edited by Carlo G. CERETI, Roberta GIUNTA

PRESERVATION OF CULTURAL HERITAGE OF THE KURDISH REGION IN IRAQ

Italian Cooperation Project in Iraqi Kurdistan (2009-2010)

IsIAO

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Preface

It is with great pleasure that I present this publication, which gathers the results of the activities of the Italian Cooperation Project, *Preservation of Cultural Heritage of the Kurdish Region in Iraq*, entrusted to this Institute by the Ministry of Foreign Affairs and concerning an area in which IsIAO has great scientific prestige and credibility, earned over many years of hard and demanding work. IsIAO is in fact since a long time involved in the field of archaeological research in many countries of the Middle and Far East, in collaboration with universities and cultural institutions of Italy and of the host countries, also thanks to the financial support provided, through specific contributions, by the Directorate General for Development Cooperation of the Ministry of Foreign Affairs.

The scientific skills and experience gained in this field have also been offered to the Directorate General for Development Cooperation and to the Directorate General for the Mediterranean and Middle East Countries for the elaboration and implementation of programs of technical assistance in the fields of preservation and enhancement of Cultural Heritage and training of local staff.

This Cooperation Project was carried out in accordance and collaboration with the institutions of Iraqi Kurdistan in charge of preservation of Cultural Heritage, in particular the MoTh (Ministry of Tourism and Heritage), now Ministry of Municipality and Tourism, and the HCECR (High Commission for Erbil Citadel Revitalization).

During more than 18 months of work many activities and initiatives were implemented, in the fields of documentation, urban planning, design and development of GIS projects, restoration plan, archaeological surveys, cataloguing and valorization of the Museums' property and, above all, scientific and technical training of local experts. All activities aimed at providing a contribution for a better management and fruition of the Artistic and Cultural Heritage of the Kurdish Region in Iraq and the strengthening of its institutions.

This publication, edited by the two co-directors of the Project, Prof. Carlo G. Cereti and Dr. Roberta Giunta, offers all the fundamental information to understand the interventions carried out and the results achieved. And this edition is particularly convenient: the experience can be taken as a guideline for other realities, to straighten a field – that of Cultural Heritage – of great importance, in which the intervention programs have the prevalent aim of preserving and enhancing, as in this case, the important artistic patrimony of the area. The final aim was also of contributing to generate phenomena of sustainable development and therefore tangible improvements of both social and economic nature.

Gherardo Gnoli

President of Istituto Italiano per l'Africa e l'Oriente (IsIAO)

The support to the rehabilitation and the valorization of the cultural heritage of a Country where civilisation was born several millennia ago, and spread from there for centuries in other parts of the world, is a crucial aspect of the Italian engagement for the reconstruction of Iraq, according to a long Iraqi-Italian tradition of joint activities in this field.

The awareness of such heritage is a fundamental element of national identity and Nation building. And at the same time its recovery and viability are strong factors of economic and social development through their beneficial effects on tourism and on a wide range of job creating cultural activities and other related sources of employment.

Along with the support from Italy to the Iraqi museal system, notably in Baghdad, Nassiriya, Diwania and Najaf, the project implemented in Kurdistan by IsIAO with local counterparts for the Erbil Citadel with the support of the Italian Ministry of Foreign Affairs and of the Regional and Provincial Administrations in Erbil is a major component of this action, together with other initiatives conducted since few years in the Region, like the studies on the Paikuli tower carrying two inscriptions, the surveys at Sulaymaniya area, and the cataloguing at the Sulaymaniya, Erbil and Dohuk Museums with the view of their rehabilitation and development.

This book documents the work done by the Italian scholars and experts, remarkably led by Carlo Cereti and Roberta Giunta, together with their Iraqi colleagues. It describes the activities on the Erbil Citadel, the oldest urban site in the world continuously inhabited, and in particular the topographical survey, cartography and photogrammetry, the design of the restoration of one of its most beautiful buildings, the Rashid Agha *diwan khanah*, the preparation of the archaeological investigation and the establishment of a Geographic Information System of the site, as well as the work done on the numismatic collections of the Kurdistan Region Museums and the Cartography of the Paikuli area. The exchange of experiences among colleagues of both sides and training on the job are a key feature of the project.

It is certainly the beginning of a work which will continue, together with UNESCO and other partners, and which will further strengthen a solid experience of cooperation between Italy and Iraq in this field, with the awareness of the contribution that their peoples have given along the centuries to the history of Mankind.

Maurizio Melani
Director General for the Country Promotion
(Economy, Culture and Science)
in the Italian Ministry of Foreign Affairs
and Former Ambassador of Italy to Iraq

When in February 2009 the High Commission for the Recovery of the Citadel of Erbil asked Italy to finance a project aimed at the preservation and enhancement of the site, our Country accepted the proposal with enthusiasm. The experience and skills gained by Italian experts in that field made however Italy the natural partner. To this was added the desire to expand the already extensive cooperation between Italy and Iraq in the cultural and archaeological fields, in which our Country since many years performs high value operations. They are a priority of our contribution to the reconstruction of Iraq, whose renaissance also passes through the rediscovery and enhancement of its own Historic and Cultural Heritage.

The Erbil Citadel is one of the earliest urban sites of history. One of the first things I did after taking the charge of Ambassador of Italy to Iraq was to visit it. I was greatly impressed, not only by the majesty and beauty of the ruins, but also by the passion of the experts, Italians and Iraqis, who were working there. It's not a coincidence that, in addition to the recovery and revitalization of the Citadel, the Italian team focused heavily on the training, in order to ensure the sustainability of the interventions and to set the basis for an effective "follow-up".

Thanks to the skills of the experts of IsIAO who were responsible for the implementation of the Project it was possible to develop a restoration plan for one of the most significant, from the point of view of the historical and artistic value, Houses of the Citadel, also among the most heavily damaged. Working in close synergy with the Kurdish authorities, the Italian experts have laid the premises so that the masterpiece may return to the earlier glories and shape, through coordinated interventions at multiple levels: from the topographic survey of the subsoil exploration with the most innovative radar technology, from the graphic processing of the ancient structure to the studies on the consolidation of the foundations.

But the aim constantly pursued by Italy in this Project was not only that, yet essential, of contributing to the restoration of the Citadel. The ultimate goal, medium and long term, was the development of an integrated system able to protect and enhance the Historical and Artistic Heritage of the Kurdish Region and of the rest of the Country. In the same perspective may be explained the interventions, supported by our Country, focused at the valorization and cataloguing of the findings of the Museums of Erbil, Dohuk and Sulaymaniya, with particular regard to the remarkable numismatic heritage conserved in the three Museums. Again, the IsIAO researchers worked closely with the local authorities, transferring their knowledge to experts who will soon be able to perform these tasks independently.

Projects such as this here presented remind us of the benefits resulting from a serious international cooperation, focused and, above all, agreed between donors and beneficiaries. The rest is due to the excellent and increasing relations between Italy and Iraqi Kurdistan, as well as to the passion and proficiency of our archaeologists, our researchers and our experts.

Gerardo Carante
Ambassador of Italy to Iraq

This publication presents a summary of the major results achieved during the previous 18 months of work of the Italian Cooperation Project in Iraqi Kurdistan, which mark an important passage in the history of the collaboration between Italy and Iraqi Kurdistan, being the first phase directly sponsored by Italian Cooperation. The collaboration between the two parties began five years ago, in 2006. IsIAO was among the first institutions to begin a project in the Kurdish region of Iraq after the fall of Saddam Hussein's regime, thanks to an intuition of Amb. Riccardo Sessa, then Director for the Mediterranean and the Middle East of our Ministry of Foreign Affairs, and the active support of Prof. Gherardo Gnoli.

The first phase of the activities was run under the supervision of Amb. Gianludovico de Martino, who was at that time the Head of Task Force Iraq. A very important role was played by H.E. Baker Fattah Hussein, the present Ambassador of Iraq to Brazil, who helped us to organize our first inspections in Iraq. At that stage, our efforts were focused on the recovery of the Sasanian tower

of Paikuli, not far from the town of Darband-i Khan, about 100 km south of Sulaymaniya, and on a cooperation with the Museum of Sulaymaniya. Our aim was also to assist the local authorities in preserving the significant Cultural Heritage of the northern provinces.

In 2008, while designing the latter phase of the project, we had long talks with our Embassy in Baghdad, chiefly with Amb. Maurizio Melani, and with the Italian Cooperation led by Min. Elisabetta Belloni, who both suggested to include the Historical Citadel of Erbil in our project. Given the importance of the site, our team accepted this proposal with great enthusiasm.

Through consultation with the different institutions involved, we were able to devise a very ambitious project, whose organization was possible thanks to the precious support of Couns. Bellelli, Head of Desk Iraq at Italian Cooperation. The structure of this program included the participation of the three provinces building up Iraqi Kurdistan, Erbil, Sulaymaniya and Dohuk, and entailed two major lines of intervention:

1. Understanding and exploring the Cultural Heritage of the region and its potential of valorization:
   a. study of the territory (cartography of the area around Paikuli)
   b. study of the museums' collections (catalogue of the numismatic property of the museums of Sulaymaniya, Erbil and Dohuk).

2. Study and restoration of Erbil's historical Citadel:
   a. graphic and topographic documentation (Erbil Citadel, Rashid Agha *diwan khanah*)
   b. restoration project of the Rashid Agha *diwan khanah*
   c. archaeological investigations on the Erbil Citadel.

Thanks to the continuous and close cooperation with the local authorities, all the goals of the project have been achieved, though each to a different extent. If the Cooperation Project will have further steps – as we sincerely hope – more accurate results will certainly be earned for several of these activities.

We want to thank all those who have made this project possible. First of all H.E. Amb. Saywan Sabir Mustafa Barzani, Prof. Gherardo Gnoli, Min. Elisabetta Belloni, Amb. Maurizio Melani, H.E. Amb. Gerardo Carante and Couns. Massimo Ernesto Bellelli, who have all constantly sponsored our Project. The Kurdish partners, Arch. Dara Talaat Mohammed Ali al-Yaqoobi, Arch. Ranan Khasraw Tawfiq, Dr. Abubaker Othman Zendin, Dr. Kamal Rasheed Raheem, Dr. Hashim Hama Abdullah, Dr. Payadar Abdulmuhsen Muhammed, Dr. Haydar H. Husayn, and Dr. Hassan Ahmed Qasim Barwary, who allowed us to complete our activities. All the numerous local specialists with whom all we have had the pleasure to collaborate.

Finally, we would like to thank all the Italian specialists involved in the Project, as well as Dr. Antonella Martellucci, Sara Mattarozzi and Federico Franci, who have worked hard behind scenes. Last but not least, we wish to thank Arch. Anna Maria Ceci, who carried out the major part of the back stage work at the Ministry of Foreign Affairs, helping us to better define the Project both conceptually and from an administrative point of view.

Carlo G. Cereti
Full Professor, "Sapienza" University of Rome
Roberta Giunta
Full Researcher, University of Naples "L'Orientale"

Topographic Survey and Cartography in the Ancient Center of Erbil

1.1

Sven Stefano Tilia

The Citadel is certainly the element that most characterizes the city of Erbil and affects its whole urban plan. The development in concentric circles and radial disposition of the road network is a clear indication of such an organization, because the hill on which the Citadel stands – almost circular in shape – functions as a geometric and ideal fulcrum. The extraordinary continuity of life of this area emphasizes the important role that this site also plays in a rapidly evolving modern urban setting. It is therefore fundamental to have a cartography able to describe both the actual state and the buried evidence.

The first step, in any project concerning the topographical mapping of large scale areas, led to the acquisition of the maps used to integrate the new surveys. In collaboration with the HCECR and its technicians, all the available cartography was explored, choosing the map that had the detail to represent the town in all its components, and a scale sufficiently large to clearly distinguish every single structure. However, the most appropriate map was obtained processing an aerial image (probably satellite), certainly georeferenced but without proper perspective corrections. It was clear that a cartography with careful dimensional features was not available, much less in the scale required by the present project. It was therefore decided to create a new one, on the basis of satellite images, acquired through new generation satellites, suitable for a stereo-photogrammetric restitution process and appropriate software.

In the meantime, the surveying activity in the Citadel initially focused on covering two needs: the detail mapping of the Rashid Agha *diwan khanah* and the creation of a system of geo-referenced stations useful for other surveys in the area. For this purpose, we placed a fixed point on the roof of the house (also visible from the sky through an appropriate highlighting signal), whose function was to work as a basis for all the subsequent surveys and a control point for satellite mapping. The position of this point was measured with a single GPS antenna, obtaining the differential correction thanks to a US NGS (National Geodetic Survey) CORS station (Continuously Operating Reference Station) placed in the city of Erbil (hence at a perfectly useful distance): the necessary data were gained through a simple web download. After this first reference station, others were placed and all the points, necessary for the different planned surveys, were subsequently measured with a Total Station.

For the architectural survey of the Rashid Agha *diwan khanah* an adequate number of stations was positioned, for the measurement of all the points necessary for the realization of the plans, sections/prospects, and of the markers needed as control points for the terrestrial stereo-photogrammetry through the Menci system (Fig. 1).

Starting from the reference point described above, using the Total Station, we proceeded to the materialization of additional stations placed in appropriate positions to map the reference points – already placed by a local topographical company (Avaland Surveying and Engineering) on behalf of HCECR – in order to create a topographical network over the entire area of the Citadel. Such measurements allow, now and in the future, the integration of the data collected by the Italian

Fig.1. Rashid Agha diwan khanah. Point acquisition and resulting plan view

Project with the existing and future ones.

In 2010, GPR (Ground Penetrating Radar) surveys were carried out as an additional task, not planned in the initial program. These surveys were to be placed within the topographic system that was gradually developing to better assess the position and extent of any possible anomaly in relation to the existing buildings. The base stations already in place have been particularly useful in the central area of the Citadel (close to the offices and the big flag), right where it was decided to start the GPR acquisition campaign. Such measurements were the detection of the 4 vertices of each investigated area (usually of rectangular shape) in order to fix their position inside the topographical grid; the height of the 4 vertices provided then the reference for assessing the depth of the anomalies found. The coverage of the entire main road (north-south) was not a problem since all the points to measure were visible, thus easily detectable with the Total Station placed on the already known stations. The necessary stations were added where it was not possible to map the investigated areas, as in the areas on the left and right of the South Gate, in the North Gate, in the narrow streets that are the direct branches of the main road (e.g. the one between blocks B43, B21 and B19), in the area south of the block B24 and between blocks B3 and B4 (both near the Rashid Agha *diwan khanah*). Using the station on the roof of the *diwan khanah* as a fixed base, direct measurements using differential GPS were taken in RTK (Real Time Kinematic) mode in all the areas where it would be too laborious to extend the topographical grid. This methodology was possible thanks to the reduced distance between the fixed base and the points to measure, and to the availability of the radio connection for real time calculation. On one occasion it was not possible to measure the points with the GPS directly because the areas to be surveyed were located inside a building (B18). In this case we used a mixed technique: materialization (with GPS) of two stations (reciprocally visible) on the roof of the examined building; positioning of the Total Station on one of these; orientation on the second and creation of a polygonal able to get inside the building and to allow the placement of a station for measuring of all the points necessary to define the areas of the GPR survey.

The sites of the coring carried out by the HCECR were located in addition to the survey areas. The exact location and height of departure of these cores will be useful in the analysis and calibration of the GPR results. Although we lacked an adequate cartography, all of these measurements were placed (with a certain degree of approximation) within the existing map (Fig. 2).

The mapping of the activities aimed at creating a possible new cartography of the Citadel began in the meantime. As mentioned above, the strategy consisted in obtaining satellite images, useful for a stereo-photographic restitution, with the highest resolution possible, in order to distinguish the individual structures in the urban context. Currently there are two products able to provide a level of detail higher than any other commercially available product: the sensors WorldView-1 (panchromatic only) and WorldView-2 (panchromatic and multispectral), belonging to the

DigitalGlobe company and to the GeoEye-1 (panchromatic and multispectral) of the homonymous company, both of which provide a resolution of 0.5 m (measured on the ground) per pixel. The choice between these was based on the availability of the product within the deadline of the project itself, rather than by its technical features. The GeoEye-1 images, while requiring a smaller number of GCP (Ground Control Points) would have taken one year of delivery! Therefore, the choice of the WorldView-2 images was obliged.

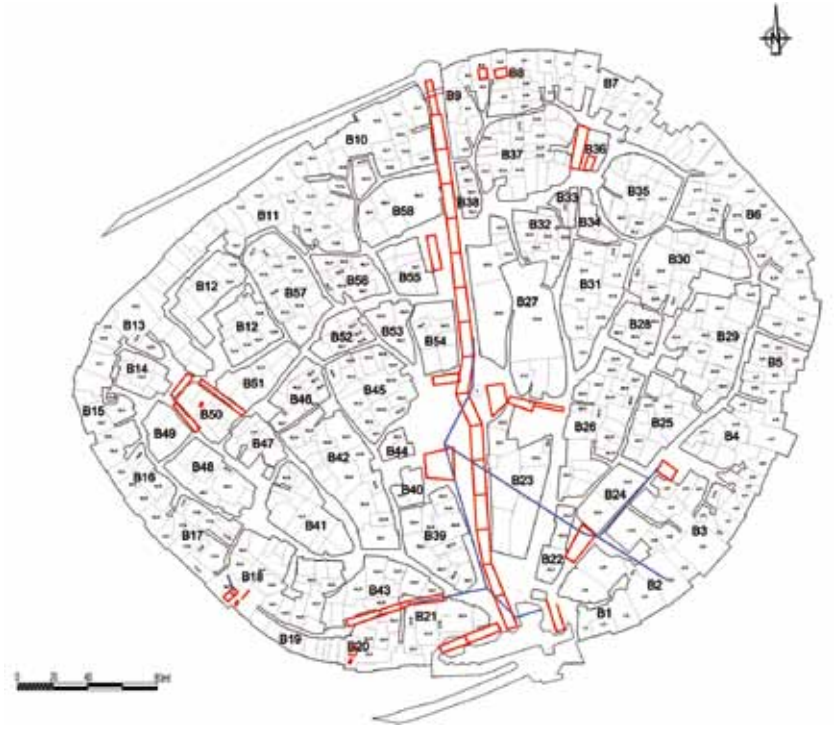


Fig. 2. Map of the Citadel. The red poligons indicate the GPR prospected areas, and the blue lines the topographic traverse

These satellite images were delivered in late 2010 in the form of a stereo-pair covering an area of 15 x 14 km. The vastness of the acquired area, compared to our needs, is due to the commercial type of the WorldView-2, that does not allow the purchase of smaller areas, in particular for products aimed at the stereo-restitution. This gave us the possibility of mapping the whole urban and suburban area of Erbil.

