



**THE THEATRE-AMPHITHEATRE OF THE  
SANCTUARY OF APOLLO IN CYRENE.  
Master Conservation Plan**



**Director:**  
**Serenella Ensoli**

**THE THEATRE-AMPHITHEATRE OF THE SANCTUARY OF  
APOLLO AT CYRENE**

Made possible with the support of:



**Global Heritage Fund**

*Picture on front cover*

Cyrene, the Terrace of Myrtousa, seat of the Sanctuary of Apollo, seen from north-west. In the foreground, the Theatre-Amphitheatre (aerial photo of '900: from S. Ensoli [and.], *Cyrene*, Milano 2000, p. 14)



# **THE THEATRE-AMPHITHEATRE OF THE SANCTUARY OF APOLLO IN CYRENE**

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# 1. INTRODUCTION

The ancient city of Cyrene, founded by Thera's settlers on the African coast in 631 B.C., according to the Greek historian Herodotus, included a Theatre since 500 B.C.

This monument, situated at the western end of the Terrace of *Myrtousa*, where the Sanctuary of Apollo is located, is the polis' most ancient and imposing entertainment-building. Its history includes a number of building stages, from the Greek period until well into the Roman period, when the Theatre was transformed into the Amphitheatre and the area for the *ludii* was separated from the area strictly connected to the sacred rituals through the Wall of Nikodamos.

Within the expeditions led by the 'Missione Archeologica Italiana a Cyrene' (MAIC) in 2005 and 2006, a huge project on the Theatre-Amphitheatre was started, thanks to the co-operation of the Department of Antiquities of Libya and thanks to the financial contribution of the Global Heritage Fund, granted to the 'Dipartimento di Studio dei componenti culturali del territorio della Seconda Università degli Studi di Napoli' (SUN) for the research project of Serenella Ensoli, Director of MAIC.

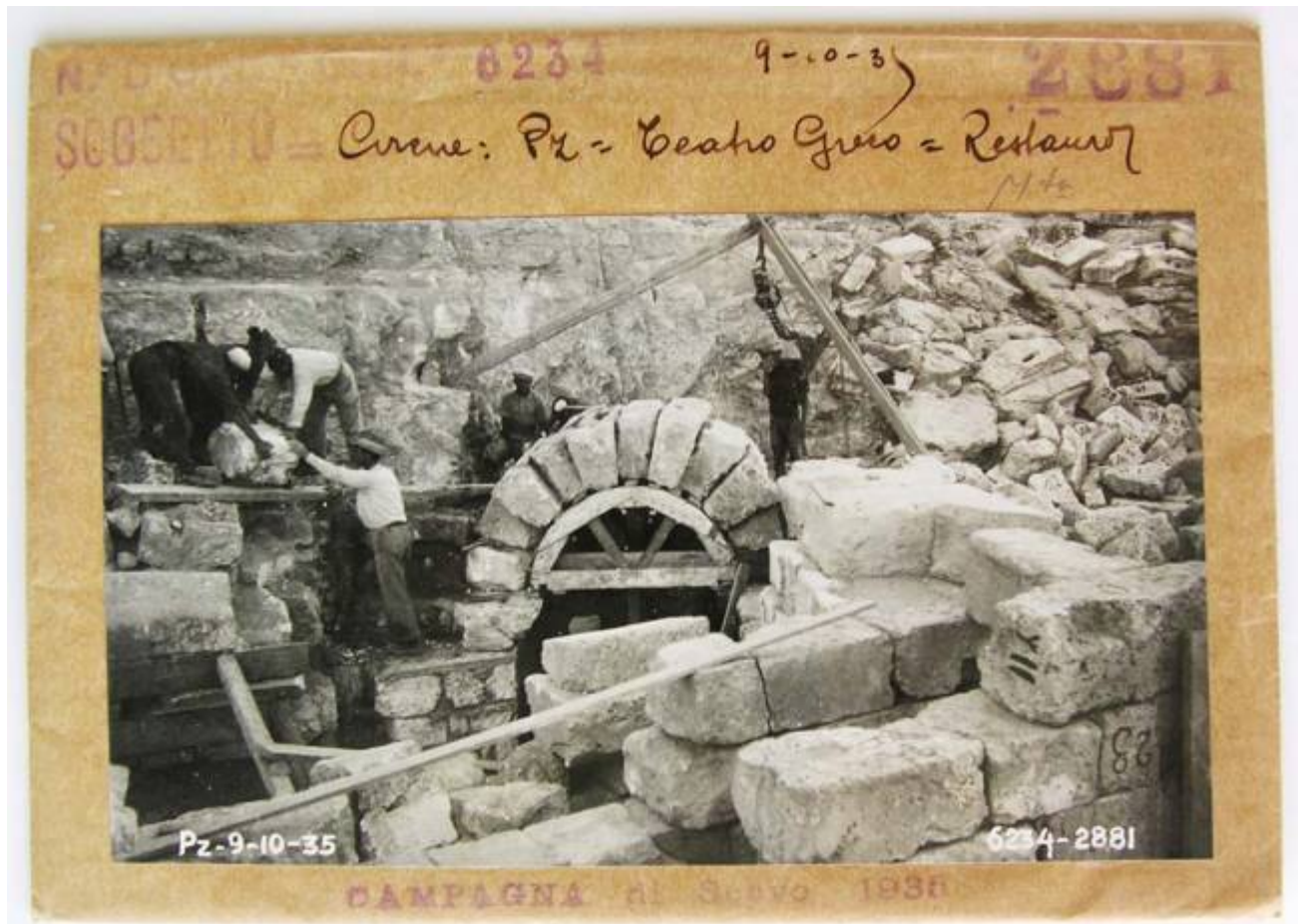
The study, documentation and field research investigations carried out by MAIC have focused on the development of integrated actions, aimed at the accomplishment of 'Stage One' of the Project:

*"Graphic, photographic and photogrammetric documentation of the monument and preliminary surveys for the restorations and anastylosis plan"*.



Cyrene, The Sanctuary of Apollo

**The research in the Archive** of the Department of Antiquities of Cyrene made it possible to know the various stages of the excavations and the restorations of the Theatre-Amphitheatre carried out by the historical Italian Missions in the thirties, which had never been documented up to now, thus providing data of fundamental importance for the project of the restoration of the monument.



Cyrene, Theatre-Amphitheatre during the works of 1935

**For the first time**, field-work was carried out within an articulated series of researches:

- stratigraphic investigations undertaken inside and outside the monument allowed for important scientific results concerning the planovolumetric and architectural arrangement of the building in its consecutive stages of existence; the diagnostic investigations carried out on the equilibrium of the structures and of the subterranean areas and on the consistency and resistance of the stone-materials have already allowed for the elaboration of a geo-engineering project in order to safeguard the extremely precarious equilibrium of the Hypogeum and to determine the type and consistency of the materials to be employed in the conservative restoration of the building and of its architectural elements.



Cyrene, the Theatre-Amphitheatre during the works of 2006

- the employment of the “direct survey” metric on the field, processed through a CAD system with a scale of 1:50, concerned the three sectors of the *cavea*, the *scaenae* and the *orchestra*; the employment of the computerised “indirect survey” (laser scanner, photogrammetry, GPS), carried out by the Team of the CNR-ITABC, includes three-dimensional renderings of the planimetry and of the elevations of the monument. The investigations, even though not completed, have already provided very satisfactory results;
- the complete reconnaissance of more than 2500 architectural elements recovered during the thirties during the excavation of the site allowed for the creation of a database of fundamental importance for the reconstructive study of the monument. The same method was applied to the cataloguing of the epigraphic material found up to now in and around the Theatre-Amphitheatre, in situ and out of situ.





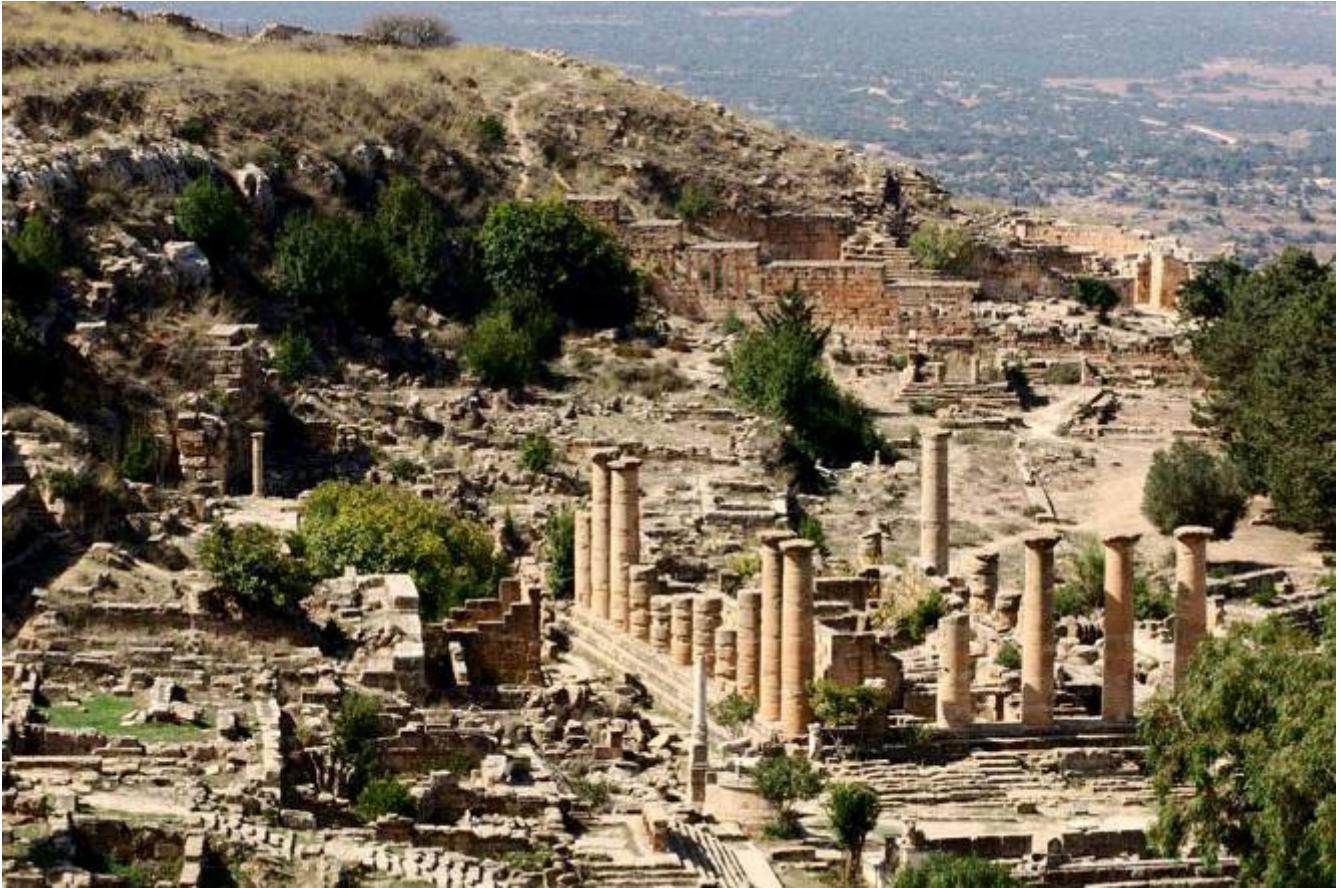
Cyrene, the Theatre-Amphitheatre during the works of 2006: application of the scanner laser per the survey three-dimensional of the cavea

### **The project for the restoration and for the anastylosis of the Theatre-Amphitheatre**

starts from the morphological and structural analysis of the monument, from its conservation problems, investigated also through the contribution of the diagnostic tests (from the chemical analysis on the stone samples to the geo-engineering investigations for the restoration of the subterranean structures). The scientific investigations in the field, and the complete graphic documentation of the building and of its architectural elements scattered in the territory, contribute to the reconstruction of the stages of the life of the monument, also through the study of the comparisons with analogous architectural complexes surviving from the Greek and Roman world.

The activity in the field and in the laboratory of the CNR-ITABC and of the CNRS (School of Architecture of Marseille, France), that participate in the project, will allow to project and accomplish, through the development of a software application for a guided simulation through techniques of “artificial intelligence”, an computer system for the simulation of the restoration and of the anastylosis of the Theatre-Amphitheatre.

The Preliminary Report of the feasibility study concerning the restoration of the Greek Theatre and the Roman Amphitheatre, takes into account, as a preliminary project, the four possible stages of intervention, the first of which, necessarily, concerns also the preliminary project for the setting up of the site.



Cyrene, The Sanctuary of Apollo and, in the background, the Theatre-Amphitheatre

**The enhancement of the ‘territorial’ context** represents a further stage in the works, unavoidable within a complex project like that of the Theatre-Amphitheatre of Cyrene, which looks towards a scientific activity aimed at the defence, the safeguard and the conservation, but also to the promotion and the scientific propagation of the “product” by means of incrementing the development of cultural tourism on an international level.

In this respect, the Sanctuary of Apollo can be promoted as a new cultural attraction within the context of the ancient city of Cyrene, not unlike the archaeological parks, thanks to the creation of appropriate structures of preservation and welcome and to the creation of “serviced pathways” with the necessary didactic-scientific apparatus, and of Antiquaria, that is, of small Laboratory-Museums.

**The creation of a Training School** represents, in Libya, a very urgent operation. A Pilot Project, like that of the restoration-anastylosis of the Theatre-Amphitheatre of Cyrene, which makes use of an integrated system of actions by employing innovative studies and technologies, cannot neglect the planning of effective training programs and formation of the qualified personnel, through courses of direct teaching and workshops, in Italy and abroad, with the contribution of the Universities, the Antiquity Departments, the supervisors and the other national and international structures of guarantee.

## **Conclusions**

The ‘Theatre-Amphitheatre of Cyrene’ Project represents an important goal and at the same time a great “challenge” both for the Department of Antiquities of Libya and for the MAIC, together with all the institutions and the bodies that will take part in it also as contributors, among which, first of all, the GHF.

The building, possibly the most “poetic” of North Africa, also because of its acknowledged historical and architectural value, and for its scenic position which overlooks the great valley of the utmost terrace of Gebel Akdar, ornamented with magnificent rock-tombs, can represent, once restored, a great pole of cultural attraction and tourism on a world-wide level. Such a monument would allow the organisation of events of a very high level, a sort of means of cultural interchange between Mediterranean countries.

## **Team of the MAIC**

Serenella Ensoli: Director of the MAIC and of the Project  
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Farage Abdulaati Hamed, Inspector  
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**Institutions taking part in the entire project:**

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**UMR 694 MAP - CNRS, School of Architecture of Marseille, France**

## 2. Cyrene and the Sanctuary of Apollo on the Terrace of Myrtoussa

### 2.1. Cyrene: historical and topographic profile of the ancient polis

Cyrene, according to Herodotus, was founded by King Batto in 631 B.C. The wealthy colony of Thera (the contemporary island of Santorini) quickly became an extraordinary pole of attraction for Mediterranean trade. Cyrene, sacred to Apollo of Delphi, even more monumental during the Classical and Hellenistic periods, thrived also in the Roman and Late-Roman periods. Only after the earthquake of 365 A.D., did the violent hostility of the inland populations and, most of all, the increasing dryness of the region cause its partial decline.

Cyrene extends on two hills of the plateau called Gebel Akdar (Green Mountain), about ten kilometres from the coast and about 600 metres above sea-level. Morphologically, the territory of the polis is characterised by three distinct strips of productive land, almost flat: a narrow coastal belt, called "Sahel", a second one 5-8 kilometres wide, at about 300 m altitude, and a third one, from 600 to 800 m of altitude, which sloped down towards the pre-desert belt, called the region of the "Balte".

The ruins of Cyrene, within the walls, extend for 1600 m in length (direction north-west/south-west) and 1000 m in width (direction north-east/south-west), leaving out the necropoleis and the extra-urban sanctuaries. It is difficult to establish the number of its inhabitants at the moment of the city's maximum expansion, also because many residential areas have yet to be investigated. It is certain that the extension of the area encircled by the urban walls of the Hellenistic period, 5560 m long, the presence of very broad civic spaces within the city districts, the existence of a number of places for sport and shows and their capacity, and the extension of the necropoleis that surround the entire polis let us think of a very high number in ancient times.

The urban map of Cyrene, designed at its foundation and completed in the Hellenistic and Roman periods, is known thanks to the excavations of the urban areas and to the analysis of aerial photographs.

Thanks to the different orientation of the streets, it was possible to determine the original urban nucleus on the Acropolis, a first expansion in the level area to the east, towards that which would become the Agora district, and a second one which constitutes the broader criss-crossed grid plan of the Hellenistic period.

This data, and the functional direction of the main street, called by Pindar (*Pythian V*) "Skyrotà" (gravelly), led to the division of the polis into seven districts: Acropolis, Apollonion (The Sanctuary of Apollo), northern hill, Agorà, Olympieion (Sanctuary of Zeus), Central District, Southern District.



