
NEW PERSPECTIVES ABOUT IRON AGE AND THE OASIS CULTURE IN THE OMAN PENINSULA. TWO CONCLUSIVE SEASONS AT AL MADAM (SHARJAH, UAE)¹

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ABSTRACT

In the course of the last two seasons of work (2010-2011 and 2011-12) at al Madam Site (AM 1 and AM2) the Spanish archaeological team working in Sharjah since 1994, has got unexpected results concerning to the economy and culture of the Iron Age villages, that we just knew. For example, we can study the use of the environment in order to collect building materials or the nature of farmlands. Before the provisional closure of our work in al Madam, we find some news aspects about Iron Age communities in the Oman Peninsula.

RESUMEN

En el curso de las dos últimas campañas (2010-11 y 2011-12) en al Madam (AM 1 y 2) se han obtenidos inesperados resultados en dos áreas de la economía y la cultura de los poblados apenas conocidas hasta hoy. El uso del entorno para reunir material de construcción y la naturaleza de las explotaciones agrarias. Al cierre provisional del yacimiento encontramos aspectos novedosos sobre la Edad del Hierro en la Península de Omán.

KEYWORDS

Oman Peninsula, Iron Age, mud-brick, mud-brick working area, falaj, gallerie de captage, network chanel for agriculture.

PALABRAS CLAVE

Península de Omán, Edad del Hierro, adobe, área para la elaboración de adobes, falaj, gallerie de captage, red de acequias para la agricultura.

This paper² pretends to present a general assessment of the work carried out during the last two archaeological seasons in al Madam –an oasis located in the piedmont of the Oman Peninsula, UAE–: the season of 2010 and the one of January and February of 2012 (Fig. 1).

¹ I would to express my gratitude to His Highness Dr. Sheikh Sultan Al Qasimi, Ruler of Sharjah, who has always shown the utmost kindness to the archaeological missions in Sharjah. Similarly, I wish to express special thanks to Dr. Sabah Abboud Jasim, Director General of Antiquities of Sharjah, for his constant and friendly support to the Spanish mission. Also my thanks to Mr. Aissa Abbas, archaeologist of the Sharjah Archaeological Museum, for their friendship and cooperation. Always, but especially why collaboration has given me for this article, I want to express my gratitude to Prof. Dr. Hans Peter Uerpmann, University of Tübingen. The Spanish archaeological mission also receives institutional and economic support of the Ministry of Education and Culture of Spain and the Autonomous University of Madrid. My sincere thanks for everybody.

² This paper was presented at the 8th International Congress on the Archaeology of the Ancient Near East, held between April 30 and May 4 at the University of Warsaw. For various issues I could not deliver it on time for publication in the proceedings, which is why I do it now here.



Fig. 1. Top, right, general map of the United Arab Emirates and the situation of the oasis of the Madam (1). Bigger, the new village of the Madam (2), the village of Sa'biyya (3), central area of the town of AM I-Thuqaibah, currently being excavated (4), the House 6 and the mud-brick working area (5) the situation of the excavated sector of the falaj or underground gallery (6), old crop area and ditches (7) (Preparation of the map: M. Mañé, Spanish Mission in Sharjah).

According with the research lines followed in al Madam since 1994, these conclusive seasons have succeeded in clarifying two essential features of the culture and economy of the oasis during the Iron Age: the first one, the nature of the agriculture and its relationship with the hydraulic architecture; and the second one, the techniques involved in the exploitation of resources for the production of building materials.

Both subjects are original contributions for the archaeology of the area. It seems likely that these systems may have existed also in other sites –and they will be possibly discovered soon–. However, and for the first time, the Spanish archaeological team has brought them to light, establishing the function of these structures and giving a precise chronology of them.

1. INTRODUCTION

In 2006, during the ICAANE that took place in Madrid, I reported the state of the research at that time³. Among other things, I did mention two significant finds that we had started to study in that moment, and which we provisionally dated to the second half of the Iron Age.

³ J. M^a Córdoba.- “Informe preliminar sobre las últimas campañas en al Madam (2003-2006)”, en J. M^a Córdoba et al. (eds).- *Proceedings of the 5th International Congress on the Archaeology of the Ancient Near East*, Universidad Autónoma de Madrid, Madrid 2008, 493-508.