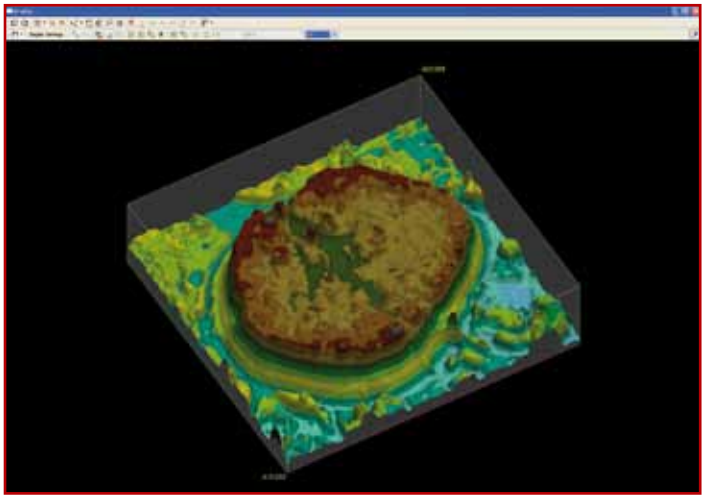
The software of digital stereo-restitution used in this project is the application suite called INPHO (Trimble), equipped with all the fundamental tools of inner orientation, relative and absolute, aerial triangulation (combination of a large number of stereo-pairs within a single project with a minimum number of control points), automatic generation of DEM (Digital Elevation Model) and subsequent editing of it, creation of true-orthophoto, creation of radiometrically corrected photo-mosaics (color uniformity between adjacent slides), and finally the possibility of using more traditional stereo-photogrammetric techniques for feature collection, through the independent module Summit Evolution (DATEM). In our case, however, the decisive feature was the possibility, through the exploitation of the RPC (Rational Polynomial Coefficients), to use images obtained from satellites such as Quickbird, Ikonos, Worldview (1 and 2) and GeoEye in the process of stereo-restitution. In particular, the last two sensors provide the opportunity to acquire

Fig. 3. Collecting the GCP (Ground Control Points) with differential GPS measurements

a product already developed for the use in stereophotogrammetry through images of the same subject obtained from different points of view in the same orbit (minimum time difference between the images). Remains anyway the need to acquire, through topographical surveying instruments, the GCP (Ground Control Points) for georeferencing the images.

The latest activities in Erbil were indeed devoted to the acquisition of the GCP (Fig. 3). Through an examination of the images, specific areas were identified (at the 4 corners and along the 4 sides of the images, as well as in the center, coinciding with the Citadel) inside which to look for elements on the ground that can be easily and clearly recognized in the images themselves. The methodology was difficult because some of these areas were not accessible (e.g. the airport area, occupying the entire north-west sector of the stereo-pair and a vast military zone along the west side) and we had to search for points in adjacent areas, even if not ideally positioned. With the acquisition of the GCP the next step of the stereo-restitution could be carried out. For now, the partial restitution of certain aspects of the Citadel is planned, and it would allow a better definition and positioning of the analyses performed therein, such as the profile of the buildings as a background in the representation of the sections illustrating the GPR surveys. It was not possible to complete the phase of production of the actual cartography in this first year, phase that we hope will continue next year (Fig. 4).

Fig. 4. Vertically exaggerated solid elevation map of the Citadel



The final product will be, as well as a digital cartography, a Geographic Information System, viewable and searchable in various ways and able of producing additional cartography, depending on the layers selected during the consultation.

The Graphic Documentation of the Rashid Agha *diwan khanah*

1.2

Angela Bizzarro

The graphic documentation (plans, prospects and sections) of the Rashid Agha *diwan khanah* is part of a wider georeferenced system concerning the Erbil Citadel. All the activities of topographic, photogrammetric and detail surveying were coordinated by the writer, with the involvement of Alessandro and Sven Stefano Tilia and the collaboration of Daniela Citro, Giolj F. Guidi, Rossana Nicolò and Bafreen Abdulqader Ali.

The restoration project of the building, coordinated by Giuseppe Morganti, will be planned on the basis of this careful survey (Fig. 1).

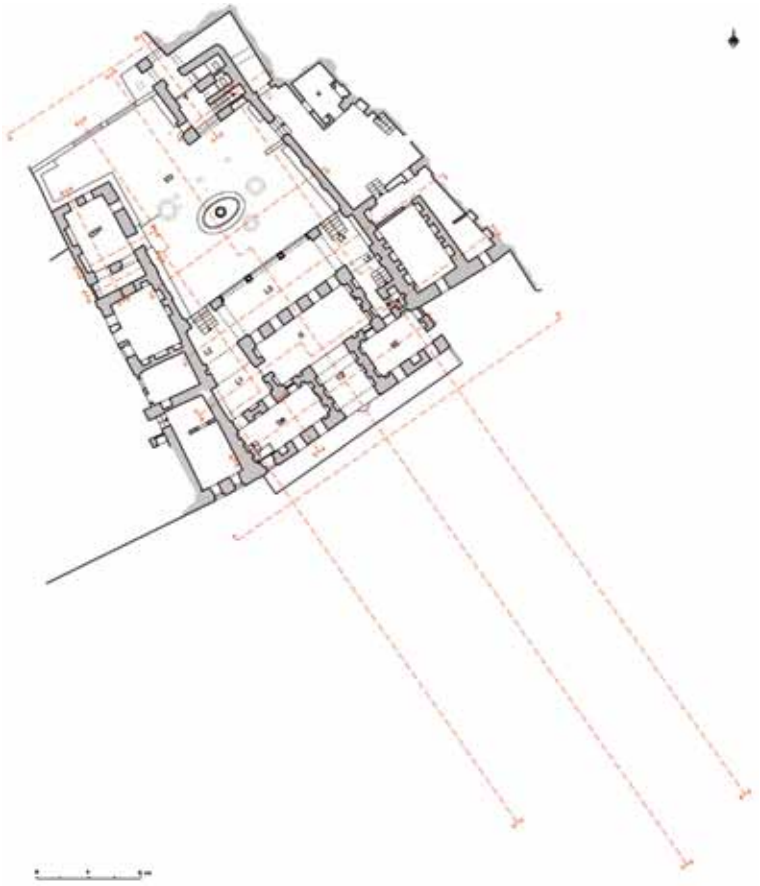


Fig. 1. Plan of the main floor, with the localization of sections and prospects

The first steps of the process were the positioning and survey – through differential, double frequency GPS (LEICA GX1230 GG) – of a datum point (identified by a nail) on the *diwan khanah* roof, with the aim of associating its position to the survey of other appropriately placed

points in the Citadel and creating a series of "baselines". These "baselines" were used both for georeferencing the archaeological evidence in UTM coordinates (WGS84), and for combining the plans of the *diwan khanah* with the other documentation of the surrounding structures (Fig. 1). A topographical traversal net was created with the use a LEICA TCR1205 total station. It comprises 59 stations and more than 7,400 measured points for detail-scale documentation.

The technical devices available today allow an integrated survey capable (depending on each case) of combining information gathered through different methods: in the present case-study the traditional mapping systems were associated with topographical survey, surface scanning and digital photogrammetry. The great amount of digital graphic restitutions obtained from the archaeological evidence under examination focused on the drafting of different aspects of the restoration project: from the structural and architectonic one to that related to wall surfaces, building techniques and analysis of decoration elements.

The methodology here presented implies a very careful survey, with a high metric precision. For the detail-scale documentation of the actual state of conservation of the *diwan khanah* a great number of plans (the main floor – including the eastern area and the harem in the west – the underground floor and the roofs), prospects and sections/prospects were created.

All the decorated wall surfaces were documented through the use of the Menci ZScan system (3D models and true orthophotographs), which allows the creation of 3D models of surfaces. The processing of such models made it possible to create mosaics of metrically corrected and measurable orthorectified images (Figs. 2-3).

The ZScan system is a useful tool for the acquisition of point clouds by using a high-resolution digital SLR camera with fixed lens, calibrated in the Menci Software laboratories, a precision slide with a recirculating ball bearing carriage and software based on an algorithm of multifocal analysis of images. Each 3D model is created using 3 images taken from fixed positions along the precision slide.

Fig. 2. Definition of the 3D models based on triple images

Fig. 3. Referencing of the different surfaces and creation of the actual ortophoto

The point clouds obtained with this system show colors with photographic accuracy, and it is possible to visualize the related raster texture on every 3D model.

The post-processing of the cloud points (editing, merging, creation of orthophotos, exportation) were performed through the ZMap software, produced by Menci Software.

Unlike the usual photographic images, the digital documentation obtained through this methodology allows multiple output applications, such as a digital draft of the decorations or the definition of layers of the different states of preservation of the walls (Figs. 4-6).

Fig. 4. Longitudinal section L2a (above)

Fig. 5. Longitudinal section L2a, detail of the diwan *(below)*

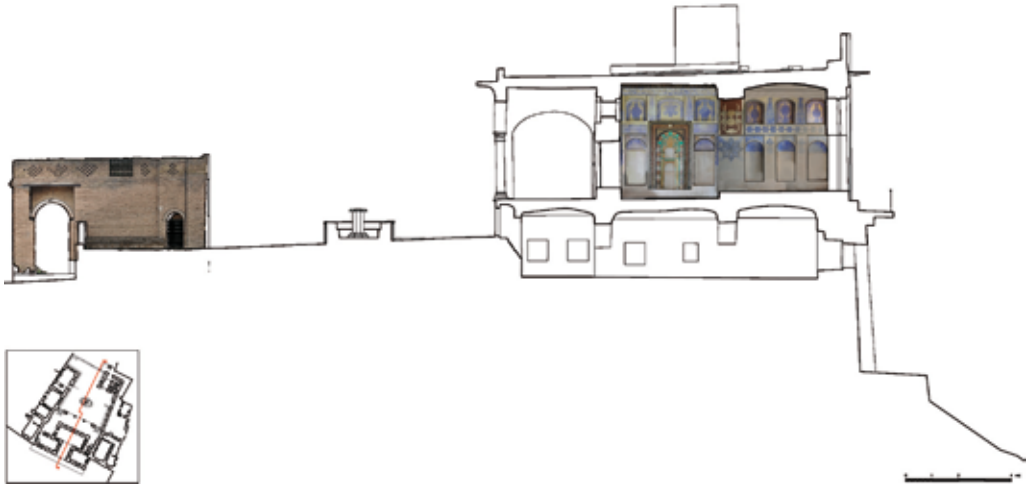


Fig. 6. Arch of the diwan: the surface of the intrados developed as a plane

In collaboration with Julian Bogdani, this complex system of data acquisition, closely connected thanks to the geographic reference of the data, is managed through a Geographical Information System (GIS) in which different kind of information are contextualized with all the related analyses, from the general to the detailed plan, to the sampling areas (Fig. 7).

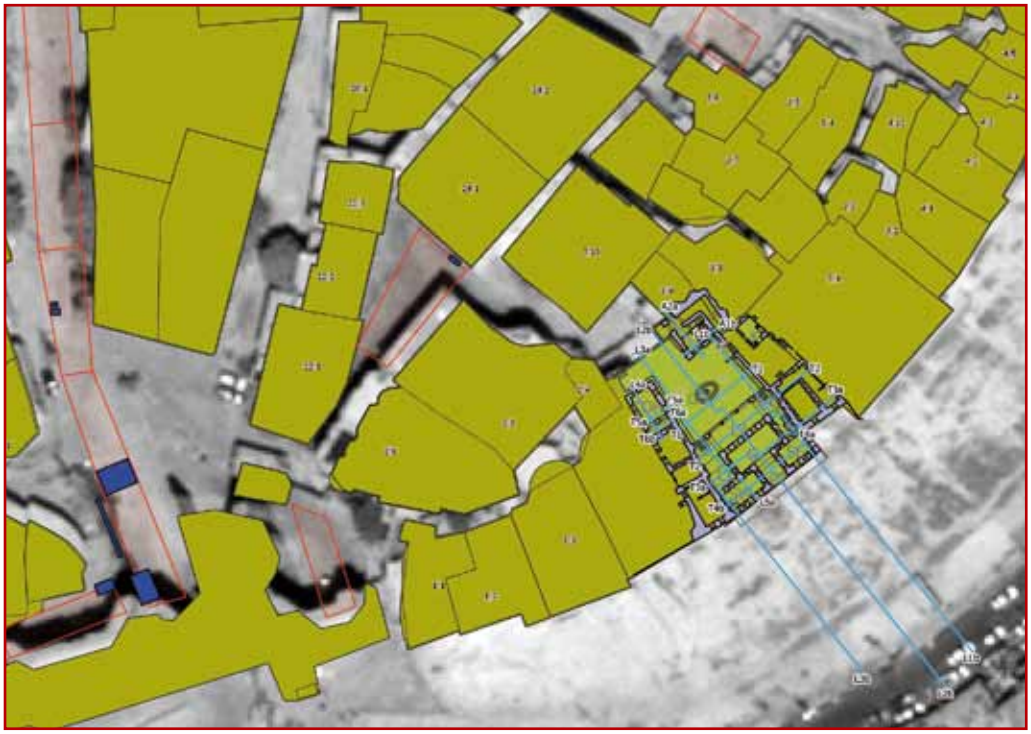


Fig. 7. View of the GIS system with the Rashid Agha diwan khanah and the surrounding areas of the Citadel. The red lines cover the geophysical surveys (in blue, the detected anomalies)

Project Methodology and Historical Profile

2.1

Giuseppe Morganti

In May 2010 Jerry Podany[1] asked Giorgio Torraca[2] to express his opinion on the topicality of the theme of 'Heritage Conservation: past, present and future'. One of the questions was: 'Why are we (or why we should be) interested in conservation?'. In response, among other things, Torraca noted: 'In studying ancient materials and deterioration processes, I had invariably found that the most refined analysis always raised more problems than those they solved. This was exactly what humanity has been set up to do: achieve infinite knowledge through an infinite amount of data measured and shared by an infinite number of people. Conservation would then be an infinitesimal part of the human attempt to know everything about the present and about the past, in order to foresee the future and achieve the power we attribute to the gods, like omniscience and immortality'.

These words powerfully express a sort of metaphysical motivation of the restoration activity. In other words – conscious of the human nature and our responsibilities towards works of art – it may be said that the purpose of preserving the historical heritage is to pass on the set of values, preserving the meaning and avoiding damage. The historical and artistic heritage helps to define the identity of any place and any community. It is a fundamental expression of cultural richness and diversity; an irreplaceable testimony of the past, whose protection and preservation, in all latitudes, represents a common value for all Nations that have the responsibility to work together in order to transmit this heritage to future generations.

However, the term under examination implies a deep comprehension of the importance of the historic building and its changes over time, and therefore a careful consideration of the values – both historical and contemporary – to assign to the building to be preserved. It should also be noted that the importance of the site can lie in both the original and the latest phase, and in any transformation. If it was deliberately destroyed in the past, even this may be an important factor for understanding its meaning, as it is the history of its preservation and restoration.

Any assessment of the importance of a historic building should thus be based on an appropriate program of research, surveys and analysis, aimed at conservation. The restoration project of the Rashid Agha *diwan khanah* is designed to fit coherently into this methodological framework.

The restoration activity must meet the aesthetic, historical, spiritual and social heritage, taking into account both the physical integrity of the object and the context to which it belongs. The products, materials and procedures used should not damage the works of art and, likewise,

1 'The project was meant to encourage a dialogue between those who have given so much to the profession over their long years of service and those who have just entered the field. But what his words offer is, like Giorgio Torraca himself said, a gift to all of us' (see www.iiconservation.org/index.php).

2 The Italian conservation scientist Giorgio Torraca, who died on September 25th, 2010 of complications from pneumonia, was a brilliant chemist and teacher who devoted his career to the preservation of historic buildings, monuments and archaeological sites. He helped co-ordinate international responses to the flooding of Florence in 1966, was consultant from 1992 for the cleaning of the Sistine Chapel in Rome, and was a member of the committee for the stabilisation of the Leaning Tower of Pisa (2004-09).

should not attempt on people and environment. The methods and modes of operation, as the materials used, should not prejudice – as much as possible – any future intervention, analysis or appreciation. That is why the project is inspired by the basic criteria of the correct and scientific restoration methodology, which also provides that any activity carried out on the monument must be compatible, reversible, recognizable and limited to the minimal intervention. For this reason, the project relies on the principles expressed in the main internationally recognized charters and guidelines.

An *appropriate program of research, surveys and analysis, aimed at conservation* should be the starting point of such a project, if we want it to be scientifically correct. The development of the project provides then historical, scientific and technical research and feasibility studies. These investigations are necessary to determine methodologies and aims of restoration: a diagnostic test of the building is essential in the process, because it allows the detection of the constituent materials of the object to be preserved, allows an assessment of the state of preservation, reports any previous alteration – nature, extent and causes – leading to the proper definition of the most appropriate treatment. One of the main research activities focused on the investigations to ascertain the architectural history of Rashid Agha *diwan khanah*.

The identification of the vicissitudes through which the architecture is created and develops – site, materials, cultural environment, functional purposes, ambitions of the client – is the necessary prerequisite for understanding the architectural organism. This survey also provides a fundamental guideline for the recovery and enhancement of every historic building, in order to find a use compatible with its vocations. Vocations that can be understood only by tracing the formative stages of the building in its context: in our case, the Rashid Agha *diwan khanah* in the Citadel, where it occupies an important position. In fact, it constitutes one of the most interesting and beautiful buildings both for its location along the outer perimeter of the walls, and the quality of the decorations.

The main source for the reconstruction of the historical phases of the building was, in the case of Rashid Agha *diwan khanah*, the observation and interpretation of the structure itself. Indeed, the historical documents referring to the earliest stages of the site and its origins are almost entirely absent. It was possible to identify with some reliability only the latest phases of reconstruction and expansion, almost exclusively through iconographic data and oral sources. In this context, the topographic survey, the stratigraphic tests and the direct observation were the basic methods to identify the later stages of construction and make hypotheses on the earliest phases.

A couple of examples illustrate the process used and explain the meaning of *observation of the structure* and *historical research on its development*.

In the first case, the observation of the building makes it possible to fix the exact date of the expansion of the building to the south, towards the edge of the hilltop. Studies carried out by the joint venture[3], commissioned by UNESCO to draft the Master Plan for the revitalization of the Citadel, state that 'there are only three dates recorded in inscriptions and only one house with a precise construction date provided by the family [...]'[4]. This corresponds to the Hashim Chalabi's House; Rashid Agha *diwan khanah* is one of the three buildings that preserve dating inscriptions inside. The inscription is on the marble architrave of the door that leads to the south-west *oda*: here we read the engraved dates 1321 and 1323 (of the Hegira), corresponding to the years 1903-04 and 1905-06,

[3] Consultancy for Conservation and Development; Huszar Brammah & Associates; EURONET Consulting.

[4] See *UNESCO Master Plan, Comprehensive Survey*, vol. I, p. 39.

respectively. As the room where the door gives access belongs to the enlargement that determined the present size of the house[5], these dates may be interpreted respectively as the beginning and end of this construction phase. Besides this, an examination of the topographical heights, allowed by the accuracy of the survey, permitted to reconstruct a reliable urban situation previous to the presence of the Rashid Agha *diwan khanah* as we see it today. In fact, the layers detected through the survey operations of the site highlight the possibility (quite obvious) that the altitude of the earlier buildings was lower than today. What is less obvious is that the earlier buildings, smaller and almost certainly with only one floor, became the underground quarter of the house built above. This conclusion can be drawn quite immediately by observing the longitudinal section of the house (Fig. 1), which shows that the level of the street in front of the entrance to the Rashid Agha *diwan khanah* is approximately the same of the present basement of the building.