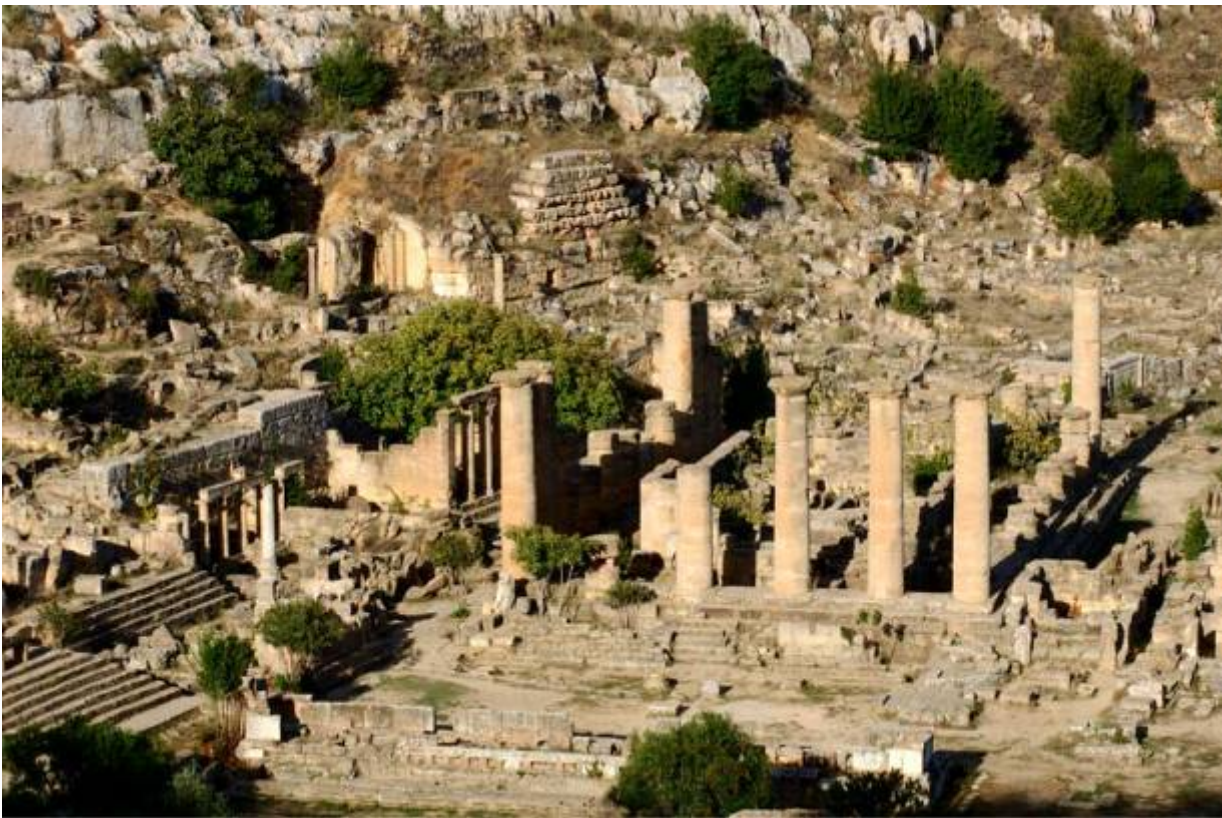
Cyrene, urban map of the city

## 2.2. The Sanctuary of Apollo in the Greek and Roman age and the History of the Excavations

The Sanctuary of Apollo, the city's most fascinating and representative site, extends on an ample natural terrace at the foot of the Acropolis, called 'of the Myrtousa', since in ancient times it was covered with myrtle. It was enlarged and shaped into terraces in time. On the southern slope there is the Upper Terrace, where spurt forth the Springs Kyra and of Apollo. On the northern slope there is the Lower Terrace, which represents the heart of the sanctuary and contains the Temples of Apollo and of Artemis, Cyrene's tutelary gods.



Cyrene, the Sanctuary of Apollo: the Upper Terrace with the sacred springs



Cyrene, the Sanctuary of Apollo: the Lower Terrace with the Temple of Apollo and, to the south, the Fountain of Philothales and the Temple of Isis

The sanctuary's existence begins already at the moment of the foundation of the city in the 7th century B.C. and as any Greek sanctuary it is initially constituted by three fundamental elements: the temple, the sacrificial altar and the perimeter wall that defines the sacred space. The springs, at the time, were still outside the sanctuary, because they also had utilitarian functions and were therefore secular. The sacred area extends its perimeter in the Archaic (7th cent. B.C.) and Classical ages (5th-4th cent. B.C.), including new temples to Apollo and to Artemis and, most of all, already in 500 B.C., the grand Theatre situated on the western extremity of the plateau. The sanctuary has its maximum expansion in the Hellenistic period (3rd-1st cent. B.C.), when it encompasses also the Upper Terrace and it is enriched with sacred buildings dedicated to other gods, among which the Egyptian goddess Isis, with porticoes, donari, fountains and other votive monuments.



Cyrene, the Sanctuary of Apollo: in the foreground the Great Baths built by the emperor Trajan and restored by Hadrian

The urban structure of the Sanctuary of Apollo, very similar to that of Delphi, is fundamentally changed when, in the age of Trajan, the Great Baths were built in the area north-east of the Lower Terrace, and rebuilt by Hadrian after the Jewish revolt. Not long afterwards, between the second half of the 2nd and the beginning of the 3rd cent. A.D., the Greek Theatre was transformed into the Amphitheatre and the *temenos*, reduced westwards, was delimited by the Wall of Nikodamos, built in order to distinguish the ancient sacred area from that of the *ludii*. The road network of the Greek period that accessed the Theatre, initially passed through the two Temples of Apollo and Artemis. Later it was moved to the north of them, following a path more and more serviced, that in the Roman period became compulsory because of the construction of other cult edifices.



After the works of the British, Smith and Porcher in 1861, the excavations carried out by Italians between the World Wars rediscovered the sacred area as a whole. In the same period, many restorations were carried out, among which the Temple of Apollo, the Temple of Artemis and the Via Colonnata. From 1957 on, with the creation of the 'Missione Archeologica Italiana a Cyrene' supervised by Sandro Stucchi, until the end of the '70s, extensive studies on the structures previously excavated were carried out. The investigations within the sanctuary, nevertheless, effectively began only in 1980. Since then, until nowadays, the Sanctuary of Apollo was subjected to a complex series of new systematic investigations in the field, and to scientific studies and restorations.



Cyrene, the Sanctuary of Apollo: the Greek Propylaia after the partial anastylosis

Among the most important results that have been achieved in the last 25 years, the first concerns the Greek Propylaea. In the excavation, five superimposed portals were found, the most ancient of which lies 6 metres deep and dates back to the 5th cent. B.C. A partial reconstruction (anastylosis) of the monument was also carried out, in ancient times it was provided with a triple stairway that allowed the passage between the Upper Terrace and the Lower Terrace of the sanctuary. Nowadays, visitors have the possibility of climbing to the esplanade of the Temple of Apollo tracing the ancient sacred way. Connected to these investigations were those on the long Seat of Elaiatas, which was used as a place for rest by the believers, during the great processions in honour of Apollo and of Artemis, and those on the Fountain of Hermesandros, built in memory of the 120 oxen offered in sacrifice to Artemis. Important preservative interventions were carried out on both monuments.

Concerning the studies undertaken on the Temple of Apollo, the identification of the magnificent grandiose decoration of the tympanum in marble ought to be mentioned, which dates back to the 4th cent. B.C., depicting the mythological arrival of the Greeks to Cyrene and the sacred union of Apollo with the Nymph Kyrana. The myth and the single figures were taken up by the artist of Alexandria of Egypt who created the Portland Vase, kept in the British Museum in London. The vase in cameo glass, found in Rome, was a wedding gift for the daughter of the first Roman emperor, Augustus.



Cyrene, The Sanctuary of Apollo, Donarium of the Strategoi: the figures of the protecting god *epibomios*, sitting on his altar, belonging to the group of the tympanum of the Temple of Apollo created in the 4th cent. B.C.

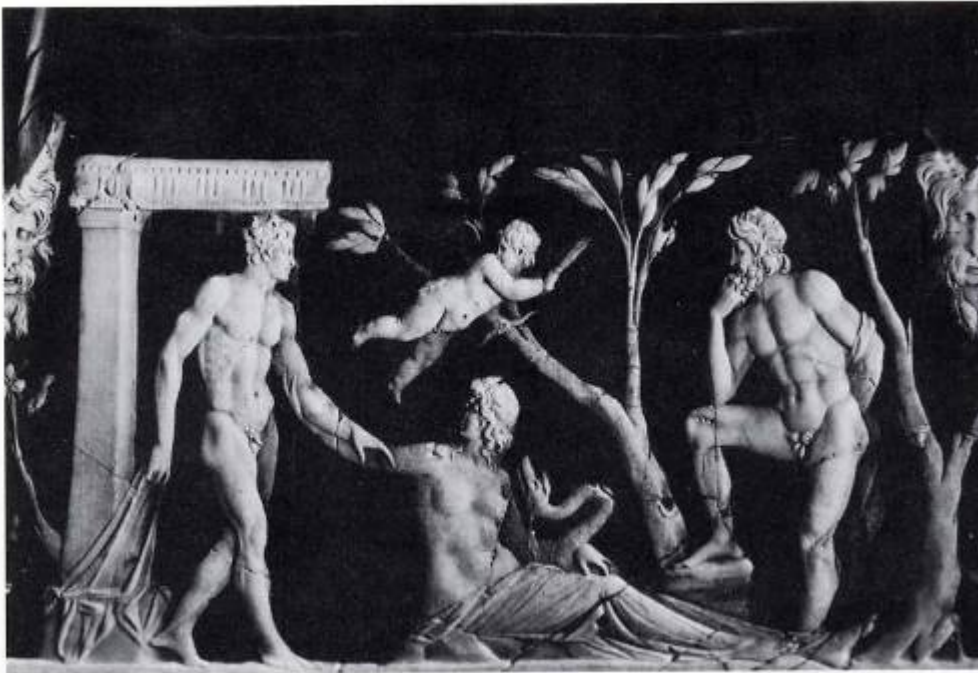


FIG. 8 - Vaso Portland; lato A del fregio (foto British Museum).



FIG. 9 - Vaso Portland; lato B del fregio (foto British Museum).

London, British Museum: the figured frieze of the Portland Vase which reproduces the myth of the hierogamy of Apollo and the nymph Cyrene, represented in the decoration of the tympanum of the Cyrene temple.

Among the many other works carried out by the Italian Archaeological Mission in the sanctuary, it is necessary to mention those undertaken on the Fountain dedicated by the priest of Apollo, Philothales. The complete graphic rendering of the monument and the reconstruction *in loco* (anastylosis) of the colonnade and of the trabeation were carried out.

It is important to cite the works carried out in the Temple of Isis, that nowadays holds no secrets, also in relation to the rituals that were practiced, and the works in the Precinct of the Myrtle. In this case as well, a partial reconstruction (anastylosis) of the monument was carried out thanks to the complete graphic rendering of the building. The epigraphic documents and the literary and figurative sources made it possible for it to be identified with the Precinct, which held the sacred grove that protected the marriage of the god Apollo with the nymph Cyrene.

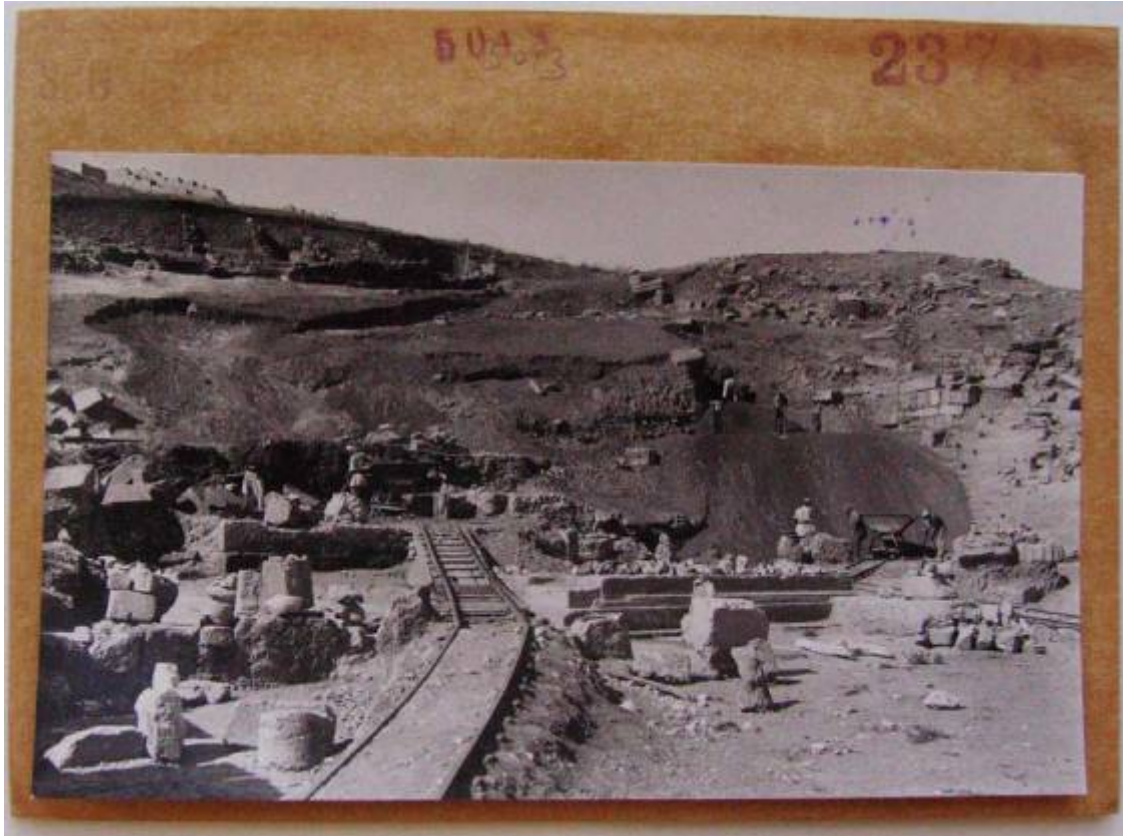


Cyrene, The Sanctuary of Apollo, the Precinct of the Myrtle: accidental (?) reconstruction. Within the monument a myrtle grove sacred to Aphrodite was preserved.

### **3. The Theatre-Amphitheatre: studies and investigations carried out by the MAIC in 2005 and 2006**

The results of the study-investigations, of the documentation and of the field-research carried out by MAIC in Cyrene in the two excavation campaigns of 2005 and in the two campaigns of 2006 were painstakingly documented with analytical reports.

Following this are mentioned the most significant results, which have followed and follow nowadays a program of capillary and exhaustive works.

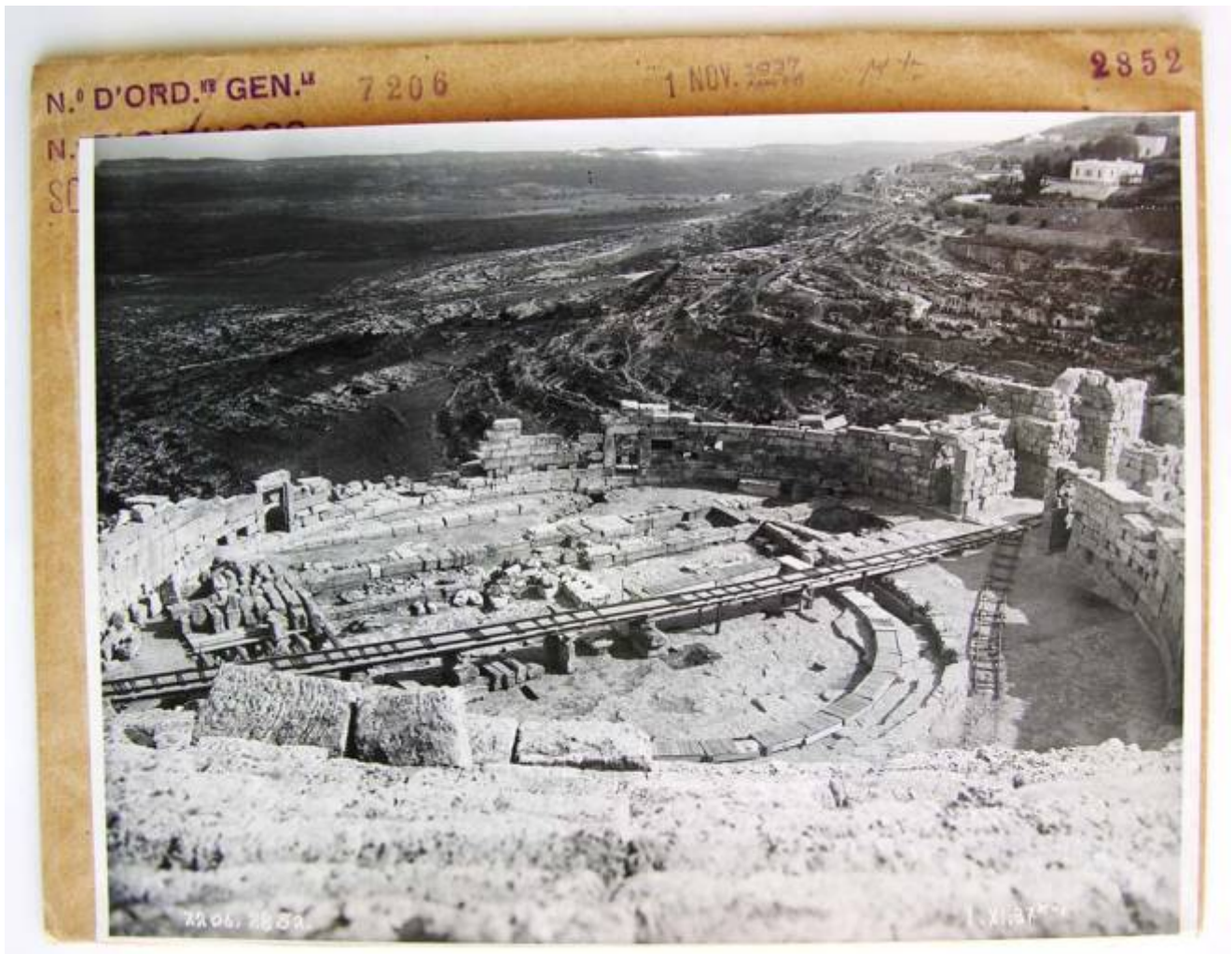


Cyrene, the excavations in the area east of the Theatre-Amphitheatre during the works of 1933

#### **3.1. The Recovery of the Photographic Documentation of the '30s in the Archive of the Department of Antiquities of Cyrene and the Bibliographical Research**

The first goal set by the MAIC in 2005 was to retrieve all the cognitive elements necessary for the new investigations, that is, first of all, the historical documentation of the interventions. Since there was no report of the works carried out by the historical Italian Missions in the '30s, recovery was through digital scansion and computer processing of all the photographic material concerning the works carried out on the Theatre-Amphitheatre kept in the Archive of the Department of Antiquities of Cyrene.

Such researches, coupled with an in-depth bibliographical research carried out in Rome, allowed knowledge of the various stages of the excavations and of the restorations of the Theatre-Amphitheatre providing data of fundamental importance for the project of restoration of the monument. Today it is possible to claim that in the '30s the Superintendent was Gasparre Oliverio and then, from 1935, the great Giacomo Caputo, while the Architect who planned the restorations and the anastylosis of Cyrene was the most famous within the Mediterranean: Italo Gismondi. The years in which the excavations and restorations of the Theatre-Amphitheatre were carried out are four: 1932, 1933, 1935, 1937.



