).
5. There is a lot to learn from ancient technologies and practices; the symposium was a successful first step and the continuation of this research will certainly suggest improved solutions for current and future problems.

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