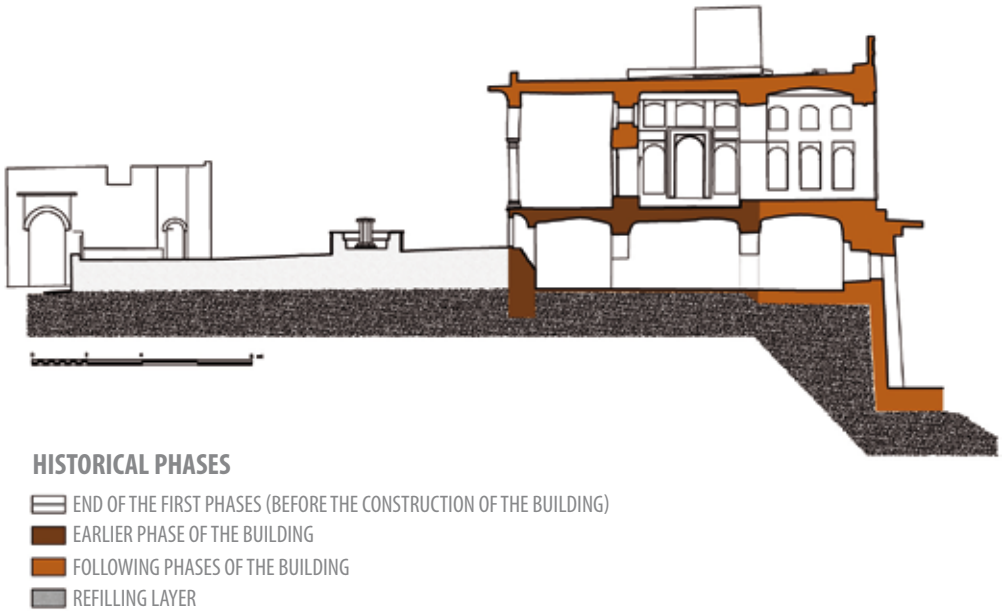


Fig. 1. Longitudinal section on the entry of the house

In the plan, a clear continuity is visible when connecting the walls on the sides of the Rashid Agha *diwan khanah* (Fig. 2) with an ideal line, to which the internal walls, parallel to the slope, also align. This suggests the possible trace of the earlier perimeter walls of the Citadel. These town walls were on the hilltop, and were subsequently incorporated within the outer buildings. The phase of the small structures with one floor, on which the Rashid Agha *diwan khanah* was superimposed, reflects this earlier situation. At this stage the house was greatly expanded, enlarged with one floor, and advanced beyond the line of the ancient town walls, with the outer portion resting in a very risky position, on the steep slope of the hill. One can deduce that the earliest part of the house kept the original foundations, insufficient in size and depth for the increased loads of the new building; the consequences are visible today and cause the current instability[6].

[5] Connected to that particular moment of the urban history of Erbil when all the urban plan outgrew the perimeter of the walls, occupying part of the slope of the hill (see *UNESCO Master Plan, Comprehensive Survey*, vol. I, pp . 14-15).

[6] See Santoro in this volume.

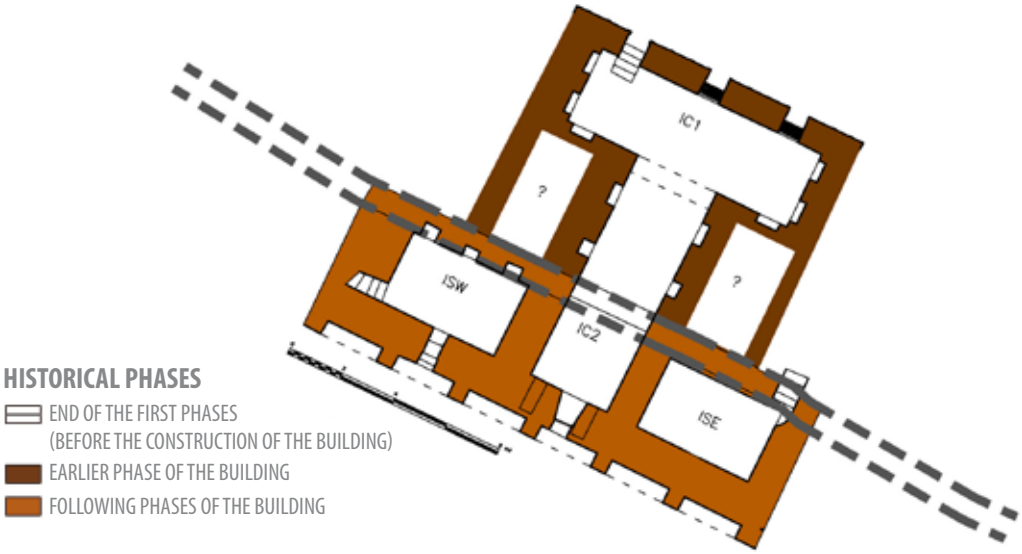


Fig. 2. Lower floor plan, with the indication of the probable profile of the ancient town walls

From the origin to its present configuration the Rashid Agha *diwan khanah* underwent several further interventions of reconstruction and modernization, testified – especially for the last thirty years – by a number of photographic documents (though, not always accurately datable), printed reports and articles[7].

The analysis and comparison of these data with those derived from the observation of the structure, and the contribution of the stratigraphic tests carried out on the walls, paintings and decorative surfaces (on the constitutive materials and products used during the restorations), led to the identification of the different interventions and construction phases, allowing the reconstruction of the chronological synthesis reproduced below (Fig. 3).

before 1903-1906	*(before the present structure of the Rashid Agha diwan khanah) a group of small, one-floor buildings, leant against the earliest town walls, on the hilltop*
1903-1906	*construction (perhaps in different phases) of the Rashid Agha diwan khanah, on top the small existing buildings that became the underground rooms of the new house. The construction goes forward in the direction of the slope, partly founded in the steep zone*
before 1958	*significant differences in the outer façade, changed during the recent works (after 1980)*
before the 1970s	*changes and enlargements of the street in front of the Rashid Agha diwan khanah, with alterations also to the perimeter fence, towards the town*
1980-1984	*first set of recent restorations, with the total reconstruction of part of the porch, the eastern perimeter wall and the entrance*
after 1990	*the house suffers damages as a result of the conflicts*
1994-1996	*second set of recent restorations, focused mainly on the decorative surfaces*
1998	*beginning of the abandonment and ruin*

Fig. 3. Synthesis of the recent construction phases

[7] I wish to thank Arch. David Michelmore (Consultancy for Conservation and Development), who kindly reported the printed documents.

Diagnostic and Conservation

2.2

Giolj F. Guidi

The evaluation of the state of preservation of the materials used in the construction of the Rashid Agha *diwan khanah* was carried out during the April-May 2010 campaign. All the rooms of the building, the materials used in its construction, in addition to those employed for the laying of the architectural elements, were taken into account for this purpose.

Fig. 1. The façade (view from the garden). NNW prospect

The façade looking on to the courtyard (Fig. 1) is the only one characterized by extensive use of stone, mainly consisting of polychrome marble, of colors variable between white and dark gray tending to black. The slabs, composing the vertical ashlars, are affected by splitting and detachments, especially in the joint areas, where the loss, although partial, of the cement mortar is clear. The slabs on the right and left of the windows with bars show, on the contrary, phenomena of surface corrosion, due to rainwater runoff. From the vestibule of access to the courtyard of the house, one can see, on the left of the façade, a brick wall (NE prospect) with false columns defining false blind arches (Fig. 2), which rises to the level of the upper terrace. On the right one can also see a wall of the same height, also in brick, but completely plastered (SW prospect), in which splitting and detachment of the plaster from the masonry below, due to the swelling caused by the seepage of rainwater, are evident. Moreover, the problem of seepage from the roof and the top of the perimeter walls of the court is particularly relevant because of both the disintegration of the cementitious mortar placed at their top, and the condition of complete decay of the wood shelter which certainly had a protective function, in addition to adorning the upper part of the outer walls of the house (Fig. 2).

Fig. 2. Façade, NNW prospect (view from the roof). Degradation of wooden shed

The paving of the raised floor of the loggia, covered with the same marble used in the façade, appears in a fairly good state of preservation, except for a few steps of the two access staircases from the garden that are partially damaged. All

Fig. 3. Damage caused by water seepage on the SW wall, adjacent to B1-1/3 building

plastered walls of the loggia, instead, are generally very compromised as a result of the seepage of capillary rising water, revealed by dark spots and disintegration of the plaster (Fig. 3).

The *diwan*, characterized by a wooden lacunar ceiling and walls decorated with vegetal motifs in blue (Fig. 4), and stucco bas-reliefs painted with pigments of different colors (light green, emerald green, dark green, brown and gold), introduces directly to a side room (*oda*) that leads to a wide balcony overlooking the modern city. These rooms are in fairly good state of preservation, except for problems of rainwater seepage from the upper terrace, which caused in particular the partial loss of the blue pigment. The gates to the *diwan* and the adjacent room (small *oda*) are decorated with an architectural motif with an inlaid arch, made in Mossul stone (characterized by the specific dark gray color), which is in good condition except for the scratches and marks, probably of anthropic origin. The typical phenomena of superficial alteration of the plaster, resulting from the seepage of water from both the roof and for capillary rising humidity from the rooms below, are also evident in the case of the small *oda*. The underlying masonry is very damaged and the bricks are completely broken up in the areas where the plaster is completely missing.

As for the underground rooms, the larger one, typically "T" shaped, and the second one (with a rectangular shape) are in bad condition because the bricks and, above all, the plaster are degraded, as a result of the seepage of water for capillary rise. In this second room, in addition, the frieze that defines the upper perimeter band and the one located in the center of the ceiling are severely compromised both for the dissolution, as a result of seepage of water, and for the presence of gaps and lacunae. Finally, the back façade of the house, made of non-plastered bricks (SE prospect) is in sufficiently good state of preservation, except for some visible fissures and, at the bottom, large areas where the deterioration of the bricks is at an advanced stage because of water seepage and compression produced by the upper layers (Figs. 5-6).

Fig. 4. Diwan. Blue vegetal motif

Given the complexity and the large number of building materials used in the house, 50 significant samples of the following materials were collected in order to define their physical-chemical and mineralogical composition: marble,

pigments on stucco, stucco, bricks, saline efflorescence, mortar and plasters. The latter two were analyzed through: optical microscopy with polarized light on thin sections (Moreland 1968; Hutchinson 1974; MacKenzie, Guilford 1985; Zezza 1996), X-ray diffraction (Klug, Alexander 1954; JCPDS 1990; Bonissoni, Ricci Bitti 1998) and X-ray fluorescence (Seccaroni, Moioli 2002).

Fig. 5 (left). Lower portion of the back façade. SE prospect

Fig. 6 (right). Erosion of the bricks. Detail

The knowledge of the structure, the chemical, physical and mineralogical features of the material on which the cause acts, the type of manufacturing and construction, the environment, the degradation agents and the triggered dynamics were taken into account in determining the phenomena of alteration and degradation of the materials. These data make it possible to determine if the cause is contemporary or earlier, continuous, isolated or cyclic, ordinary or extraordinary. The relationship between causes, agents, dynamics and effects shows complex reasons for the different phenomena and degradation processes of the materials. Each cause can be the sum or the result of the interaction of more actions of decay produced by one or more natural or anthropic agents. It is possible that a single agent can cause different types of actions; the most significant case, observed in the Rashid Agha *diwan khanah*, is the presence of water, both meteoric and from capillary rise, evident in the most important degradation phenomena such as saline efflorescence, scaling, erosion, disintegration, exfoliation and detachment. On the basis of what has been explained above and the analytical results obtained from the chemical-physical and mineralogical methods of analysis, the following conclusions can be drawn.

1. Stone covering of the façade. The façade is characterized by a raised loggia with four columns made of parallelepiped-shaped blocks, and covered with mostly rectangular slabs. The pavement of the raised floor of the house and the moldings of the window (which give light to the *diwan*) are built with the same stone, set in a well-defined architectural motif, which is also visible in all the luxury houses of the Citadel. Their condition is, objectively, sufficiently good, except for the presence of small cracks and gaps, as well as phenomena of surface dissolution and saline deposition as a result of rainwater runoff. The chemical-physical and mineralogical investigations allowed the mineralogical and petrographic classification of this stones: they are all made of gypseous alabaster ($CaSO4 \cdot 2H2O$), some with homogeneous texture, with variable color from yellow to dark green, others with variegated texture, with color varying from white green to dark green. These stones come from the Mossul quarries.

2. Pigments. The only rooms that are decorated with vegetal motifs are the *diwan*, the great and the small *oda*. Blue is the predominant color, both on the upper and lower band of the three rooms,

while the stucco architectural motifs in low and high relief – also visible in the underground rooms – are painted with pigments of different colors. The analytical investigations revealed the use of modern pigments (purpurin with copper, zinc and iron basis).

3. Mortars. The mortars, especially those in the outer walls, appear in bad state of preservation, due to partial or total disintegration. The ones used as binder for the bricks in the walls are in better condition, with the exception of the underground rooms, where there are significant phenomena of capillary rising water. The chemical-physical and mineralogical investigations have detected the prevalent use of lime-based mortars, except in one case, where a plaster-based mortar is used.

4. Coring. The mortar extracted from the cores in the foundations is composed of lime and plaster.

5. Plasters. The plasters, usually gypseous, are most likely due to past restoration activities.

6. Stucco. The stucco, used for architectural friezes both in the *diwan*, and in the underground rooms, is mainly composed of plaster and sand.

7. Bricks. Generally most of the walls, especially those bordering the courtyard of the house, are made of bricks with different colors, from yellow to light brown that, in the most exposed areas, take a darker color due to aging (oxidation of the exposed surface). In many cases, the structure of the bricks shows traces of the straw used into the brick mixture. Furthermore, especially in the underground rooms, red, dark brown and (in scarce number) green bricks are visible. On average, their mineralogical composition is characterized by the presence of K-Feldspar ($KAlSi_3O_8$) and Plagioclase [$(Na,Ca)\cdot(Si,Al)_4O_8$] as main minerals, Quartz (SiO_2) and Hematite (Fe_2O_3) subordinates. Because there are also calcite ($CaCO_3$) and dolomite ($Ca, MgCO_3$), a firing temperature below 700°C is supposed.

8. Saline deposits. Surface saline deposits were sampled especially in the underground rooms, due to seepage of water (capillary rise) from the foundations. Those deposits were identified as chloride: Halite (NaCl) and Sylvite (KCl).

Bibliographical References

Bonissoni G., Ricci Bitti R. 1998, *La diffrattometria dei raggi X per materiali policristallini*, Milano.

Hutchinson C.S. 1974, *Laboratory Handbook of Petrographic Techniques*, New York.

JCPDS 1990 - Joint Committee on Powder Diffraction Standards, *Mineral Powder Diffraction Files*.

Klug H.P., Alexander E.L. 1954, *X-ray Diffraction Procedure for Polycristalline and Amorphous Materials*, New York.

MacKenzie W.S., Guilford C. 1985, *Atlante dei minerali costituenti le rocce in sezione sottile*, Bologna.

Moreland G.C. 1968, *Preparation of Thin Sections*, in 'American Mineralogist' 53, pp. 2070-2074.

Seccaroni C., Moioli P. 2002, *Fluorescenza X, Prontuario per l'analisi XRF portatile applicata a superfici policrome*, Firenze.

Zezza U. 1996, *Petrografia microscopica*, Pavia.

The Knowledge of the Building as a Basis for the Intervention and the Restoration Plan Design

2.3

Rossana Nicolò

Knowledge is the first fundamental act of protection and the basis of a restoration project[1]. This operation is possible through the coexistence of investigations and experts working together and establishing the value of the monument. The systematic survey of the architecture, the analysis of the building materials and the degradation constitute the essential and fundamental means to understand the structure; the comprehension of the relationships between this data supplies a complex but clear outline of the problems and suggests the guidelines for the restoration of the monument. In this process, it is necessary to compare, through a continuous and fruitful reference between general and particular, the overall knowledge of the building with the punctual analysis, paying great attention to the broader context of the Citadel, its significant archaeological value and the traditional building materials and techniques used in adjacent structures.

The Rashid Agha *diwan khanah* consists of different elements that characterize it as a complex architectural structure: it has an external public façade on the perimeter of the Citadel, richly decorated representative rooms (that make it the one most valuable houses of the Citadel), a loggia and a courtyard with fountains and several rooms that overlook it, which reveal the importance given to public areas within the Citadel. The Rashid Agha *diwan khanah* is then a "permeable" building, through different openings, from the inside to the outside.

Fig. 1. Capital of the loggia pillar

The façade is visible along the southern perimeter of the Citadel, very close to the new gate built under the dictatorship of Saddam during the 1980s[2]; the brick front is characterized by the presence of substructures[3] with slightly pointed arches that hold the balcony, a series of windows and the upper masonry structured with a decorative motif.

1 Carbonara 1996a, 1996b.

2 The previous door was characterized by a smaller access, with pointed arch and a building, on the east side, with windows, loophole and crowned with flat-ended battlements.

3 There are a few façades on substructures along the entire perimeter of the Citadel. Among these, the Ali Pasha *diwan khanah* is particularly interesting and has deep arches with decorated lintel, two other simple round arches made of bricks (Consultancy for Conservation – HBA – Euronet Consulting Joint Venture, *Conservation Master Plan 2010*, *Annexes*, p. 426).

Fig. 2. Base of the loggia pillar

The position is one of the finest features of the building; the *diwan* and the lateral *oda* are dignified by the view of the surrounding landscape – now the modern city in constant urban development –, accentuated by the wide central opening[4] and the smaller lateral windows, which are arranged asymmetrically on both sides. The planimetric structure, with *diwan* and side rooms, and loggia on the courtyard, is similar to 19th century Ottoman houses and reproposes the common typological composition of prestigious residential architecture[5].

On the inside, the Rashid Agha *diwan khanah* opens on to a courtyard with a fountain through a loggia with arches on pillars, built in the so-called Mossul stone[6]. The decorative motifs recall the traditional architectural styles, albeit with simplified forms and technique: bases with torus and scotia and simple capitals with similar elements (astragal, band, cyma recta, listel and cyma reversa), now very damaged (Figs. 1-2).

Fig. 3. Loggia ceiling

The investigation dedicated to the surface finishes of the floors, walls and roofs detected the presence of valuable flooring (in stone) only in the loggia; other floors were recently rebuilt in ordinary materials. The stucco-covered walls with painted decorations are included in the decorative apparatus. The brick walls, in some portions, are decorated with geometric patterns obtained by changing the position of the individual bricks.

Particular attention was paid to the ceilings (both vaulted and wooden false ceilings): the masonry vaults in the side rooms of the loggia – some visible, some plastered – have a lowered geometrical shape, that makes them very fragile (for the shape, as well as for the presence of static instability); in the *harem* room there is a very low composite vault with octagonal shape and groins. The flat roofs are also valuable for the wooden false ceilings, with geometric decorations obtained through painted backgrounds; in particular, the one in the loggia shows circular and star-shaped patterns, reproduced by wooden sticks colored in black, almost alluding to a stained glass window (Fig. 3).

[4] The opening was different in 1958, consisting of a tamponed wall with three windows, as shown by some images in the Doxiados Archive in Athens.

[5] Kuban 2010, pp. 469-496, 475. Consultancy for Conservation – HBA – Euronet Consulting Joint Venture, *Conservation Master Plan 2010*, p. 69.

[6] Gypseous alabaster, see Guidi in this volume.

Fig. 4. Diwan, east wall

The Rashid Agha *diwan khanah* stands out in the Citadel for its decorative apparatus, although altered during the recent restoration[7], and for a number of significant features. The part of the *diwan* certainly has the more complex decoration, with walls covered with frescoes, an upper band of stucco and a decorative architectural element that evokes the shape of a *mihrab*[8] on the eastern wall (Fig. 4). The ornament inserted under the arch of the *diwan* was modified during recent restorations and has stucco inserts that are symmetrically disposed at the base in relation to an oval, from which two garlands with geometric and vegetal patterns diverge. At the center of the arch, a circular element with ramifications (with the shape of geometric and vegetal spirals) perfectly reproduces the decoration of the ceiling of the underground room.

The most interesting decoration, in fact, is in the south-west underground room. However, in addition to the stucco on the ceiling, repeated in the other decorative surfaces, there are a few fragments of vegetal frieze, set on a horizontal band at the height of the small openings that give light to the room. The stucco decoration is raised from the painted background, and the decorative pattern is symmetrical, though not rigid, with some slight variations probably due to the technique[9].

[7] See Morganti in this volume. The same information is also included in the report of the restoration project delivered to the Kurdish part at the end of the activities.