Cyrene, the Theatre-Amphitheatre at the end of the works carried out in 1937

### **3.2. The database of the architectural elements located in the areas adjacent to the monument. For the virtual 3D rendering of the Theatre-Amphitheatre.**

One of the goals accomplished by MAIC in the campaigns of 2005 and 2006 was to proceed to the complete reconnaissance of all the architectural elements recovered in the '30s in the excavation of the monument and in the adjacent areas, with particular attention to the plateau west of the Theatre-Amphitheatre. In this area, more than 2000 elements belonging to the various architectural elements of the building were moved, in anticipation of the completion of the immense anastylosis: a project never accomplished because of the war.

The work of reconnaissance, extremely demanding and supported by an important work of cleaning committed to Libyan operators, included the cataloguing of the inventory, both on paper and computerised, complete with digital shootings, with the graphic documentation and with the description of every single block, either whole or fragmentary, of more than 2500 elements, lined up on a number of rows westwards, southwards and eastwards of the Amphitheatre.

This imposing work makes it possible to recognise the typology of every single piece and, consequently, in relation to the computer software that the MAIC are completing together with the CNR of Rome and with the CNRS of Marseille, the exact position of every element as it was in ancient times, in order to render in 3D the original architectural structure of the Theatre-Amphitheatre and in order to build the reconstructive plastic model of the monument.



Cyrene, Theatre-Amphitheatre: the plateau west of the monument with around 2500 blocks moved in the '30s and today catalogued and classified by the MAIC



Cyrene, Theatre-Amphitheatre: detail of the Corinthian capital, to be attributed to the Southern Entrance of the monument, placed among the blocks catalogued and classified by the MAIC on the plateau south of the monument

### **3.3. The “re-discovery” of the rocky level of the orchestra and of the scaenae**

The rocky plane was completely cleared from the earth of the orchestra and the stage building of the Theatre of the Greek period, transformed into an arena in the Roman period.

The limestone plane, already researched during the excavations carried out by the Italians in the 30s, had been drawn at the end of the 50s by Italo Gismondi, who had noticed the presence of loglines and of grooves interpreted in relation to receiving wooden elements.

The current intervention allowed a re-discovery of the grooves and the cuts in the rock and to discover more of them, undocumented, some of which were still obliterated by lime fillers meant to regularise the rock surface.

In the space of the orchestra, between the numerous series of grooves obtained in the rock and to be related to the first stages of the Theatre with a wooden scaenae, three parallel rows in east-west direction can be determined. Of particular interest, furthermore, are a great rectangular basin coated with opus signinum obtained almost in the centre of the orchestra and a small basin with a perfectly circular shape close to the north-east limit of the ancient orchestra.



In the area of the scaenae more rows of grooves and cuts in the rock were discovered, the first related to the original wooden structure and the others to the positioning of the later walls in *opera quadrata*, which constituted the stage building, of which remain the foundations of the various building phases.

The semicircular area that encircles the orchestra was revealed, which originally belonged to the cavea of the Greek Theatre. Evident signs of the cuts of the steps that belonged to it remain, which have been removed according to the transformation of the space into an arena in the Roman period.



Cyrene, Theatre-Amphitheatre: view of the scaenae and of the orchestra from the east



Cyrene, Theatre-Amphitheatre: view of the central-eastern sector of the scaenae and of the orchestra



Cyrene, Theatre-Amphitheatre: view of the scaenae from the west



Cyrene, Theatre-Amphitheatre: view of the scaenae and of the orchestra from the south



Cyrene, Theatre-Amphitheatre, view of the orchestra from the south/south-west: in the foreground the cuts in the rock carried out in the Roman period to remove the seats of the *ima cavea*



Cyrene, Theatre-Amphitheatre, sector west of the orchestra: particularly the grooves obtained in the rock



Cyrene, Theatre-Amphitheatre: the rectangular pit cut in the rock at the centre of the orchestra, recycled into a basin in the Roman period coated with *opus signinum*

### **3.4. The planimetry and the elevations of the Theatre-Amphitheatre: the direct survey on the field and the computerised indirect survey (laser scanner, photogrammetry, GPS). For the completion of the documentation.**

Regarding the technique of “direct survey”, carried out at the scale of 1:50, most of the planimetry of the Theatre-Amphitheatre was accomplished in 2005 by means of processing with the CAD system, as we can see from the technic-scientific plates made by Eng. Andrea Buttarini in collaboration with Professor Graziella Barozzi and Professor Anna Pagnini.

In 2006, three areas and phases of intervention were set, interrelated, but carried out separately within the perimeter of the monument, already previously set graphically. The three sectors are constituted by the cavea, the orchestra and the scaenae, with a metric survey on the field. Of particular interest are the direct surveys of the scaenae and of the orchestra, the study of which would have been more difficult to interpret if limited to the indirect survey.

Parallel to the essential work of the direct survey of the Theatre-Amphitheatre, the computerised survey of the monument was carried out by the Team of the CNR-ITABC, which includes 3D rendering of the planimetry and of the elevations.

Once the polygonal net with the total station Trimble 5600 was completed, the polygonal was geo-referenced on a geographic scale through the use of a GPS differential Leica, according to the RTK system (Real Time Kinematic). With the use of the GPS in static mode, the altitude of the Theatre-Amphitheatre was verified to be 556 m above sea level. The employment of 3D laser scanning techniques has described with absolute precision and with homogeneity the detected structures. The data are now being processed.

The work carried out with the laser scanner was supplemented with a photogrammetric survey of the missing parts.

The direct and indirect survey, not yet completed, will continue according to these two technical and research courses.

Finally, through the development of a software application for a guided simulation, through the “artificial intelligence” techniques, future plans include to plan and program a computer system for the simulation of the restoration and of the anastylosis of the Theatre-Amphitheatre.



Cyrene, Theatre-Amphitheatre: the access arch to the gallery north of the East Entrance



Cyrene, Theatre-Amphitheatre: sector south of the East Entrance during the operations of photogrammetric survey

### 3.5 The stratigraphic soundings

The stratigraphic soundings carried out by the MAIC in the campaigns of 2005 and 2006 have led to important scientific results.

South of the *summa cavea*, the foundations of a long wall were found, together with a staircase orthogonal to it, which rises from a mosaic floor. The strata defined in the excavation provided ceramic material datable to the Roman period.

At a little distance, towards the north, was found a dry wall for the containment of an imposing hard core south of the *cavea*.

The soundings established that in ancient times, the Theatre-Amphitheatre had on the top of the *cavea* some elevated structures, probably arched, which supported further rows of seats accessible by staircases collocated on the southern side of the monument. This represents a fundamental element in understanding the architecture of this grand edifice for entertainment in its last stage and in order to tackle the project of restoration.



Cyrene, the Theatre-Amphitheatre, stratigraphic investigations on the southern side of the monument: the foundations of the east-west wall and the staircase



Cyrene, the Theatre-Amphitheatre, view of the area east of the monument: to the east, the “Donarium with flight of steps” and to the west, the Wall of Nikodamos

The stratigraphic investigations carried out around the “Donarium with flight of steps” and within the semi-hypogeal environment connected with the Donarium, which has already been a subject for diagnostic investigations of the geo-engineeristic kind for its consolidation, have also been of extreme importance for the chronology of the building stages of the Theatre-Amphitheatre.



Cyrene, the Theatre-Amphitheatre: the “Donarium with flight of steps”



The study simultaneously carried out in the monumental area east of the Amphitheatre provided further results. A building, cut into the rock, provided with several levels in order to contain the natural inclination of the terrain was recognised. The presence in the upper terrace of the monument of a quadrangular well, and the comparison with amphitheatres in the Roman world can allow for the identification of the structure as a monumental fountain.



Cyrene, the Theatre-Amphitheatre: the monumental Fountain discovered in 2006 east of the monument

### **3.6 The database of the epigraphic material in situ and out of situ**

An inventory was completed, supplied with digital and graphic documentation of the epigraphic material discovered up to now within and outside of the Theatre-Amphitheatre, in situ and out of situ, but relating to the monument. In order to allow for the specialist study of the inscriptions, the creation of a database was initiated.

The abbreviations on the front side of the seats constitute the most represented class of materials. Nevertheless, actual inscribed texts are also present: the longest inscription is carved in Greek letters on one of the seats of the cavea. Among the epigraphic material in situ but not *in opera*, should be highlighted some marble bases of statues with dedicatory inscriptions of the Greek and Roman periods, some of notable historical and prosopographic interest.



Cyrene, the Theatre-Amphitheatre, area near the “Donarium with flight of steps” : marble base with the footprints of the feet of four statues and, inscribed on the foreheads, four epigraphs with the names of the depicted characters.



Cyrene, Theatre-Amphitheatre, area near the “Donarium with flight of steps”: fragment of a base

#### 4. The Theatre-Amphitheatre in the Greek and Roman periods

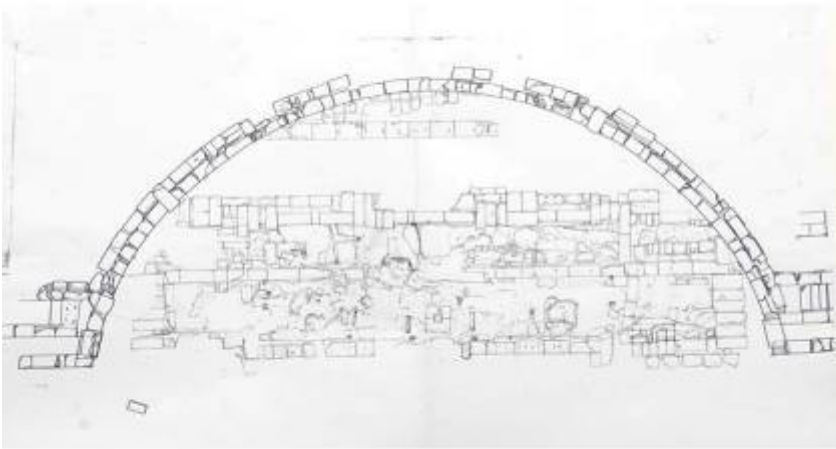


Cyrene, Theatre-Amphitheatre: view from the north-east

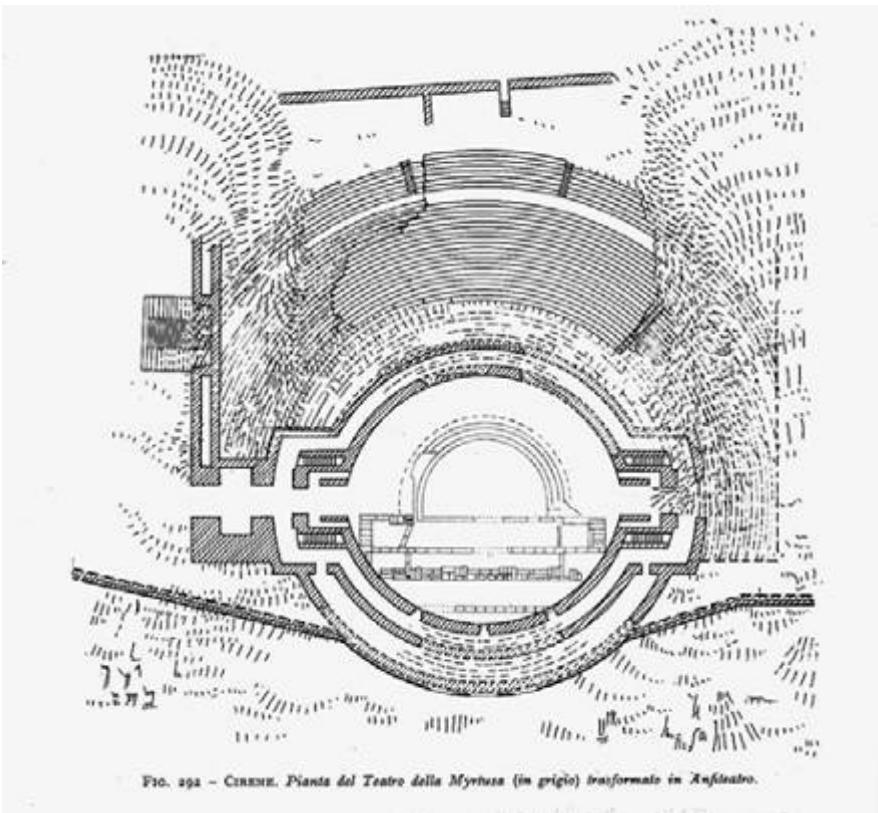


Cyrene, Theatre-Amphitheatre: view of the scaenae and of the orchestra from the south and from above

The works carried out by the MAIC led to a consistent series of important scientific results concerning the monumental stages of the Theatre-Amphitheatre. The monument had a tormented history since the end of the 6th cent. B.C. until well within the Roman period, a history that was defined for the first time by Sandro Stucchi in 1975 and today, in the perspective of the recent investigations, susceptible to notable acquisitions.



Cyrene, Theatre-Amphitheatre: direct survey of the scaenae



Cyrene, Theatre-Amphitheatre: summarising planimetric reconstruction of the studies carried out before the works of the MAIC

The series of grooves ordered on three rows, cut into the rock of the natural plateau and still visible in the later orchestra can be related to the first wooden scaenae. Such grooves, made in order to receive the wooden beams of the stage and of the backcloth, caused Carlo Anti to hypothesise the reconstruction of a structure analogous to that of the first trapezoidal Theatre of Siracusa, dated just after 500 B.C. Probably at that time the public sat on the slope of the Acropolis.

As far as the much bigger **second scaenae system is concerned**, it is also confirmed by the grooves cut into rock which were meant to receive the wooden beams. The latter allow for the reconstruction of a scaenae much deeper than the previous one, but narrower (28 x 12 foot = m 8,28 x 3,55) and a proscenium slightly wider and deeper than the first phase (36 x 8 foot = m 10,58 x 2,35). In this case there are no traces of the cavea.

Concerning the **third building phase**, which can be ascribed to the second half of the 4th cent. B.C., many remaining elements allow for the reconstruction of the original appearance. Notable traces of the foundations of the scaenae, the grooves in the rock for receiving the wooden material that constituted the proscenium and elements of the eastern wall of *analemma*, determined a cavea a little less than semi-circular.

The width of the Theatre was of 220 feet (65, 12m). The cavea was probably curved also on its outside. The new scenic structure was of stone and longer than the previous one, measuring 60 feet, and 11 feet deep (m 17,76 x 3,25). The shape was simply rectangular, without *paraskenia* at the sides of the *logheion*, which in this phase was 10 feet deep (2,96 m).

One of the entrances to the monument was located to the south, that is on the slope of the hill of the Acropolis, as it is documented in the subsequent stages of the monument also thanks to the investigative excavations carried out by MAIC in 2005 and 2006.

The analogies with the first circular Theatre of Siracusa are many, especially when it comes to the shape of the cavea and of the scaenae, but also with the Theatre of Iasos, which has walls of *analemma* converging towards the orchestra. When it comes to the dating of this third phase of the Cyrenaic Theatre in the second half of the 4th cent. B.C., it can be related to the expense listed in one of the bills of the Demiurgoi of three tragic choruses and of one dithyrambic chorus, that is, the choruses necessary for an entire tetralogy of three tragedies and one satyr play.

The **fourth and most important monumental** phase was in the Ptolemaic period, perhaps also because of the influence of Alexandria of Egypt, where Ptolemy Philadelphos increased the theatre activities. This is the period in which the Cyrenaican architecture is most affected by the Egyptian-Alexandrian one. The previous cavea was enlarged towards the north and, in order to hold up the embankment, two walls of *analemma* were built, still visible in their foundations, converging towards the *logheion*, as before. It had a semi-circular shape on the outside and held some rows of seats cut in the rock around the semi-circular orchestra, which had a diameter of 56 feet (16, 56 m). The new scaenae, moved towards the north, reached the length of 100 feet (= 29,60 m).

This new Theatre, of the kind “with *paraskenia*”, with high *logheion* on pillars with jutting semi-columns, like in Priene (Asia Minor) and in Oropos (Greece), probably had a *scaenae* with three openings on the lower level, behind the pillar portico, and three symmetrical on the upper one. The whole *scaenae* had a depth of 25 feet (7,40 m) and the *logheion* a depth of 8 feet (m 2,36).

The monument was restored for the **fifth time** in the first half of the 1st cent. A.D. The walls of the *analemma*, lined up and not diverging any more, were re-built north of the previous ones, while the terracing-walls outside of the *cavea* were restored in a rectilinear fashion, so that the outside perimeter of the *cavea* became trapezoidal. The lower flights of steps of the *cavea* had seats resting upon an embankment, creating an arch with its centre other than that of the steps of the *ima cavea* of the previous stage, while the *scaenae*, which maintained its design, was remodelled according to the Roman fashion.

The old face of the *scaenae* was provided with columns bordering the three doors and, at the sides of the *logheion*, the two *versurae* were preserved. The *scaenae frons* remained straight and without niches, like in the Hellenistic period. Every element of the elevation is missing and therefore it is not possible to establish whether the colonnade had one or more levels.

It should be remembered that a *scaenae* of the Roman period, autonomous from the *cavea*, is documented in two building stages of the Roman-period Theatre of Dionysos in Athens.



Cyrene, Theatre-Amphitheatre: view of the orchestra from the south-west



Cyrene, Theatre-Amphitheatre: view of the scaenae and of the orchestra from the west



Cyrene, Theatre-Amphitheatre: view of the sector east of the scaenae



Cyrene, Theatre-Amphitheatre: the seats of the ancient *proedria* after the interventions of the Roman period



Cyrene, Theatre-Amphitheatre: view of the cavea from the west



**The last rebuilding was during two different moments of the 2nd cent. A.D.** It first concerned, just after the Jewish revolt of 115-117 A.D., the change of the Greek structure, constituted by the cavea and by the scaenae, to a structure of a Roman kind, by merging the two elements. Finally, in the second half of the century, the transformation of the Theatre to the Amphitheatre.

