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Dall'Aquila a Stoccolma...

Il Qanat nel deserto del Kavir

Il programma intensivo MathMods



L'area di Sahrae Jelay, nei pressi di Shahrood

Scienze ambientali

Multidisciplinary investigations in the Qanats of the Kavir desert (North-Eastern Iran)

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The term qanat refers to ancient systems for the transport of water in desert areas. Found in many parts of the Near & Middle East, as far as North Africa, they are most prevalent in Iran in terms of number and typology. New, multi-disciplinary studies have been embarked upon in collaboration with the University of Shahrood for research into the many qanats in the region and the bordering karst areas, which are the primary source of groundwater recharge for these hydraulic works.

Con il termine di qanat sono indicati arcaici sistemi per la conduzione di acque nelle aree desertiche. Presenti in moltissime aree del vicino e medio oriente, sino al nord Africa, trovano in Iran una delle maggiori espressioni, numeriche e tipologiche. Con la collaborazione dell'Università di Shahrood sono state avviate ricerche multidisciplinari per lo studio dei molteplici qanat presenti in quella regione e nelle aree carsiche limitrofe che costituiscono, nei fatti, le principali fonti di approvvigionamento dei bacini acquiferi pertinenti tali opere idrauliche.

The term qanat, also transcribed as kanat or ghanat, generically refers to an ancient hydraulic system implemented for irrigation purposes in desert areas and is known as such throughout Iran. However, this type of irrigation system is also well known in Libya, Algeria, Morocco and Tunisia and in Egypt under the terms of foggara or rettala. Here however, the term used is manafis, while in Oman such systems are known as aflaj and in the

Turfan depression in China they are known as karez (or kariz). And not only here - identical structures with the same function and local names have also been reported in Iraq, Syria, Lebanon, Yemen, Turkey, Turkmenistan, Afghanistan and Pakistan. Some have also been identified in the desert areas of Mexico, and from their identical structural configuration and functionality it is clear that these were created in this specific location thanks to technology impor-

ted by Spanish colonisation. They have in common several assumptions, that is the fact that they are to be found in desert areas and that they consist of long underground channels (often tens of kms in length) that are easily identifiable from the outside, with an orderly series of wells in close succession. The primary water table having been intercepted by a primary well that was often tens of metres deep, the water was channelled to the bordering plains via a tun-



La torre dell'orologio che è anche simbolo dell'Università di Shahrood



L'interno di un qanat in attività

nel, that was sometimes lined (Rings of clay or cement of variable thickness, known by the Persian name of 'kawals' are used as tunnel wall and roof support, especially in the presence of unconsolidated soils), and just under two metres in height. The underground channel prevents water evaporation and transports it directly to the oasis where it is used wisely and sparingly, in accordance with regulations, processes, procedures and secular methods. Thus the oasis, the desert and the qanat are the individual components of a single element and the expression of a specific reality not to be found in any other location. In this perspective, Iran occupies a position

of significant importance and, generally speaking it was thought, until fairly recently, that this specific type of hydraulic work originated in this very part of the Near East, where of the many areas, the region of Semnan, and in particular the province of Shahrood, where the phenomenon is very diffused and there are a high percentage of fully functional structures, held special significance. This region is situated in Eastern Iran, between the northern margin of the Dashtë-Kavir and the eastern Alborz Mountains, in a peculiar lithological and geomorphological context presenting a series of openings that are indicative of the location of the access shafts

to the underground channels. The fundamental contribution of the University of Shahrood (Without the essential cooperation of the University of Shahrood, with its generous hospitality and fundamental support in making available its logistics equipment, this collaboration would not have gone ahead. The University Polytechnic of Shahrood is one of Iran's most prominent Universities, with an educational and logistics structure of great significance and importance. The Department of Environmental Science of the University of l'Aquila and the Institute of Chemical Methodologies of the Italian Research Centre jointly prepared a Memorandum of Understanding for qanat research and which envisages,



Lo sbocco di un qanat nei pressi di Chah Cham

in particular, the study of the vast karst area of the Tapal Mountain. We would like to extend our thanks to Prof. Ali Moradzadeh, Chancellor of this University, to Mr. Ali Younesian and to Prof. Gholan

Hossein Karami, who planned and implemented this collaboration) has allowed for the implementation of the first research studies into the first general reconnaissance for the definition of the investi-

gation areas. In this respect, several qanat were explored and three areas were identified for conducting a series of in-depth investigations and registering the hydraulic works uncovered on

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special index cards. The vast area covered by the planned investigations is situated south of the Alborz mountain range in northern Iran and consists of Quaternary-Neocene deposits such as conglomerates, sands and clays, which present clear

aspects of fluvial sedimentation and of braided alluvial fan in particular.