[8] Organized into bands with the central part excavated with niches and withdrawn towards the line of the wall. The upper part is flat-ended and frames the central portion, arched, with a central circular element with geometric star-shaped decoration, similar to the one on the arch of the *diwan* and in the stucco with geometric and vegetal spirals in the underground room.

[9] See Colombo in this volume.

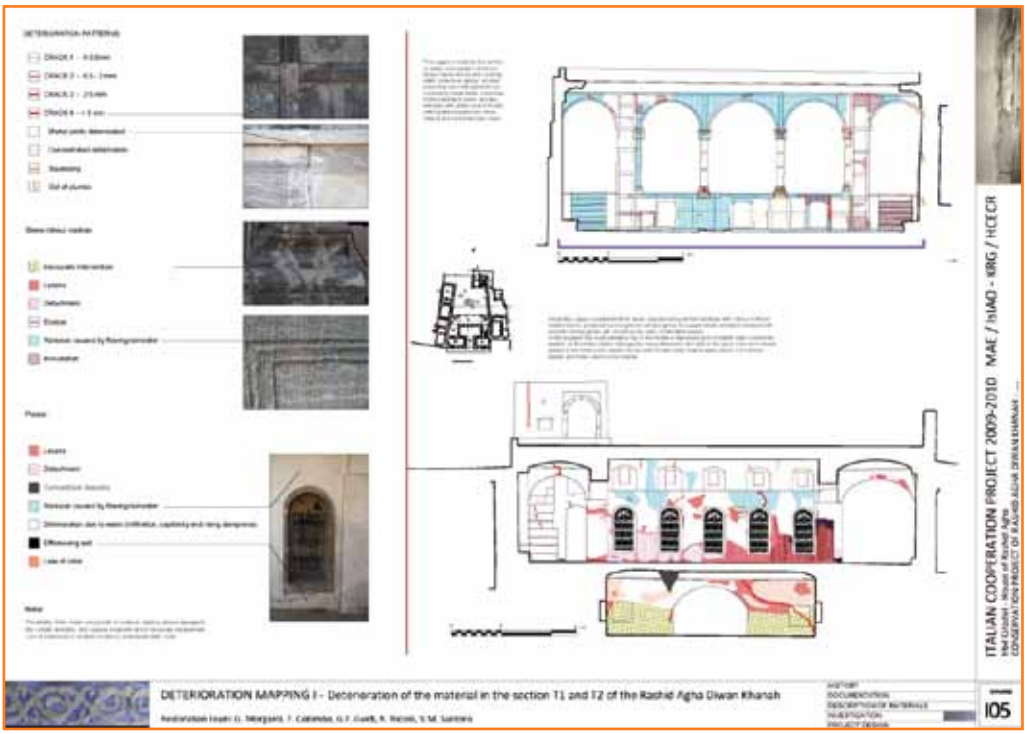


Fig. 5. Example of the degradation map of the materials

Degradation

The Rashid Agha *diwan khanah* shows a significant state of degradation[10], due to structural problems, together with numerous problems related to water, rising humidity that damages the walls, bad draining of the rainwater that has consumed significant portions of the stone façade of the loggia, both externally and in the floor, and deterioration of the wooden flat roofs.

The wide climatic variations in temperature and the strong solar radiation contribute to the erosion of the surfaces and the decay of the properties of the materials that sometimes do not present the chemical and physical qualities for the required tasks from the beginning.

Inappropriate interventions to solve these problems carried out during recent restorations represent another disturbing element for the comprehension of the figurative unity of the monument. For example, the cementitious plaster used in the lower floor to reduce the gaps caused by rising humidity and the cement integrations used to repair the architectural elements of the loggia (bases, ashlars of the pillars and capitals), damaged by the excessive load, show both deep material and visual breaks, and become cause of further deterioration. The lack of maintenance and the loss of windows frames and protection also have irreparably damaged the rooms and the decorations conserved inside, already severely compromised by poor reconstructions.

The features of degradation have been identified for the different materials, and are represented through appropriate layers on the geometric map of the building (Fig. 5).

[10] Fiorani 1996a, 1996b. For the definition of degradation see Normal I/88, *Alterazioni macroscopiche dei materiali lapidei. Lessico*. CNR-ICR, Roma 1988.

The Restoration Project

The restoration project aims primarily at preserving the artefact and recognizing its value[11]. This aim is pursued by limiting and correcting the conditions that foster both structural and architectural degradation, as well as the degradation of surfaces. These are topics that, in the present case, must be carefully evaluated due to the extent and seriousness of the situation. Secondly, it is necessary to provide an enhancement of the structure, to be achieved by choosing a destination profile coherent with the original vocation of the building. We suggest using the whole complex for representation purposes, with a small part as a museum, a space for a conservation laboratory (in the underground rooms), the decorated rooms (*diwan*) for conferences and ceremonies[12] and the terrace with panoramic view and a refreshment-room (Figs. 6-7).

Fig. 6. Ground floor plan with functional destination

The restoration project is based on the principles of recognition of the value of the building, and respect for the traditional materials and techniques employed. It aims at bringing back the figurative palimpsest compromised by decay and partly irreversibly lost. The choice of the minimum intervention, which nevertheless employs the most innovative techniques for the restoration and static improvement – one of the crucial problems of the house[13] –, is suggested also in the restoration of the surfaces through the reintegration of the gaps according to the principles of reversibility and recognizability. Regards the architectural aspects, the choice of adapting the building to a VIP area allows to make a few measured interventions.

Some proposals are focused at reinterpreting, with a contemporary perspective, traditional materials and elements of the structure: the wooden shelters can be restored with the replacement of the deteriorated or permanently lost portions, using lamellar wood and marine plywood in place of the damaged one, improving the resistance to water with small technological devices. We will attempt to recover the lower decoration, consisting of colorful wooden elements. This reinterpretation with a contemporary perspective of the shelters is proposed as a guideline for other elements: a similar methodology will be applied in the restoration of the wooden roofs, the decorated and painted false ceilings. We will use the pattern of one of them, the one of the loggia, as the inspiration for the design of a panel that will form a glassy diaphragm (Fig. 8) into the south-west room (which will host the offices), with the stairs leading to the underground room, used as a restoration laboratory (because it retains the most valuable decoration).

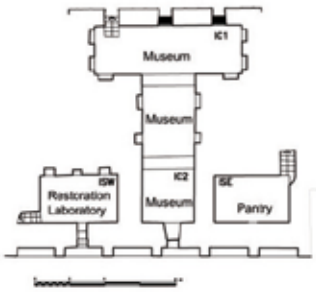


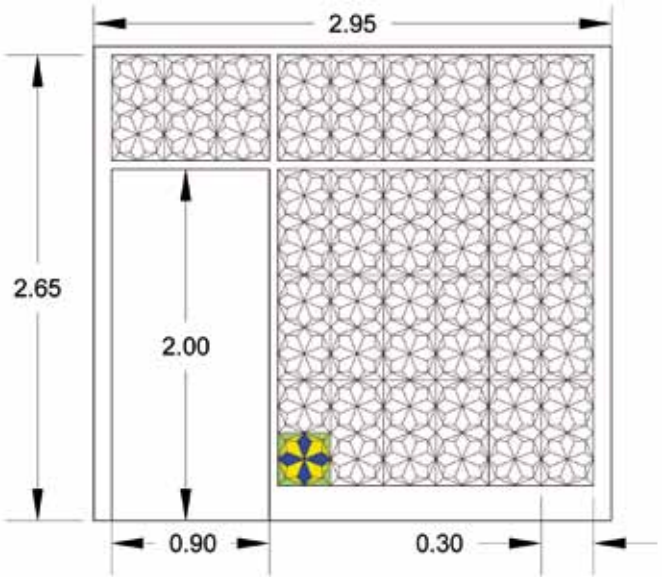
Fig. 7. Underground floor plan with target functional destination

The figurative reintegration of the images of the brick vaults will be implemented through the recovering of the joints. Such reconstruction is also suggested for the architectural elements of the loggia, bases and capitals, heavily compromised by improper interventions. The central underground

[11] Brandi 1977.

[12] Consultancy for Conservation – HBA – Euronet Consulting Joint Venture, *Conservation Master Plan 2010*, *Annexes*, p. 414.

[13] See Santoro in this volume.



room, designed to become a museum, will be made more easily accessible by improving the functionality of the staircase; the interior restored by removing the concrete and applying plaster of adequate quality.

A reversible installation is also proposed to make the courtyard more usable, both in winter and summer: fabric curtains, to be anchored to elements distinct and distinguishable from the existing structure, will suggest a migratory and ephemeral dwelling, and recall the local tradition, particularly skilled in and appreciative of this kind of craftsmanship (Fig. 9).

Fig. 8 . Glassy diaphgram for the Main office

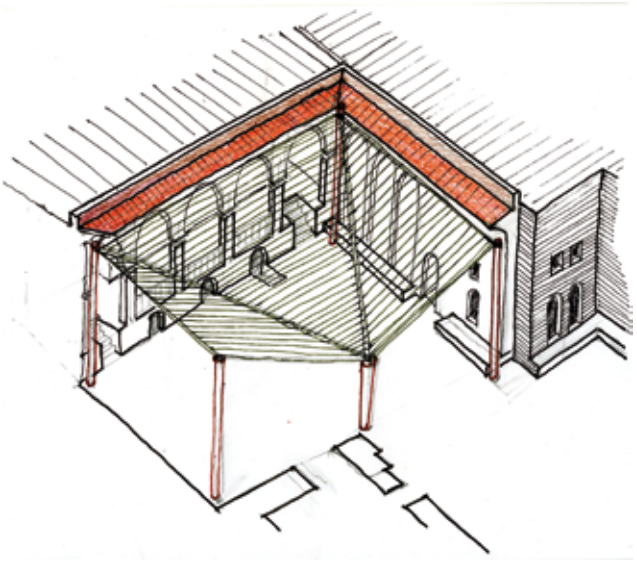


Fig. 9. Studies for the installation of a lightweight tented covering on the courtyard

Bibliographical References

Brandi C. 1977[2], *Teoria del Restauro*, Torino (1st ed. 1963).
Carbonara G. (ed.) 1996a, *Trattato di restauro architettonico*, IV vols., Torino.
Carbonara G. 1996b, 'Analisi degli antichi edifici', in Carbonara 1996a, II, pp. 419-517.
Fiorani D. 1996a, 'L'invecchiamento e il degrado', in Carbonara 1996a, II, pp. 297-409.
Fiorani D. 1996b, 'Rilievo del degrado e diagnostica', in Carbonara 1996a, II, pp. 523-581.
Kuban D. 2010, *Ottoman Architecture*, Woodbridge.

Restoration Project of the Architectural Elements

2.4

Fabio Colombo

About a year after the beginning of the operations, the investigations led to an overview of the steps for the development of a conservation and restoration project of the architectural elements of the house (Fig. 1).

Fig. 1. Detail of the painted decoration of room C1 (phases 2 and 3)

The need to identify the different historical phases of the house and its building materials involved the analysis of a large number of samples in order to obtain the highest degree of information. The study of the building techniques represented a very significant phase of the investigation because the results of the acquired scientific documentation were extremely useful for defining the choices to be implemented in the conservation work (Figs. 2-4).

For the paintings and stucco, and, more in general, for the partial rebuilding of the plaster, four distinct phases were found:

1. green and a neutral color painting;
2. green color painting, with vegetal decorations and stucco;
3. former rebuilding, with vegetal decorations obtained with a technique very similar to phase 2, and repainting of some stucco decorations;
4. second and last rebuilding, with blue color painting, geometric elements in purpurin.

In many cases, such as in the preparatory drawing of the first phase, engraved and finished with pencil, the overlap of the phases appeared particularly evident. Moreover, the presence of dust,

sometimes found between the two layers of painting, allows a number of possible hypotheses that require further study. On the basis of preliminary observation, it is reasonable to assume that the dust layer was formed by incoherent deposits accumulated on the wall surface before the drafting of the second – and now visible – preparatory layer. The difference in style and technique between the phases is also clear: in phase 2 there is a high degree of knowledge of the painting technique, while in later phases, there is clearly decreased meticulousness in the representation of the details.

Fig. 2. Stratigraphic test in the SW room, south wall. Note the green painting of the phase 1

It will be especially important to decide the right period of the year to start the work: the Citadel of Erbil is in a region where temperature changes are significant; for this reason some interventions, in temperatures above 35° and below 6°, must be avoided, because outside of this range the behavior of the materials used for conservation is not reliable.

Fig. 3. Geometric decoration in purpurin (phase 4), performed on the vegetal decoration in blue (phase 3)

Fig. 4. The image shows a stage of the stratigraphic investigation carried out with the tip of a scalpel on a portion of the decoration in room C1. Note the overlap of phases 2 and 3, the preparatory incision, the drawing in graphite (pencil), the traces of dust between the two layers and the clear difference of the constituent pigments of the two pictorial phases

The materials composing the painted surfaces and stucco are highly sensitive to moisture; for this reason, dry methodologies, with non-aqueous solvents, should be preferred. For example, when cleaning the wall paintings it is conceivable to use sponges of Wishab type or neutral gum for dry cleaning of painted surfaces; compressed air is preferable to water for the removal of soft or incoherent deposits.

Moreover, to improve the economy of the preservation project, we plan to use, where possible, local materials and equipment, or from neighboring regions.

The intervention phases that we consider absolutely necessary for the development of a proper restoration and conservation project are the following.

- The intervention must be documented in every phase, through the appropriate graphic and photographic methodologies or in general visual surveys. Documentation will consist in collecting, recording and organizing all written and visual information on Cultural Property including its condition, treatment and measurements. It includes the justifications for conservation-restoration decisions. This documentation is integral to the Cultural Property and its conservation-restoration.
- Preliminary safety measures for all the areas involved in the consolidation interventions, by the temporary removal of some elements (floors) as well: application of layers of Japanese paper, gauze, pre-consolidation by means of resins and glue. These interventions are to be carried out in close contact with technicians and workmen in charge of the structural consolidation.
- Environmental remediation: making safe the unsafe areas and dismissed materials and equipment removal.
- Incoherent deposits removal: removing loose material (dust, sand, soil, animal waste) by means of soft-bristle brushes and vacuum cleaner.
- Biocide treatment: application of appropriate biocides by brush or atomizer. The application should be adopted only when opportune, and extended only where necessary.

- Disinfestations: extensive treatment in order to remove any form of biological pest colonies.
- Removal of obsolete equipment (pipes, cables, nails, plumbing): this phase of the work will be a highly critical point, having to face even the moving of original parts and their subsequent relocation.
- Efflorescing salt removal: the use of mechanical instruments such as scalpels, hard brush, small soft-bristle brushes and dental equipment (micro-explorers-drills) will be preferred instead of chemical products.
- Preconsolidation: application of resins and silicates by means of syringes, drip dispensers and atomizers.
- Surface consolidation: application of resins and silicates by means of syringes, drip dispensers, atomizers and brushes.
- In-depth consolidation: injections of natural lime flowing mortars through syringes fitted with extensions.
- Removal of cement fillets and fills: this operation will be mechanically implemented by means of automatic equipment such as micro-air drills.
- Concretions removal: paper pulp (laponite or sepiolite) packs will be used for concretions, stains and stain removal, using deionized or distilled water as the solvent, as well as mechanical methods in case of harder concretions.
- Recovering the original plaster layer: mechanical removal of non-original plaster layers.
- Surface removal of non-original paint layers: mechanical/chemical removing of recent layers of plasters or painted or protecting films.
- Rod insertion: in-depth reinforcement (of stone, plaster, stucco...) by means of rods, preferably fiberglass rods, because fiberglass is not subject to changes in volume as consequence of temperature changes.
- Walls brickwork reintegration: the lacunae of the walls will be reintegrated by the use of bricks, similar to the original ones, in order to make the reintegration visible only to close observation.
- Plaster fills and fillets: reintegration of plaster using natural lime mortars, similar to the original ones.
- Plaster and masonry micro-filler: reintegration of plaster and masonry micro-cracks using natural lime mortars, similar to the original ones.
- Final presentation (plastering, coating, protective layers drawing up): preparation of films consisting of watercolor painting or filleting, aimed both at the aesthetic presentation and surface protection.
- Metal features treatment: brushing, removal of the oxidized coating, anti-oxidant treatment.
- Reintegration/replacement of metal/wood/glass/ceramic elements/features.
- Cleaning: this is a very delicate working phase. The interventions will be highly selected and diversified according to specific materials and their condition. This phase will be described in a specific chapter in detail.

Technical Proposal for Restoration, Strengthening and Reinforcement Design

2.5

Valter M. Santoro

Strengthening and Reinforcement Implementation of the Conservation Project of the Rashid Agha *diwan khanah* in Erbil will allow the recovery of the lost safety levels of the building (Fig. 1).

The main features of the interventions are based on the hinge principles of the modern Italian approach to the Restoration Project, that are:

- non invasive techniques of implementation,
- respect for the original architecture and building materials, in order to maintain its authenticity,
- respect for the potential archaeological sites,
- compatibility of the added materials from all mechanical, physical, chemical and thermal point of view,
- reduced impact of the new works on the architectural context.

Fig. 1. General view of the Rashid Agha diwan khanah from downhill

Following those guidelines, the structural project was addressed to eliminate the causes of damages, originated, as recognized during the phase of study, by the inadequate bearing capacity of the foundation of the structures, and to reduce the hazard of new damages consequent to potential seismic events (Fig. 2). The result would be a general improvement, even though not a complete retrofit (that would cost more impacting activities).

The possible interventions for the foundation set up were addressed to reduce or, hopefully, to eliminate the risk of further deformation at the foundation level, due both to a limited bearing capacity – because of the local and geotechnical conditions – and to the seasonal variation in water content of the soil.

Fig. 2. Example of crack pattern of damaged structures

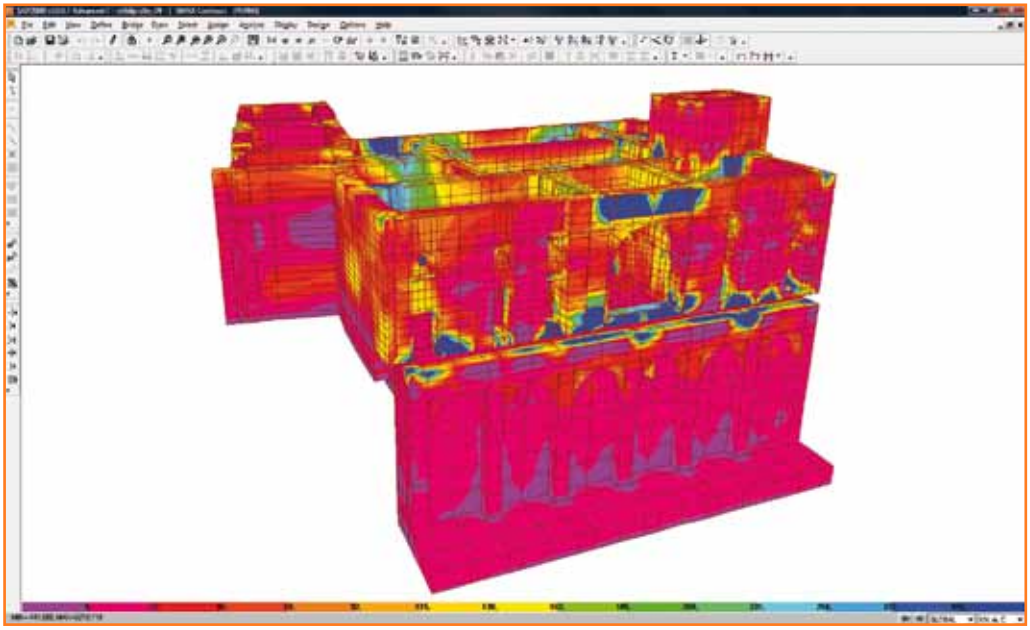


Fig. 3. Stress analysis of the whole building through a numerical structural model

During the phase of investigation, study and analysis, a three-dimensional numerical model was developed, for the evaluation of the stress condition on the structure of the building, related to the abnormal behavior of the foundation and to the response to the seismic actions (Fig. 3).