The first intervention concerned the cavea. This and other modifications, nevertheless, did not lead to the block of the *parodoi* and to the subsequent construction on the outside of the eastern side of a “great flight of steps”, on top of the southern one, which provided access to the cavea, as the investigations carried out by the MAIC in 2005 and 2006. The “flight of steps” was actually a celebrative monument, that is a Donarium built as a sort of pyramid surmounted with an imposing marble base which supported three portrait-statues nowadays lost. They probably represented the donors who provided the funds for one of the major re-workings of the monument.

The second imposing intervention concerned the structure of the arena, which took the lower third of the cavea and had an oval shape with the longer axis of 110 Roman feet and the shorter of 95 feet (m 32,67 x 28,21), and the building of two great entrances on this axis. From the entrances it was possible to have access to an indoor corridor, partly cut in the rock, and to small stairs that led to the lower rows of seats.

What was obtained at the expenses of the cavea was built north of it with additional rows of seats, in spite of the fact that the terrain did not allow for a complete duplication.

The investigations of the MAIC on the southern side of the monument make it certain that in this last stage the cavea was erected with additional rows of seats supported by imposing supports, perhaps arched, served with access stairs. This absolutely new element extends our vision of the project of the Roman architect to whom we owe the transformation of the monument. Finally, the cavea of the previous Theatre had a new series of seats directly superimposed on those already existing.

These interventions, which transformed the monument to a semi-amphitheatre and changed its function, find analogies with other entertainment buildings of the 2nd cent. A.D. in Filippi, in Augusta Raurica and in other sites. They foresaw, perhaps already in the previous phase, also a separation of the monument from the sacred area through a ponderous wall erected with the supervision of Nikodamos east of the Amphitheatre.

The investigations also allowed the discovery of numerous inscriptions, carved on the seats and on artefacts recovered in the reconnaissance and in the soundings, useful for the chronology of the architectural stages of the monument and that hold a particularly important historical-social meaning also in relation to ethnic groups that constituted the population of Cyrene after the arrival of the new settlers after the Jewish Revolt.



Cyrene, Theatre-Amphitheatre: the “Donarium with flight of steps”, already interpreted in the previous studies as the entrance to the monument



Cyrene, Theatre-Amphitheatre: view of the East entrance from the arena



Cyrene, Theatre-Amphitheatre: the sector of the southern gallery of the East entrance rebuilt in the thirties



Cyrene, Theatre-Amphitheatre, Entrance East: the small stairs of access to the seats originally built on the northern side of the monument



Cyrene, Theatre-Amphitheatre, Entrance West: the small stairs of access to the seats originally built on the northern side of the monument



Cyrene, Theatre-Amphitheatre: the remains of the elliptical gallery that originally encompassed the northern side of the monument

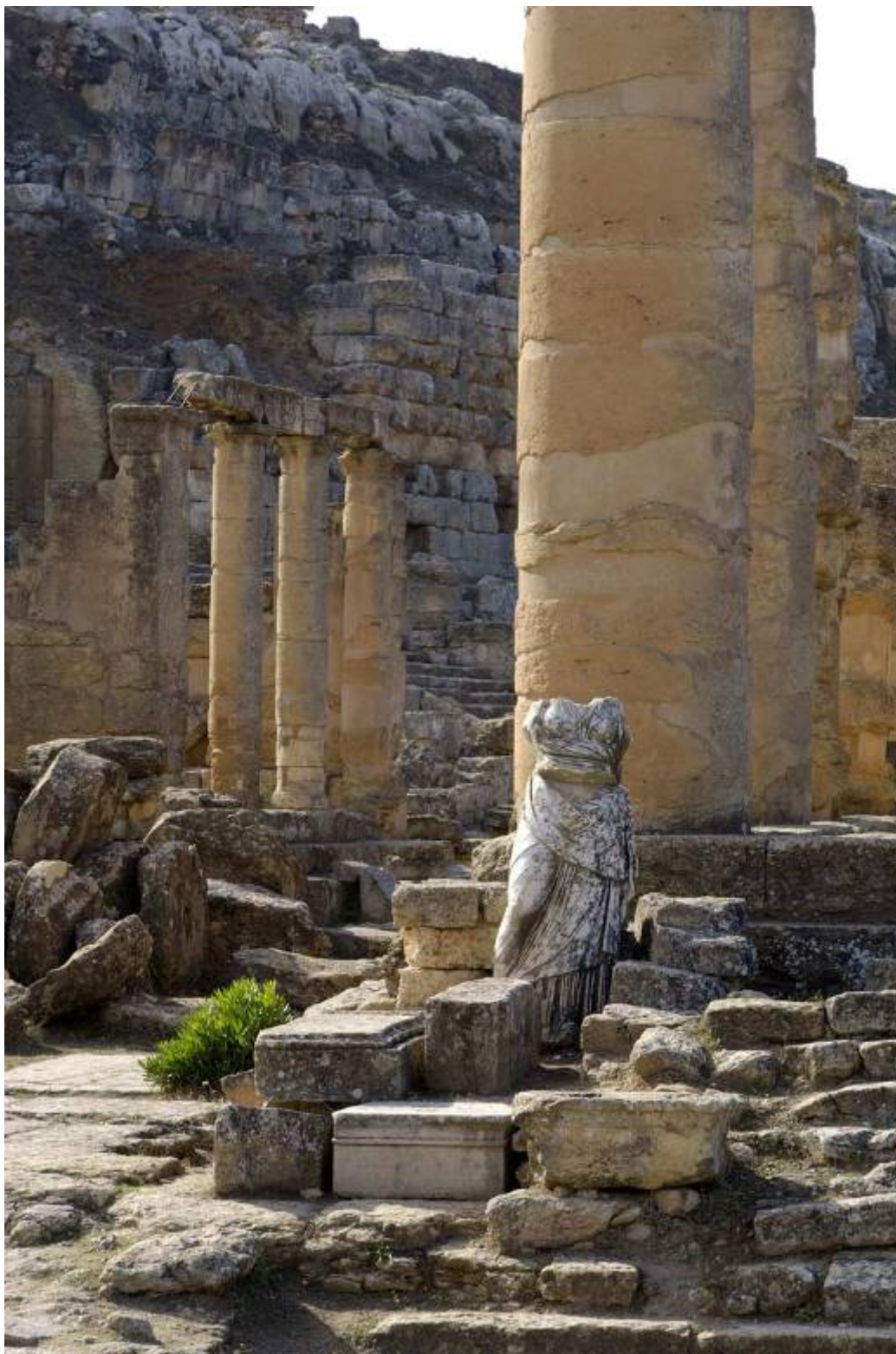


Cyrene, Theatre-Amphitheatre: detail of the inner sector west of the semi-circular wall that encompassed the arena on the northern slope



Cyrene, Theatre-Amphitheatre: view of the monument from the sector south/south-west of the cavea

**5. The monument: architecture, preservation, diagnostics and 3D virtual rendering. For the restoration and the anastylosis of the Theatre-Amphitheatre.**

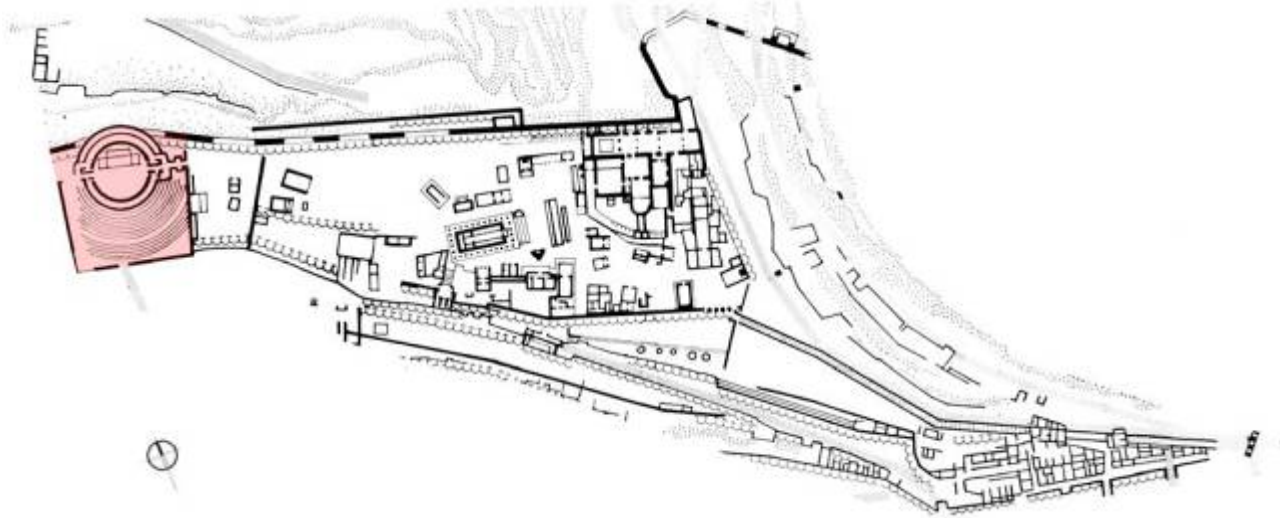


Cyrene, the Sanctuary of Apollo: detail

## 5.1. Preliminary report of the feasibility study for the restoration of the Greek Theatre and the Roman Amphitheatre, Cyrene (Libya)

### 5.1.1 Morphological and structural descriptive analysis

The Roman Amphitheatre rises west of the Sanctuary of Apollo on the Terrace of Myrtousa at m 556 above sea-level. Its structure, enclosed in a circular area of about 70 m in diameter, shows parts still visible of the various stages of the Greek Theatre and a great part of the Roman enlargement.



Cyrene, the Sanctuary of Apollo: planimetry and, in red, Theatre-Amphitheatre

Entering from what nowadays is the main entrance on the east side, which links the Sanctuary of Apollo, the Amphitheatre reveals the first enormous collapse of rows of steps and blocks that reaches down to the Arena and that concerns also the area of the corridor below, revealing a collapse of the rock dug by the Romans at the moment of the reutilisation of the Greek Theatre, for reasons still to be verified, but presumably because of an earthquake.



Cyrene, Theatre-Amphitheatre: the collapse of the west sector of the cavea

Among the blocks that constitute the flights of steps of the Cavea, the Greek and Roman phases are well distinguished. The Cavea of the Greek Theatre Greek is partially covered by the Roman flights of steps that are superimposed with the interposition of mixed material (stone-blocks and stones). This was perhaps in order to provide a steeper inclination to the new amphitheatre structure, while the remaining part is completely uncovered, allowing an examination of the building and working phases and the works at the moment of the Roman re-use of the Greek Theatre.

The extremities of the Cavea on the east and west sides have collapsed completely showing subsidence of the ground below. The hypothesis is thus reinforced about the realisation of the earth fill in the central-upper part of the Amphitheatre as support for the rows of Greek, and then Roman, seats. This hypothesis is also reinforced by the analysis of the surrounding terrain, which shows discrepancies with the terrain at the sides of the edifice, which are man-made as well. Furthermore, it is evident as well that the Greek flights of steps, in the upper right part of the Cavea, are not cut in the rock.

Similar to the intervention in the Roman period, because of the lack of a natural rock support, they were made in the quarry and set onto a support of stone-blocks not bound with mortar.





Cyrene, Theatre-Amphitheatre: the east sector of the cavea with the two superimposed stages, Greek and Roman

At the entrance to the Amphitheatre are immediately evident the curved walls, made with stone blocks of various size and belonging to the Roman phase, which define the ancient area of the Scaenae and of the orchestra of the Greek Theatre, which had become an arena. On the southern side, part of the reconstructed wall also includes a length of service corridor that was underneath the first rows of Roman seats and that was covered with a half-barrel vault that follows the elliptic curvature of the Arena.



Cyrene, Theatre-Amphitheatre: the eastern sector of the elliptic gallery on the southern side of the arena

On the northern side, the ellipsoidal shape of the area is much more consistent in the stonework and allows for clear and immediate visual reconstruction of the shape of the Arena carried out by the Romans: In the south, through the excision and the removal of the first Greek seats and, in the north, through the terraced expansion on the escarpment.

The second entrance in the west is now almost completely buried and shows few elements for interpretation, which in any case give a quite precise idea of the axially and geometry of the Amphitheatre, almost ensuring that an analogous structure would be discovered through excavations at the east entrance.

In the north, a second great collapse of the structural elements of the service corridor and of the Roman flights of steps that dominated it, is located on the downhill slope. All this reinforces the hypothesis that a substantial part of the rows of Roman seats also extended towards the north following therefore the elliptic shape of the Arena.



Cyrene, Theatre-Amphitheatre: the collapse (in red) of the side north of the monument on the hill slope

### **5.1.2 Phases of the restoration interventions**

For a restoration project of such an artefact of this entity, which involves different problems for the interventions on the different sectors, it is mandatory to deconstruct the whole *iter* of the project and of the study into stages.

While maintaining the goals to be achieved with a philological restoration, it is necessary to take into account the co-existence of different periods and of different strata.

After many inspections and in-depth consideration of the geological, engineering and technical kind, the project idea is to define and break up the different areas of intervention.

Four areas were set which have common problems and peculiar situations of instability.

#### ***Area A***

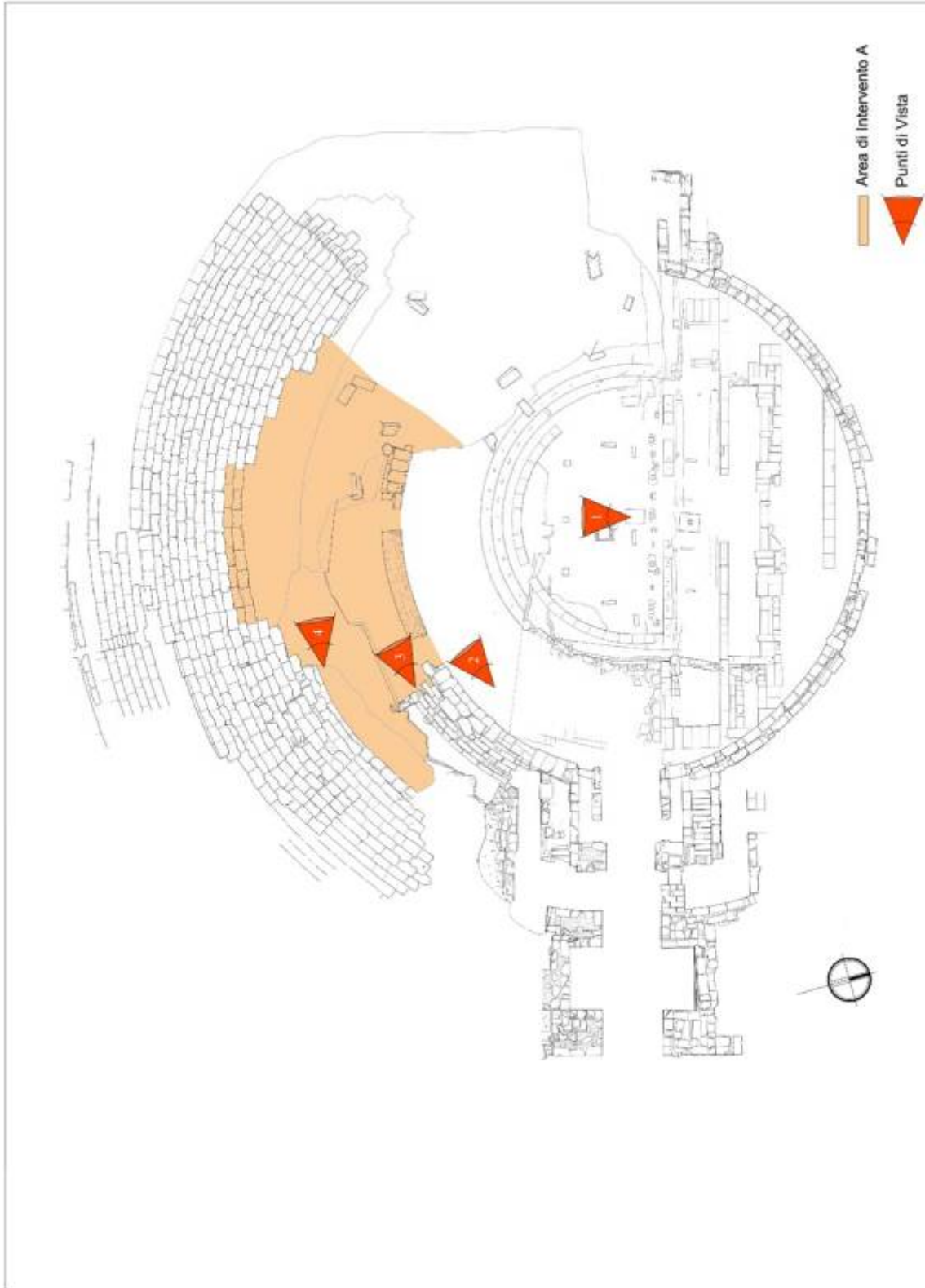
It is characterised by the collapse of five rows of seats, both the Greek and Roman. The damage took place because of the collapse of rock bank uphill of the service corridor of the Amphitheatre. Owing to this, six orders of flights of steps are currently critically unstable. It should be remembered that all the Greek flights of steps were made on embankments and that the Roman ones lean directly on the previous works.

In this area, first of all, necessary survey operations must be carried out with photogrammetric techniques of laser scanners and of GPS positioning (see report of R. Gabrielli, CNR-ITABC). Afterwards, it is planned to disassemble the blocks that constitute the flights of steps. Such removal will have to extend also to the part that appear to be little or not ruined at all. The removal of the filler materials up to the rock-strata will follow.

According to the condition of the natural terrain after such operations, it will be possible to make a project which will allow a safe re-assemblage of the various rows of steps.

As a working-hypothesis, it is planned to make a series of reinforced concrete plinths with an excavation of fixed section in the rock on which to set the poles joined by a beam. The size of such supports will be determined, as said, in relation to the general stability which can be verified only after the previously-listed operations.

As for the slightly ruined terraces which are above that area, simple operations of disassembling and reorganisation of the ancient works of support can be foreseen. Such reorganisation in any case plans interventions of consolidation and stabilization of the slope.



Cyrene, planimetry of the Theatre-Amphitheatre: *Area of intervention A* and the view-points.