Both finds seemed to answer two questions not solved then. Firstly, in a sandy and desert environment, how did the inhabitants of the villages of the oasis produce the building materials that they needed? And secondly, considering the lack of permanent rivers and the poor rainfall, how could be possible to provide all the villages with the resources required ensuring the agriculture, which is well attested by the tools found inside the houses? Well, two discoveries seemed to have responded to these issues. The confirmation of its validity is the subject of this article.

The first of these important finds was called Mud-brick Working Area (MWA 1), whose discovery was initially related only with the so-called House 6. In order to find the foundations of the building and verify the depth of the rocky natural soil, we made a sounding close to the East wall of the house. At that point, we found evidences of piles of material ready to be mixed inside several basins made into the rocky soil (Fig. 2).

One of these basins, which was still filled with its petrified content, preserved the footprints and handprints of the people who had worked there. Only a few potsherds pointed out to the Iron Age, while the stratigraphy of the House 6 and the mud-brick fragments from the pile of material confirmed this date (Fig. 3).

The enlargement of this sector –announced in 2006– turned the so-called MWA into an area of 5x10. Our first impression was that this working area was aimed at producing the mud-bricks and plasters of House 6. However, each enlargement showed us that the area increased towards North, East and South (Fig. 4). A network of small chanel distributed the necessary water. In addition, we were amazed by the nature of the area we recorded: the whitish natural bedrock could be easily kneaded -and mixed with gravel and fragments of mud-brick- when gets damp with water. This feature explains how these Iron Age peoples were able to produce their typical whitish and hard-wearing mud-bricks at the gateway to the Rub al Khali and its impressive dune fields.



Fig. 2. View of the House 6, to the south. To the right of the wall W, seated on the natural bed rock, it appears bluff down. Immediately distinguishes what would be revealed as the beginning of the MWA 1 (photo: Spanish Mission).

Fig. 3. View to the East of the first excavated sector of the MWA 1 at the beginning of its discovery. They are clearly the pile of broken bricks and other materials, kneading basins and water reserve pit (photo: Spanish Mission).

Fig. 4. View to the South of the MWA 1 at the end of another season. To the right is the main channel that brought water (photo: Spanish Mission).

Even though the function and dates of the structures were quite obvious to us, and consequently we made our suggestions known in several conferences and publications⁴, some colleagues expressed their reservations about our interpretation. They proposed an agricultural use of the basins, which in my opinion is incomprehensible⁵. This proposal was excluded already then because. The evidences of the function and the Iron Age date of this MWA were clear⁶. Furthermore, the last seasons have provided more evidences an answer to more questions, for instance: how the network of chanel that supplies water to the basins was fed? It was a communal system or it was intended as a restrictive area used by some of the adjoining buildings, as the House 6? Why the presence of significant pottery has been so unusual in the area?

The second significant find presented in the Iron Age and the Iranian World Conference (2005)⁷ and in the Madrid ICAANE (2006) was the first information of the *falaj*, more properly named *galerie de captage*⁸, which we provisionally dated to the Iron Age. It was the first time that someone had entered inside an underground gallery of this period and that had recorded its appearance and its construction techniques.

⁴ J. M^a Córdoba.- “The Mudbrick Architecture of the Iron Age in the Oman Peninsula”, in F. Baffi et alii (eds.), *Ina kibrat erbetti. Studi di Archeologia orientale dedicate a Paolo Matthiae*. Roma, 2006, 95-110. “Al Madam (Sharjah) in Eisenzeit. “Die Gründe der Wasserbaukunst und der Architektur nach den letzten Arbeiten”, paper presented to the *4th International Congress on the Archaeology of the Ancient Near East*, Berlin, April 28th-May 4th, 2004., *ISIMU 9* (2006), 241-258. M^a C. Del Cerro.- “Grundgestein und Baustoffe in AM1 Thuqaibah (Sharjah, VAE) in der Eisenzeit. Eine intakte Anlage zur Herstellung von Lehmziegel”, in H. Kühne et alii.- *Proceedings of the 4th International Congress of the Archaeology of the Ancient Near East*, Berlin: 43-50. J. M^a Córdoba.- “L’architecture domestique de l’Age du fer (1300-300 a. C.) dans la Peninsule d’Oman: quelques documents sur les villages et la culture des oasis”, in A. Avanzini (ed.).- *Eastern Arabia in the First Millennium BC*. L’Erma di Bretschneider, Roma 2010, 143-157. Vid. 152-155.