The city of Shahrood is dependant on underground water, primarily on water channelled by ancient qanats and, in periods of greater demand, on the integra-

tion of recently-constructed wells. The location of the Shahrood qanat, consists of a degraded flood plain extending from west to south-east. This is bordered by the peaks of Mount Shahvar (3945 m) to the north-north west and of Mount



I peculiari aspetti morfologici del deserto del Kavir

Tapal (2815 m) to the south. These peaks are part of the aforementioned Alborz Mountain range. There is a watercourse with supercritical/ephemeral flow (Mojen), with a course roughly parallel to that of the qanat. The latter develops horizontally for approximately 25 km, with a distance between the highest and lowest points of 385 m with a 1.5% gradient. The final section of the plain presents clear evidence of various, abandoned qanat, which appear to have been built in different periods to drain water from the eastern and southern buttresses of Mount Tapal and Mount Shahvar respectively. This latter range presents Ordovician schist and sandstone,

Silurian basalt, Devonian and Carboniferous schist, sandstone and limestone, Permo-Triassic limestone and Eocene volcanic deposits. This is the main groundwater recharge area. In fact, these peaks block the damp currents from the Caspian Sea, promoting precipitation. The Tapal Mountain range consists of Jurassic schist and sandstone, Jurassic-Cretaceous limestone and Eocene limestone and tuff. This area contains clear evidence of karst phenomena and it would appear that this is the main recharge area for the alluvial groundwater used by the qanat.

The first preliminary/research campaigns have highlighted two

main topics that require further investigation. The first relates to providing an improved definition of the hydrological and hydrogeological aspects of the area, for the purposes of the possible numeric modelling of the groundwater tables in which the qanat were built in order to improve the functionality of these water collection systems. The second topic requiring further investigation is the development and the importance of these works over time and in the social and economic context of these areas.

One significant aspect, requiring further investigation, came to light in the area behind the village of Shahrood, known as Sahrae Jelay, situated along one



Angelo Ferrari

of the most interesting sections of the Silk Road, dotted with noteworthy fortified structures, among which a particularly imposing tell, and an abundance of scattered pottery.

Paleoclimatic interpretation of the sedimentary series studied suggests the following:

- the most recent alluvial cone deposits were deposited under conditions of strong morphological instability caused by the lack of vegetation as a direct result of the exceptionally dry climate;

- the silts which make up the plain were deposited during a period of greater morphological stability: it can therefore be deduced that there must have been vegetation on the surrounding slopes and that there must have been fairly regular rainfall;

- the red tinge of the deeper alluvial deposits implies that in some distant period there must have been a groundwater table near the natural surface level. The disappearance of this groundwater table can be attributed to both climatic changes and to excavation of the various qanat that cross the area and that may have drained it of water.

It is therefore possible that alluvial silt deposits were deposited during the most humid phase that was typical of the first half of the Holocene period (approximately 10,000 to 50,000 years ago), while the coarser, alluvial cone deposits date to the next period. The many remnants of mediaeval pottery are to be found scattered on evident deflation surfaces formed after the

alluvial silt has been swept away, the very same surfaces that present as a typical desert pavement in the surrounding areas. The surfaces are in fact characterised by concentrations of small pebbles, which were originally encompassed in the silt: the wind manages to sweep away the silt but is unable to remove it so that it rests on the deflation surface, accumulates and forms the typical desert morphology. The same applies to the fragments of pottery: since these would have been encompassed within a fine deposit or would have rested on a silt surface, the action of the wind eroded the ground without removing the pottery, which now rests atop those alluvial deposits that are less prone to erosion. This interpretation implies that

the settlement from which the pottery originates must have been located on ground that has now disappeared and which, presumably, could be cultivated. Deflation is a sure sign of soil aridification and this phenomenon can be attributed to climatic changes, however the movement of the groundwater table to greater depths, also associated to excavation of the qanats, could have put any wells used for irrigation out of use. In any case, both the excavation of qanats and aridification would have taken place at a subsequent date to that of the settlements from where the pottery originates.

Last but not least, the research project did not overlook the possibility of salvaging these structures, even for cultural ends, or

the conservation of these structures for possible future itineraries of a cultural and tourist nature. In particular, a valorisation model for the most important qanat will be developed via their inclusion in historical and cultural heritage programmes for those areas presenting these ancient and complex hydraulic works. This programme will attempt to sensitise local authority and public interest, already focused on the preservation and maintenance of their qanats, to the possibility of considering the qanat as one of the elements to be used in terms of tourism. These ancient water supply systems for desert areas could be successfully considered within a cultural tourism and study tourism circuit, to allow people

to get to know the fascinating qanat area in terms of its landscape and anthropogenic transformation, particularly oasis settlements. We could make a feature of the agricultural products cultivated in areas to which the qanats provide irrigation water, with a possible focus on particular indigenous cultivars and above all the identification of a parallel oasis food itinerary. A further interesting consideration with regard to the province of Shahrood, lies in the fact that the cultural and tourist itineraries of the qanats in this area could be easily linked to the major archaeological and monumental complexes situated along the Silk Road, so that the individual itineraries could be integrated into wider ranging circuits.



Ezio Burri, Andrea del Bon e Carlo Giraudi tra due collaboratori di Shahrood