Vista 1 - Area A

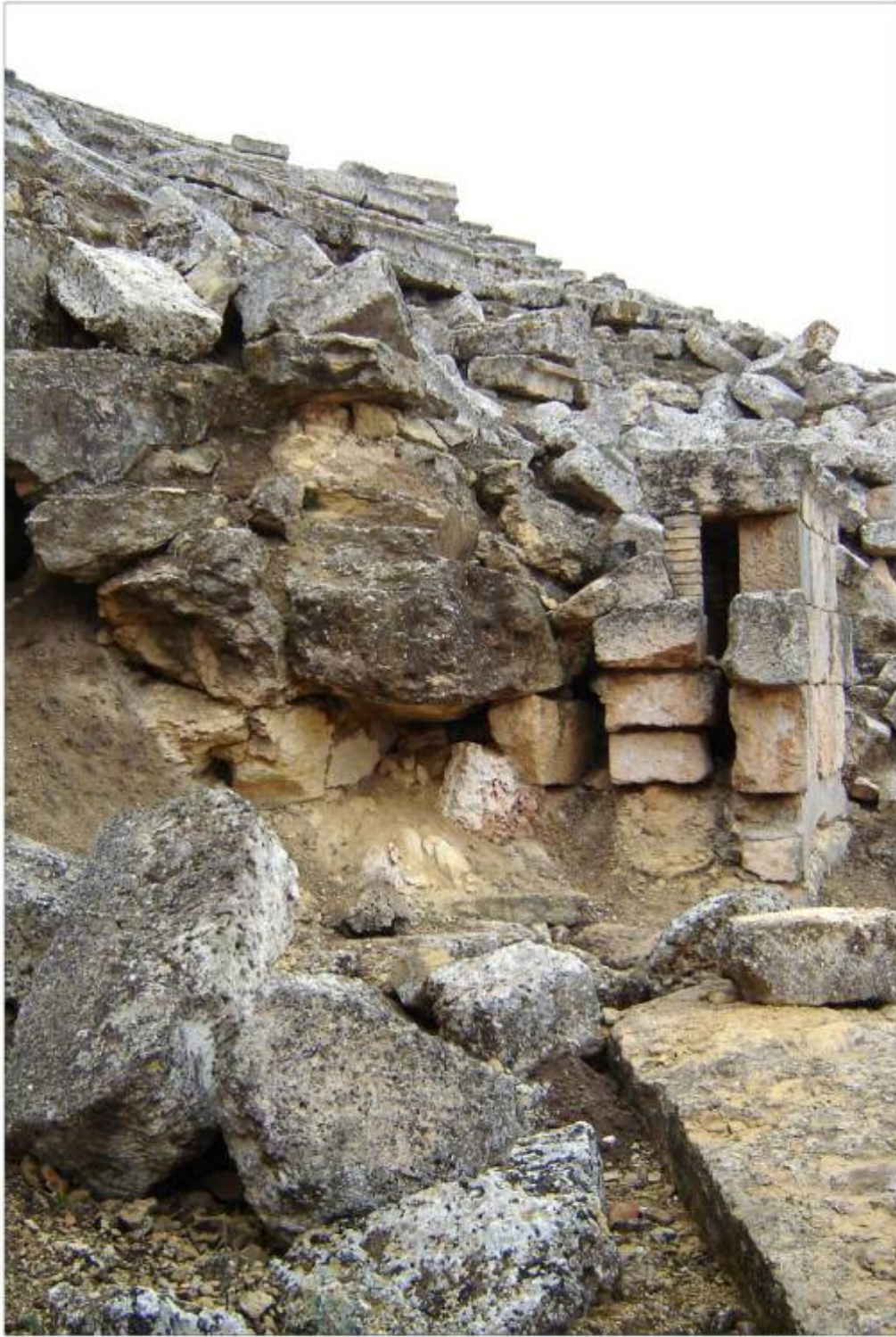


Vista 2 - Area A



Vista 4 - Area A

Cyrene, Theatre-Amphitheatre: views 1, 2, 4 of *Area of intervention A*



Vista 3 - Area A

Cyrene, Theatre-Amphitheatre: view 3 of *Area of intervention A*

## ***Area B***

In this zone, ruins and collapses are of a considerable magnitude.

The operations of survey, numbering of the blocks and their spatial positioning will have to be carried out stratigraphically any time underlying elements are exposed.

In this case as well it is likely that both the Greek and the Roman parts rest upon earth-fill and not on rock.

As in *Area A*, but in this case much more extensively, supporting structures for the terraces must be planned.

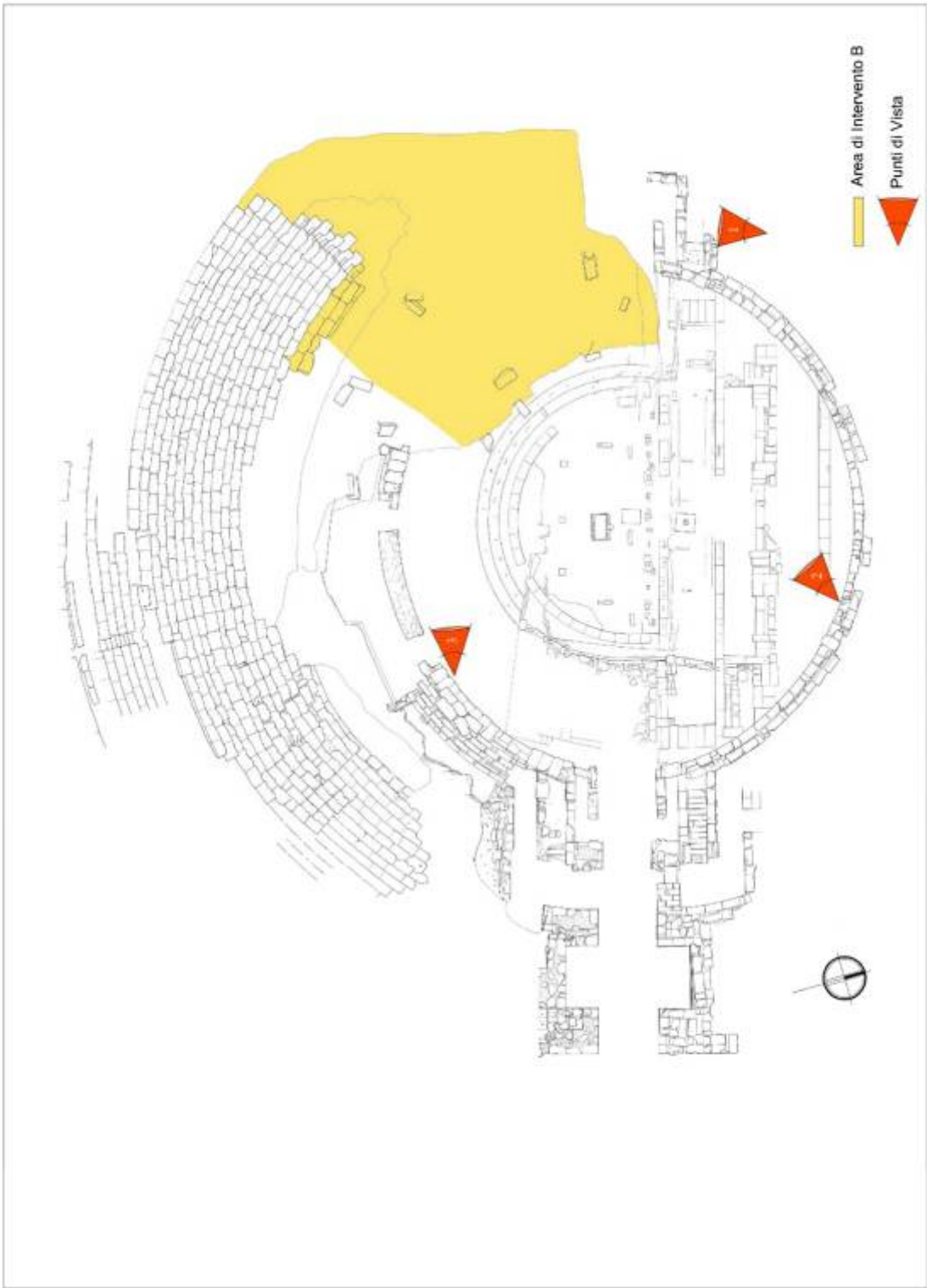
Before the total removal of the earth-fill, it will be necessary to carry out some geognostic soundings in order to establish the depth of rocky surfacing.

In the case that these levels are so deep that it would be impossible to completely remove the filling soil, the support works for the flights of steps could rest upon micro-poles.

Once the flights of steps have been secured and rebuilt, the reconstruction of at least part of the service gallery is planned.

For such an operation, support works for the rocky face that the Romans excavated in order to build the gallery and that nowadays shows clear signs of collapse, will be necessary, to be carried out with the most appropriate techniques of restoration.





Cyrene, planimetry of the Theatre-Amphitheatre: *Area of intervention B* and view-points



Vista 1 - Area B



Vista 2 - Area B

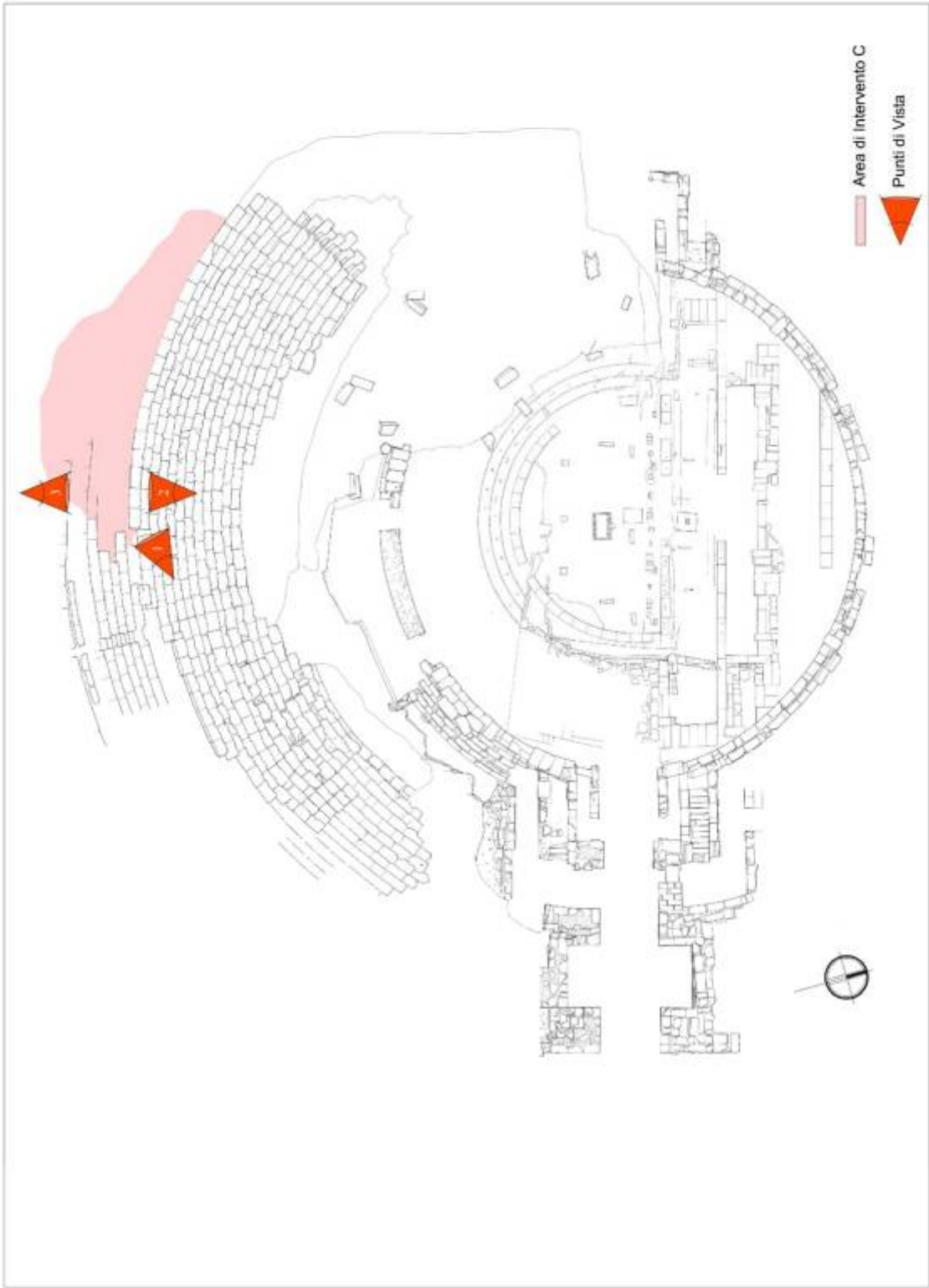


Vista 3 - Area B

### ***Area C***

In this area the water erosion has destabilised a circumscribed area. In this case as well, the Greek and Roman steps can be reassembled by restoring the earth-fill appropriately consolidated.

Within the *diazoma*, the great blocks set vertically have a slight capsizing of about 5-7 degrees from the vertical caused by a slight subsidence at the bottom. The blocks will have to be disassembled and reassembled after the reclaiming and consolidation of the areas of support.



Cyrene, planimetry of the Theatre-Amphitheatre: *Area of intervention C* and the view-point



Vista 3 - Area C



Vista 1 - Area C



Vista 2 - Area C

Cyrene, Theatre-Amphitheatre: views 1, 2, 3 of *Area of intervention C*

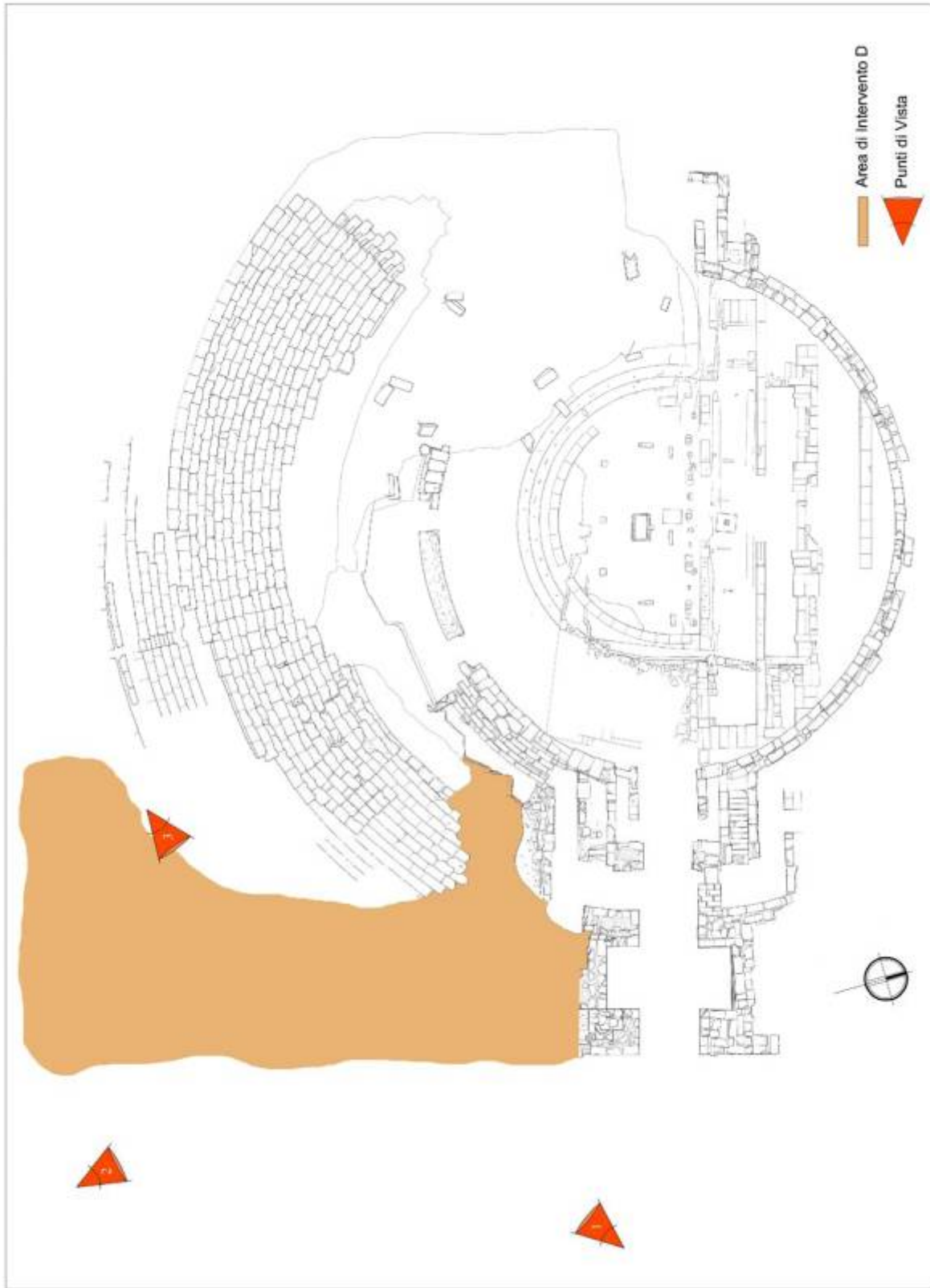
### ***Area D***

This area presumably was unstable already in the past. This is shown by a number of straight walls which also have precarious balance.

A remodelling of the terrain is planned to be carried out with limited operations of stratigraphic alleviation and works of drainage which would channel the vadose waters outside the area.

The wall-structures below *Area D*, dry-made, show outward subsidence. After the reduction and the reclaiming of the vadose waters, interventions of alternated repositioning will have to be carried out in order to align the wall-septum and adequately reinforce it also through the use of concrete mortar in the interconnections.

Other solutions cannot be hypothesised at this stage of the study.



Cyrene, planimetry of the Theatre-Amphitheatre: *Area di intervento D* and the view-points



Vista 1 - Area D



Vista 2 - Area D



Vista 3 - Area D



### **5.1.3 Preliminary project for the Site-Preparation**

From the reconnaissance carried out in the Amphitheatre and in the surrounding area it was ascertained that the morphological characteristics of the terrain cause some difficulties for the structure of the site:

- 1) The area of intervention has differences in height of about 30-40 m, which make the set up of the site difficult.
- 2) The phases of the work on areas A, B, C, D have the same problems of the organizational structure of the site. A crane will be employed to move the blocks in the whole area, and especially on the inner west side, where the collapsed area is imposing. On the north outer side, the collapse of the blocks of the Service Corridor should be noticed into the escarpment for about m 10, where there is no access for their retrieval.