In the course of the *Second International Conference on the Archaeology of the United Arab Emirates. Fifty Years after Umm an-Nar*, held in Abu Dhabi (1 to March 4, 2009), I presented a paper on the subject, accompanied by lots of documentation to prove it. In the brief discussion that followed, a colleague proposed an “agricultural function” of the area. He thus suggested an untenable interpretation with archaeological evidence developed *in situ*. Probably the startling novelty of our proposal it was difficult to accept. At the same time, the evidence of a mud-brick working area at Madam assumed that something similar should have been discovered before in other sites. Because our finding is that we always excavated until the natural soil or the bed-rock, a basic archaeological methods not common in the archaeology of the region until a few years ago.

⁵ J. M^a Córdoba.- “Al-Madam 1-Thuqaibah (Sharjah, UAE): Recent Findings in the Mudbrick Working Area”, in **D. T. Potts (ed.)- Fifty Years of Emirates Archaeology, Abu-Dhabi**141-147.

At the Conference on *The Iron Age in the Iranian World*, held at the University of Ghent, Belgium, from 17 and November 20, 2003, C. del Cerro and I presented a paper entitled “Archéologie de l’eau dans Al Madam (Sharjah, UAE). Puits, aflaj et sécheresse pendant l’Age du fer”. This paper was generally accepted. Subsequently it was published in *Iranica Antiqua XL* (2005), 515-532.

⁶ R. Boucharlat.- “Les galeries de captage dans la péninsule d’Oman au premier millénaire avant J.-C.: questions sur leurs relations avec les galeries du plateau iranien”, *Journal of Achaemenic Studies and Researches* 11 (2000), 157-183. “Iron Age Water-draining Galleries and the Iranian Qanat”, in D. Potts, H. al Naboodah, P. Hellyer (eds.).- *Proceedings of the First International Conference on the Archaeology of the U.A.E.*, Zayed Center for Heritage and History, Abu-Dhabi 2003, 161-172.

⁷ A. Benoist, M. Mouton.- “L’Age de Fer dans la plaine d’al Madam (Sharjah, U.A.E.) : prospections et fouilles récentes”, *Proceedings of the Seminar for Arabian Studies* 27 (1994), 59-73.

⁸ Having overcome the initial surprise at this zig-zag track, according to the theory (a *falaj* must be perfectly straight), we conclude that it was due to the difficulty of maintaining an underground gallery straight, digging from two points simultaneously. By contrast, when both digging in two directions intentionally deflected to the right or the left, it is easier to meet at the same point at some time. So we have said on many occasions to many colleagues. It was our obvious conclusion, the only ones we have found a gallery like this. The

Since the prospection of 1993⁹ and the confection of the archaeological map, several lines of whitish hills were identified in the area. These hills, which were heading towards the oasis, are accumulations of the rocky soil extracted from the natural bedrock. Initially, it was thought that these piles of material marked the wells of the underground galleries of various Iron Age *falajs*. By making some soundings into several of these hills, we found only a few potsherds of this period. However, it was necessary to excavate.

In my previous reports, I did detail the discovery of a gallery into the sector AM2. We opened a large sounding 2 km far from the oasis (Fig. 1), finding a number of wells. After excavating some of them, we reached the underground gallery, which surprisingly described a zigzag pattern¹⁰. This gallery was cut into the natural bedrock –the same rocky soil used to produce the building materials and in which the production process took place–.

At a some moment, this gallery (160 cm high and 50 cm wide) must has been dugged down again, becoming finally a very narrow gallery of almost 4 m high (Fig. 5). Years ago, G. Weisberger had witnessed a similar work of a contemporary *falaj* because a drought and

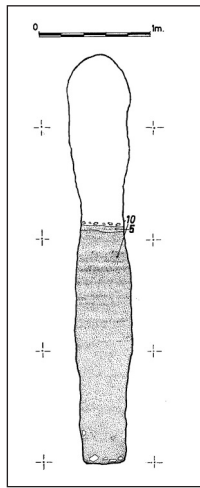
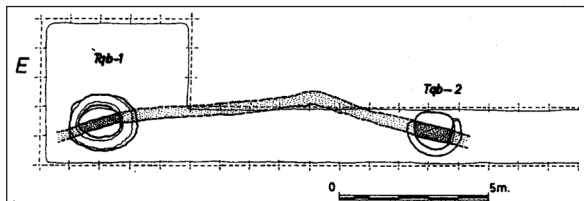


Fig. 5.1. Drawing section of the underground gallery next to Well 1 (drawing: M. Á. Nunez).