The visualization of the stress distribution shows the concentration of stresses into the walls, revealing high hazard conditions. Cross matching between the results of the theoretical analysis and the map of degradation, reported by the on site survey, shows good accordance, and validates the drawn hypothesis (Fig. 4).

The basic aims of the project of strengthening can be achieved reinforcing the wall foundations by means of a deepening of the bearing surface elevation and of an enlargement of the dimensions of the base. This can be performed through traditional excavation works, that must be carried out step by step for limited extension samples, building new brick masonry structures effectively connected to the original foundation.

By this way, the strengthening of the foundations is based on a technique that allows all the preliminary archaeological investigations around the existing foundations. In case of non subsistent boundaries, an effective enlargement or underpinning of the walls will build up. The technique, known as "check and spread" implementation, will offer further knowledge of the archaeological deposits of the site.

The connection between the new structures and the existing ones will be realized through advanced techniques and innovative materials, whose use is based on the aforementioned criteria. The connecting tie rods are of fiber glass type, and will be tensioned without any permanent device, transferring the pre-stress along the drilling shaft itself (Fig. 5).

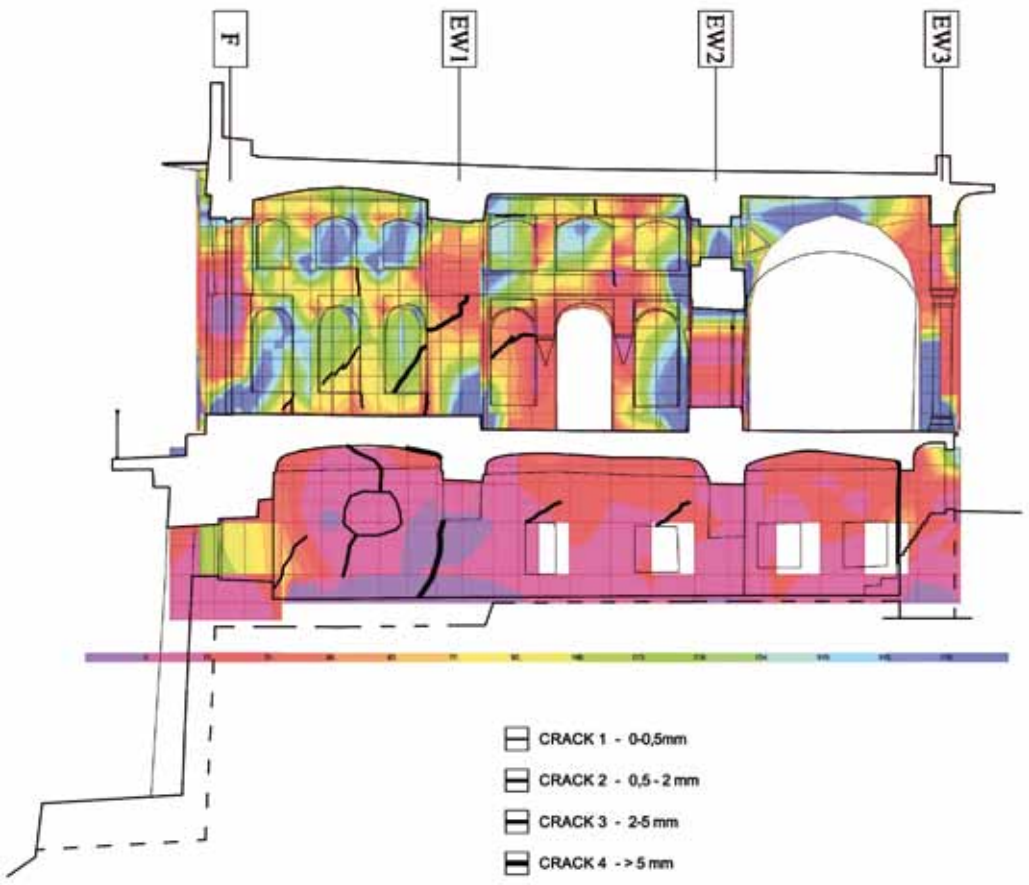


Fig. 4. Stress distribution from the numerical model for a longitudinal wall overlapping the crack pattern

The re-filling of the extra excavation volume will be carried out through a granular soil backfill wrapped in geotextile fabric, in order to provide an effective drainage against the raising dampness along the hypogean walls.

Similar procedure is foreseen for the chaining bars and rods at the two levels, where the lack of connections between the opposite walls can produce further damages.

Effective reconnections between the façade and the side and parallel walls will be also foreseen, in order to ensure the cooperation of structural function for all the reacting elements as compared to the static loads, to the coactions induced and to any seismic action.

A key role will be played by the tie rods and by the anchors connecting the downstream wall and the arched buttresses to the back top of the hill. These will ensure the stability of the boundary structures of the buildings against the overturning, both in static and seismic loading cases. In order to make it compatible with the archaeological characteristics of the backfill of the hill, special anchoring devices, called TFEG, will equip the bearing ends of the rods. They consist in a telescopic spikes that locally penetrate into the soil, avoiding, in this way, any cement injection of the shaft and consequently any contamination of the possible significant archaeological layers.

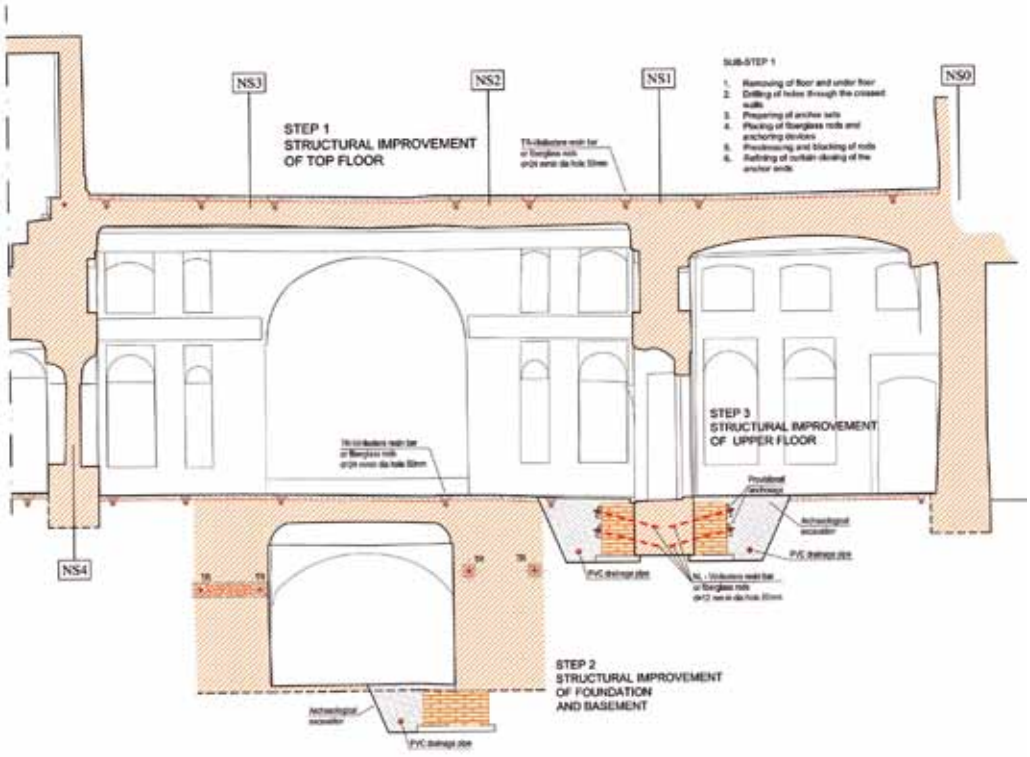


Fig. 5. Strengthening measures for the foundations of the walls

The slabs and vaults of both ground levels will be lightened and reinforced through new timber slabs, more suitable for the seismic response of the overall structure and for any inter-wall connecting function.

Special implementation are provided for the local damaged structures, walls and vaults, based on traditional technique, such as pointing, re-pointing, local grouting, stitching.

Geophysical Prospections with GPR RIS/MF System. A Preliminary Archaeological Survey on Erbil Citadel

3

Luca Colliva
Alessandro Colucci
Giolj F. Guidi

Thanks to the agreements between the Italian Cooperation Project, co-directed by Prof. Carlo G. Cereti and Dr. Roberta Giunta, and the High Commission for the Erbil Citadel Revitalization (HCECR), directed by Arch. Dara Talaat Mohammed Ali al-Yaqoobi, a survey campaign using the Ground Penetrating Radar (GPR) started in October 2010, with the specific purpose of gathering data for the stratigraphic analysis of the Erbil Citadel and achieving a deeper comprehension of its ancient development. The geophysical prospections were carried out in collaboration with UTT-MAT of ENEA (Fig. 1).

Fig. 1. Erbil Citadel. A. Colucci and GPR

The strategy of using non-invasive geo-archaeological explorations came from the need to collect information useful to an appropriate planning of extensive archaeological excavations – necessarily destructive – inside an urban context of great importance, inhabited until the second half of the 20th century.

The prospections were carried out by the authors, in collaboration with the Topographers Angela Bizzarro and Sven Stefano Tilia, the Chief Architect of HCECR, Ranan Khasraw Tawfiq, the Architect Bafreen Abdulqader Ali and the Civil Engineer, Jaafer Saeed Ibrahim (Figs. 2-3).

Figs. 2-3. Erbil Citadel. A. Colucci with the members of the HCECR (left) and with Bafreen Abdulqader Ali, Architect of the HCECR (right)

The Erbil Citadel and Its Historical and Archaeological Context

The architectural structures that now occupy the top of the Erbil Citadel, making it one of the most striking places of the Iraqi Kurdistan, if not of the whole Iraq, date mostly to the late Ottoman period. From an archaeological point of view, however, the importance of many of these buildings, despite their value, must be reconsidered in comparison to the heritage hidden into the hill, that seems to conserve a deep archaeological stratigraphy, whose history is still largely unknown.

The study of the sources and data collected during the Kurdish-Czech archaeological campaign (2006), directed by K. Novácek, allows a partial reconstruction of the millenary history of this site, but there are still so many uncertainties suggesting that what has been done until today is only the beginning of a longer, complex and varied study.

The materials collected on the surface by the Kurdish-Czech mission testify a human presence in the territory since the Prehistory: the ceramic fragments suggest a human occupation of the area since 4000 (perhaps from 6000 BC), while the stone materials, although still under analysis, seem to attest the first human traces in the Palaeolithic period. Such a continuity of human settlement, if confirmed, would be of great importance for a better understanding of the historical development of the area.

The cuneiform sources attest the existence of an urban site at least since the end of the 3rd millennium, as evidenced by some tablets that report the attack and destruction of the town of Urbilum by the sovereigns Šulgi and Amar-Sin of the 3rd dynasty of Ur[1].

The Mesopotamian documents of the later periods refer to a city of great political and, especially, religious importance: although some scholars consider late and popular the etymology which derives the name of the settlement from the Assyrian Arba'ilu (the four gods), and uncertain the presence of the four temples hypothesized; the existence of a huge sanctuary dedicated to the goddess Ishtar, and at least another building dedicated to the god Assur are well attested in the documents.

It is still uncertain if these early settlements were in the place where the Citadel stands today; however, the chronology of the materials found on the surface and the nature of the hill (which, as we will see, seems to be entirely artificial), make this hypothesis plausible.

For the following periods – during which, once again, the toponyms Old Pers. Arbairā and Gk. Arbēla suggest an identification with the present Erbil – the archaeological and historical data are very scarce and allow to understand only small aspects of a past still largely obscure.

We know that the city was under the Achaemenid control, and that it was the place where Darius I defeated Tritantaechmes, one of the rebels who opposed his ascension to the throne. In Arbela, Darius III took refuge after the defeat suffered by Alexander at Gaugamela in 331 BC. Controlled by the Seleucid empire, the territory first passed under the control of the Arsacid dynasty, probably after the victorious campaigns of Mithradates I, and then under Tigranes of Armenia, when he conquered the region of Adiabene. At the beginning of the 1st century AD the town became the capital of a vassal kingdom of the Parthian Empire – whose first ruler is known as Izates – and, during the four centuries of the Sasanian Empire, it became the administrative center of the province of Nódh-Ardashirakan. During the 7th century, with the coming of Islam, the town lost its importance and regained prestige, independence and economic power only between the 12th

[1] Unger 1928, p. 141.

and 13th century, when it became the capital of the Begteginid dynasty. Repeatedly attacked by the Mongols, it did never suffered a complete destruction, and, once conquered by Suleyman "the Magnificent", in 1534, while administratively passing under the control of Mossul, it remained one of the major fortified centers of the Ottoman Empire.

The GPR

The GPR (Ground Penetrating Radar) is a methodology used to carry out non-invasive geophysical prospections and allows the detection of various kinds of discontinuities, even at a considerable depth (12-15 m). Through the reflection of electromagnetic waves, the GPR gives, as a result, a series of images that represent sections of the investigated medium with the interpretative detection of the presence and position of evidence (under the soil level) or anomalies in the medium itself. In recent years the use of GPR for geophysical surface exploration has been increasingly widespread, and there was a significant rise of interest in this methodology, both for the non-invasive character, and for the high accuracy achieved through the development of specific software applications. In particular, this technology has been recognized as particularly useful in the field of archaeology for its reliability in detecting walls, metallic objects and cavities of different size.

The GPR is based on the same principle of the traditional radar[2], albeit with some significant differences:

- in a traditional radar, the irradiated electromagnetic wave spreads through the air; in the GPR propagates into the under-soil or other solid materials;
- traditional radar can detect targets at several kilometres of distance, the GPR works generally at distances of a few metres;
- the resolution of a traditional radar is in the order of tens of meters, the GPR can reach resolutions of at least tens of centimeters.

The key features of the GPR are:

- the range, e.g. the maximum distance (or depth) at which a target (or a reflector) can be detected;
- the spatial resolution, e.g. the minimum distance that can exist between two targets so that they can be distinguished by the GPR as two physically different objects (instead of as a single one);
- the accuracy, e.g. the ability to accurately determine the position of the targets.

In its most common configuration, the GPR system irradiates energy (electromagnetic impulses) into the ground through an antenna: the transmitter generates a very short electrical impulse, lasting a few nanoseconds. The impulse (an electromagnetic wave) is irradiated into the ground through a receiver-transmitter antenna. The irradiated signal is sensitive to the electromagnetic characteristics of the soil, and in particular to the dielectric constant (a function of the chemical-physical state of the elements that compose a particular material and depends on environmental factors, such as humidity).

[2] Goodman, Nishumura 1992; Conyers, Goodman 1997; Conyers 2004; Daniels 2004, 2006.

In the wave propagation across the soil the following effects are visible, and are the basis of the GPR:

- the reflection of the electromagnetic wave that takes place every time the propagation medium shows a variation (or heterogeneity) of the electromagnetic characteristics, such as in the case of a target;
- the attenuation of the electromagnetic wave, whose energy decreases gradually with the increase of depth: this factor is the main reason for the limited depth of investigation;
- the speed of propagation, which can significantly change (of almost 10 times), according to the nature of the terrain.

The antenna gathers the reflections and transforms them into an electrical signal. The reflection originated by a buried object is made of an impulse delayed for an amount of time proportional to its depth.

During the GPR surveys, the antenna or the array of antennas can operate in contact with the surface or spaced over it, and can collect a complete set of reflections of adjacent lines, which compose the profile of the radar section. The quality of the obtained profiles can be improved by appropriate digital processing; the most common processing methodology is noise filtering.

One of the main features of the GPR is the depth of penetration: this is extremely variable depending on the nature of the material, since it is strongly influenced by the conductivity of the material itself. For this reason, there are special cases of soils (solid rock, ice, dry sand, etc., characterized by low conductivity and good homogeneity of the composing materials) where penetration can be very high (up to 50 m); nevertheless, in general, the depth of investigation is limited to a few tens of meters. The GPR surveys are impossible in environments saturated with salt water, and are very limited in water-saturated clay soils; on the contrary, concrete layers or resistive soils do not disturb this equipment.

The chosen frequency is of great importance: the wave penetration into the soil is inversely proportional to the frequency of the antenna. For this reason, GPR systems are equipped with multiple antennas with varying frequencies, from a minimum of 80 MHz up to a maximum of 2,5 GHz, in order to be able to supply the most appropriate frequency, depending on the nature of the soil to investigate. In general, the choice of the frequency is the result of a compromise between the following requirements:

- the low frequencies are advisable for deeper penetration;
- the high frequencies are advisable because they allow a better resolution and, therefore, a better quality of the radar image; in addition, high frequency antennas are smaller, lighter and therefore easier to handle.

In practice, where the depth of investigation is limited to 10-100 cm, in general, an antenna with a frequency of 1,000 MHz (1 GHz) is applicable, while for depths of 50-500 cm, antennas with frequencies between 200 and 600 MHz are generally used.

Operative Features of the GPR

The methodology is completely non-destructive, and does not cause any mechanical stress to the artefacts, or induce any modification in their chemical and physical state.

The availability of multi-array and multi-frequency methods provides a high quality and reliability of the results, optimizing in the process.

The progress speed of the sensor may vary depending on the target and the operating frequency, from a minimum of a few kilometres per hour up to a maximum of over 100 km/h.

The results can be gathered, processed, interpreted and visualized in a geo-referenced context, included in a CAD drawing (in scale or schematic). They can also be stored in a GPR database, capable to interact with other databases.

Generally the radar survey is divided into two main phases:

- topographic survey of the site to investigate and on field data acquisition;
- data processing, production of cartography, technical reports and geo-reference of the investigated areas.

The Campaign of Prospections on the Citadel

The campaign of GPR prospections lasted 25 days, during which 42 areas were surveyed, for a total of approximately 5,000 sq m.

The three areas reported in the Citadel Conservation and Rehabilitation Master Plan were selected as suitable sites for future archaeological excavation: the central area (from a EP2010_S16 to EP2010_S22); a north-eastern area, corresponding to block B36 and its immediate neighbourhood (EP2010_S39 and EP2010_S40); a western area, corresponding to block B50 and its immediate neighbourhood (from EP2010_S33 to EP2010_S35).

The main street (Citadel Street), which crosses the Citadel for its entire length along the north-south axis (from EP2010_S01 to EP2010_S15), and a small site (currently used as a parking area) located to the east of the southern gate (EP2010_S36) were added to these three areas after a preliminary on site inspection.

The north-south axis was chosen for its central position and for the possibility to compare the collected data with those published by the Kurdish-Czech mission, which carried out some prospections during the 2006 campaign. The parking area was taken into account for its proximity to the perimeter wall, and for being one of the lowest parts of the Citadel. This scarce elevation is probably due to the removal of part of its surface stratigraphy during the construction of the Main Gate. Position and height made that area particularly suited for the identification of possible fortifications, and gave the opportunity to investigate deeper stratigraphic layers.

The first results and the meetings with the HCECR staff urged us to explore some more areas in the southern part of Citadel and along the perimeter town walls: the road that runs along the inner front the South Gate, to the south of block B21 (EP2010_S23 and EP2010_S24); the first part of the lane that from the gift shop proceeds to the west, skirting blocks B21 and B43 (from EP2010_S25 to EP2010_S28); the inner courtyard of the house of block B20 (EP2010_S29); the inner courtyard of the farthest house of block B19 (EP2010_S30); two small areas inside house B18/1 (EP2010_S31 and EP2010_S32); the inner courtyards of houses B8/2 and B8/3 (EP2010_S41 and EP2010_S42); the area in front of house B24/1 (EP2010_S37); the area between blocks B3, B4, B24 and B25 (EP2010_S38).