Given the difficult conditions of work in the said area, the installation of a stable site is planned to be able to operate in all the phases, both for the scientific investigations and the cataloguing of the materials, and for the moving and placement of the architectural elements, to sum up, all the stages of the works of restoration and of anastylosis.

Therefore, the following mechanical aids are essential:

- 1) a fixed crane to be installed in the centre of the Arena (for all the phases and areas of intervention A, B, C, D and following). The crane boom must cover the whole area of work by 50 m of radius.
- 2) a fork lift for moving the blocks out of the area of the Amphitheatre;
- 3) the site equipment, including compressors, concrete mixers, drills, rock drill, winches, belts and various tools.

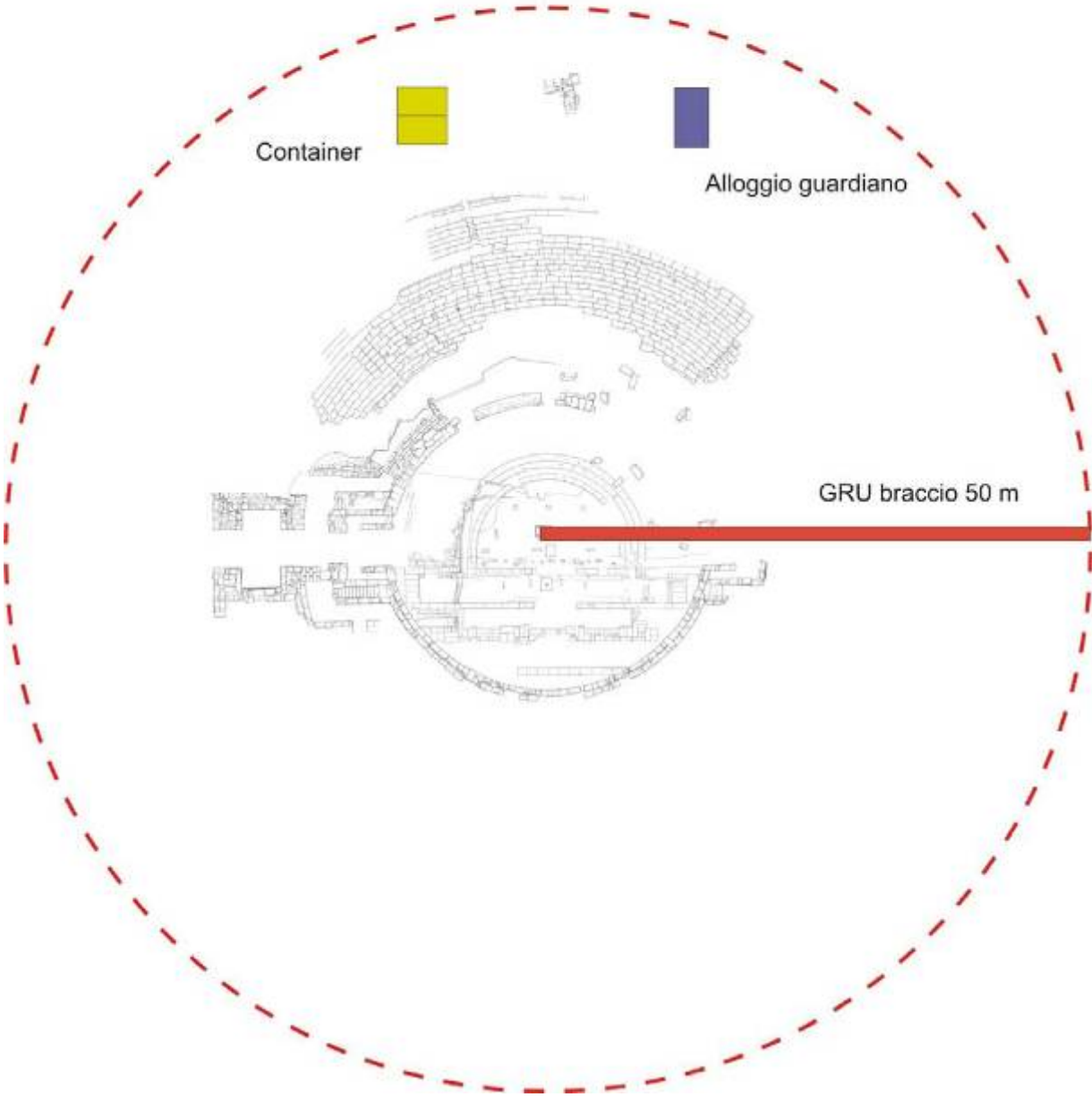
4) 2 containers, one for the materials of use (steel, resins, cement, sand etc.) and a second one for the electric and mechanical equipment.

*Furthermore:*

- the site will need a water duct or a water reserve and three-phase power supply (380 V) of at least 50 KW of power.
- the entire area of work will have to be fenced-off, lit up and with a small building/quarter for the site caretaker.

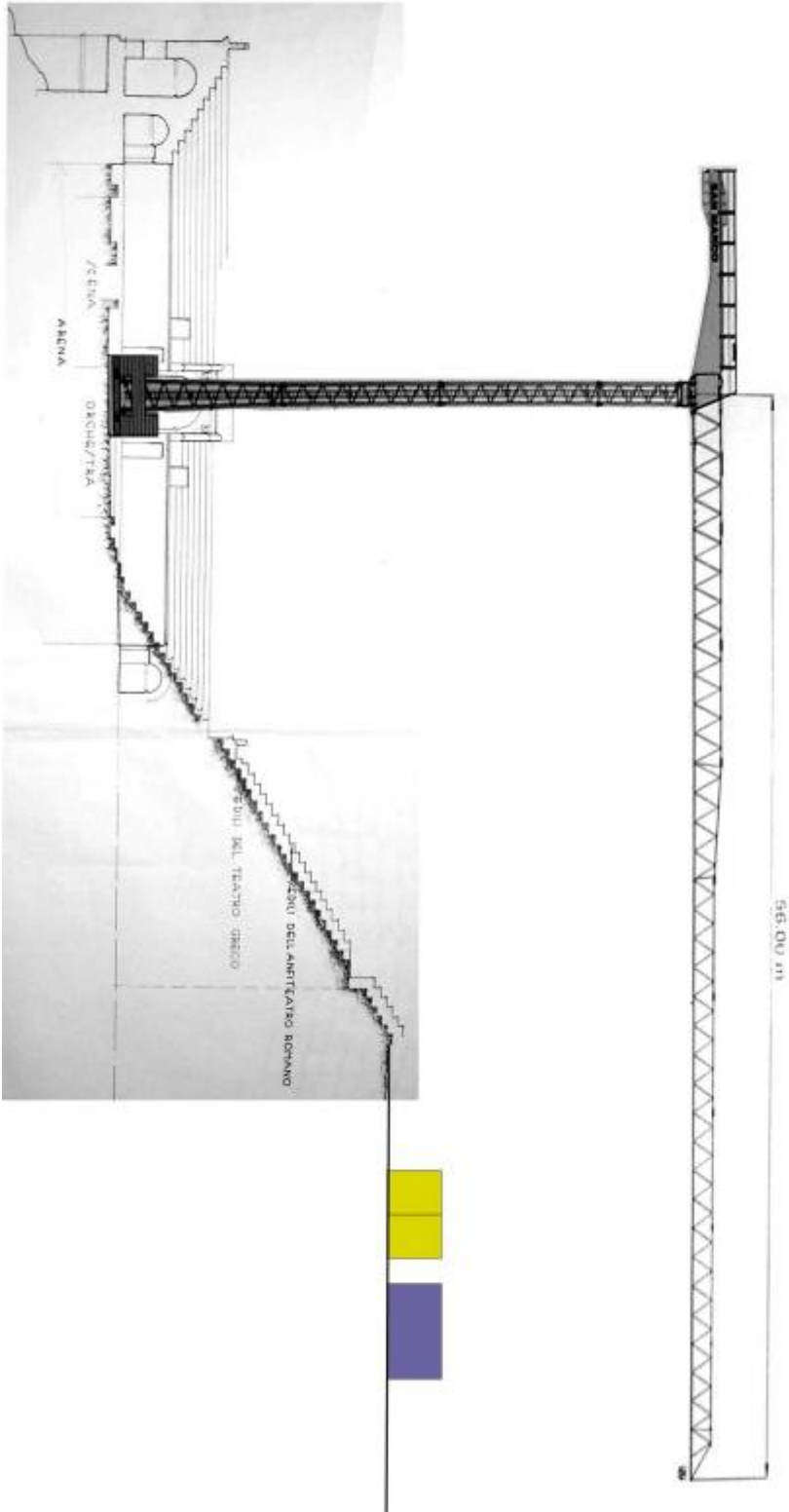
It is estimated that, with the current costs, the expenses for the site are around the indicative amount of €300.000,00.

Schema di Cantiere in Pianta



Schematic map of the site

# Schema di Cantiere in Sezione



Section of the site

## **5.2. The diagnostic investigations: the chemical analysis of the samples and the geo-engineering project of the hypogeal environment**

The diagnostic investigations consisted of the following operations:

**A.** Sampling of the mortars present in the scaenae and in the orchestra of the Theatre-Amphitheatre of Cyrene.

The mineralogic-petrographic study of such materials aims to reveal the techniques employed and to determine the different stages of the interventions carried out in the area.

**B.** Sampling of the different lithological types employed in the building of the structures of the Theatre-Amphitheatre.

The goal of the study of the stones has a two-fold importance:

-B.1- To determine the stone-types most frequently or exclusively employed in the various building phases;

-B.2- To determine the ongoing degradation processes and/or previous (especially during the interment) in order to determine the most appropriate techniques and the products for the operations of conservative restoration.

X-ray diffractometric analyses of the samples of mortar and stone will be carried out at the laboratories of the Centro Researches Archeometriche "CE.S.AR" of the Università di Urbino, in petrographic optic microscopy, electronic scanning microscopy and with micro-probe EDAX.

**C.** The underground environment, mostly artificial, obtained by the last sector of the monument, behind the "Donarium with flight of steps," is subjected to photographic and graphic surveys.

The space shows worrying and serious signs of structural instability. A number of subsidences took place in the past as well and they are testified by a series of pillars that should have supported the vault, which is deeply damaged and with prisms lowered by a few cm. Some pillars have collapsed and those still standing show unmistakable signs of excessive load. In order to monitor possible ongoing movements, many glass "spies" were collocated.

Establishing the safety of the environment is an absolute priority. Its collapse would cause the collapse of part of the flights of steps and of two walls that are adjacent to it and that already show clear signs of ruin.

The elaboration of a geo-engineering project of reinforced concrete works is in progress in able to ensure the endurance of the subterranean area.



Cyrene, Theatre-Amphitheatre: the entrance of the hypogeum near the northern side of the “Donarium with flight of steps”



Cyrene, Theatre-Amphitheatre, hypogeum: view of the northern inner wall during the excavation



Cyrene, Theatre-Amphitheatre, hypogeum: view of the inside



Cyrene, Theatre-Amphitheatre, hypogeum: view of the inner vault with the flaws and the glass “spies”

## **5.3. Virtual system for the anastylosis of the Greek Theatre – Roman Amphitheatre of Cyrene**

### **5.3.1 Introduction**

The study of the territory was fine-tuned according to an accurate capture of environmental data (topography, geo-morphology, lithostratigraphy, use of the soil/terrain etc.) useful for the integrated study of the archaeological site and for the reconstruction of the interactions between man and environment.

A site, in fact, can be characterised within its environmental context through the definition of an integrated method of analysis, founded on the integration of different sets of data present on the territory.

The possibility of spatially link data of different nature and extension, fundamental for an integrated investigation, is provided by the Geographic Information Systems (GIS). The use of such systems forces a deep consciousness of the potential of the computer tools and of the scientific and technological methodologies, fundamental in establishing the spatial relations between the information related to the human processes and the surrounding environment.

### **5.3.2 Goals and conducted activities**

The work has been aimed at the survey of the wall-structures present in the archaeological area of the Greco-Roman Theatre of Cyrene, survey fundamental for the correct planning of a possible conservative intervention of the monumental area. The geometric and descriptive information of the 3D processing will constitute the framework of the computer system, where it will converge with all the geo-referred information of the territory.

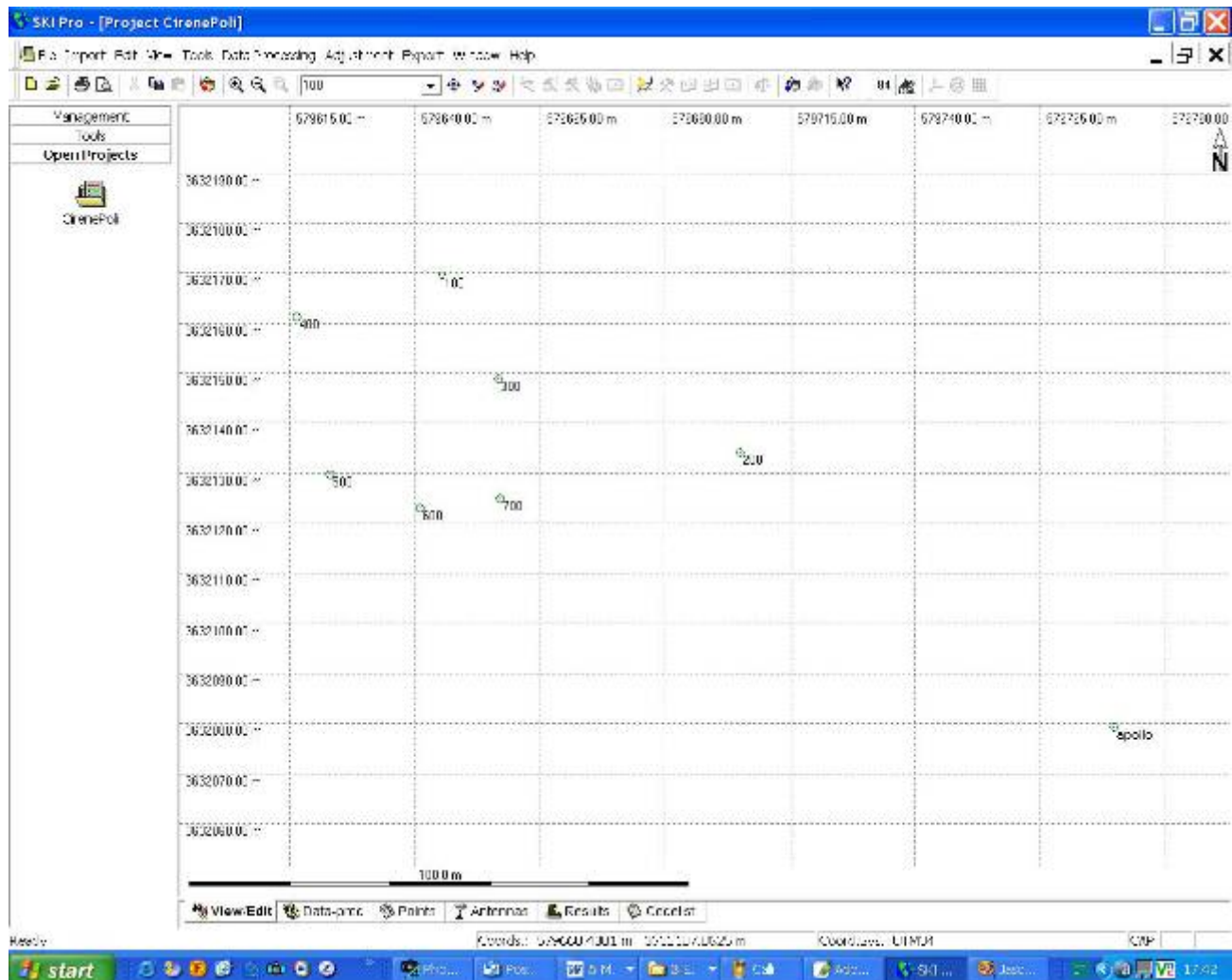
The general goal of the project is to link to the base information system a database containing all the descriptive data of the single artefacts derived from the excavation and reconnaissance cataloguing.

The final product will be the planning and realisation of a computer system for the simulation of the restoration and of the anastylosis, employing techniques typical of the dedicated systems, better known as “Artificial Intelligence.”

Here is the sequential description of the different stages of intervention:

A. In the first part of the work a polygonal net with the total station Trimble 5600 was constituted by numerous points distributed on the area of interest. Such points were positioned on the ground through concrete stakes documented with descriptive monographs. The polygonal (net) was then geo-referenced on a geographic scale through the employment of a differential GPS Leica to which will be related any subsequent intervention of survey. The main advantage of the method of GPS capturing is that it determines immediately the position of a point on the territory, facilitating immensely the topographic operations. In particular, the system employed in this perspective is called RTK (Real Time Kinematic), the increased efficiency of which relies on the rapidity of acquisition of the points (it does not need long periods of initialising) and in the possibility of verifying the reliability of the data directly on the field.





Elaboration of the polygonal net with the total station Trimble 5600

B. In order to correctly link the altitudes to a geodetic reference system (altitudes above sea level), a point above sea level was acquired by using the GPS in static mode. This method, utilised for topographic aims in which a centimetric or subcentimetric is required, requires two receivers to be set on topographic tripods with a period of initialisation of about 30 – 90 min. According to the acquired coordinates it was ascertained that the Theatre has an altitude of 556 m. above sea level.

C. The survey of the structures of the Theatre was carried out through the application of laser techniques of three-dimensional scanning. Such tools are the result of the modern technological innovation in the topographical and architectural surveys; the system, in fact, is able to provide millions of points (in the three coordinates x, y, z) during the process of acquisition and with good and consistent precision it describes the surveyed target.