Fig. 5.2. Final view of a section of the underground gallery. Note the angular layout. On the background, the light from one of the wells (photo: Spanish Mission).

Fig. 5.3. Beginning of the zig-zag path of the gallery, between wells 1 and 2 (drawing: M. Á. Nunez).



attribution of this theory to another person is incorrect or at least incomplete, as quoted in an article which I am also a signatory. Certainly want to mention that I accepted the invitation to participate in this work in tribute to Serge Cleuziou with my friends and colleagues M. Mouton and A. Benoist, with thanks to my friends and in memory of Prof. S. Cleuziou. The article is excellent except for two issues, which did not share at the time (as I said to my colleagues) and share now. I point out in this note because I feel obliged: only mission I lead knows perfectly -why we date it correctly from the beginning- the *falaj* AM2, not who dated it hastily in the Islamic period and spread so who wanted hear him without consulting us. I further understand that the zig-zag path has nothing to do with the religious worship of snakes. The ancients could not have thought so complex, and less apply it to something as problematic as an underground construction. In my opinion the zig-zag is a simple practical decision. Thus: M. Mouton, A. Benoist, J. M^a Córdoba.- “La serpent, gardien du cuivre et des eaux de la montagne d’Oman?”, in J. Giraud, G. Gernez, V. De Castéja (eds.).- *Aux marges de l’archéologie. Hommage à Serge Cleuziou*. De Boccard, Paris 2012, 387-401. Vid. 396 y 399.

⁹ G. Weisgerber.- “Mehr als Kupfer in Oman”, *Der Anschnitt* 33, 5-6: 174-263.

¹⁰ This was well documented in a paper presented at the *Seminar for Arabian Studies* held in London between 22 and 24 July 2004. The paper “The so-called *falaj* from area AM2, Thuqeibah (Sharjah, UAE). Archaeology and questions arising from the 2004 season”, was signed by J. M^a Córdoba, Maria C. del Cerro, M. Mañé and M. Pozo. The acceptance of what was presented and documented was general.

the fall of the water tables¹¹. At al Madam it seems that we are facing the same situation, but more than 2500 years ago.

Even though there were no potsherds for dating our gallery, the construction techniques, the ways to access or the traces left by the tool were coincident with the ones found in the wells of the village: so then, an iron Age date was proposed¹². However, some colleagues have said that this structure should be Islamic¹³. In my opinion this statement was completely unfounded and prejudiced. Then, and in order to refute this interpretation and definitely clarify the situation, I considered essential trying to verify the connection between the *galerie de captage* and the agricultural area to whom the water was supplied. Agricultural area in which we should find distinctive evidences of the date of use of the structure. This is important because the original and significant discovery of the gallery, in itself, did not solve a few questions: was the gallery really excavated and used during the Iron Age? Where is its way out? Maybe in a cistern? Or perhaps the gallery ends in a network of chanel, like in Iran or the Oman Peninsula nowadays. Could we think on an irrigation system for an agricultural area even in that period?

These questions and the ones mentioned for the working area have already been successfully answered. For this reason, we are now able to give a new perspective about the construction abilities, the control of the environment and the nature of the agriculture in the Oman Peninsula during the Iron Age.

2. THE MUD-BRICK WORKING AREA: A COMMUNAL SYSTEM OR A SPECIALIZED SECTOR?

During the last seasons we did enlarge the MWA towards North and East in order to define the whole area, delimited by the edges of the rocky platform. The consecutive enlargements revealed a great number of basins, areas for the extraction of the construction material, a well-established network of chanel for the water supply, some reserve wells, mud-brick *in situ* and many potsherds that definitely dated the use of this area to the Iron Age II-III. Even though we found the key to understand how the sector functioned in the southern area, which was covered by modern gardens.

We achieved the delimitation of the entire MWA during our last season of fieldwork. We also started the conservation project of this complex, which we will integrate into an archaeological park. The exceptionality of this area make necessary to protect it. It is a singular evidence for the Ancient Near Eastern archaeology.