Fig 4. Erbil Citadel. GPR exploration along the main road

The north-south axis was investigated in its entirety, but many of the other areas were only partially surveyed, because of the presence of prefabricated structures, rubble or buildings.

All the selected areas were geo-referenced and placed on a specific thematic map, and will soon be managed into a GIS system linked to a relational database.

During this campaign, the investigated areas of the Citadel were analyzed through longitudinal and transverse radar scanning, using an antenna system in RIS-2K/MF 200-600 MHz configuration (Fig. 4).

The number of detected anomalies, monitored up to 7-9 m of depth, and the results obtained encourage us to continue the exploration. A new campaign is being prepared and these GPR surveys will be supported by other investigation methodologies, such as seismic surveys and cores, in order to obtain data on the deeper layers and to improve the knowledge on the stratigraphy of the site.

Fig. 5. Plan of the Erbil Citadel with the areas investigated through GPR and the identified anomalies (processing by S.S. Tilia)

Results of the Investigations

The composition of the soil and the high level of humidity, common to all the areas under investigation, have significantly limited the penetrating power of the radar: the area clearly visible reaches the depth of about 2-3 m; below, the signal is strongly attenuated, and the results at depths between 4 and 9 m are only partially reliable. More depth could be achieved through the use of lower frequency antennas, although it would imply a consequent loss of detail in the detection of small anomalies.

The propagation speed, suitable to define the depth, was calculated by approximation, using the results of four cores carried out for the realization of the Conservation and Rehabilitation

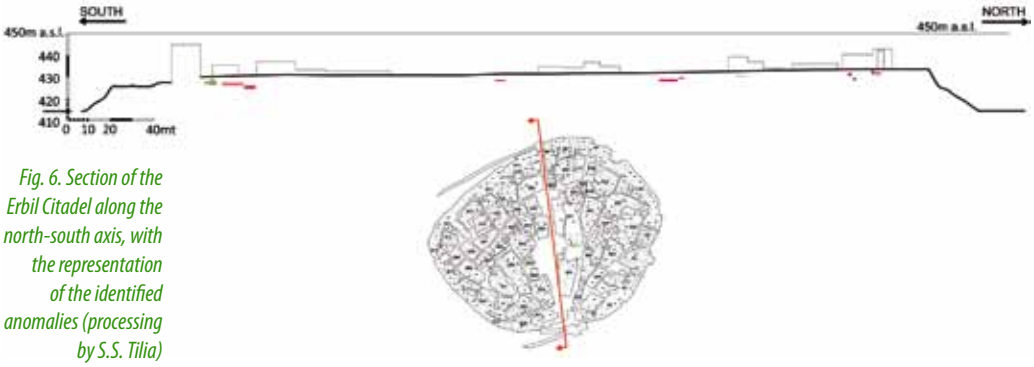


Fig. 6. Section of the Erbil Citadel along the north-south axis, with the representation of the identified anomalies (processing by S.S. Tilia)

Master Plan: the interface between the first and the second layer was quite evident in the radar prospections, and it was identified also in the cores. This comparison made it possible to calculate the propagation speed in the soil and then to extend it, for similitude, in all the investigated areas.

The comparison between the calculated speed and the reference tables also allowed to establish that the detected archaeological stratigraphy is largely composed of clay materials.

A common feature to all the prospections is the presence of a deep layer, of approximately 1.5-2 m, of landfill. This layer was not taken into account in the analysis, considering it not significant for the purposes of the on going investigation.

The boxes shown in the 3D CAD visualization qualitatively indicate the position of possible continue structures or anyway extended evidences, but their size is only indicative. The punctual tag (with marker) indicates the presence of anomalies clearly visible in some profiles but not identifiable in other contiguous profiles, because of the excessive variability of the intensity of the radar signal. The radar survey does not identify the object, but just a different physical behaviour of the materials in the subsoil, indicating the probable presence of evidences or objects whose composition is different from the matrix around them.

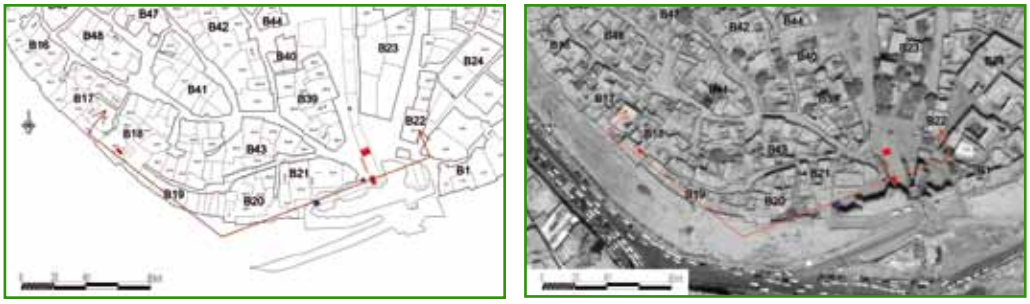


Fig. 7. Plan of areas EP2010_S23, EP2010_S24, EP2010_S29, EP2010_S31 and EP2010_S32, with the representation of the identified anomalies (processing by S.S. Tilia)

Archaeological Results and Interpretive Hypotheses

The high number of anomalies found, their presence in almost all the investigated areas and the different depths at which these anomalies appear confirm the existence of a very complex stratigraphy (Figs. 5-6).

These data also decisively strengthen the hypothesis, already supported by the results of the four cores carried out in 2009, that the hill on which the Citadel stands might be a tell formed as a result of the accumulation and erosion of masonry structures and materials resulting from the millenary human occupation of the area.

Comparing these anomalies with the data collected during a small stratigraphic test opened in 2006 by the Kurdish-Czech mission, it is possible to conclude that the structures detected in the stratigraphy at the depth of 0-2.5 m belong to 19th century dwellings, partly still visible in the 1920 cadastral map.

Along the central axis the traces of both the removal of much of the surface stratigraphy and the construction of the main street and the two gates are clearly recognizable.

The most interesting data, however, come from the areas along the perimeter wall: in some of these areas – EP2010_S01 and especially EP2010_S23, EP2010_S24, EP2010_S29, EP2010_S31 and EP2010_S32 – several large anomalies were found, which, for position and typology, seem to indicate the presence of fortifications or defensive structures (Figs. 7-10). At present state of analysis it is impossible to date these remains with certainty, although the measured depth and the comparison with the stratigraphy found in the test of the Kurdish-Czech mission allow to suppose

an Ottoman chronology. However, we cannot exclude the possibility that the original core of these structures, certainly reinforced and rebuilt several times over the centuries (given the numerous sieges that the town had to face), can date back to the Begteginid period.

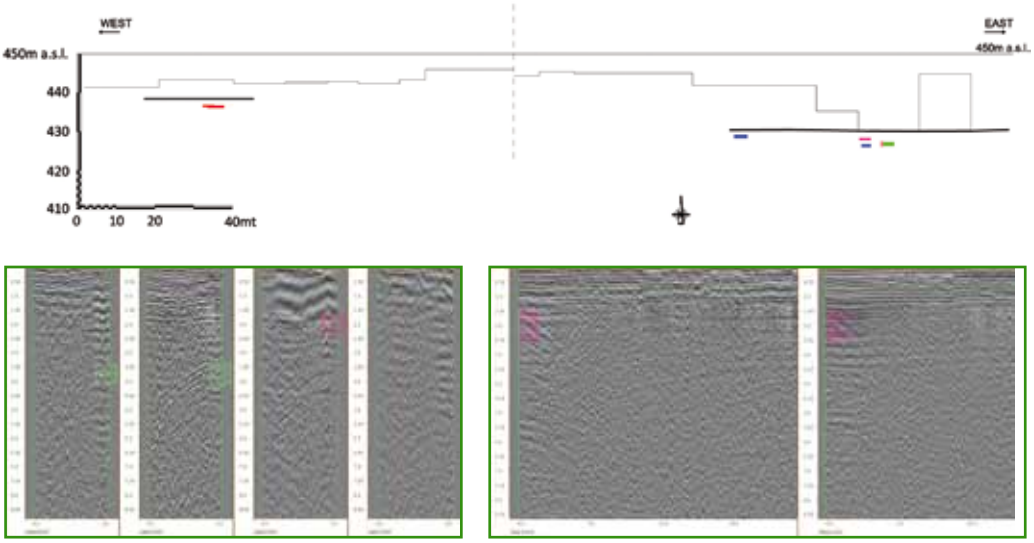


Fig. 8 (on the top). Section of areas EP2010_S23, EP2010_S24, EP2010_S29, EP2010_S31 and EP2010_S32, with the representation of the identified anomalies (processing by S.S. Tilia)

Fig. 9 (above, on the left). Radar profile of area EP2010_S23 (processing by A. Colucci)

Fig. 10 (above, on the right). Radar profile of area EP2010_S24 (processing by A. Colucci)

Bibliographical References

Conyers L.B. 2004, *Ground-penetrating Radar for Archaeology*, Walnut Creek.

Conyers L.B., Goodman D. 1997, *Ground-penetrating Radar: An Introduction for Archaeologists*, Walnut Creek.

Daniels D.J. 2004, 'Ground Penetrating Radar', in *IEE, Radar, Sonar and Navigation Series*, Bodmin.

Daniels D.J. 2006, 'Ground Penetrating Radar' (2nd ed.), in *Proceedings of the 11th International GPR Conference* (Ohio State University, Ohio, USA).

Goodman D., Nishimura Y. 1992, '2-D Synthetic Radargrams for Archaeological Investigation', in *Proceedings of the 4th International Conference on Ground Penetrating Radar*, Rovaniemi.

Hansman J.F. 1986, *s.v. Arbela*, in 'Encyclopaedia Iranica, Online Edition', 15 December (http://www.iranica.com/articles/arbela-assyrian-arbailu-old).

Novácek K. 2007, *Research of the Citadel at Erbil, Kurdistan Region of Iraq, First Season. Final Report*, Plzen.

Unger E. 1928, *s.v. Arbailu*, in 'Reallexicon der Assyriologie' 1, pp. 141-142.

The Project of an Information System of the Erbil Citadel

4

Julian Bogdani

The Geographic Information System of the Erbil Citadel aimed at creating a shared work platform, able to link all the data produced by the multidisciplinary research team of the Italian Cooperation Project in the capital of the Iraqi Kurdistan. The project has been created and developed, at this early stage, by the writer, in close collaboration with Angela Bizzarro; it is however necessary to note that the improvement and enrichment of the system were made possible only through the fundamental contribution of all the members of the project.

Since the beginning of the activity, the system was planned and created with a multi-scale attitude, able to receive and manage data coming from research carried out at different geographical scales.

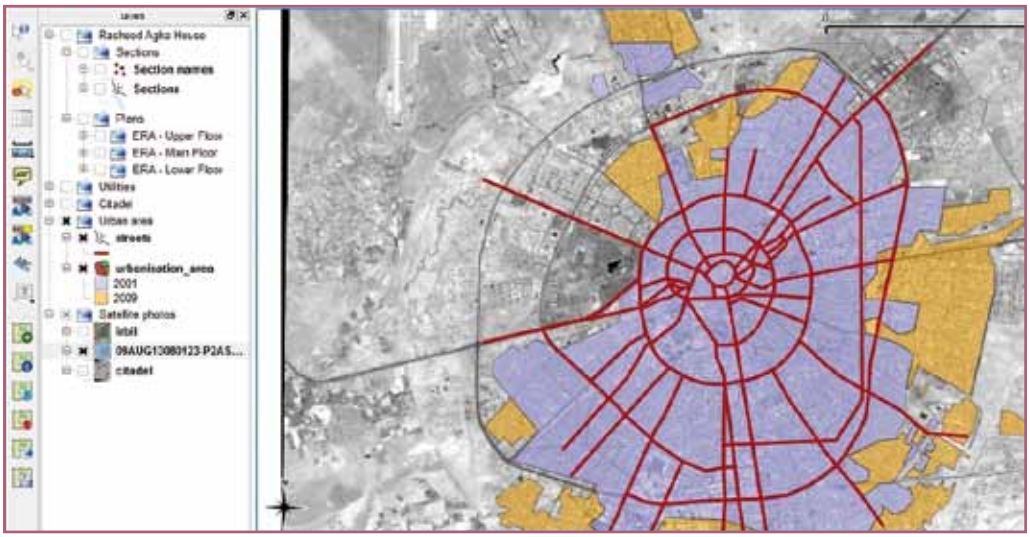


Fig. 1. Visualization, at an urban scale, of the GIS system dedicated to the center of Erbil

The first of these scales is the extension of the city of Erbil and its immediate surroundings. The main contents are various satellite images, purchased for the purpose. In addition to providing the coverage of the area (at a satisfactory degree of metrical accuracy), for which no other more accurate coverage is available, they are also a valuable document for the reconstruction of the urban development of the modern city.

Purchased satellite images taken at different times were used to process layers for the analysis of the dynamics of the recent urban development of the past 10 years (Fig. 1). These analyses will certainly be of great benefit to any archaeological investigation at an urban scale, or even higher.

The amount of data and information increases with the enlargement of the scale. For the area of the Citadel, in addition to satellite images, a preliminary vectorial map, a survey of the buildings, the districts and the streets, on the basis of satellite photos and direct survey, are also available.

Although the accuracy of this survey is not adequate for a detailed research, it provides a good general informative background for further investigation. In addition, the geophysical surveys at this scale show all the relevant data: the investigated areas and the anomalies found, accompanied by information on the type, depth, etc.

Fig. 2. Detail of the main floor of the Rashid Agha diwan khanah in the GIS system of the Erbil Citadel, with the localization of the main sections

The third level of information, concerning the Rashid Agha *diwan khanah* (Fig. 2), is by far the most detailed thanks to recent activity of the Italian Cooperation Project. In this house accurate and multidisciplinary surveys were carried out, both aimed at documenting the evidence, and, mostly, carrying out a restoration project. The results of these surveys and investigations performed on field with different methodologies (Total Station, direct measurements, stereo-photogrammetric surveys – especially of the walls – GPS acquisitions, etc.) were geo-referenced on the basis of specifically recorded GPS points. Similarly, all the data concerning the samples of the petrographic analyses and pigments were localized on the plans and/or sections and processed. The detailed projects (sections and prospects) are linked with the core data referring to the plans of the several floors of the building. Aware of the difficulties of managing the third dimension in the GIS environment, these data were gathered in smaller projects, connected to the main core: these projects include the orthophotos (from the stereo-photogrammetric processing), the direct survey with Total Station, as well as the detailed diagnostic analyses of the present state of conservation of the structures and decorations (carried out by the restoration team).

This system of organizing the information has been designed for a future implementation in two different directions: horizontally – by increasing the number of data in the available layers – and vertically – by deepening the analysis of the acquired data through levels of representation not yet enabled in the structure of the main system. These two goals can be achieved both through the prosecution of the research and field surveys of the Italian Cooperation Project, and by the local authorities, who will inherit our organized informative system.

The usability of this data collection, organization and optimization is of great importance to all those who contributed to its construction. In addition, the developed GIS platform not only works as an archive of the gathered and processed documentation, but also as a tool for further analyses and visualization. For this reason it was decided to create a centralized repository of all the data, accessible through the web only by authorized users. It is a rather complex webGIS platform (Fig. 3) which ensures a continuous flow of geographic information from the central archive to the single scholar and vice versa. Its implementation required the development of a complex centralized system of geographic servers, where all the data (gathered during field activities) were collected, sorted and processed as explained above.

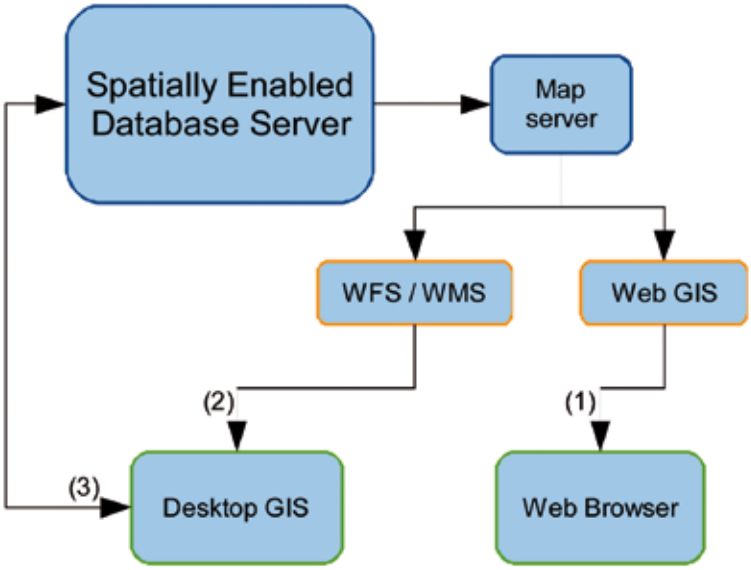


Fig 3. Structure of the webGIS system

Dedicated communication channels were also created and optimized in order to provide access to the data in various ways, according to the user's needs and access privileges.

The first and most immediate of these communication channels allows to view and query all the geographic data (and information associated with them) on a web platform accessible through the most common web browsers (Fig. 3, no. 1). This tool does not require any software installation and allows full access to the data archive through a simple interface, provided with all the visualization and basic analysis tools (overlaying, measurements, query of attributes, etc.). This channel is very suitable for basic users, who need to access, view and query the data without the need to install or manage other GIS software (Fig. 4).

A second access channel uses the WMF and WFS standards for data transmission (Fig. 3, no. 2). This system allows the users to employ their own GIS software on their own terminal, connect to the database through the internet and import in view mode all data that they need. This is a professional access channel, which allows the user to work independently on an single terminal, to build customized maps and create new thematic layers. The use of GIS software provides the opportunity to exploit the data not only as a cartographic basis, but also to interpolate them and perform rather complex spatial analyses. This channel, thus, enables expert users of GIS software to manage the data present in the database for new processing. However, this is a channel that does not allow the users to edit the data, but only their visualization and analysis.

The last communication channel provided by this system is two-way: on the one hand, it allows the visualization and analysis of the data, on the other the editing (Fig. 3, no. 3). This is an access channel that has all the features of the previously described one. It is capable of allowing full usability and accessibility of the data, offers the chance to cross-reference and analyse information without

restrictions and to edit the archive (deletion, insertion of new elements or modifications of existing items). For this last feature, access to the third communication channel is strictly confidential and can be activated only on special occasions.

Given the considerable physical distance between the various partners and experts who collaborate in this project, the network can only be Internet-based. For this reason, the security, authentication and access control systems play an important role in the architecture of the whole system. For the same reason, it is not possible to give here more details about the web addresses from which it is possible to reach the archives, but we hope that, thanks to future agreements and projects, it will be possible to create the conditions and opportunity of a publication (partial and subsidiary) of this data archive for a non-professional audience.