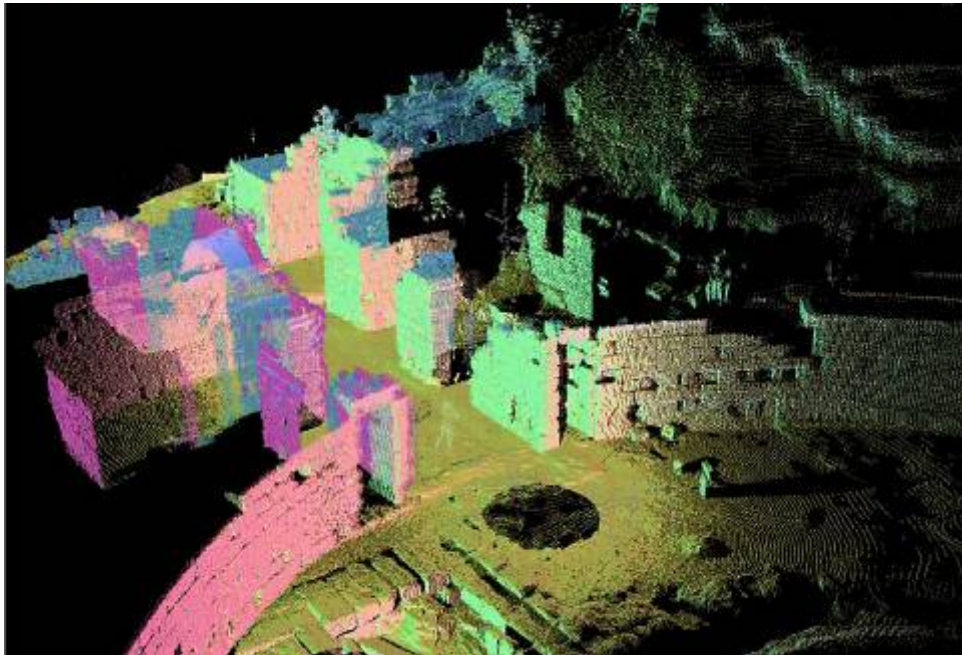
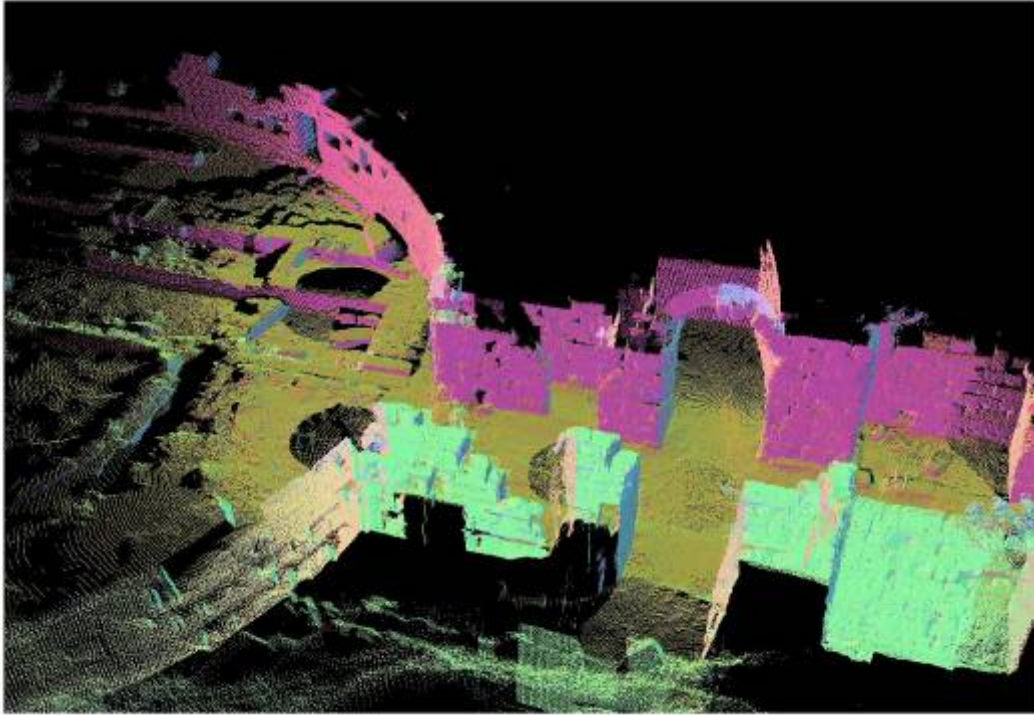


Cyrene, Theatre-Amphitheatre during the works of 2006: application of the laser scanner for the three-dimensional survey of the East Entrance

The stage of acquisitions for each scanning section lasted about 20 min. for a solid angle of  $360^\circ$ . In total, 41 scansions have been carried out in order to survey every single part of the Theatre; specifically for the survey of the cavea, 23 scansions were carried out and the remaining 18 for the access corridor and for the scaenae and the orchestra.

In fact, it is necessary to specify that a single scansion is not sufficient to cover the whole region or the concerned object, but several scansions have to be carried out from diverse and different perspectives; the method of survey through laser scanner is limited to the visual field of the instrument, and in order to obtain a complete model of a complex object, numerous scansions from different perspectives are often necessary. The possible obstacles to the visual field of the instrument are both the objects interposed between this and the surfaces to be scanned and the unevenness of the surfaces themselves. Adjacent surfaces, but with different altitude, as for example in cavea, produce in correspondence of a corner, on the farthest surface of the scanner, a shade zone the extension of which depends on the difference in altitude and on the angle of incidence of the laser.

The three-dimensional geometric models, attainable through the 3D Laser Scanner allow us therefore to obtain true scientific surveys, on top of showing the real dimensions of objects or architectural structures, to underline possible deformations and geometric shape.



Cyrene, Theatre-Amphitheatre, the area of the East Entrance: Meshing of the three-dimensional survey carried out with 3D laser scanner

Once the complete net of points of the object of the study is obtained, it is possible to proceed to the processing of the obtained data through different schemes and procedures according to the final result that is aimed for. The stages of *post-processing* require times of processing equal to five times the time necessary for a survey on the field. Therefore, foreseeing a future campaign of acquisitions of about 15 days, the final result of the processing of the final model will not be completed before a

couple of months. In fact, in order to obtain a complete geometric model these procedures have to be followed:

- creation of the mesh: conversion of the net of points into a surface made of triangles which produces a representation more intuitive than the model, especially if mapped through the use of images.

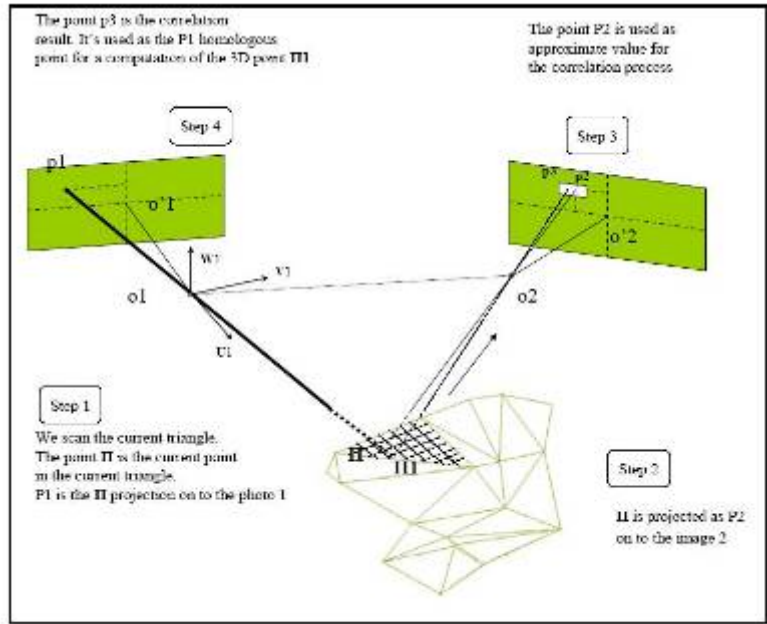


Cyrene, Theatre-Amphitheatre, the arch of access to the gallery north of the East Entrance: Texturing of the photographic image, carried out with 3D laser scanner, on a geometric model

- mapping of the texture: the mapping of the texture consists of establishing an univocal correspondence between the triangles of the mesh and the points of the photographic image which will be “spread” on the three-dimensional model.
- extrapolation of geometric information from the model: the model created with the laserscanning method, and subsequently integrated through photographic modelling, is by all means a three-dimensional geometric model, from which is possible to extract all sorts of information. This takes place through the use of proper applications with the possibility of exporting the model in standard formats as the \*.dxf in order to be processed by the CAD software. Some examples of the use of the instruments available from the software and useful.

D. To complete the system, the methods of laser scanner survey were integrated through a photogrammetric survey of the missing zones; a solution surely to be appreciated because of its applicative simplicity and the compactness of the instrumentation.

In this perspective and whenever necessary, photographic shots of the subjects were made, with a highly professional and calibrated photographic instrumentation; the frames were captured through a flexible and easy to carry system of photographic survey and a register of recovery. The single frames will therefore be geo-referenced and orientated. The process consists of recognising and associating the same points belonging to the single frames.



Elaboration of the photogrammetric system applied to some sectors of the Theatre-Amphitheatre

The goal is to create a simplified geometric model, that is a surface mesh, and a series of oriented photos in order to determine the 3D points visible on each photo and included in the mesh. The aim is to generate, starting from an irregular set of points hand-measured by an operator, the new points through a process of automatised measurement. The system automatically generates a triangulation on some 3D points from which can be interpolated points that are then projected on a reference image.



The integration of the different methods will allow for the creation of descriptive numerical models of the shape, of the function and of the deterioration of the artefacts (walls, blocks etc). The output of such processing will be in formats usable by commercial software for reading territorial data and 3D graphics.

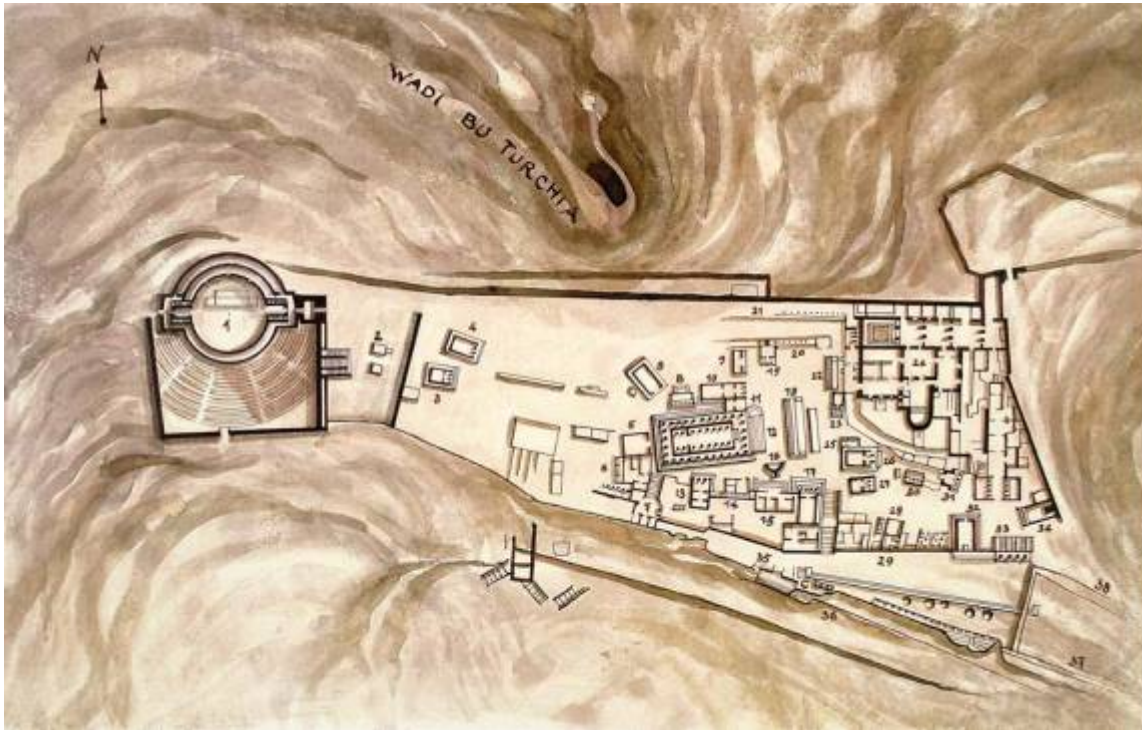
### **5.3.3 Program of future activities**

- Completion of the surveys carried out with the three-dimensional laser scanner laser. In particular the acquisitions will have to be concentrated on the area adjacent to the Theatre.
- In order to make the local-scale three-dimensional models the generation of DEM will be possible through the use of differential GPS in kinematic mode (kinematic real time- RTK); this instrument allows to capture on the field dozens of thousands of altimetric points related to the area of sampling of the survey with altimetric precision of a few centimetres. This methodology can be integrated with the survey of points through the total station in order to extend the investigation, for example, in areas where the morphology prevents a correct satellite visibility or in places not easy to reach.
- Photogrammetric survey of the blocks belonging to the structures of the Theatre. To each of them will be linked a descriptive table related to the archaeological – architectural analysis carried out by the archaeological team.
- Development of a software application for a guided simulation through computer techniques related to the techniques proper for an expert system, better known as “Artificial Intelligence.”

Fig. on the previous page:

Cyrene, Theatre-Amphitheatre: elaboration of the application of the photogrammetric system on the entrance wall of the hypogeum

## 6. Enhancement and “serviced” pathways within the Sanctuary of Apollo



Cyrene, the Sanctuary of Apollo, planimetry



Cyrene, District of the The Sanctuary of Apollo: the Via Colonnata of access to the Terrace of Myrtousa, seat of The Sanctuary of Apollo



Cyrene, the Sanctuary of Apollo seen from the east

Within a project as complex as that of the Theatre-Amphitheatre of Cyrene, which looks towards a scientific activity aimed at the defence, safeguard and conservation, systems of enhancement of the territorial context should also be necessarily researched, which represents the preliminary stage for an adequate promotion and scientific publication of the “product” as a means of incrementing the development of cultural tourism on an international level.

In this respect, the Sanctuary of Apollo can be promoted as a new cultural attraction within the context of the ancient city of Cyrene, not unlike the archaeological parks.

For the Sanctuary of Apollo, systems of redevelopment and maintenance of the more degraded monumental areas will be studied, looking towards the future restoration of the buildings. Appropriated structures of surveillance and welcome should be made ready. “Serviced” pathways for the fruition of the archaeological context with opportune topographic itineraries, provided with didactic-scientific apparatuses, complete with every element: from the history of the excavations and of the findings to the plano-volumetric and chronological development of the monumental area.



Within the perspective of the promotion of the museo-graphic culture Antiquaria-laboratories need to be built. An example, if suitably “restored,” could be represented by the Donarium of the Strategoi, a building of the 4th cent. B.C. entirely rebuilt/reconstructed by Italo Gismondi and nowadays seat, among other things, of the sculpture of the Temple of Apollo. The structure, to be entirely restored, and its content, extremely heterogeneous when it comes to the materials included, could represent a first step towards this goal.



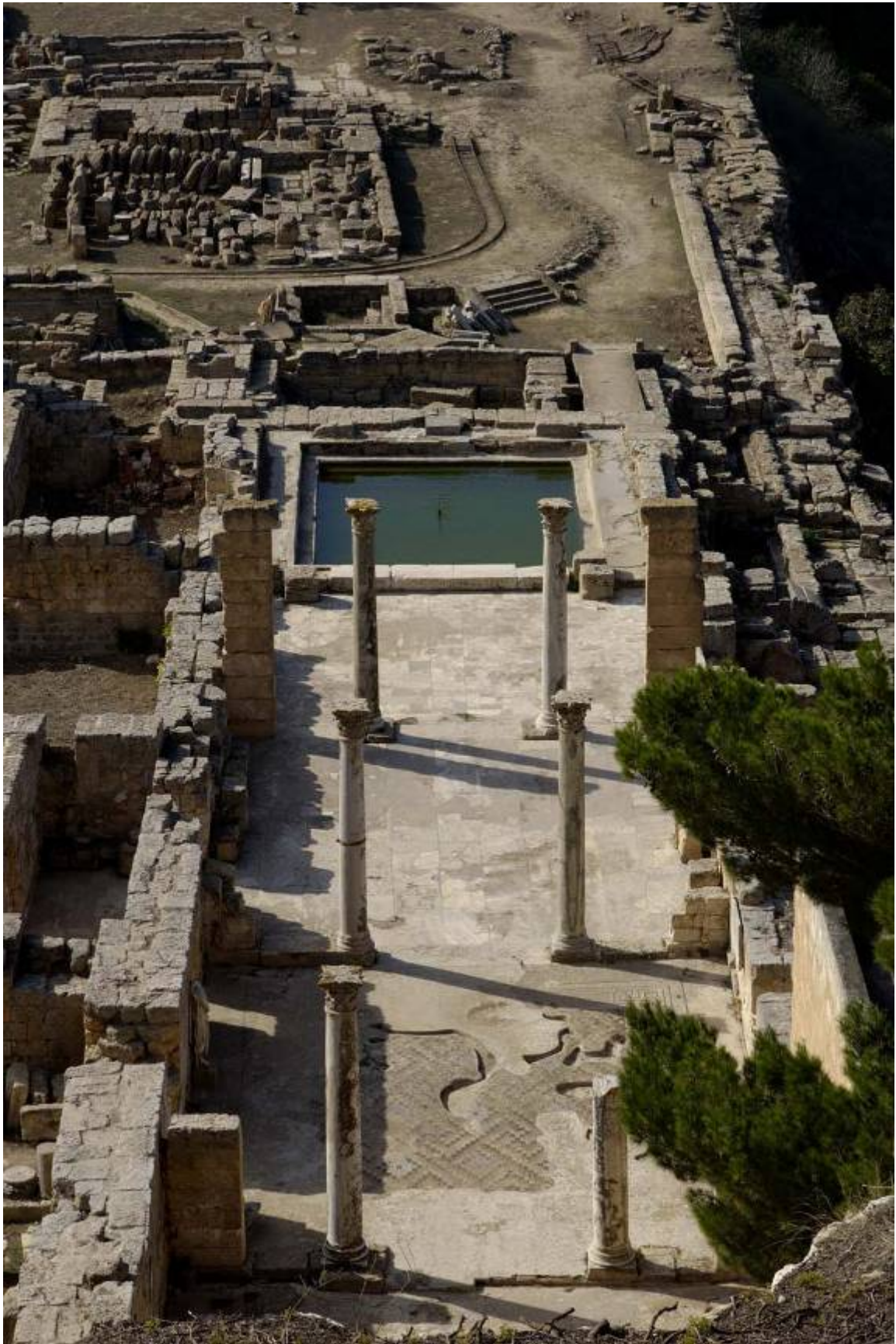
Cyrene, the Sanctuary of Apollo, view of the central area from the north/north-east: in the foreground the Temple and the Altar of Apollo, the Exedra of Apollo Karneios