¹¹ In a quick visit to our archaeological site, made when in UAE news spread that the Spanish mission had found an underground gallery or *falaj* of the Iron Age, a well-know specialist concluded -despite much evidence against- that it was an Islamic construction. So spread it, conditioning the same prejudices that had been questioned before the discovery nature of the mud-brick working area. Later, our dating has been confirmed and our finding is cited among the structures of the Iron Age. But I do not know, it has been an admission of error or apology, even if we have had some problems because of such prejudices, main reason I remember the circumstances now and here

¹² M. Pozo, J. Casas y . A. Martín Rubí.- “Estudio mineralógico, químico y textural de materiales y elementos arqueológicos en asentamientos de la Edad del Hierro del oasis de al Madam (Emirato de Sharyah, EE.AA.UU)”, *ISIMU* 2 (1999), 605-634.

¹³ A. A. Kubba.- *Mesopotamian Architecture and Town Planning from the Mesolithic to the end of the Proto-historic Period c. 10,000-3,500 B.C.* BAR International Series 367, Oxford 1987, 98. D. G. Youkhana.- *Tell es-Sawwan. The Architecture of the Sixth Millennium B.C.* NABU Publications, London 1997, 44-45.

The initial area of 50 m² has turned into a working installation of 35 x 26 m that exceeds the 900 m² and that is dated to the Iron Age II-II. I did not know any similar structure, not even dated to the previous period (the Bronze Age), neither in the Oman Peninsula nor in other Near Eastern regions. Consequently, we have not parallels except for the future finds that will be discovered in homologous villages (Fig. 6).

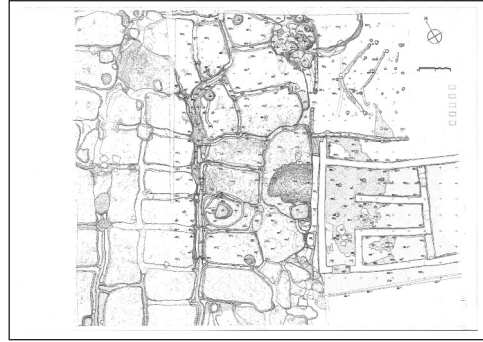


Fig. 6.1. General view of the Mud-brick Working Area 1 at the end of the season in February 2012 (photo: Spanish Mission).

Fig. 6.2. Partial drawing of the manufacturing area, immediately to the 6th House. Distribution channels down from the well at the bottom of the picture, not included in this (drawing M. Á. Nunez).

The lack of clayey soils –clayey soils are common for other Near Eastern regions– did force the Iron Age inhabitants of the oasis to make use of the rocky natural soil; a solid layer extended 1 m below the surface. That characteristic is also the reason why we did not find ancient areas of mud-brick production in the clayey regions, but we found in the oasis area. Because the conditions in oasis area of the Oman Peninsula are very different. When the rock gets damp turns into an easily moulded material, which mixed with sand and gavel becomes a suitable raw material to produce tough mud-bricks¹⁴.

In the southern sector of the area we found a 5,60 m deep well cut into the rock. This well supplied water to the channel network. Its shape, ways to access and tool traces make it completely similar to the one found between the houses of the village years ago. It seems that there are some holes around the mouth of the well that could have held a wooden structure. This structure may have been used to take out the water and distribute it into a sink and a principal channel. Two main channels structured this distribution system, and by taking advantage of a descend slope South-North, they distributed water into the basins. The enlargement of this area in the Antiquity towards North and East should have been progressive, but always using the slope in order to guarantee the flow of water. In addition, they did open new basins and expand the channels when some of the basins had reached a certain depth. These old structures were abandoned and their surface was used to dry the mud-bricks.

Subsequently, when this area was abandoned it consisted in: one well that supplies the water to the distribution system; two main channels of distribution; 64 basins; two extraction areas with tool traces; drying areas; mud-bricks *in situ* and hundreds of human

¹⁴ Thanks to our collaboration with Prof. H. P. Uepmann, Dr. B. Kromer carried out the analysis of these shells in Mannheim, suggesting the following dates: between 1160 and 882 BC (with the 68% probability), or between 1160 and 808 BC (95 % probability).

footprints and handprints. In addition, the exceptionality of this area has been reinforced because of the ceramic evidence: we finally found several potsherds close to the well that dated the structure to the Iron Age II-III (Fig. 7).