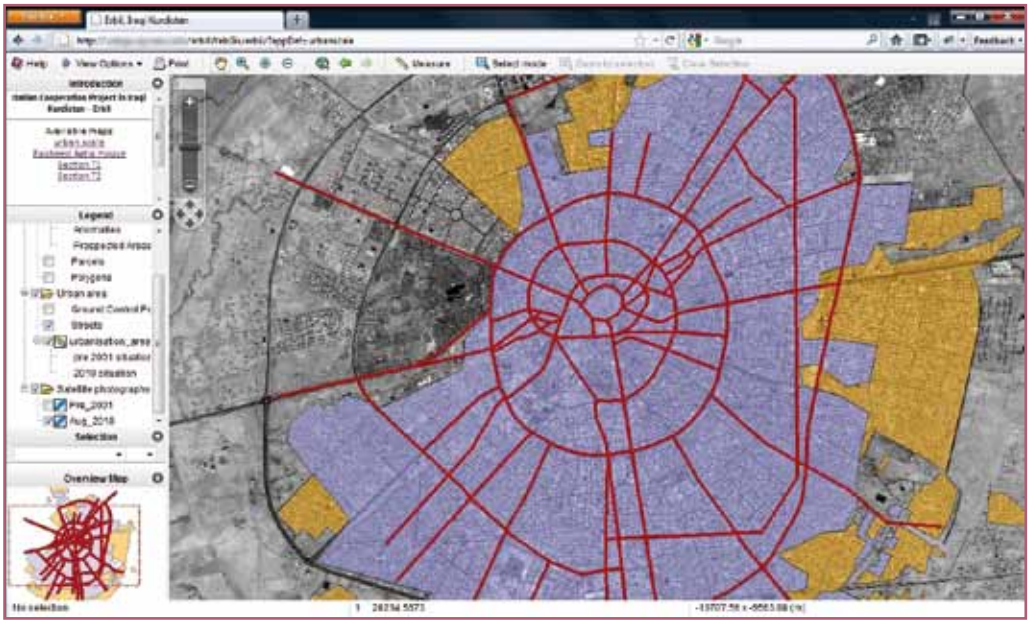


Fig. 3. Visualization, at an urban scale, of the webGIS system (shown with Mozilla Firefox web browser) dedicated to the center of Erbil. See the view of the same area in the desktop GIS system in Fig. 1

Cartography of the Paikuli Area

5

Alessandro Tilia

Since the beginning of the Italian activities (2006) in the Iraqi Kurdistan, the lack of an adequate cartography (essential basis for the archaeological research) was clear. The only available maps used by the Department of Antiquities of Iraq were those contained in an atlas supplying essentially the name of the sites, villages and roads, without any other geographical reference.

After a careful research it was decided to use the Soviet military topographic maps – the only ones at a high detail level – which ensured the full coverage of Iraq. 49 tables were acquired in digital format, on a scale of 1:100,000, covering the whole territory of the three provinces of Dohuk, Erbil and Sulaymaniya. To be used as a cartographic basis of the territory of the Iraqi Kurdistan, these maps were first geo-referenced, beginning from their geographic coordinates, related to the Pulkovo42 datum, and projecting them into the UTM WGS84 coordinate system. This step enabled the creation of a starting point for the archaeological GIS, on an ESRI ArcGIS Desktop platform.

At first analysis, these maps show a number of issues, such as the difficulty to decipher the names of the sites, transliterated into Cyrillic, and many inaccuracies. In particular, in the table of the district of Halabja misplacements of the villages and a translation of the orography of about 200 m were observed, discrepancies that were not found, for example, in the table of the city of Sulaymaniya. From those observations, therefore, the need to create a new more accurate and detailed cartography arose. The best methodology to obtain this goal was identified in the technique of the digital photogrammetry applied to satellite images, using the INPHO software platform.

The area around the Paikuli monument, subject already to an excavation project by the Italians in 2006, was chosen as sample area. Specifically, the QuickBird satellite was used, for its level of resolution, for the presence of the multi-spectral and panchromatic band, and finally for the possibility to acquire immediately available archive images. Among the three possible levels of images offered by the QuickBird satellite, the one defined Standard or OrthoReady was selected, correct from the geometric and radiometric point of view.

Fig. 1. A view of the north-east area covered by the satellites images

The steps necessary for the ortho-rectification of the images involved, firstly, the identification of the inner orientation by means of the RPC (Rational Polynomial Coefficient) coefficients – linking the coordinates of the image pixels with those measured on the ground – and, then, the identification of the outer and absolute orientation (identification, on the same images, of homologous points

of known coordinates) using the GCP (Ground Control Point). The GCP are points measured on the ground, visible on both images composing the stereo-pair and, in this specific case, provided with centimeter accuracy. For this purpose, a survey through differential GPS (DGPS) was carried out; the DGPS methodology is based on the use of two dual-frequency GPS antennas, of which the first (reference) is placed on a point of known coordinates, the second (rover) is used for the measurements of the points. Lacking the data in the territory to identify a landmark with known coordinates, a new one has been created, on the basis of the network of permanent CORS stations (Continuously Operating Reference Stations) of the U.S. NGS (National Geodetic Survey) on the Iraqi territory. The landmark was placed near the site of the Paikuli monument, with a station of several hours, and corrected through the observation of the ISER permanent station at Erbil of the CORS network (the closest to the site under examination).

Fig. 2. The detail of the rocks in the satellite image used for the GCP in the north-east side

Having set the coordinates of the base station (reference), the subsequent step was the acquisition of the GCP through the fast static procedure, consisting of measurements lasting 20 minutes, instead of the fastest one, the RTK (Real Time Kinematic), that uses a radio connection between base station and rover. This choice was made necessary because of the distances between the measured points and the base station, longer than the radio coverage. The identification of the GCP was problematic for two reasons: the area is very steep (Fig. 1), and the large time interval elapsed between the acquisition of the two satellite images composing the stereo-pair – November 2002 and July 2006 respectively –, circumstances that made extremely complicated the search for recognizable elements on both images. The choice of the GCP has fallen on natural elements, such as large rocks, or artefacts such as stone walls used as fences for animals and boundaries within cemeteries or corners of mud houses leant against the hill and then just emerging from the surrounding terrain.

Fig. 3. A view of the rocks in the north-east side

A total of 11 points were mapped on the ground (Figs. 2-3), 5 of which were used as GCP and the remaining as control points. Once having oriented the stereo-pair (Fig. 4), the digital elevation model DTM (Digital Terrain Model, Fig. 5), consisting of a grid of regular points with a distance of 15 m, was extracted. This grid of points, exported in DXF format, was included in the GIS system to create a TIN (Triangulated Irregular Network) surface, from which a map with contour lines can be generated and further analysis may be performed.

Using the OrthoVista module, also belonging to the INPHO software, the stereo-pair of QuickBird images was orthorectified pixel by pixel, oriented through the RPC coefficients and GCPs, on the basis of the previously generated DTM. This image (Fig. 6), defined as true orthophoto, corrected from

geometric distortions and made planimetric, is geo-referenced, and ready to be imported into the GIS system and to become the basis to trace cartographic elements such as roads, rivers, villages, etc.

In order to make the data gathered so far available, with the help of Julian Bogdani, it was decided to publish all the information levels through the ESRI ArcPublisher software so that they can be visible, searchable and printable through the ArcReader viewer (Fig. 7).

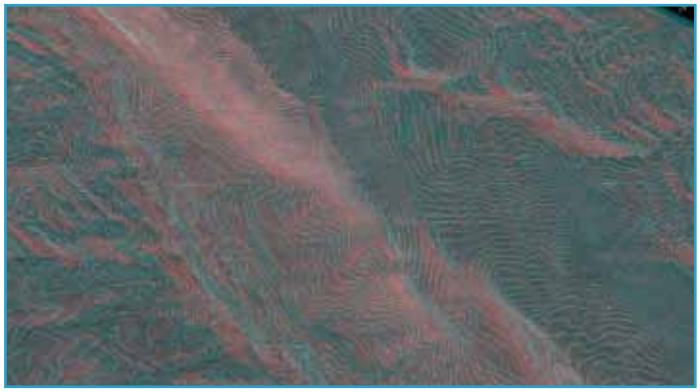
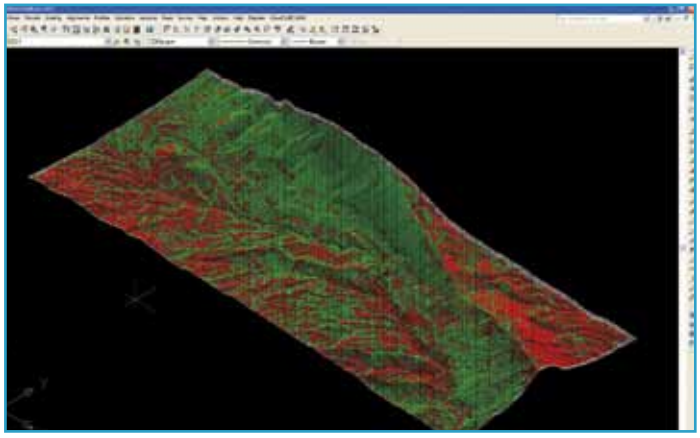


Fig. 4. Stereo view of the satellite images with contour lines

In conclusion, we can say that, despite the difficulties encountered during the cartography production process, the results are encouraging, especially with a view to using next generation satellite images, such as GeoEye and WorldView, which offer products that are already stereo-restitution oriented and with higher resolution.

In addition to the cartography implementation activities, similar digital photogrammetry techniques were used to document the Paikuli monument, with the aim of enriching the GIS database. The survey was performed by Angela Bizzarro and Sven Stefano Tilia with the Menci ZScan system.



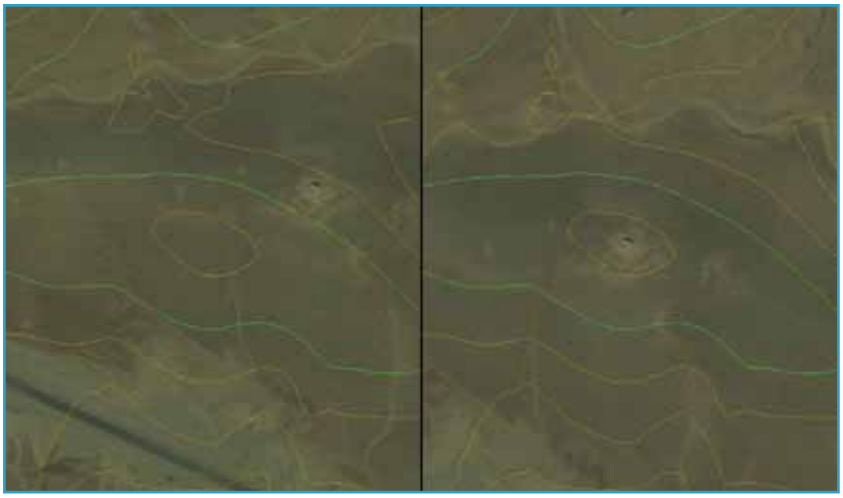


Fig. 5. A 3D view of the grid created through the stereo-pair of satellite images

Fig. 6. Detail of the satellite image, in which the Paikuli monument can be seen, before (left) and after (right) the orthorectification process

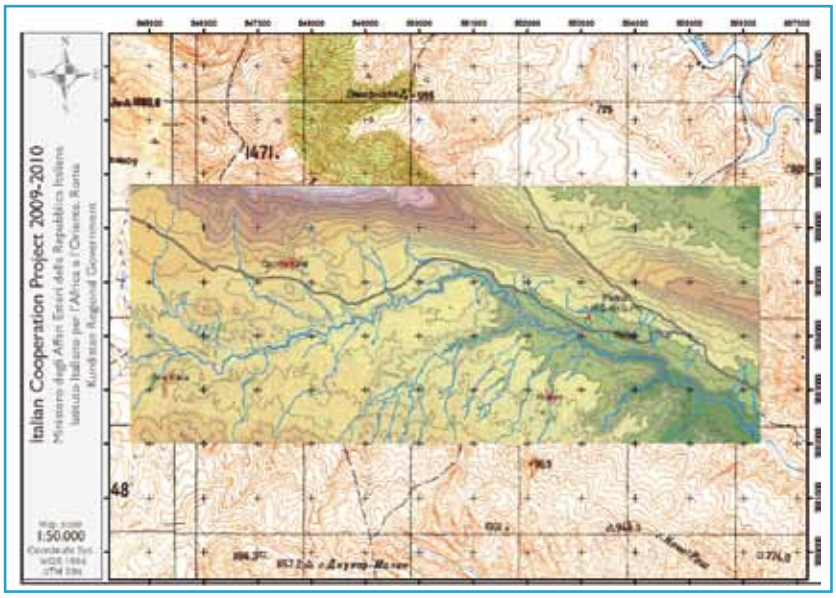


Fig. 7. Example of cartography of the Paikuli area into a GIS system

The photogrammetric images have been geo-referenced through a number of control points measured with the Leica TCR1205 Total Station, on the basis of a polygonal of points in UTM WGS84 coordinates obtained through the use of the differential dual frequency GPS Leica GX 1230. This system allows the scanning of the artifact surfaces, in order to obtain an RGB point cloud (Fig. 8) from which to subsequently extract the orthophotos of the walls of the Sasanian tower, through the ZMap application. The drawings of the prospects were obtained from the orthophotos.

Fig. 8. 3D model of the north wall of the Paikuli monument, acquired through the Menci ZScan system

All the activities explained above were carried out in collaboration with the staff of the Museum of Sulaymaniya and, in particular, with Karwan Abdulrahman, Rebin Mahamad Rashid and Osman Tawfeeq Fatah, who followed all aspects of both the theoretical and practical work.

We would like to extend special gratitude to the Director of the Antiquities of Sulaymaniya, Dr. Kamal Rashid Raheem, and the Director of the Museum of Sulaymaniya, Dr. Hashim Hama Abdullah, for all the support and help given throughout the development of the project.

Coins Cataloguing Activity in the KRG Museums: A Methodological Introduction

6.1

Simona Artusi

A section of the Italian Cooperation Project has been devoted to promoting the Museum activities. With this purpose a project cataloguing of the Museum property was started, involving the three KRG Museums: the Slemani Museum, the Erbil Museum and the Dohuk Museum[1].

In order to acquire a complete knowledge of an individual class of artefacts, the cataloging project involved only one section of the collections of the three museums, section that, according with the local authorities, was limited to the numismatic heritage. Both the Italian and the Kurdish parts have realized, since the beginning, the necessity and the urgency to operate in this field. The 'necessity' is due to the importance of coins, among the most significant documents that can provide considerable evidence for the study and understanding of the social and economic history of the region. The 'urgency' has several reasons: the great amount of the numismatic documents and the large quantity of un-inventoried coins; the precariousness of the state of preservation; the lack of an appropriate methodology in the coin cataloguing system and the non-existence of digital cataloguing media; last but not least, the absence in loco of numismatic specialists.

Thanks to the precious collaboration of the Kurdish Institutions[2], it was possible to quickly create, in each Museum, an effective work team with the involvement of a large number of local personnel. The local personnel has always worked alongside the Italian mission during the project, with interest, participation and constancy.

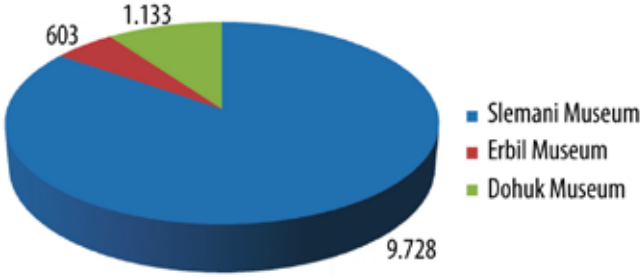


Fig. 1. Total amount of catalogued coins in each KRG Museum

The work focused on a preliminary examination, data recording and preservation of the coins, and tried to achieve a geographical and chronological classification of the documents. Each coin was given an identification number, its images were digitally acquired and the main numismatic information (e.g. attribution, chronology, value, measures, etc.) was entered into a digital database.

The database, which has been punctually elaborated by the Italian members of the project and divided into three different digital archives (related to the three Museums), gives indeed the possibility to register the data, acquire statistical and qualitative information among the data, have

[1] Only the collections of the Dohuk Museum are still closed to the public, because the Museum has found a new home, currently under restoration. All the archaeological materials belonging to it are now at the Directorate of Antiquities of the town.

[2] Our best acknowledge to the Director General of Kurdistan Antiquities, Dr. Abubakr Othman Zemdin; to the Directors of Slemani and Erbil Antiquities, Dr. Kamal Rashid Raheem and Dr. Haydar Hasan Husayn respectively; to the Museums' Directors, Dr. Hashem Hama Abdullah (Slemani Museum), Dr. Ahmad Jawdat (Erbil Museum), Dr. Hassan Ahmed Qasim Barwary (Dohuk Museum); to Dr. Gouhar Shemdin and Dr. Payadar Abdulmuhsen Muhammad of the Heritage Dept. of the Ministry of Municipality and Tourism.

on-line access all over the world, have both a scientific and educational task and constitute a first step for future websites of the Museums.

The cataloguing project also included preliminary activities related to coin conservation and training activity of local personnel[3]. With the exception of few examples, which were displayed in the Slemani Museum and the Erbil Museum galleries, the coins had been kept in the museum storerooms, placed without any criteria in plastic or paper packages, often in a precarious state of preservation. Part of the work was dedicated to planning a provisional way and place of preservation of the material: inventoried coins have temporarily found their own place in plastic multi-spaces sheets inserted into file-boxes, each of which belonging to a specific historical period.

The total amount of catalogued objects consists of 11,464 coins, 9,728 of which at Slemani Museum, 603 at Erbil Museum and 1,133 at Dohuk Museum (Fig. 1).

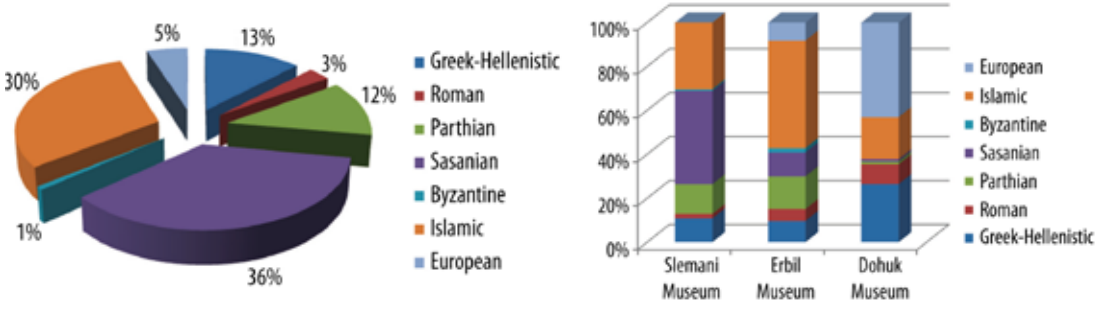
The Slemani Museum collection required a significant portion of the activities. This is due to the wide number of coins belonging to this collection, the total amount of which, according to what estimated by the Museum Director, would seem to reach a number of approximately 25,000 coins. As for the Erbil Museum, 603 coins have been catalogued out of a total number of 730 coins of the collection. The remaining coins (ca. 100) need to be cleaned or restored first.

The catalogued coins cover a wide chronological span, ranging from the 5th century BC to the 20th century. On the basis of the current state of research, the most representative historical periods date back to the Sasanian (3rd-7th century) and Islamic (7th-20th century) eras[4], representing 2/3 of the collections (Fig. 2).

The remaining numismatic documents belong to Greek, Hellenistic, Roman, Parthian (including Elimais, Persis, etc.), Byzantine and European coinage.

The chronological distribution of the coins differs from one museum to the other: Sasanian and Islamic coins represent the largest portion at Slemani Museum; the Erbil collection consists mainly of Islamic coins, while at Dohuk Museum a large number of European and Hellenistic coins is attested (Fig. 3). These percentages could be modified in the near future especially because of the presence of modern forgeries, which have been already partially identified in the collections of the three Museums[5].