Cyrene, The Sanctuary of Apollo, view of the central area from the west: in the foreground the south-eastern corner of the Temple of Apollo



Cyrene, The Sanctuary of Apollo, view of the central area from the south/south-west: in the foreground the Exedra of Apollo Karneios and the Altar of the tutelary god



Cyrene, The Sanctuary of Apollo: the *Frigidarium* of the Great baths



Cyrene, the Sanctuary of Apollo: view of the Temple of Apollo from the south-west

## 7. Bibliography

### Cyrene: the Sanctuary of Apollo

S. Ensoli, *Notizie sulla campagna di scavi del 1987 sulla terrazza della Myrtusa a Cyrene*, in *Atti dei Convegni Lincei*, 87. *Giornata Lincea sulla Archeologia Cirenaica*. Roma, 3 Novembre 1987, Roma 1990, pp. 157-178, tavv. I-XI

S. Ensoli, *Indagini sul culto di Iside a Cyrene*, in *Atti del IX Convegno su L'Africa Romana*. Nuoro, 13-15 dicembre 1991, Sassari 1992, pp. 167-250, tavv. I-XXVI

S. Ensoli, *L'iconografia e il culto di Aristeo a Cyrene in età greca*, in *Cyrenaican Archaeology. An International Colloquium*. Cambridge, March 29th-31st, 1993, Oxford, 1994 (*Libyan Studies*, 25), pp. 61-84

S. Ensoli, *La fortuna di Lisippo*, in *Lisippo. L'arte e la fortuna*, a cura di P. Moreno, S. Ensoli,

M.E. Tittoni-F. Pirani, Milano 1995, pp. 290-303

S. Ensoli, *I Propilei Greci del Santuario di Apollo a Cyrene. Rapporto preliminare dei lavori compiuti negli anni 1980-1984 e 1987*, *LibyaAnt*, n.s., 1, 1995, pp. 61-71, tavv. XIX-XXVI

S. Ensoli, *I rifornimenti idrici del Santuario cyreneo di Apollo dal IV secolo a.C. alla fine dell'età tolemaica*, in *Scritti di antichità in memoria di Sandro Stucchi, I. La Cirenaica; la Grecia e l'Oriente mediterraneo*, a cura di L. Bacchielli, M. Bonanno Aravantinos, Roma 1996, pp. 79-110

S. Ensoli, *I Greci in Occidente*, Milano 1996 (II edizione, rivista e aggiornata), pp. 754-755, nn. 414, 416-418

S. Ensoli, *Il "Recinto del Mirto" nel Santuario di Apollo a Cyrene. I risultati sulle indagini di scavo e sul restauro del monumento*, Roma 1996 (stampato in proprio dall'autore), pp. 15, ill. 13

S. Ensoli, *Sanctuary of Apollo – Greek Propylaea and adjacent monuments*, *LibyaAnt*, n.s., 3, 1997, pp. 235-236, tav. CXV, b

S. Ensoli, *The Myrtle Enclosure*, *LibyaAnt*, n.s., 4, 1998, p. 159, tav. XXXV, b

S. Ensoli, *Agia, Eros e Eracle. Repliche e rielaborazioni di modelli lisippeï in Cirenaica*, in *La Cirenaica in età antica. Atti del convegno internazionale di studi, Macerata 18-20 Maggio 1995*, Macerata 1998, pp. 219-242, tavv. I-XVII

S. Ensoli (a cura di), *Cyrene*, Milano 2000, pp. 230, ill. 310; contributi di S. Ensoli:

*L'Acropoli*, pp. 52-54;

*Il Santuario delle Divinità Alessandrine*, pp. 55-57;

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*La scultura di carattere religioso*, pp. 193-194;  
*Le rappresentazioni del mito*, pp. 199-202;  
*La scultura decorativa*, pp. 203-206.

S. Ensoli, *Il vaso Portland e Cyrene*, in *Atti del Convegno Internazionale di studi sull'Archeologia Cirenaica. Urbino 4-5 luglio 1988*, Roma 2002 (*QuadALibia*, XVI. *Archeologia cirenaica*), pp. 165-260

S. Ensoli, *Studi, scavi e scoperte dal 1996 al 2003: nuovi elementi per servire alla storia della religione e dei complessi monumentali di Cyrene*, in “*Studi, scavi e scoperte in Cirenaica. Nuovi dati da città e territorio*”, *Convegno Internazionale di Studi, Chieti 24-26 novembre 2003*, a cura di E. Fabbriotti, Oxford 2005, pp. 17-36, figg. 1-16, tav. II

S. Ensoli, *La statua di Zeus Egioco a Cyrene*, in *Cyrene e la Cirenaica nell'antichità. Atti del I convegno internazionale di studio, Roma-Frascati, 18-21 dicembre 1996*, a cura di L. Gasperini, E. Lanzillotta, pp. 209-258, c.s.

S. Ensoli, *Sorgenti, fontane e culti nel Santuario di Apollo a Cyrene*, in *Atti del Congresso Internazionale 'Archeological Discoveries and Studies in Great Jamahiriya', Tripoli, 22-23 September 1998*, a cura di A.E. Al-Khadduri, c.s.

S. Ensoli, *Scavi e restauri nel Santuario di Apollo a Cyrene*, in *Convegno di studio sui Quarant'anni della Missione Archeologica Italiana a Cyrene*, Università di Macerata, *Antica Biblioteca*, 6-7 novembre 1998, a cura di L. Gasperini, c.s.

S. Ensoli, *Profilo storico dei culti e dei monumenti religiosi in Cirenaica e in Tripolitania*, in *Libia*, a cura del Dipartimento alle Antichità di Tripoli, c.s.

S. Ensoli, *Il culto e i santuari di Iside a Cyrene: i risultati delle indagini svolte sino al 2004*, in *Serekh (Associazione Amici Collaboratori Museo Egizio)*, Torino, Centro Congressi dell'Unione Industriale, 08.11.2004, a cura di A. Roccati et Alii, c.s.

## **Cyrene: the Theatre-Anphitheatre**

E. Ghislanzoni, *Notizie archeologiche sulla Cirenaica*, *Notiziario Archeologico*, 1, 1915, p. 192, fig. 63

G. Cultrera, *Architettura ippodamea: contributo alla storia dell'edilizia nell'antichità*, *MAL*, 17, 1923 (1924), p. 210, nota 3

- G. Oliverio, *Scavi di Cyrene*, Bergamo 1931, p. 63
- P. Romanelli, *La Cirenaica romana (96 a.C. – 642 d.C.)*, Verbania 1943, p. 256, nota 3, fig. 35
- C. Anti, *Teatri greci arcaici da Minasse a Pericle*, Padova 1947, pp. 122-125, figg. 32-33  
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- G. Caputo, Edifici teatrali della Cirenaica, *Anthemion in onore di Carco Anti*, Firenze 1955, pp. 281-291, spec. pp. 282, 290, nota 3, tav. XXV
- G. Caputo, *Il teatro di Sabratha e l'architettura teatrale africana*, Roma 1959, p. 68
- S. Stucchi, *Cyrene 1957-1966: un decennio di attività della Missione Archeologica Italiana a Cyrene*, Tripoli 1967, p. 8, nota 2
- R.G. Goodchild, *Kyrene und Apollonia*, Zuerich 1971, pp. 125-127, fig. 15, tavv. 48, 69-70
- S. Stucchi, *Architettura cirenaica*, Roma 1975, pp. 35-36, 69-70, 135, 208, 286-289, figg. 24-25, 54-55, 115, 198-199, 290-295, tav. I, n. 1
- C. Courtois, *Le bâtiment de scène des théâtres d'Italie et de Sicilie. Etude chronologique et typologique*, Louvain-la Neuve 1989, p. 204
- H.P. Isler, *Teatri greci e romani. Alle origini del linguaggio rappresentato*, a cura di P. Ciancio Rossetto, G. Pisani Sartorio, III, *Censimento analitico*, Roma 1994, pp. 137-138
- S. Stucchi, in *EAA*, Suppl. II (1971-1994), Roma 1994, s.v. Cyrene, p. 166
- S. Ensoli, *Il vaso Portland e Cyrene*, in *Atti del Convegno Internazionale di studi sull'Archeologia Cirenaica. Urbino 4-5 luglio 1988*, Roma 2002 (*QuadALibia*, XVI. *Archeologia cirenaica*), pp. 165-260 (*passim*)
- S. Ensoli (a cura di), *Cyrene*, Milano 2000, p. 123, figg. a pp. 14, 42, 105, 106, 117
- S. Ensoli, *Il Teatro-Anfiteatro del Santuario di Apollo a Cyrene: nuove ricerche*, in *XI Convegno Internazionale di Archeologia Cirenaica, Urbino, 30 giugno – 2 luglio 2006*, c.s.

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Cyrene, Theatre-Amphitheatre: the entrance to the hypogeum near the northern side of the “Donarium with flight of steps” (MAIC, photo by P. Semprucci)  
Cyrene, Theatre-Amphitheatre, hypogeum: view of the northern inner wall during the excavation (MAIC, photo by P. Semprucci)  
Cyrene, Theatre-Amphitheatre, hypogeum: view of the inside (MAIC, photo by P. Semprucci)  
Cyrene, Theatre-Amphitheatre, hypogeum: view of the inner vault with the flaws and the glass “spies” (MAIC, photo by P. Semprucci)  
Elaboration of the polygonal net with total station Trimble 5600 (MAIC, photo CNR-ITABC)  
Cyrene, Theatre-Amphitheatre during the works of 2006: application of the laser scanner for the three-dimensional survey of the East Entrance (MAIC; photo of P. Semprucci)  
Fig. a-b. Cyrene, Theatre-Amphitheatre, the environments of the East Entrance: Meshing of the three-dimensional survey carried out with the 3D laser scanner (MAIC, photo CNR-ITABC)  
Cyrene, Theatre-Amphitheatre, the arch of access to the gallery north of the East Entrance: Texturing of the photographic image, carried out with 3D laser scanner, on a geometric model (MAIC, photo CNR-ITABC)  
Elaboration of the photogrammetric system applied to some sectors of the Theatre-Amphitheatre (MAIC, photo CNR-ITABC)  
Cyrene, Theatre-Amphitheatre: elaboration of the application of the photogrammetric system on the entrance wall of the hypogeum (MAIC, photo CNR-ITABC)

## Cap. 6.

Cyrene, the Sanctuary of Apollo, planimetry (MAIC, drawing by A. Pagnini)  
Cyrene, District of the The Sanctuary of Apollo: the Via Colonnata of access to the Terrace of Myrtousa, seat of the The Sanctuary of Apollo (MAIC, photo by P. Semprucci)  
Cyrene, the Sanctuary of Apollo seen from the east (MAIC, photo by P. Semprucci)  
Cyrene, the Sanctuary of Apollo, view of the central area from the north/north-east: in the foreground the Temple and the Altar of Apollo, the Exedra of Apollo Karneios (MAIC, photo by P. Semprucci)  
Cyrene, The Sanctuary of Apollo, view of the central area from the west: in the foreground the south-eastern corner of the Temple of Apollo (MAIC, photo by P. Semprucci)  
Cyrene, The Sanctuary of Apollo, view of the central area from south/south-west: in the foreground the Exedra of Apollo Karneios and the Altar of the tutelary god (MAIC, photo by P. Semprucci)  
Cyrene, The Sanctuary of Apollo: the *Frigidarium* of the Great baths (MAIC, photo by P. Semprucci)  
Cyrene, the Sanctuary of Apollo: view of the Temple of Apollo from the south-west (MAIC, photo by P. Semprucci)

## 9. Appendices

### A. From the Pilot Project to the Training School

The project of restoration and of anastylosis of the Theatre-Amphitheatre of Cyrene represents in Libya a Pilot Project that makes use of an integrated system of actions for the defence, the safeguard and the conservation and the enhancement, but also the promotion and the scientific publication through innovative studies and technologies.

Such a project cannot neglect the planning of effective training programs and formation of the qualified personnel, through courses of direct teaching and workshops, in Italy and abroad, with the contribution of the Universities, the Antiquity Departments, the Supervisors and the other national and international structures of guarantee.



Cyrene, Theatre-Amphitheatre during the works of 2006: application of the scanner laser for the three-dimensional survey of the monument

Such projects, including foreign language and computer courses, must be appropriate both for the accomplishment of the contents of the project of the Theatre-Amphitheatre of Cyrene, and for the study of the institutional and legislative aspects of the conservation and circulation of assets and for the development of Management, of the Marketing and of the Promotion of Cultural Assets, also in relation to the development of a tourism of international level “educated to knowledge”.

According to this, it will be necessary to elaborate and carry out studies and researches, projects and plans of feasibility, master courses, courses and education programs for the formation of qualified personnel.



Cyrene, Theatre-Amphitheatre during the works of 2006: the pupils of the MAIC

## **B. The Theatre-Amphitheatre of Cyrene: criteria for the restoration and anastylosis**

Within a complex restoration as that of the Theatre-Amphitheatre of Cyrene a philological approach is essential, which would take into account the co-existence of several periods and physiological strata.

The criteria will therefore be those of the conservative philological restoration:

***Minimal intervention:*** each addition or intervention cannot be extraneous to the edifice itself. The restorer must have in mind the essentiality of the reparation of elements missing or damaged because of the deterioration, and of the integration of lines and volumes, the lack of which would prevent a clear reading of the monument.

***Reversibility:*** that is, the possibility to restore the state previous to the recovering. It is necessary to carry out works as little invasive as possible and that would cause minimal disturbance in the nature of the building.

***Distinctiveness:*** the intervention of restoration must follow criteria of authenticity and distinctiveness. Such criteria represent a guarantee of a deep knowledge of the work and stimulate ingenuity.

***Feasibility:*** tool for the control of the degree of feasibility of the work.

***Compatibility:***

- physic-mechanical. In pairing up materials and contemporary techniques it is necessary to ensure the compatibility of tension-diffusion, elasticity, thermal expansion, gelivity.

- chemical. It concerns the relations between the element and the new material (formation of damaging by-products); the relations between the new material and the environment (stability against rain, light, temperature).

***Maintenance:*** a system must function according to parameters like: aimed performances, work organisation, procedures, methods and time after which the intervention has to be periodically carried out.

The process of anastylosis will also have to take into account the necessities of the present time. The philological method, therefore, has to be transformed. It will have to employ planning ingenuity in order to reform and regain the unity of the work, making it alive and present.

There is the necessity of returning to the Amphitheatre the function and the vitality that it has lost with time. The philological criteria, within a restoration of critical type, allows to “actualise” a creative act, adjusting the shape to the demands of the new cultural function. Critical restoration as a synthesis of knowledge and creative sensitivity.

The project, in the end, as a result of the process of analysis and of the ensuing diagnosis, will have to define the structural and historical problems.

## **ANALYSIS**

- History of the ‘organism object’ of study and its evolution in history;
- documentation, history and study of all the interventions of restoration carried out on the work up to now;
- study of Greek theatres, Roman amphitheatres, Greek theatres recycled as Roman amphitheatres in Libya and in the Graeco-Roman world;
- analysis and study of Greek and Roman building techniques, of the materials employed and of their provenience (quarries) at the moment of the accomplishment of the ‘organism’;
- survey of the surrounding conditions, especially the environmental context and characteristics as geographic orientation, humidity, winds and precipitations;
- graphic survey of the entire work and of the surrounding terrain to be carried out integrating methods of direct survey (metric, on the field) and indirect computerised. (photogrammetric, GPS and laser scanner);
- study and survey of the geologic condition through cognitive investigations paired up with planimetries and maps indicating the different lithic situations;
- structural analysis paired up with planimetries and elevations, complete with mapping, indicating places, times and entity of ruins and degradations.

## **DIAGNOSIS**

- Characterisation of the building materials through acquisition of significant samples of the artefact and subsequent laboratory analysis, in order to proceed towards (cf. THERAPY) the preliminary operations of conservative restoring (cleaning, consolidation, plastering and gluing, protection and standard maintenance);
- study of the alterations of the materials;
- study of the structural ruin and of the geologic dynamics that have led to the collapse of the lithic banks, through diagnostic investigations which would employ techniques as probings, endoscopic investigations, flat jacks, 'fessurimetrics', etc., on top of the laboratory exams;
- processing and interpretation of the data through the study of all the pathological dynamics and of the likely causes of deterioration;
- graphic reconstruction of the Greek Theatre and Roman Amphitheatre;
- determination of the executive stages of the reuse of the Theatre Greek for the realisation of the Roman Amphitheatre.

## **THERAPY : example of intervention in *Area A***

Characterised by the collapse of five rows of seats, both the Greek and Roman.

The ruin is to be related to the collapse of the lithic banks uphill of the service corridor of the Amphitheatre. Consequently, six orders of flights of steps are currently critically unstable; it should be mentioned that all the Greek flights of steps were built on embankments and that the Roman ones rest directly upon the previous works.

After the necessary operations of survey carried out through photogrammetric techniques of laser scanner and positioning through GPS, the disassembling of the blocks that constitute the flights of steps is planned for this area. Such removal must be extended also to the parts that appear little or not ruined. The removal of the filling materials will follow, up to the rocky strata.



According to the situation of the natural terrain that will result from such operations, it will be possible to make a project that will allow for a safe re-assemblage of the various rows of steps.

As a working-hypothesis, the plan is to make a series of reinforced-concrete plinths with a fixed-section excavation in the rock, on which will lean the poles linked with beams. The dimension of such supports will be according of the general stability, which can be verified only after the operations previously listed.

Concerning the terraces slightly ruined above this area, simple operations of disassembling and reorganising the ancient works of support are foreseen. The reorganisation includes in any case interventions of consolidation and stabilisation of the slope.