It is clear that this working area had been in use while the water supplies made possible the exploitation of the rocky soil. The abandon of this sector should be related to the moment when the well ran dry, as a result of the fall of the water tables. The well of the village and the galleries of the *falaj* also attest this crucial moment.

Consequently, at a certain moment it was necessary to abandon all the structures. The sun had dried the soil, which recovered then its rocky nature. The evidences of the use of the area were preserved, although the dunes would cover them soon. This is the reason why we conserve the print of the people who presumably worked in the MWA1.

A team of paleoanthropologists of the Universidad Autónoma de Madrid are carrying out a working method based on the individualization of the human prints. They are trying to suggest a total number of prints, as well as to identify their individuals (including age, weight, height or sex). We hardly have reference works in this field, which means that this is a very thorough job that will provide a curious and interesting view of the Iron Age peoples.

Another important subject to discuss is the dimensions of this MWA1. It is clear that this was not a small area destined for the building of House 6, as it seemed at first. Due to the enormous surface of the area, it is worth considering if this production of mud-bricks and plasters may have also supplied to more distant houses. The mud-bricks are usually fragile. However, if they are well tied and transported by donkeys, does not involve any problem. Max Oppenheim witnessed a similar situation in tell Halaf, when the local people constructed the house of the German mission (Fig. 8); this is possibly the same case that we have in al Madam. It is true that we found some basins and evidences related



Fig. 7. Fragments of a typical Iron II-III pottery, found in situ beside of the well that gave water to the work area (photo: Spanish Mission).



Fig. 8. Transport of bricks for the construction of the house of the German mission at Tell Halaf, in 1911 (photo: O Seemann?) (N. Cholidis, L. Martin. – *Die Geretteten Götter aus dem Palast vom Tell Halaf*. Berlin 2011, p. 112, photo 62).

to the exploitation of the natural soil close to other houses of the archaeological site, for instance House 4, 2 or 3. But the magnitude of these remains is minor, which probably implies that they needed complementary material.

Then, if we were talking about a communal use of this working area, it might be wondered whether specialized workers were producing the construction material for the whole village –as in the V millennium the masons of Tell es Sawwan¹⁵–, or on the other

¹⁵ M. Wuttman.- “Les qanāts de ‘Ayn-Manāwīr (oasis de Kahrga, Égypte)”, *Journal of Achaemenid Studies and Researches* 11 (2000), 109-135.

hand, if the ancient inhabitants themselves used the MWA1 according to their needs. Unfortunately, this is still an unresolved question, although the current study of the human prints may bring us closer to an answer.

3. THE IRRIGATION CHANEL NETWORK AREA (ICNA) AND ITS CONNECTION WITH THE *GALERIE DE CAPTATION*: AN AGRICULTURAL IRRIGATION SYSTEM

Once we had found the underground gallery of the sector AM2, the main objectives of last seasons were: to clarify the nature of its way out and its connection with the agricultural land, as well as try to verify the date proposed.

Both, the aerial pictures and the surface surveys would suggest that the underground gallery should emerge to the surface at about 800 m distance to the already excavated sector. It is on this area, not far from the ancient village and the modern oasis, where the hills, those accumulations of rocky soil extracted from the natural bedrock, disappeared (Fig. 9). This plain was partially delimited by a semicircle of small hills; in addition, we did not find any potsherd there. For these reasons, it seemed to be an ideal place for agricultural purposes, and it is apparently what it was.

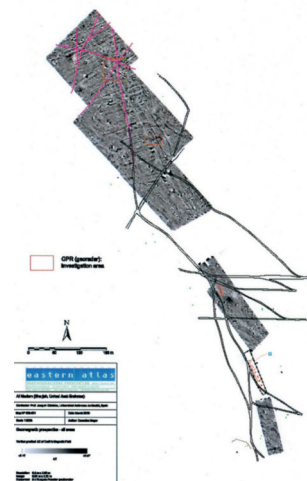


Fig. 9.1. Aerial view AM2 sector. On the right stands the dig underground gallery. Towards the bottom and to the left, the flat plain that seemed possible agricultural area (photo: Spanish Mission).

Fig. 9.2. AM2 geomagnetic prospecting. Bottom right, between two prospected areas, the sector of the underground gallery excavated. The white portion failed prospect, by the construction of a modern highway. Above, the area in which the continuous line is lost in a very confusing area (Geomagnetic prospecting: Eastern Atlas, Berlin).