Figs. 2-3. Chronological distribution of catalogued coins (on the left) and its percentage (on the right) in the Numismatic Collections of KRG Museums



[3] Training activity represented a fundamental aim of this project. It proceeded in parallel with the cataloguing activity. The team was trained in order to acquire basic knowledge on coins, the necessary tools to manage and catalogue coins properly; furthermore, part of the team was involved in training courses on entering data into the digital database. Lectures and workshops regarding the understanding of some aspects of Ancient and Islamic coins were provided by Italian experts.

[4] We wish to thank Dr. F. Sinisi and Dr. N. Schindel, specialists of Iran pre-Islamic numismatic, for their fundamental suggestions and Dr. Giunta for her precious contribute on Islamic coinage.

[5] See Ranucci in this volume.

The Numismatic Collections of the KRG Museums: Ancient Coins. A Preliminary Survey

6.2

Samuele Ranucci

Advances in cataloguing the three numismatic collections of Iraqi Kurdistan museums have made it possible to better understand the types of coins that they contain. These collections, formed over a number of years, contain a variety of different coinages – which can be broadly classified as ancient – spanning over a thousand years of history, from the 6th century BC to the first half of the 7th century AD, when the Sasanian Empire was conquered by Muslims (633-636).

It is unfortunately not possible, in most cases, to identify the date and place of discovery of the coins in the museums of the KRG Museums, but it is reasonable to suppose that many were found in the region of modern Iraq, or in immediately adjacent areas. In particular, it is reasonable at least to assume a local origin for the many coins that were issued by various authorities and mints within the region at various times. The circulation of these coins must, in fact, have been predominantly local or regional. The region largely corresponds to what the ancient Greeks called Mesopotamia (Μεσοποταμία): the land "between the rivers".

The patrimony of the KRG Museums includes significant numbers of most of the different types of coins that circulated in Mesopotamia, at various times in its history. The coverage of the individual collections varies, however, with some gaps in the smaller collections.

The first coins to be used in the area are the silver *sigloi* of the Achaemenid Empire (539-330 BC) of the Medes and Persians, with the King as an archer on the obverse, and an imageless incuse punch on the reverse (Fig. 1).

A museum display of maps of the area through the ages, showing the places of issue and circulation areas of attractive specimens of ancient coins from local collections, would be an effective way of guiding students or tourists through a visit. Coins, which by their nature are significant symbols of the authorities that issued them, and which are often inscribed, have a high potential educational value. The map in Fig. 2 is a clear example, around which an instructive display of coins could be organised. It shows one of the most significant periods in ancient history, and consequently in the history of ancient coinage: the conquest of the Persian Empire by Alexander the Great.

Alexander's legacy – in terms of the many new cities he founded, and the coins produced – is huge, and of relevance to Iraqi Kurdistan today. Most of these mints continued striking coins after Alexander's death in 323 BC, a date that conventionally initiates the Hellenistic period.

Fig. 1. Examples of silver sigloi *of the Achaemenid Kings (Source: Classical Numismatic Group, Inc., Triton XI, 08.01.2008, lot 1732)*

The disruption of normal life caused by the movement of armies is one of the main reasons for hoarding coins. It is therefore not surprising that hoards or parts of hoards from periods of military activity can be identified in KRG coin collections.

The break-up of Alexander's conquests on his death saw the consolidation of the Seleucid empire (named after Seleucus I, *Nikator*, the Victor, one of Alexander's generals), which at its

greatest extent stretched from the Mediterranean to the frontiers of India. Seleucid coinage, the direct descendant of Alexander's coinage, is one of the richest and most stylistically beautiful in the Ancient World. This, as we shall see, makes it – like the Alexander coins and other Hellenistic coinages – attractive to counterfeiters.

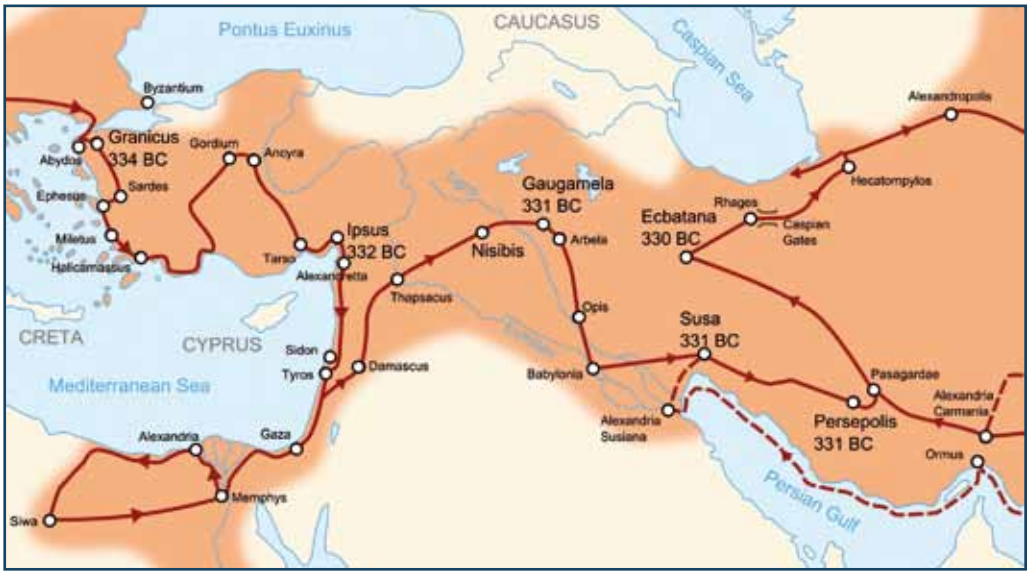


Fig. 2. Alexander's conquest of Persian Empire

A new era began when the Parthians conquered most of the former Median Empire (Iran and northern Iraq) in 148 BC. By 141 BC, Mesopotamia was also in their power. The long Parthian domination – which lasted until the Sasanians replaced them in 224 AD – is well represented in every KRG coin collection.

Fig. 3. Traian, AE, sestertius *(Source: Classical Numismatic Group, Inc., Mail Bid Sale 66, 19.05.2004, lot 1436).* Roman Imperial Coinage, *vol. II, 642*

The Parthians were enemies of the Romans, whose influence in the area grew rapidly in the 2nd and 1st centuries, with the annexation of the remnants of the Seleucid Empire, and the conquest of Armenia from the Parthians in 20 BC. Mesopotamia itself was conquered by Trajan in 116 AD. Roman rule was short: the new provinces of Mesopotamia and Assyria were abandoned by Hadrian in 118 AD, due to incessant rebellions.

Trajan's conquest, ephemeral though it was, was widely celebrated in the media of the period, particularly coins. For example, a *sestertius* (Fig. 3) depicts a female figure of Armenia lying between the male figures of Euphrates and Tigris at Trajan's feet. The legend reads ARMENIA ET MESOPOTAMIA IN POTESTATEM POPVLI ROMANI REDACTAE: Armenia and Mesopotamia brought under the power of the Roman People. One may guess that these coins circulated mainly in the western part of the Empire.

The influence of Roman power in the region continued for a long time, and a further short-lived Roman conquest of Mesopotamia took place in 198 AD. The many cities that struck coins under the authority of Rome, or in the name of the Roman emperors of the 2nd and 3rd centuries AD, testify to this influence.

The relevant provincial, quasi-autonomous or autonomous coinages of the cities of the region are widely documented in the collections of the KRG Museums. Since the study of the collections is incomplete, it is too early to say if all the following mints are represented, but most surely are[1].

Edessa (Greek Εδεσσα, Arabic الروها al-Ruhā, Kurdish *Riha*, today the Turkish city of Şanliurfa or Urfa) struck as capital of the independent kingdom of Osrohene from the end of the Seleucid period, and under alternating Parthian and Roman rule for a time, then became a Roman province in 195 AD.

Anthemusia (or *Batnae*, Greek Βάτναι, today called Sürüç), in the territory of *Edessa*, minted Roman coins from Caracalla to Maximus.

Carrhae (Greek Κάρραι, Arabic حرّان Ḥarrān), south-east of *Edessa*, near the Syrian border, minted quasi-autonomous and Roman bronze from Marcus Aurelius to Tranquillina, and silver *denarii* for Marcus Aurelius, Faustina Junior, Lucius Verus, and Lucilla. *Denarii* were issued during Verus' campaign against the Parthians (163-166 AD).

Nisibis (Arabic نصيبين Niṣībīn, Kurdish *Nisêbîn*, in Mardin Province, Turkey) was the chief town of the district called Mygdonia, on the river Mygdonius (Jaghjagh), tributary of the Chaboras (Khabur). Under the Seleucid king, Antiochus IV, the city received the name of *Antiocheia*. Roman coins from Elagabalus to Trajan Decius were minted here. The titles *Septimia* and *Julia* are respectively in honour of Septimius Severus, probably the founder of a colony here, and Philip the Arab. The title *Metropolis* seems to have been conferred upon the colony by Severus Alexander.

Nicephorim (Arabic الرقــة al-Raqqa, capital of a governatorate in Syria), near the Euphrates, about sixty miles south of *Carrhae*, may have minted coins for Gordian and Gallienus.

Rhesaena (Arabic رأس العين Ra's al-'Ayn, capital of a governatorate in Syria), near the sources of the river Chaboras, was made a colony, probably by Septimius Severus, with the *Legio III Pia* settled there, and minted coins from Caracalla to Herennius Etruscus.

Singara (Arabic سنجار Sinjār, Kurdish *Şengal*, in Niniwa governatorate, Iraq) was a colony on the river Mygdonius, south-east of *Nisibis*, where coins were minted from Severus Alexander (*Metropolis Colonia Aurelia Septimis Severiana Singara*) to Philip the Arab (*Julia Septimia Colonia Singara*).

Hatra (Arabic الحضر al-Ḥaḍr, like Sinjar in the Jazira region of northern Iraq) withstood Trajan's siege in AD 117 and was conquered and perhaps completely destroyed by the Sasanian king, Shapur I, in AD 241. The city's coins in the 2nd century AD imitate the Roman provincial coinage of Syria. They carry the Roman inscription, S C, which in Rome stood for SENATVS CONSVLTO: "by decree of the Senate" or "with permission of the Senate". But on *Hatra*'s coins this is upside down, and crowned by an eagle.

Seleuceia ad Tigrim, in *Babylonia*, was founded by Seleucus I at the point where a royal canal connected the Euphrates with the Tigris. The largest mound at *Seleuceia* is now named Tell Umar. It seems to have been the chief Mint of the Parthians (250 BC to 226 AD), which explains the almost complete absence of coins in its own name.

A few other mints mentioned in the literature for the area that interests us may have struck coins, or a single coin. This is the cases of *Zautha* and two mints in Assyria: *Atusia* (or *Atumia*) *ad*

[1] The list of cities is derived – with the addition of *Hatra* and of some topographical information – from Barklay V. Head's *Historia Numorum* (Oxford 1887) and George F. Hill's *Cathalogue of Greek Coins of Arabia Mesopotamia and Persia in the British Museum* (London 1922). These traditional authorities have, in the case of most of the cities, been complemented by more recent detailed studies.

Caprum (on the Lesser Zab river) and *Demetrias ad Tigrim*, mentioned by the ancient author Strabo as being in the neighborhood of Arbela (Erbil).

In concluding this brief overview of the ancient coinages represented in KRG museums, we must say a few words about the many modern forgeries encountered during the cataloguing of the collections. A systematic effort to identify and isolate fake coins in the Sulaymaniya and Erbil collections was therefore undertaken. A few fakes only were noted in Dohuk.

In Slemani Museum, the total number of fake coins so far identified is 729, of about 2,000 ancient coins already inventoried, with Parthian coins not yet examined. Some have probably come from the tourist souvenir market, often in many copies: up to 63 identical pieces. They imitate 67 different coin types of the Greek (Classical and Hellenistic), Roman (Imperial and Provincial) and Byzantine periods, dating between the 5th century BC and the 7th century AD.

The total number of fake coins currently identified in Erbil is 31, again often in many copies: up to 9 identical pieces. They imitate 16 different coin types, dating between the 5th century BC and the 4th century AD.

These preliminary lists – still far from being complete – are intended to help both in preventing the acquisition of further fakes, and as a basis for isolating modern forgeries. One of the main goals in the near future is to work with the staff of the museums to complete the identification of fakes, so we can focus our energies on the genuine original coins.

The Numismatic Collections of the KRG Museums: Islamic Coins. Preliminary Results

6.3

Simona Artusi

The Islamic coinage plays an important role in the collections of three KRG Museums. Among the coins catalogued, it represents 30% of the total amount[1], ranking in second place, immediately after the coins of the Sasanian period, which constitute 36%[2].

From a preliminary analysis of the documents, the coins of the Islamic period cover a very broad geographic area, as they are issued in a number of mint towns of the Asian continent (Fig. 1), more precisely, in the areas of *Bilād al-Shām*, Anatolia, Upper Mesopotamia (including present Iraqi Kurdistan), Lower Mesopotamia, Iranian territories – including the eastern regions corresponding to present Uzbekistan, Turkmenistan and Afghanistan – and India[3].

Fig. 1. Geographical map of the most important areas of Islamic monetary production detected on catalogued coins of the KRG museums

The western Islamic areas are poorly attested only by a small amount of Egyptian gold coins (*dīnār*), minted in Cairo (مصر Miṣr) during the caliphate of the Fatimids (969-1171), and a single 9th century silver specimen (*dirham*) minted in Palermo (صقلية *Siqiliyya*) under the Aghlabids (800-909)[4].

The chronological expansion of the production attested by the catalogued specimens is very widespread. The coins are distributed, albeit in significantly different percentages, during a period of over 1,400 years of Islamic history, as they date from the mid 7th to the 20th century. The most ancient coins date back to the earliest Islamic period – before the monetary reform of the fifth Umayyad caliph between 696 and 699 –; they are conventionally known as Arab-Byzantine and Arab-Sasanian, because they were obtained mainly through the reworking of the minting dies of the two Empires defeated the Muslims: the Byzantines and the Sasanians[5].

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1 The total number of the catalogued coins in the three Museums belonging to the Islamic period is 3,127, except one hundred Islamic bronzes observed in the collections of the Erbil Museum, which need cleaning and restoration, as well as a small number of specimens for which deeper investigations are needed.

2 For a better comprehension of the quantity, chronological differences and distribution of the coins, see Artusi in this volume, Figs. 1-2.

3 The Indian subcontinent is only represented by a small number of coins, minted during the Moghul dynasty (1526-1707).

4 Unfortunately it is not possible to determine the date and place of discovery of almost all the Islamic coins conserved in the collections of the KRG Museums. In most cases, these were acquisitions by dealers or collectors, while in others the presence of earth residues suggests that they may be archaeological finds, although no documentation about them is available.

5 The influence of the Sasanian coins survived in some Islamic regions even after the birth of the Islamic coinage, as evidenced, for instance, by the Tabaristān specimens (a region whose boundaries coincide approximately with those of the Mazandaran, south of the Caspian Sea), both under the dynasty of the non-muslim Dabuyids (686-759) and under the Abbasid rulers (from 767 to 792, see Giunta 2009). Some very fine examples coming from Tabaristān region

The period of the caliphates of the Umayyads (661-750) and the Abbasids (750-1258) is well documented in the museum collections, especially with the silver coinage (*dirham*) minted in Mesopotamia, Syria and western Iran[6].

During the five centuries of the Abbasid period, several dynasties of emirs and sultans held power – more or less independently – in various territories of the caliphate, minting their own coins which, in most cases, were very similar to the contemporary Abbasid ones, and thus generally distinguished from them by identifying the authority or mint. Despite the preliminary character of the cataloguing activity carried out this year – in which little attention was paid to the deciphering of the legends – many of these monetary series were however identified, especially those of the Hamdanids of Syria and Upper Mesopotamia (906-1004), the Buyids of Iraq and Iran (932-1062), the Samanids of Khurasan and Transoxiana (819-1005) and the Ghaznavids of Afghanistan (977-1186).

The post-caliphal period (from the second half of the 13th century) is represented by a large amount of coins dating to the period of the Ilkhans (1258-1357) and the Timurids (1370-1579). The latest coins are related, in particular, to the late phase of the Ottoman period (19th century) and the modern States. Many of these specimens, mostly from Iran, are holed, because re-used as pendants or ornaments.

Fig. 2. Map of Turkoman mints (Spengler, Sayles 1992, p. xxiii)

In order to obtain as much information as possible about the production and circulation of coins in Iraqi Kurdistan and the surrounding areas, the activities also included some specific research – though still preliminary – on a particular production of a territory that includes the entire Kurdish region (Fig. 2), production chronologically limited to the 12th and 13th centuries.

This group is especially composed of bronze coins issued by some dynasties of Turkish-Central Asian origin. These examples represent an interesting monetary production, characterized by the almost constant presence of an anthropomorphic figurative decoration – mostly only on the obverse – generally absent on the Islamic coins and partly inspired by Greek, Roman and Byzantine coinage tradition. In our preliminary research we were able to identify some of these Turkoman mints (Fig. 3), that allowed to demonstrate that the greatest amount of coins and the largest variety of iconographical types has to be attributed to the cities of northern Iraq: Mosul (موصل Mawṣil), Sinjar (سنجار *Sinjār*) and Erbil (اربيل *Irbīl*).

The presence of coins struck at Erbil, capital of the KRG, has prompted us to undertake more detailed analyses on the history of its mint. It has been ascertained that Erbil was a mint city since the Abbasid period, mainly close to the end of it, around the first half of 13th century, a period which has not yet been attested in the KRG Museums collections. The city reached its greatest importance under the Turkoman dynasties, above all under the Turkoman Begteginids (1145-1233) and, in particular during the years of rule of the third and last ruler of this dynasty,

have been detected in the KRG collections.

[6] A number of modern forgeries belonging to both the mentioned historical periods was observed in the collections and needs further investigation.

Muzaffar al-dīn Gökbörī b. 'Alī Küchük (1168-1233), brother-in-law of the famous Saladin[7]. In addition to a large number of bronze coins, we have documented some fine Begteginid gold coins, almost rare specimens among the other known collections. During the Ilkhan period (second half of the 13th century) Erbil had lost some of its power. Nevertheless, it continued to struck coins, even though only silver and bronze. Among the examined coins were numerous silver and very few bronze specimens, usually rarely attested.

The large quantity and importance of the Islamic coins belonging to the collections of the three KRG Museums certainly deserves a more comprehensive and complex study, which we hope will be carried out in the near future, in anticipation of the enhancement of the local historical and cultural heritage and a wider fruition within the Museums.

Fig. 3. Table of the main Turkoman Dynasties and mints and their presence on coins catalogued in the KRG Museums Collections

Bibliographical References

Bosworth C.E. 1996, *The Islamic Dynasties*, Edinburgh.

Giunta R. 2009, *Le monete post-sasanidi e arabo-sasanidi del Ṭabaristān (Iran, VIII secolo)*, in *Le Monete islamiche. Parte seconda e terza*, Documenti del Museo Nazionale d'Arte Orientale 'Giuseppe Tucci', Roma.

Sourdel D. 1978[2], *s.v. Irbil*, in 'Encyclopédie de l'Islam' IV, p. 80.

Spengler W.F., Sayles W.G. 1992, *Turkoman Figural Bronze Coins and Their Iconography*, Lodi, Wisconsin.

[7] Gökbörī, perhaps of Kurdish origin, was in Harrān until 1190, thereafter in Erbil. His father, Zayn al-dīn ' Ali Küchük, ruled in Sinjār, Harrān and Tikrīt (Bosworth 1996, p. 192). During the 43 years of Gökbörī's reign, Erbil became an important capital city, with new quarters being built at the foot of the Citadel. The only physical remains of the architectonic activity of that ruler (mostly hospitals, Koranic schools and *ribāṭ*) is represented by the brick minaret once belonging to a mosque now disappeared (see also Sourdel 1978).

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