

Water and Wastewater Technologies in Ancient Civilizations: Prolegomena

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, that 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 a Specialist Group on Water and Wastewater in Ancient Civilizations was undertaken by the International Water

Association (IWA) Head Quarters a few years ago. The provisional objectives of the Group are:

- (a) To study water and wastewater technologies from ancient civilizations with a potential to be adapted and utilized for countries under stress;
- (b) To reveal the cultural heritage in several regions of the world to make visible ancient technologies which have contributed to the development of the water sciences; and
- (c) To identify research needs for the future improvement and water and wastewater practices, which in a long term may contribute, to the development of integrated methodologies.

In parallel, three years ago, the 1st IWA International Symposium on Water and Wastewater Technologies in Ancient Civilizations, was announced. The Symposium was organized by IWA, in collaboration with the National Agricultural Research Foundation, the Hellenic Municipalities Association, the Prefecture of Iraklio, the Hellenic Union of Municipal Enterprises for Water Supply and Sewerage, and other national and international agencies, in Iraklio, Greece, from 28 to 31 October 2006. The aims of the Symposium are:

- (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 themes of the Symposium are:

- (a) Methods and techniques of water management
- (b) Farmers and citizens: the socio-economic role of water
- (c) Water use
- (d) Wastewater and stormwater technologies
- (e) Historical development of water technologies
- (g) Ideology and the Power of Image: water as symbol

The Symposium aimed to bring 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 are included in this volume. The papers have a wide geographical coverage: Asia (Japan, China, India, Sri Lanka, Iran, and Near East), America, Africa and Mediterranean, with the prominence of the Ancient Greek and Roman worlds. The time frame of the themes presented in the papers extends from prehistorical to medieval and contemporary times; a few papers examine modern themes trying to trace old influences. Some papers have more philosophical and scientific, rather than technological, content, examining the birth and historical evolution of water sciences.

We are impressed by the information gathered and processed by all authors of the papers. Some of the papers are of very of high quality – but not all of them. Despite the efforts of reviewers and the members of the Organizing and the Programme Committees, it was very difficult to bring all papers into a high level, particularly in terms of language. We hope that the readers of this volume will tolerate an occasionally lower level of processing and presentation of the information given. We did the same deliberately, for two main reasons. First, we found it very useful to collect as many information bits as possible with the widest coverage. With think that in this initial, exploration phase of research, this is more important

than the language and the quality of presentation. Second, we are aware that 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.

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