In order to find the way out of the underground gallery, and considering the difficulty of following the trajectory of the line of hills, we decided to carry out a geomagnetic survey. Having almost 45 m of hollow and clean gallery, we thought that it would be easy to find its complete trajectory.

Then, and before having the final results of the survey, we did open a sector where it seemed possible to find the way out. According with the geomagnetic survey, this area was characterized by the presence of disturbances and fillings. The sounding that we had opened there showed us some positive unexpected results: under the 50 cm surface level

of sand, we found a level of rocky gravel, which usually lies directly on the rocky natural soil. We also realised that a small channel was excavated into this layer, with other minor channels (Fig. 10). The trajectory of this channel is coincident with the one of the underground gallery, a fact shown by the geomagnetic study. In addition, we found a large number of *Thiaridae* shells inside this channel –a species that is especially present into very clean watercourse–. We found the first potsherds of the Iron Age within the channel and its diversions as well. Only Iron Age potsherds. Subsequently, we provisionally concluded that this was an agricultural area feed by this channel, which was supplied with the water of the *galerie de captage*.

This hypothesis was corroborated by the work done during the last seasons. Seasons in which we found an extraordinary irrigation network and cultivation management system dated to the Iron Age. The enlargements to the NE and SW of the channel have verified its crucial role. On both sides of this principal channel –50 cm deep, 1 m wide and, by the moment 52 m long– appeared several perpendicular channels. On the northeastern side, there are 12 of these minor channels and 3 large ponds; 6 of them irrigate several rounded holes, similar to our tree pits (Fig. 11). Even though the sector towards the SW of the principal channel is not so excavated as the northeastern one, we found 7 minor channels as well as several similar holes.

The materials found in these channels are basically: potsherds dated to the Iron Age and shells *Thiaridae* and *Therebralia*. This ceramic evidence supported the date that we had already proposed (Fig. 12). Additionally, the analysis of the *Thiaridae* gives us a more precise date¹⁶: between 1160 and 808 BC (95 % probability). Nowadays, and even considering this margin of error, the use of this network during the Iron Age is



Fig. 10. Sector AM2. Small main channel and secondary ditches (photo: Spanish Mission).

Fig. 11. Detail of several tree pits linked by their corresponding irrigation ditch (photo: Spanish Mission).

Fig. 12. Pottery of the Iron Age found in the area (photo: Spanish Mission).

unquestionable.

Besides, we made 12 sounding between this sector and the excavated area of the underground gallery. We wanted to certify the connection between both sectors. While it is true that we have not found yet the way out of the underground gallery, the existence of a surface channel is certain. It is already know that the slope of the principal channel of the Irrigation Chanel Network Area is coincident with the one of the earlier phase of underground gallery. In addition, the southeastern enlargement of this network evidenced that, at some point, the channel was also re-cut. This fact is demonstrated by several of the

¹⁶ W. S. Alkhalifa.- “Tradiciones de la vida rural en la región de al Madam (Emirato de Sharjah, EAU). La agricultura y los usos del entorno”, *ISIMU* 14-15 (2011-2012), 69-80. Arabic version: 12-25.

12 sounding. Then, this work would have corresponded to the re-cutting documented also for the underground gallery; a decision that would be the starting point of the crisis that forced the abandonment of both, this structure and the villages.

The general view of the channel network is impressive (Fig. 13). If we assume that the so-called tree pits were used to plant trees, and considering then that these trees would be irrigated throughout the entire year, we could talk about a well-organised irrigation system. This system would consist in several lines of trees, usually palm tree and among them, we could find seasonal plants growing into the sand. So, these trees, apart from producing their own benefits, would protect the other plants from the heat. This network is extraordinary similar to some other mechanism used in Iraq or in the own region of al Madam (Fig. 14). We do not know which plants were cultivated at that time. Sandy soils do not preserve the pollens. However, and based on the existence of milling tools inside the houses, the crops cultivated should have been adapted to the climatic conditions.

It is also interesting to underline the exceptionality of this find. I do not have knowledge of any similar structure in the archaeology of the Iron Age in the Oman Peninsula. Hopefully, we could mention the *qanats* and the channels of ‘Ayn-Manawir

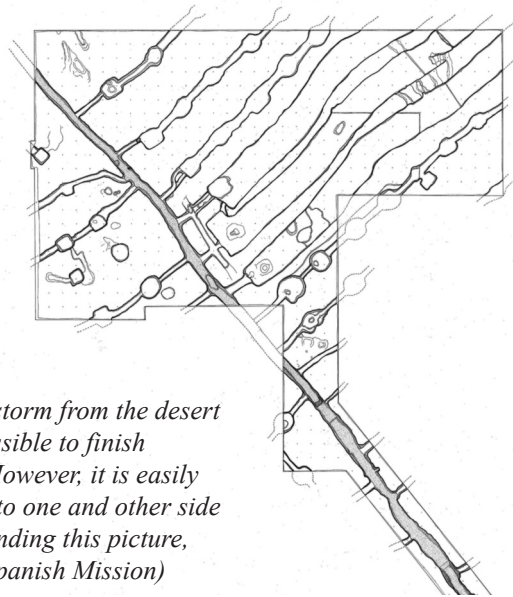
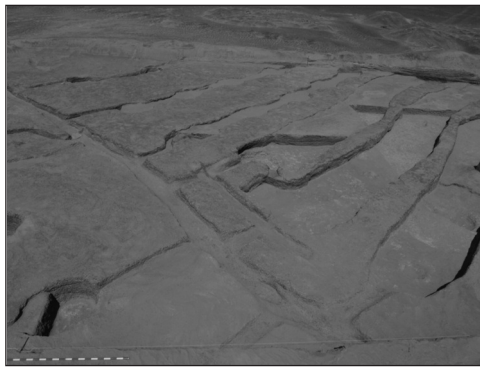


Fig. 13.1. Final picture of the 2012 season. A sandstorm from the desert of Arabia, which lasted several days, made it impossible to finish cleaning the area before taking the final pictures. However, it is easily distinguished the main channel, secondary ditches to one and other side and tree pits. Drawing allows provisional understanding this picture, which will be repeated in the next season (photo: Spanish Mission)

Fig. 13.2. The network of channels to end of 2012 season. The main channel, the secondary network, the tree pits and ponds reserve (?) seems obvious (drawing M. Á. Nunez).

(Kharga, Egypt)¹⁷, even we should bear in mind that these are earlier examples and not exactly the same case than our.

Therefore, and for the first time, we found evidences of the exploitation of an irrigation area supplied by a *galerie de captage*. This is a sustainable agricultural irrigational system perfectly adapted to a limited, but constant, flow rate coming from the water table. An effective exploitation method still preserved through the ways used by the

¹⁷M. Wuttman.- “Les qanāts de ‘Ayn-Manāwīr (oasis de Kahrğa, Égypte)”, *Journal of Achaemenid Studies and Researches* 11 (2000), 109-135.



Fig. 14. Current agricultural plot, very close to the excavation area. Note the working palm farm lines, tree pits and other plants growing on the sand, under the protection of the palms (photo: Spanish Mission).

traditional agriculture of the region.

4. CONCLUSIONS

Al Madam discoveries shed some light on certain notable interpretations generally accepted to explain the culture of the oasis of the Iron Age. A methodological and precise archaeological digging has made it possible.

First one, we have evidenced the technique used to produce mud-bricks in an adverse environment and without clayey soils. The singular nature of these Iron Age mud-bricks have been described as well. Remains of parallel structures should also exist in other contemporary sites with similar features. Their communal use or, on the contrary, a specialization of their workers, are questions that will be discussed in a near future. The preserved human prints are bringing us closer to the sociology of this period.

Second one, the chanel network and the lines of tree pits have evidenced that the ancient agriculture in al Madam was quite similar to the one traditionally developed in the same area only 100 years ago¹⁸. The *galerie de captage* provided a limited but constant flow rate, which was sufficient for the palm trees needs. As in Iraq or even in this same region, these trees were protecting the minor cultivation grown between their lines: these crops were so protected from the extreme heat, from the 45/50 degrees or more between

¹⁸ W. S. Alkhalifa.- “Tradiciones de la vida rural en la región de al Madam (Emirato de Sharjah, EAU). La agricultura y los usos del entorno”, ISIMU 14-15 (2011-2012), 69-80. Arabic version: 12-25.

the sowing and the harvest seasons, as the Bedouins did only one century ago. Landscape and climate were similar to the current conditions. We know that the livestock farming was also important for the inhabitants of al Madam, too as a source of natural manure for the agriculture.

I consider that this new perspective improves our knowledge of the oasis culture of the Iron Age period.